CERTAIN PSYCHOLOGICAL VARIABLES AS PREDICTORS OF ACHIEVEMENT IN MATHEMATICS OF SECONDARY SCHOOL PUPILS OF KERALA

MUMTHAS, N.S.

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UNIVERSITY OF CALICUT

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DECLARATION

I, Mumthas, N.S., do hereby declare that this thesis, "CERTAIN PSYCHOLOGICAL VARIABLES AS PREDICTORS OF ACHIEVEMENT IN MATHEMATICS OF SECONDARY SCHOOL PUPILS OF KERALA" has not been previously formed the basis for the award of a Degree, Diploma, Title or Recognition.

C.U. Campus,
30. 04 .2001.

Mumthas

Mumthas, N.S.

Dr. V. Sumangala
Reader
Department of Education
University of Calicut.

CERTIFICATE

I, Dr. V. Sumangala, do hereby certify that this thesis entitled "CERTAIN PSYCHOLOGICAL VARIABLES AS PREDICTORS OF ACHIEVEMENT IN MATHEMATICS OF SECONDARY SCHOOL PUPILS OF KERALA" is a record of bonafide study and research carried out by **Mumthas, N.S.**, under my supervision and guidance and that it has not been previously formed the basis for the award of a Degree, Diploma or Recognition.

C.U. Campus,
30.04.2001.

Dr. V. Sumangala

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Mumthas, N.S.

5

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

APPENDIX

INTRODUCTION

- Need and Significance of the Study
- Statement of the Problem
- Definition of Key Terms
- Variables
- Objectives
- Hypotheses
- Methodology
- Scope of the Study
- Limitations of the Study

Twenty first century will, in no doubt, be 'a dawn of challenges' for the new generation. Our quality of life and economy in future years depends on how well our youngsters are utilising the resources of today's learning. Students need a breeding ground to sharpen their existing skills, acquire new skills, conceive and experiment with new ideas, enhance the curiosity levels and perfect their independent pursuit of knowledge. Today's children are tomorrow's youth and hence the beginning should be made from the very basic of education.

To majority of the society, quality education is a passport to comfortable and secure life. It is right that education should provide hope and open avenues for a secure future. It should create intelligent, hardworking and productive men and women for our society. Education should enable youngsters to become contributing members of the society through knowledge, skills and character development; provide access to first-rate training for people of all ages and backgrounds, and make it possible for them to compete in a global economy. To achieve this, our courses and syllabi should emphasise relevance and application to the real world. In a knowledge based society, the content and process of education has to undergo continuous reorganization and upgradation. Unless the system of education works properly - at all stages of education, in all parts of the country - the ambitious programme of educational reform envisaged in National Policy on Education[1] (1986) will come to a naught. So we need a total radical overhaul of the system.

The learning of mathematics can provide a basic preparation for full participation as a functional member of society. Furthermore, a solid mathematical preparation offers to the student an entry into a wide array of career choices. Therefore, from a societal perspective, mathematical competence is both an essential component of the preparation of an informed citizenry and a requisite for the education of personnel required by industry, technology, engineering and science.

The study of mathematics occupies a central place in the school programmes of all countries. It is therefore estimated that in most school systems 15 to 20 percent of instructional time is devoted to the learning of mathematics (Travers[2], 1994). The importance afforded to mathematics in the school curriculum reflects the vital role of it in the contemporary society. But in our society, which is developing very fast on account of advances in science and technology, a subject of concern in the school curriculum is often mathematics. As mathematics is a highly structured body of knowledge, there is an inherent difficulty for many of the children to keep up-to-date with the learning of the subject. Though a permanent solution has not been emerged, the importance of making mathematics learning more effective cannot be overlooked.

1.1. NEED AND SIGNIFICANCE OF THE STUDY

In a rapidly developing country like India which is surging fast in the new millennium, the whole system of education revolves round the academic achievement, though various other outcomes are also expected from the system. Thus a lot of time and effort of the schools are used for helping students to achieve better in their scholastic endeavours. Inspite of this, our students are achieving low in various subjects. But this variation in achievement is found so much in mathematics. Eventhough many attempts were made to improve the level of attainment, there seems to exist mainly three categories of students viz., high-, average- and low- achievers.

For the present era, children with special abilities are in great demand because India needs for her challenging future a host of creative scientists, innovative planners, intuitive technocrats and intelligent politicians. The progress of a nation in various fields largely depends on how these special abilities are nurtured and how they are used in the development of society. The students having surpassing abilities become stars with plus factors while those having weaker abilities are considered just a burden in our classrooms. The low achievers do form a potential threat not only to the teachers in the classroom, to educationists developing new theories, to administrators intending to solve the problems in the schools but also to the society and ultimately to the welfare of the country as a whole.

The importance of achievement has raised several questions for educational researchers like 'what are the psychological factors that promote achievement in students?' and 'how far do the different factors contribute towards academic achievement ?'. Researchers have come out with varied results to the above questions, at times complementing each other, but at times contradicting each other. Some of the factors, which creates the disparity in achievement identified by Lalithamma[3] (1975), Katiyar[4] (1979), Patel[5] (1984), Kumari[6] (1985), Narayanan[7] (1987), Madhavan[8] (1990), Gupta[9] (1992), Montague and Applegate[10] (1993), Behera[11] (1998) and Deshmukh[12] (2000) are intelligence, numerical reasoning, inducto-deductive reasoning, achievement motivation, attitude, anxiety, problem solving ability, creativity and self-concept.

Though only a few among the above cited studies have pinpointed their attention on the achievement in mathematics, it can be said that mathematics achievement of a child is caused, promoted and affected by various factors including those arising out of the person or self, teaching -learning set up, subjects of study and so on. Identification of these variables contributing prominantly to educational achievement is the necessity of this time of unprecedented expansion of the educational system, the enormous financial investments in schools and for pointing out priority areas of educational expenditure.

A review of the previous studies revealed that variables like numerical reasoning, ability to use symbols, spatial ability, abstract reasoning, inductive reasoning, deductive reasoning, problem solving ability, creativity, mathematics interest, self-concept, attitude towards mathematics, attitude towards academic work, mathematics anxiety, achievement motivation etc. which can be labelled as psychological variables, are significant for achievement in mathematics. Achievement in mathematics is correlated with numerical reasoning (Patel[5], 1984; Dubey[13], 1987; Malini[14], 1995), ability to use symbols (Malini[14], 1995; Sumangala[15], 1995), spatial ability (Tracy[16], 1987; Waxman, *et al*[17]., 1996; Seokhoon & Betty[18], 2000), abstract reasoning (Jain[19], 1979; Bhattacharya[20], 1986; Sumangala[15], 1995), inductive reasoning (Malhotra[21], 1982; Kumari[6], 1985), deductive reasoning (Malhotra[21], 1982; Kumari[6], 1985; Mathews[22], 1996), problem solving ability (Das[23], 1978; Montague, *et al*[24]., 1992; Lawson & Chinnappan[25], 1994), creativity (Panicker[26], 1979; Tuli[27], 1985; Ronna & George[28], 1999) and anxiety (Somasundaram[29], 1980; Hadfield, *et al*[30]., 1992; Patel[31], 1997) are some of such studies. Studies conducted on the relationship of achievement in mathematics with self-concept, attitude towards mathematics, attitude towards academic work, anxiety and achievement motivation have rendered conflicting results. The review of studies also revealed that studies relating achievement in mathematics with interest, inductive reasoning and deductive reasoning are very few.

Thus the above cited psychological variables are of much concern to all those who work with mathematics education. Though the nature of relationship of some of these variables with achievement in mathematics had been studied individually by many researchers, but an endeavour to examine the influence of the psychological variables collectively on achievement in mathematics is practically lacking. Hence the investigator made an attempt to find out the influence or contribution of a select set of psychological variables to achievement in mathematics and hence to identify the significant predictors of it. The investigator also thinks that these psychological variables are interacting with one another and hence they have combined influence on the achievement in mathematics. If adequately understood, these psychological variables can be used to predict the achievement in mathematics from a select set of psychological variables. Getting a clear picture about the psychological variables which are highly efficient in predicting achievement in mathematics and those which are comparatively less important, will help to enhance the insight of teachers and of others concerned with mathematics education.

From a select set of psychological variables which are efficient to predict achievement in mathematics, it is possible to discern the specific combinations of variables which cause different levels of attainment in mathematics viz., high-, average- and low- achievers. This will enable one for a better understanding of the causes of varying levels of achievement in mathematics. As it is felt that the interrelation of the select psychological variables and their effect on achievement in mathematics vary between high-, average and low-achievers, it is necessary to find out the combination of the psychological variables that differentiate high-, average-, and low- achievers in the subject. The investigator hopes that once these psychological factor structures of high-, average- and low- achievers are identified, this will help to take up psychologically and educationally sound principles for facilitating achievement in mathematics. That is, it will help to adopt suitable measures such as fixing the expected level of objectives of mathematics learning to be achieved, choice of teaching-learning strategies, arrangement of curricular materials, preparation of resource materials for teaching - learning etc. in connection with the psychological set up of the pupils which may lead to the total improvement of the educational system.

Hence, in the present study, the investigator made an indepth analysis with psychological variables as predictors of Achievement in Mathematics through different techniques.

1.2. STATEMENT OF THE PROBLEM

The problem for the present investigation is worded as "CERTAIN PSYCHOLOGICAL VARIABLES AS PREDICTORS OF ACHIEVEMENT IN MATHEMATICS OF SECONDARY SCHOOL PUPILS OF KERALA."

1.3. DEFINITION OF KEY TERMS

The key terms of the title are defined below for their operational meaning in the study and hence for a better perspective of the study.

1.3.1. Psychological Variables

Psychological Variables connote a set of cognitive and affective variables related to the thinking and feeling dimensions like aptitude, inductive reasoning, deductive reasoning, problem solving ability, interest, attitude, anxiety etc.

1.3.2. Predictors

Predictors are the set of variables, the knowledge of which helps to predict or infer effectively the dependent or criterion variable of the study by means of statistical treatments.

1.3.3. Achievement in Mathematics

Achievement in Mathematics refers to the relative accomplishment or proficiency of performance in Mathematics as measured by a standardised test of Achievement in Mathematics.

1.3.4. Secondary School Pupils

Secondary School Pupils stands for the pupils attending classes VIII, IX and X of the recognized High schools of Kerala.

1.4. VARIABLES

The study is designed with Achievement in Mathematics as the criterion (dependent) variable and the below listed sixteen psychological variables as predictor (independent) variables.

The predictor (independent) variables of the study are the following:

i) Numerical Reasoning
ii) Ability to use Symbols
iii) Spatial Ability
iv) Abstract Reasoning
v) Inductive Reasoning
vi) Deductive Reasoning
vii) Problem Solving Ability in Mathematics
viii) Fluency
ix) Flexibility
x) Originality
xi) Mathematics Interest
xii) Self-Concept in Mathematics
xiii) Attitude towards Mathematics
xiv) Attitude towards Academic Work
xv) Mathematics Anxiety
xvi) Achievement Motivation in Mathematics

1.5. OBJECTIVES

The study was designed with the major objective viz., "to test for the ability of each select psychological variable in predicting significantly Achievement in Mathematics of secondary school pupils and hence to identify the significant predictors of Achievement in Mathematics."

The above major objective was tested by means of the following statistical procedures, the results of each of which led to the answering of the major objective of the study.

i) Test of significance of the effect of each psychological variable on Achievement in Mathematics which indirectly indicates the possible relation of the psychological variables with Achievement in Mathematics and hence of the possible predictability.

ii) Estimation of the relationship of each psychological variable with Achievement in Mathematics which suggests the extent of predictability of the psychological variables.

iii) Identification of the significant psychological predictors of Achievement in Mathematics by regression analysis and thereby estimation of the predictive efficiency of the significant predictors in predicting Achievement in Mathematics.

iv) Derivation of the linear discriminant functions in terms of the significant predictors and hence of their effectiveness in predicting group membership like High-, Average- and Low- Achievers in Mathematics.

v) Identification of the factor structures of High-, Average- and Low-Achievers in Mathematics and thereby a comparison of the significant predictors' standing (in terms of factor loadings and communalities) in the three factor structures.

1.6. HYPOTHESES

The major hypothesis set for the present study was "Achievement in Mathematics of secondary school pupils can be significantly predicted by means of the select set of psychological variables."

The major hypothesis was tested by framing the following hypotheses, the testing of each of which is analogous to the testing of the major hypothesis.

i) Each select psychological variable has significant effect on Achievement in Mathematics.

ii) Significant relationship exists between each psychological variable and Achievement in Mathematics.

iii) Achievement in Mathematics can be significantly predicted by a combination of the predictor variables.

iv) Group membership as High-, Average- and Low- Achievers in Mathematics can be effectively predicted using linear discriminant functions in terms of the significant predictor variables of Achievement in Mathematics.

v) The position of significant predictors of Achievement in Mathematics in the psychological factor structure of the groups High-, Average- and Low-Achievers will be different in terms of factor loadings and hence of communalities.

1.7. METHODOLOGY

1.7.1. Sample

The study was conducted on a final sample of 500 (consisting of 244 boys and 256 girls) secondary school pupils of Kerala. The sample was selected from 12 secondary schools of six different districts of Kerala viz., Thiruvananthapuram, Kollam, Thrissur, Malappuram, Kozhikode and Kannur by using stratified sampling technique.

1.7.2. Tools

The following are the tools that were used to measure the variables of the study.

i) Test of Achievement in Mathematics (Constructed and Standardised by the investigator).
ii) Test of Numerical Reasoning (Sumangala and Malini, 1993).
iii) Test of Ability to use Symbols (Sumangala and Malini, 1993)
iv) Test of Spatial Ability (Sumangala and Malini, 1993).
v) Test of Abstract Reasoning (Sumangala and Malini, 1993).
vi) Test of Inductive Reasoning (Constructed and Standardised by the investigator).
vii) Test of Deductive Reasoning (Constructed and Standardised by the investigator).
viii) Test of Problem Solving Ability in Mathematics (Sumangala and Vijayakumari, 1996).
ix) Test of Mathematical Creativity (Sumangala, 1993).
x) Mathematics Interest Inventory (Sumangala and Vijayakumari, 1996).
xi) Scale of Self-Concept in Mathematics (Sumangala and Malini, 1993).
xii) Scale of Attitude towards Mathematics (Sumangala and Sunny, 1987).
xiii) Scale of Attitude towards Academic Work (Constructed and Standardised by the investigator).
xiv) Scale of Mathematics Anxiety (Sumangala and Malini, 1993).
xv) Scale of Achievement Motivation in Mathematics (Sumangala and Vijayakumari, 1996).

1.7.3. Statistical Techniques

Major statistical techniques used in the analysis of data are the following:

1. One-way Analysis of Variance.
2. Pearson's Product Moment Coefficient of Correlation.
3. Stepwise Regression Analysis.
4. Discriminant Function Analysis.
5. Factor Analysis.

1.8. SCOPE OF THE STUDY

The present study is on certain psychological variables as predictors of Achievement in Mathematics of secondary school pupils of Kerala. The relationship of Achievement in Mathematics with each of the sixteen psychological variables studied in terms of Pearson's r and its interpretations disclose the extent to which Achievement in Mathematics is determined by the above psychological variables. Stepwise regression analysis is used to identify the significant predictor variables of Achievement in Mathematics from among the psychological variables. The coefficient of determination R^2 was estimated to know the extent of predictive efficiency of the predictor variables. The multiple regression equation developed by the present study will help in the selection of pupils with high achievement in mathematics for courses which demand high ability in mathematics. This will also help the educators to identify pupils with low achievement in mathematics for giving compensatory education so that their difficulties in learning mathematics is ameliorated.

The extent to which the High-, Average- and Low- Achievers in Mathematics can be differentiated using the above identified significant predictor variables was studied by developing the discriminant functions in terms of significant predictors. Discriminant function analysis will also reveal the comparative role of significant predictors in effecting High-, Average- and Low-

Achievement in Mathematics. Further the psychological factor structure of High-, Average- and Low- Achievers in Mathematics was studied by factor analysis to expose the distinctive interaction of the psychological variables within the three achievement groups. Thus using different techniques the ability of each psychological variable in predicting Achievement in Mathematics of secondary school pupils is studied.

The sample for the study is a representative group of secondary school pupils drawn by the stratified sampling technique from 12 secondary schools of different parts of Kerala. By these, the investigator hopes that the findings of the present study are valid and are generalizable to a considerable extent.

1.9. LIMITATIONS OF THE STUDY

Though considerable effort has been made to make the study generalizable and precise as possible, there are certain limitations. The occured limitations are the following.

1. Eventhough the population of the present study comprise of all the secondary school pupils of Kerala, the sample for the study was confined to six districts of Kerala viz., Thiruvananthapuram, Kollam, Thrissur, Malappuram, Kozhikode and Kannur, for practical reasons.
2. Though 'secondary school pupils' comprise of standards VIII, IX and X, the study was limited to students of standard IX only assuming that it is the representative of the three standards.
3. Though the study used the sample of standard IX pupils, the 'Test of Achievement in Mathematics' was prepared based on the content of standard VIII Mathematics so as to conduct the data collection during the initial phase of the academic year considering the convenience of both the investigator and of the authorities of select schools.

4. Only those psychological variables which the investigator found had a considerable influence on Achievement in Mathematics were selected as the predictor variables of Achievement in Mathematics.

Inspite of the above limitations, the investigator hopes that the findings of the present study will yield valuable contributions to the theory and practice of education.

1.10. ORGANIZATION OF THE REPORT

The report of the study is organized in five chapters.

Chapter 1 presents the need and significance of the study, statement of the problem, definition of key terms, variables, objectives, hypotheses, methodology, scope and limitations of the study.

Chapter II presents a detailed review of studies on the relation of select psychological variables with academic achievement.

Chapter III presents the methodology used for the study in detail. This chapter comprises description of variables, tools used for the collection of data, sample used, data collection procedure and the statistical techniques used for the analysis.

Chapter IV deals with the analysis of the data in detail. Apart from the hypotheses and preliminary statistical analysis of the data, this chapter presents the results of one-way analysis of variance, correlational analysis, multiple regression analysis, discriminant function analysis and factor analysis. Major findings of the study are summated at the end along with ténability of hypotheses set for the study.

Chapter V deals with the major findings, conclusions drawn, educational implications of the findings and suggestions for further research in the area.

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CHAPTER II

REVIEW OF RELATED LITERATURE

- Psychological Variables and Academic Achievement
- Trend Report

Review of literature related to the area of investigation is a significant and essential part of any research work as this serves multiple purposes like knowing what others have learned from similar research problems, elimination of the duplication of the research, guidance regarding the definition and significance of research problems, formation of appropriate hypotheses and provision of helpful suggestions for significant investigations.

The present investigation is an attempt to study some psychological variables as predictors of Achievement in Mathematics of secondary school pupils of Kerala. The investigator has therefore made a review of the studies in the area of academic achievement in relation with the select psychological variables. The reviewed studies are presented in this chapter for their details and findings under the heading viz., Psychological variables and Academic Achievement.

2.1. PSYCHOLOGICAL VARIABLES AND ACADEMIC ACHIEVEMENT

Based on the psychological variables, selected for the study, studies are presented under nine headings viz.,

1. Aptitudinal Variables and Academic Achievement.
2. Inductive-Deductive Reasoning and Academic Achievement.
3. Problem Solving Ability and Academic Achievement.
4. Creativity and Academic Achievement
5. Interest and Academic Achievement
6. Self-Concept and Academic Achievement

7. Attitudinal Variables and Academic Achievement
8. Anxiety and Academic Achievement.
9. Achievement Motivation and Academic Achievement.

2.1.1. Aptitudinal Variables and Academic Achievement

An aptitude is a combination of characteristics indicative of an individual's capacity to acquire some specific knowledge, skill or organised responses such as the ability to speak a language, to become a musician, to do mechanical work etc. According to Brown[1] (1976) mathematical aptitude is a set of interrelated skills, abilities and characteristics basically inherent and that enable an individual to acquire better mathematical skills. As such mathematics aptitude of an individual means the potential ability of that person to deal with mathematical abstracts and to engage successfully in mathematical activities that involve numerical ability, numerical reasoning, ability to use symbols, spatial ability and abstract reasoning.

Studies which explored the relation between aptitudinal variables (Numerical Reasoning, Ability to use Symbols, Spatial Ability and Abstract Reasoning) and academic achievement are presented below with the relevant findings of each.

Jain[2] (1979) carried out a study on significant correlates of high school failures in mathematics and English, and found that abilities like abstract reasoning and numerical ability play a vital role in the learning of mathematics.

Katiyar[3] (1979) conducted a study on the five cognitive functions viz., abstract reasoning, numerical reasoning, numerical ability, space relations and substitution of symbols in relation to achievement in mathematics using a sample of 600 boys and 600 girls. The factor loadings obtained after factor analysis suggested that numerical reasoning and numerical ability occupies prominent place among the five cognitive functions in contributing to achievement in mathematics.

Pillai[4] (1981) studied sex differences in certain personality and aptitudinal dimensions related to science achievement and found that aptitudinal variables such as number series, science information, formulation, spatial ability, verbal comprehension and interpretation are significantly related with science achievement for both the sex groups viz., boys and girls.

Consuegra[5] (1982) in a study of gifted children reported that the obvious characteristics of the gifted in mathematics are propensity towards quantitative relationships and the use of numbers and that gifted pupils are capable of abstract thinking.

Singh[6] (1983) examined the relation of memory, symbolic representation and some other mental abilities with achievement in chemistry, using a sample of 400 B.Sc students, male and female from the eastern districts of Uttar Pradesh and found that memory, symbolic representation and reasoning ability have positive influence on the students' achievements in chemistry at graduation level.

Patel[7] (1984) studied mathematics achievement in the context of some cognitive and affective variables and obtained that among the five cognitive functions studied in relation to mathematics achievement, numerical reasoning and numerical ability occupy the prominent place.

Mehna[8] (1985) found that the multiple correlations of science aptitude, abstract reasoning and numerical ability with science achievement (for the three science subjects) are significant at 0.01 level.

Bhattacharya's[9] (1986) study revealed that abstract reasoning and mathematics achievement are positively correlated.

Dubey[10] (1987) studied the factorial nature of numerical aptitude and its bearing on mathematical learning. The study suggested that numerical reasoning and numerical ability are best predictors of achievement in mathematics.

Tracy[11] (1987) studied the relationship of toy playing habits, spatial abilities and science and mathematics achievement of children. Results indicated that males exhibit superior spatial skills and maintained greater science and mathematics achievement scores than females.

Budhev[12] (1990) in a study on the effect of cognitive variables on achievement in mathematics found that achievement in mathematics is affected by mathematics aptitude.

Monson and Fukui[13] (1991) put forward some identifiable characteristics of gifted children for regular classroom teachers. The cognitive characteristics include ability to manipulate abstract symbol system and ability to generate original ideas. Intellectually gifted children are found to have high level of abstract thinking when compared with their peers.

Bastecki and Berry[14] (1992) examined the effect of spatial ability level on the achievement of dental hygiene students using a sample of 43 first term students enrolled full time at a university school of dental medicine and found that subjects who demonstrated higher spatial ability skills obtained greater educational outcomes.

Study of Dubey and Vijayakumar[15] (1992) using a sample of 300 class X male students found that numerical reasoning and numerical facility are most important for predicting performance in algebra.

Boyd[16] (1993) reviewed studies conducted in the area of giftedness and concluded that better performance of males is a result of their higher spatial abilities.

A study of Gustin and Corazza[17] (1994) revealed that verbal and mathematical reasoning ability are the most powerful predictors of success in accelerated secondary science courses.

Study done by Malini[18] (1995) using a stratified sample of 703 (329 boys and 374 girls) secondary school pupils revealed that (i) real relationship exists between the variables numerical reasoning and achievement in mathematics for both boys and girls (ii) substantial relationship exists between the variables ability to use symbols and achievement in mathematics for both boys and girls (iii) low relationship exists between the variables spatial ability and achievement in mathematics for both boys and girls and (iv) marked relationship exists between abstract reasoning and achievement in mathematics for both boys and girls.

Sumangala[19] (1995) carried out a study with a stratified sample of 750 students of standard IX drawn from 20 schools of five revenue districts of Kerala and found that the variables mathematics aptitude and its components viz., numerical ability, numerical reasoning, ability to use symbols, spatial ability and abstract reasoning discriminate significantly between high- and low- achievers in mathematics. It was also found that the relationship of mathematics aptitude and its components with achievement in mathematics is significant and positive.

Waxman, *et al.*[20] (1996) conducted a study using a sample of 284 children studying in pre-school or kindergarten who were advanced in mathematics and found that spatial reasoning is closely related to their mathematics reasoning.

Babylatha[21] (1997) conducted a study using a proportionate stratified random sample of 540 students of standard VIII and revealed that (i) correlation between spatial ability and biology achievement is positive and significant at 0.01 level (ii) correlation between abstract reasoning and biology achievement is positive and significant at 0.01 level.

Goel[22] (1997) studied various learning problems related to arithmetic difficulties by using 300 children of standards I to II in rural and urban multigrade schools, who had poor academic achievement in mathematics and their IQ ranged from 90 to 120. The investigator found that symbol association problems, symbol confusion etc. are the problems related to arithmetic difficulties.

Seokhoon and Betty[23] (2000) investigated the nature of spatial ability as measured by four instruments based on spatial orientation and visualization, and its relationship to the mathematical performance of elementary school pupils using a sample of 127 elementary school students (72 boys and 55 girls) aged 10 to 11 years. Results indicated a positive relationship between spatial ability and mathematical performance.

2.1.2. Inductive - Deductive Reasoning and Academic Achievement

The term reasoning refers to the human capacity for drawing conclusions or making inferences on the basis of known or assumed facts, in accordance with rational rules or principles. In inductive reasoning the individual is presented with a set of elements and the task is to induce the rule structure relating the elements so that the pattern can be completed or extended. But in deductive reasoning we proceed from the general conclusions to the particular and from the whole to its parts.

Relation between inductive-deductive reasoning and achievement is a rarely touched area of investigation. Hence only very few studies are reported as found by the review. Some studies available on the relation between inductive-deductive reasoning and achievement are presented below with the relevant findings of each.

Malhotra[24] (1982) made a study on a sample of 120 boys and 120 girls in the age group of 11 to 13 years and found that (i) in case of deductive reasoning, there is significant correlation between the test scores of ability measures and linear syllogistic reasoning measure. The high ability group of students solved problems faster, thus indicating faster speed of information processing as compared to the low ability group of subjects (ii) in the case of inductive reasoning phase, the higher ability group required fewer patterns of internal representations, performing at a faster speed of information processing in reaching a solution to the problem in comparison with that of the low-ability group of children.

The objective of the study conducted by Kumari[25] (1985) was to analyse the effectiveness of inductive and deductive strategies on achievement. The study revealed that inductive and deductive strategies are equally effective for students' achievement.

Niaz[26] (1993) investigated the reasoning strategies of students in solving chemistry problems as a function of developmental level, functional M-capacity and disembedding ability and found that students who scored higher on cognitive predictor variables not only have a better chance of solving chemistry problems but also demonstrated greater understanding and used reasoning strategies indicative of explicit problem solving procedures based on the hypothetico-deductive method.

Study done by Singh[27] (1994) on a sample of 350 class XI students of three randomly selected intermediate colleges of Uttar Pradesh (104 science and 246 art students) revealed that inductive thinking model is more effective compared to traditional method in terms of achievement in economics.

Watters and English[28] (1995) measured children's (N=182) competence at syllogistic reasoning and in solving a series of problems requiring inductive reasoning and reported that syllogistic reasoning and inductive reasoning are significantly correlated with both simultaneous and successive synthesis.

Klauer's[29] (1996) study on 174 elementary school students supported the hypothesis that training in an inductive strategy would enhance performance on tests measuring fluid intelligence, support learning school relevant declarative knowledge and improve problem solving.

Mathews[30] (1996) showed that students with styles of learning favoring a deemphasis on human relationships and an emphasis on deductive thinking rated themselves higher academically than did their peers with other styles of learning and that students who were people-oriented had the lowest overall academic self assessment.

Kral[31] (1997) conducted a three year study of control and experimental groups using a pre-test and post-test design and included results of the American College Test and specially designed questionnaire. Results indicated that the hypothetical deductive reasoning pattern can be embedded into and successfully transferred across various curricula with a measurable improvement both in reasoning and subject matter achievement.

2.1.3. Problem Solving Ability and Academic Achievement

Problem solving refers to an ability which uses the cognitive representations of prior experience and current situation to derive a conclusion. That is, it is a high order ability requiring abilities like Analysis, Synthesis and Evaluation.

Very few studies have been found reported on the relation between problem solving ability and academic achievement. Some of the studies are abstracted below with relevant findings of each.

Das[32] (1978) conducted a study on certain cognitive correlates of mathematics achievement and found that verbal, numerical and problem solving abilities have influence on mathematics achievement.

Consuegra[5] (1982) carried out a study on giftedness and found that gifted pupils have advance mental abilities and unusual abilities to solve problems.

Caballos and Esteban[33] (1988) in their study, an International Study Skills Inventory (ISSI) and a non-verbal cognitive problem solving inventory were administered to 197 high school students. Academic success and successful problem solving strategies are found to correlate with specific responses of ISSI.

Haridasan[34] (1989) found that there exists significant mean difference in problem solving ability of biological science between high-, average- and low-achievers in biology.

Monson and Fukui[13] (1991) reported that intellectually gifted children have high level of planning and problem solving ability compared to their peers.

Montague, *et al.*[35] (1991) conducted a study on 60 eighth grade students and found differences among students who were low, average and high achieving on their knowledge of mathematical problem solving strategies, and knowledge, use and control of problem representation strategies.

Hembree[36] (1992) integrated the results of 487 reports by meta-analysis to study characteristics of problem solvers, conditions for harder and easier problems, effects of different instructional methods and classroom related conditions on problem solving performance. It was found that problem solving is positively related to measures of basic skills.

Montague and Applegate[37] (1993) examined the verbalizations of 90 middle school students as they thought aloud while solving mathematical word problems and reported that average achievers are less strategic in approaching mathematical problem solving than gifted students.

Byrnes and Takahira's[38] (1994) study on a sample of 40 high school students on the mathematics subtest of the Scholastic Aptitude Test supported the prediction that successful students would be better at defining problems, assembling strategies and avoiding computational errors.

Lawson and Chinnappan[39] (1994) compared the problem solving performance of high-achieving and low-achieving 11th grade students during solution of geometry problems using a think aloud procedure. Detailed analysis of problem solving protocols indicated that high-achieving students not only accessed a greater body of geometrical knowledge but also used that knowledge more effectively.

2.1.4. Creativity and Academic Achievement

According to Jones[40] (1972), creativity is 'a combination of flexibility, originality and sensitivity to ideas which enables the thinker to break away from usual sequences of thoughts into different and productive sequences, the result of which gives satisfaction to himself and possibly to others.' The term mathematical creativity stands for various aspects of divergent thinking ability estimated through its accepted characteristics such as fluency, flexibility and originality as measured by a comprehensive test of creativity.

A number of studies have been conducted in this area and some of these are presented below for the findings relating with academic achievement.

Dhaliwal and Saini[41] (1976) investigated the relationship of creativity with over and under academic achievement using a sample of 118 boys of urban high schools and found that achievement of students in English, geography and history are positively and significantly related with their fluency and flexibility scores whereas achievement in Hindi is related to the originality score.

Panicker[42] (1979) in the study 'creativity as a correlate of achievement in mathematics of secondary school students' found significant relationship between achievement in mathematics and creativity.

Asha[43] (1980) studied the relation between creativity and academic achievement of high school students using a sample of 800 students with equal number of boys and girls and found that there is positive and significant relationship between creativity and achievement scores of boys and girls.

Study conducted by Gakhar[44] (1985) using a sample of 170 standard IX students revealed that there is significant correlation between creativity and achievement in mathematics.

Tuli[45] (1985) carried out a study using a sample of 439 class IX students and found that mathematical creativity is significantly related to achievement in mathematics.

Study done by Malini[46] (1990) revealed that the main effect of mathematical creativity on achievement in mathematics is significant at 0.01 level.

Carroll and Howieson[47] (1991) carried out a study using a sample of 48 seventh grade children and obtained that on some measures of mathematics, highest scores were achieved by the high creativity group.

Subramoniyam and Remadevi[48] (1991) reported that there exists significant relation between the variables creativity and academic achievement.

Bhawalkar[49] (1992) studied the relationship of scientific creativity with achievement in mathematics and academic achievement separately by using a sample of 663 students of classes IX and X from six schools situated in Ujjain, Mhow and Indore and found that students with high academic achievement and high achievement in mathematics possesshigh scientific creativity.

Mondal's[50] (1992) study with a sample of 48 students of class VI drawn from the schools situated in semi urban area obtained that the correlation between achievement and creativity score is the highest in case of medium achiever and the lowest in case of low achiever. The high achievers are not so much creative as medium achievers.

Padhi[51] (1992) in a study to estimate the relationship among classroom environment, creativity, academic self-concept and academic achievement found that the components of creativity to be high level predictors of academic achievement.

Kim[52] (1993) in 'an investigation of the extent to which performance in selected measures of creativity is related to school achievement' found low relation between measures of creativity and school achievement.

Interaction effect of creativity, attitude towards problem solving and social position on the achievement in mathematics of secondary school pupils was the subject of investigation by Thampuratti[53] (1994). It was found that the main effect of creativity on achievement in mathematics is significant at 0.01 level. Significant difference exists in the mean scores of achievement in mathematics between the three group pairs of creativity viz., high-, average- and low- creative groups.

Bawa and Kaur[54] (1995) conducted a study (i) to determine the relationship of the dimensions of creativity with the subjectwise academic achievement of male and female subjects (ii) to study the relationship of composite creativity with the subjectwise academic achievement of male and female subjects and (iii) to study the effect of creativity on the prediction of subjectwise academic achievement of male and female subjects and the total sample. The sample consisted of 600 class X students drawn from 30 high and higher secondary schools of Patiala district. The major findings are (i) in case of males, there is a significant positive correlation between all the four measures of creativity and achievement in all the school subjects except social studies. As regards female students, there is significant positive correlation between all the four measures of creativity and their academic achievement (ii) prediction of academic achievement in school subjects is quite reliable if it is made on the basis of measures of creativity in case of males, females or total sample.

Kapoor[55] (1996) studied the creative thinking ability of high school pupils of Arunachal Pradesh in relation to their sex and academic achievement using a sample of 300 pupils consisting of 110 tribal and 190 non-tribal pupils and found that there is no difference in the mean scores of creativity of high- and low-achievers.

Rajyalakshmi[56] (1996) studied the correlation between creativity and achievement in biology using a sample of 200 high school students (96 boys and 104 girls) from six schools in Puri and Ganjan districts of Orissa and found that correlations between the measures of fluency, flexibility and originality and achievement in biology are not significant.

Chaturvedi[57] (1997) conducted a study on a sample of 1130 tribal students of class XII drawn from 12 tribal schools (740 boys and 390 girls) and found that the high and low creative tribal boys and girls significantly differ on their scholastic achievement.

The extent of relationship between creativity and academic achievement on a sample of 595 students (335 urban and 260 rural) from 19 primary schools of Bhopal division studying in class V was examined by Khare and Grewal[58] (1997) and found that the coefficients of correlation between creativity and academic achievements of students studying in urban and rural primary schools are significant.

Objectives of the study done by Rani[59] (1997) was (i) to find the relation of different levels of creativity-high-, average- and low- with achievement in English (ii) to study the relationship between the components of creativity and achievement in English. Results indicated that (i) there is no significant relation between levels of creativity and achievement in English (ii) there is significant relationship between learning English and the traits of creativity viz., fluency, flexibility and originality.

'Creativity in relation to achievement in Malayalam of secondary school students' was conducted by Sunitha[60] (1997) on a sample of 500 secondary school pupils and reported that (i) there exists a real, positive and substantial relationship between the variables creativity and achievement in Malayalam (ii) high- and average-achievers in Malayalam differ significantly in creativity and its subcomponents fluency, flexibility and originality at 0.01 level (iii) high- and low-achievers in Malayalam differ significantly in creativity and its subcomponents fluency, flexibility and originality at 0.01 level (iv) average- and low- achievers in Malayalam do not differ significantly in creativity but differ significantly only in fluency at 0.05 level.

Behera[61] (1998) found that level of academic achievement had significant effect on all the components of creativity and total creativity. The relationship between achievement and creativity is found to be significant in the cases of high achievers and central school students but negligible in cases of low achievers and state school students.

Ronna and George[62] (1999) conducted a study using 99 under graduates and reported that flexible combination ability is more important to achievement in mathematics and English than natural science or social science.

2.1.5. Interest and Academic Achievement

Interest is a type of feeling experience, which might be called 'worthwhileness' associated with attention to an object, or course of action; an element or item in an individual's make up, either congenital or acquired, because of which he tends to have this feeling of 'worthwhileness' in connection with certain objects or matters relating to a particular field of knowledge.

Some studies on the relation between interest and academic achievement are abstracted below with relevant findings.

Balasubrahmaniam and Visveswara[63] (1970) reported that among other factors, interests of the students to study English is a significant factor that affect the performance of the pupil.

Results of Pathak's[64] (1974) study suggested that high-achievers and low-achievers do not differ significantly in their interest patterns.

Lalithamma[65] (1975) conducted a study on some factors affecting achievement of secondary school pupils in mathematics and reported that achievement in mathematics is positively correlated to interest in mathematics.

Vishnoi[66] (1977) made a study on 184 male students belonging to different intermediate colleges in Allahabad Muncipal Corporation and reported that academic achievement of high- and low- achievers have no relationship with the area of interest except in literary activities.

Sreekumaran[67] (1981) carried out a study using a sample of 582 standard IX pupils and obtained that positive negligible relationship exists between science interest and achievement in biology for the total and subsamples based on sex and locale.

Varghese[68] (1986) investigated the relationship between science interest, attitude towards science and achievement in chemistry of secondary school pupils of Kerala. The study revealed that there is significant difference (at 0.01 level) in science interest between high and low achievement groups.

Study done by Sujatha[69] (1987) on a stratified random sample of 568 standard IX students of Ernakulam district revealed that the relationship between science interest and biology achievement is positive and significant at 0.01 level.

Prameela[70] (1993) carried out a study using a sample of 502 students of standard IX and found that significant relationship exists between the criterion variable achievement in physics and science interest.

Gafoor[71] (1994) found that there exists significant relationship between science interest and science achievement for the total sample and for subsamples based on sex and locale.

2.1.6 Self-Concept and Academic Achievement

Self-Concept is the individual's evaluation of himself; the appraisal of the self by the individual himself. The view of self-concept as a component of two elements viz., self-image and self-evaluation, places the self-concept within the field of attitude study.

Studies exploring the relation between self-concept and academic achievement are abstracted below with relevant findings.

Goswami[72] (1980) found that positive and significant correlation exists between global self-concept and scholastic achievement. This relationship is positive and significant for male-female and urban-rural adolescents.

Pal, *et al.*[73] (1985) conducted a study using a sample of 240 higher secondary school students and concluded that high scholastic achievers possess high self-concept in comparison to low achievers.

Hashain and Panwar[74] (1989) in a study to find the effect of levels of academic achievement and school background on self-concept by ANOVA obtained that high, average and low academic groups differ significantly in their mean self concept scores and that academic achievement is negatively related to self-concept.

Bevli[75] (1990) conducted a study on a sample of 664 school going children in Delhi ranging in age from 5½-11 years and studying in classes I, II and V. Results indicated that (i) higher the self-concept, higher the cognitive development is true only of the age group 5 ½ to 6½. The trend is reverse for the age group 9½-11 years (ii) relation between self-concept and cognitive score is positive and highly significant in the case of 5½ to 6½ years (iii) relation between self-concept and cognitive score is positive and insignificant in case of 6½ to 7½ years and (iv) relation between self-concept and cognitive score is negative in case of 9½-11 years.

Muralidharan[76] (1990) studied the relationship between parent child relationship and academic achievement in a sample of 664 school going children in Delhi, studying in classes I, II and V. It was found that the relationship between self-concept and school achievement reaches the level of significance only in the younger age group.

Wheat, *et al.*[77] (1991) in their study concluded that prior achievement, self-concept in mathematics, perception of the mathematics teachers,age, high school grades in trigonometry analysis and gender are predictors of success in college algebra.

Mishra's[78] (1992) study on a sample of 88 Oriya male students of class IX and X revealed that the relation between academic achievement and self-concept is not significant.

Payne[79] (1992) examined the effects of the variable academic self-concept on the verbal and mathematics scholastic aptitude test scores of approximately 300 black high school seniors and reported that academic self-concept had significant positive effects on mathematics scores.

Williams[80] (1992) assessed the influence of self-concept on student test performance across four subject matter areas viz., English, mathematics, reading and science using a sample of 217 public high school students in northern Oklahoma and found that self-concept contribute students' academic achievement and students' performance is uniformly affected by self-concept across all four academic areas.

Wong[81] (1992) investigated the relationship of self-concept and mathematics achievement using a sample of 1766 Hongkong students in grades 7-13 and found that achievement is closely related to academic and non-academic self-concepts.

Daniel[82] (1993) examined relationships among achievement related expectancies, academic self-concept and mathematics performance. The study revealed that students with higher academic self-concept earn significantly higher mathematics grades.

Krishnakumar[83] (1993) in an attempt to study the interaction effect of some affective variables on achievement in mathematics of secondary school pupils of Kerala got low correlation (r=0.26) between self-concept in mathematics and mathematics achievement and hence found that only 6.8 percent of variance in the achievement in mathematics is accounted by self-concept in mathematics.

Prameela[70] (1993) carried out a study using a sample of 502 students of standard IX and found no significant relationship between achievement in physics and self-concept.

Rangappa[84] (1994) studied the effectiveness of various levels of self-concept on achievement in mathematics with a sample of 1000 students studying in class VII which was selected from the schools of Bangalore urban and rural districts and found (i) significant difference in the achievement of students of class VII in mathematics of high, normal and low self-concept groups (ii) students of class VII of high self-concept group perform better in mathematics than students of normal self-concept group (iii) significant difference in achievement between high and low self-concept groups (iv) students of class VII of normal self-concept group perform better in mathematics than students of low self-concept group (v) students of class VII of high self-concept group perform better in mathematics than students of low self-concept group.

Study of Sujatha[85] (1994) on a sample of 640 standard IX students revealed that the variable self-concept has no significant effect on achievement in biology.

Evans and Goodman[86] (1995) studied the factors behind children's learning difficulties in mathematics based on three kinds of characteristics viz., characteristics of the child, of the teacher/teaching method, and of the academic subject. They found that perceived under achievement is mainly of poor self image.

A study carried out by Sumangala[19] (1995) with a sample of 750 students of standard IX drawn from 20 schools of five revenue districts of Kerala found that self-concept is significantly related to achievement in mathematics.

Tartre and Fennema[87] (1995) carried out a longitudinal study of mathematics achievement and gender of students (N=60) progressing from 6th to

12th grade and found that there is positive correlation between achievement and confidence.

Ali[88] (1996) conducted a study using a sample of 224 hockey players of 14 universities of Uttar Pradesh and reported that self-concept is a predictor of high performance. The players who have achieved high level of performance scored higher on self-concept.

Study done by Pal, *et al.*[89] (1996) on a sample of 326 students of grade IV, taken from five rural tribal schools in Raigarh and Thane districts of Maharashtra and one urban school in Mumbai revealed that self concept is significantly related to learning of mathematics.

Minnalkodi[90] (1997) conducted a study with a sample of 900 students who had opted zoology as elective in standard XI in Cuddalore educational district and found significant positive relationship between achievement scores and self-concept of students.

The study 'self-concept of adolescents in relation to their academic achievement' conducted by Pande[91] (1997) using a random sample of 200 students studying in the intermediate college of Kotdwara city, obtained that academic achievement and self-concept are not significantly related.

Sojourner and Kushner[92] (1997) conducted a study using a sample of 1868 African American students to examine school and non-school factors related to the educational attainment and found that self-concept is the strongest predictor of mathematics achievement.

Relationship of academic self-concept with academic performance of distance learners at first degree level was studied by Anilkumar[93] (1998) and found that academic performance is significantly related with academic self-concept.

Study carried out by Dubey and Mishra[94] (1999) using a sample of 400 students of standard VIII to X revealed that self-concept variables are less important predictors of academic success.

Deshmukh[95] (2000) conducted a study using a sample of 832 students ranging in age from 16 to 20 years, studying in XIIth standard in Amravati and found that high and low self-concept groups do not differ significantly on academic achievement.

2.1.7. Attitudinal Variables and Academic Achievement

Attitudes are positive or negative feelings that an individual holds about objects, persons or ideas. Attitudes are generally regarded as enduring through modifiable by experience and or persuasion and as learned rather than innate. The degree or strength of a person's attitude may vary from extremely positive through a gradation to extremely negative.

Under this section, studies on the attitudinal variables viz., Attitude towards Mathematics and Attitude towards Academic Work with academic achievement are presented with the major findings of each.

2.1.7.1. Attitude towards Mathematics and Academic Achievement

Reidesal and Burns[96] (1973) found a positive and substantial relationship between attitude towards mathematics and achievement in mathematics.

The correlation of high school failures in mathematics and English with special reference to Jammu division was studied by Jain[2] (1979) and found that attitude towards mathematics plays a vital role in the learning of mathematics.

Study done by Mishra[97] (1980) found no significant relation between attitude towards mathematics and achievement in mathematics.

Montague, *et al.*[35] (1991) conducted a study on 60 eighth grade students and found differences among students who were low, average and high achieving on their attitude towards mathematics.

Relationship of attitude towards mathematics to mathematics performance was investigated by Thorndike[98] (1991) using a sample of 722 male and 794 female students enrolled in public middle and high school mathematics courses and found that attitude towards mathematics is a predictor of final mathematics course grade.

Study done by Wong[81] (1992) on a sample of 1766 Hongkong students of grades 7-13 found that achievement is closely related to attitude towards mathematics.

Ibe[99] (1994) carried out a study on a sample of 7935 eighth grade 13 year old mathematics students and reported that attitude towards mathematics can be reliably assessed as mathematics outcome.

Sumangala[19] (1995) studied the variables discriminating between high- and low- achievers in mathematics and found that achievement in mathematics is related to attitude towards mathematics.

Wangu and Thomas[100] (1995) studied the attitude of students of class IX towards mathematics and assessed their achievement in it using a sample of 300 students covering both boys and girls. The study found a significant positive correlation between the scores of attitude towards mathematics and achievement in mathematics for the total sample as well as for the subgroups.

Carmen[101] (1996) investigated the relationship between the mathematics attitude and mathematics achievement of over 32,000 Hispanic and Asian students and found most of the attitude variables as significant predictors of mathematics achievement.

Pal, *et al.*[89] (1996) analysed the structure of content and mathematics difficulties among primary students using a sample of 326 students of grade IV, taken from five rural tribal schools in Raigarh and Thane districts of Maharashtra and one urban school in Mumbai and found that attitude towards mathematics is significantly related to learning of mathematics.

Kumar[102] (1998) carried out a study on the relationship of attitude towards mathematics with achievement in mathematics and found attitude towards mathematics as positively and significant correlated with achievement in mathematics. It was also found that 'high attitude towards mathematics' group is significantly superior in the achievement in mathematics in comparison to the 'low attitude towards mathematics' group.

2.1.7.2. Attitude towards Academic Work and Academic Achievement

Studies exploring the relation of attitude towards academic work with academic achievement are very few. Reviewed studies are abstracted below for their findings.

Study carried out by Gopinathan[103] (1981) found that attitude towards academic work has no influence on achievement in Malayalam.

'A study of certain personality variables which discriminates between high and low achievers in secondary school social studies' conducted by Rahiman[104] (1981) found that attitude towards academic work has no significant role in social studies achievement.

Nair[105] (1984) conducted a study using a sample of 1200 standard IX secondary school students of Ernakulam revenue district and reported that attitude towards academic work differ significantly between over-, normal-, and under-achievers.

The association of variables attitude towards education and achievement in Malayalam is found as significant for all the three intelligence groups and to all the subgroups based on sex and locale, in a study conducted by Baby[106] (1987).

Sreemanunni[107] (1987) studied the relationship of attitude towards education and achievement in Malayalam of socially advantaged and disadvantaged secondary school pupils and found significant relation between attitude towards education and achievement in Malayalam of socially advantaged and disadvantaged secondary school pupils.

Some factors related to achievement in Malayalam language of secondary school pupils of Kerala state was investigated by Madhavan[108] (1990) and found that there exists a significant correlation between attitude towards education and achievement in Malayalam.

Nambiar[109] (1990) conducted a comparative study of the relation of some psychological variables with academic achievement of institutionalized juvenile delinquents and normal children. The study indicated that there is no significant relation between attitude towards education and academic achievement in the case of both juvenile delinquents and normal children.

Raj[110] (1991) carried out a study on some attitude variables discriminating between over, normal and under achievers in mathematics at secondary school level and found that the mean difference of the variable attitude towards education is significant between over, normal and under achievers in mathematics.

The relationship of attitude towards education and achievement motivation with social studies achievement in high school pupils was investigated by Rejani[111] (1991) and obtained a significant relationship between attitude towards education and social studies achievement.

Sreelathamma[112] (1992) studied some affective correlates of achievement in secondary school biology and found that attitude towards education has no significant correlation with achievement in biology.

Grisay[113] (1994) conducted a study on a stratified sample of 8000 students entering grade 6 and found that the variables positive expectations, school climate, opportunity to learn, time management, and discipline are highly correlated with student outcomes.

Study of Anilkumar[93] (1998) examined the extent of dependence between academic performance and attitudes of distance learners towards distance education at first degree level and found that academic performance is significantly related to the attitude towards distance education.

2.1.8. Anxiety and Academic Achievement

Anxiety refers to the unpleasant feeling that accompanies individual's uncertainities about values and goals and their ability to meet them. When a stimulus situation contains elements which specifically arouse test or achievement anxiety, this increase in anxiety drive will lead to poorer performance in individuals who have test irrelevant anxiety responses in their response repertory. For individuals without such response tendencies, these stimulus elements will raise their general drive level and result in improved performance. The anxiety which leads to poorer performance is termed as debilitating anxiety and which raises the performance as facilitating anxiety. According to Grant[114] (1973), in instructional situations the debilitating anxiety subscale has been shown to be more predictive of student performance than the facilitating anxiety subscale.

Studies exploring the relation between anxiety and achievement are abstracted below with relevant findings.

Study of Tewari and Rai[115] (1976) revealed that (i) low achievers are significantly more anxious than high achievers (ii) anxiety is a differential personality correlate of low- and high- achievers (iii) there is a negative relationship between anxiety and students' achievement.

A study by Somasundaram[116] (1980) on certain personality variables relating to over, normal and under achievement in mathematics revealed that out of sixteen personality variables studied, the variables test anxiety and general anxiety are significant correlates of mathematics achievement. General anxiety and test anxiety were found to have negative correlation with mathematics achievement.

Ganguli[117] (1981) studied anxiety and academic achievement and found that the mean achievement test score of the low anxiety group is slightly higher than that of high anxiety group, though the difference is not statistically significant.

Study carried out by Sood[118] (1981) revealed that achievement anxiety correlates significantly with academic achievement for the SC students. That is, students exhibiting a high level of achievement anxiety will tend to score low in academic achievement test.

The result of Siddiqui and Akhtar's[119] (1983) study revealed that (i) anxiety and achievement are negatively related (ii) when inter group comparisons between means of anxiety scores of high, average and low achievers were made, the difference was found to be highly significant.

Verma[120] (1984) found that anxiety and school achievement are positively correlated. Subjects having high level of anxiety are found to be high achievers than subjects having low level of anxiety.

Shekhar and Chaddha's[121] (1991) study revealed that average achievers are least anxious followed by high achievers and low achievers respectively.

Study carried out by Gupta[122] (1992) showed that anxiety is significantly but negatively correlated with academic achievement for the total sample, arts and science groups; boys and girls.

Hadfield, *et al.*[123] (1992) conducted a study on a sample of 358 Navajo middle school students and found that mathematics anxiety and mathematics achievement are negatively correlated.

Williams[80] (1992) assessed the influence of test anxiety on student test performance across four subject matter areas viz., English, mathematics, reading and science using a sample of 217 public high school students in northern Oklahoma and found that test anxiety contribute to student academic achievement and student performance is uniformly affected by test anxiety across all four academic areas.

Study carried out by Singh and Broota[124] (1995) with a sample of 60 subjects who were selected from class X of a public school in north branch of Delhi revealed that there is significant negative relationship between test anxiety and performance.

Trivedi[125] (1995) studied the anxiety level and academic achievement of undergraduate students with a sample of 270 students selected randomly from five colleges of Kutch district and found (i) a negative relationship between the anxiety levels and academic achievement among girls, students of commerce and arts streams, (ii) among boys and students of science stream, there exists a very low positive correlation between anxiety levels and academic achievement.

Patel[126] (1996) examined the effect of general anxiety on the achievement in mathematics of secondary school students by using a sample of 293 secondary school students studying in class IX from Kaira district in Gujarat and found that the effect of general anxiety on the achievement in mathematics is significant.

Study conducted by Verma[127] (1996) on a sample of 500 male students studying in class X in 10 secondary schools of Delhi reported that the main effect of test anxiety on academic performance of the students in English, mathematics, general science and social studies is significant. The study further revealed that students with low test anxiety score higher in these courses than students with high test anxiety.

Jayasree[128] (1997) studied test anxiety and academic achievement among students of standard IX and found that test anxiety is significantly and inversely related to academic achievement.

Patel[129] (1997) studied the effect of test anxiety on the achievement in mathematics of secondary school students by using a sample of 393 secondary school students of class IX from Kheda district in Gujarat and found that low test anxiety group showed better performance in mathematics than the high test anxiety group.

Study carried out by Rajathi, *et al.*[130] (2000) on a sample of 81 teacher trainees from a self-financing college of education (30 physical science students, 29 biological science students, 13 mathematics students and 9 history students) revealed that anxiety has influence on achievement among the history and mathematics students.

2.1.9. Achievement Motivation and Academic Achievement

Achievement motivation is also referred to as the need for achievement. It is a major determinant of aspiration, effect and persistence when an individual expects that his performance will be evaluated in relation to some standard of excellence. The factors of ability and motivation are the prime ingredients in academic and intellectual accomplishments.

Studies exploring the relation between achievement motivation and academic achievement are presented below with relevant findings of each.

Christian[131] (1979) carried out a study of fear of failure, hope of success, achievement motivation, anxiety and concern in girls and found that there is significant positive correlation between the n-achievement and students' academic performance at 0.01 level.

Study carried out by Rai[132] (1980) reported that high achievers have higher n-achievement than those of average and low-achievers. The difference in the means of n-achievement between high and average; high and low and between average and low achievers are significant at 0.01 level.

A contrastive study of high and low- achievers in Malayalam with respect to some select cognitive and affective variables was conducted by Gopinathan[103] (1981) and found that achievement motivation can differentiate high- achievers from low- achievers.

A study of prejudices commonly found among secondary pupils and their repercussions on scholastic attainment, achievement motivation and social behaviour was carried out by Jha[133] (1981) and found scholastic attainment to be negatively correlated with achievement motivation.

Rajput[134] (1984) conducted a study on academic achievement of students in mathematics in relation to intelligence and achievement motivation using a sample of 100 central school students and reported that in neutral classroom conditions, achievement of students in mathematics is not affected by their achievement motivation.

Valsamma[135] (1984) carried out a study on certain personality variables differentiating under-achievers, average and non-under achievers in biology and found that achievement motivation cannot differentiate under achievers from over and normal achievers.

Narayanan[136] (1987) found that the relationship between achievement motivation and achievement in Hindi of socially advantaged and disadvantaged secondary school pupils are positive and highly significant.

Sinha[137] (1990) carried out a study using a sample of 400 high school students and reported that successful students showed higher academic motivation as compared to the failed students irrespective of sex.

Bennett, *et al.*[138] (1991) examined the effects of SQUARE ONE TV, a television series about mathematics aimed at 8 to 12 year old children on the problem solving behaviour of 240 fifth graders and found that motivation is closely related to arithmetic achievement.

Reynolds and Herbert[139] (1992) conducted a study to formulate a structural model of high school mathematics outcomes and reported that motivation had significant effect on mathematics outcomes.

The study 'high school pupils' academic achievement motivation and their academic achievement' was carried out by Sundararajan and Gnanaguru[140] (1992) and reported that there is no significant relationship between academic achievement motivation and academic achievement.

Prameela[70] (1993) carried out a study using a sample of 502 students of standard IX and found significant relationship between the criterion variable achievement in physics and achievement motivation.

Study conducted by Salimkumar[141] (1994) on a sample of 700 students studying in class IX of the secondary schools of Kerala state revealed that variation in achievement in biology is dependent upon the variation in achievement motivation to a low extent.

Singh and Varma[142] (1995) studied the effect of academic aspiration on scholastic success of class XI students and found that academic aspiration correlated positively with scholastic success of both rural and urban students and that this positive nature of correlation is statistically significant.

Varghese[143] (1995) examined the factors which affect the learners' achievement of government and private aided schools in Kerala and found that aspiration of the child had a positive influence on learner's achievement.

Study conducted by Pramod[144] (1996) using a sample of 300 students (150 boys and 150 girls) who were selected from class XI belonging to matriculation schools of Tamil Nadu through random sampling procedure found that achievement motivation is the most dominating influencing factor on academic performance. Canonical value indicated linear relationship between scholastic performance and achievement motivation.

Mavi and Patel[145] (1997) studied the relationship between academic achievement and level of aspiration using a sample of 720 standard IX students of the age group 14 covering 525 tribal and 195 non tribals and found significant positive correlation between academic achievement and level of aspiration.

A study of higher secondary school students' achievement in zoology in relation to anxiety, achievement motivation and self concept was carried out by Minnalkodi[91] (1997) on a sample of 900 students who had opted zoology as elective in standard XI in Cuddalore educational district and found that there is significant positive relationship between achievement scores and achievement motivation of students.

Study done by Rao and Rao[146] (1997) on a sample of 30 engineering college students and 30 arts and science college students of S.V. University Tirupati found that there is a positive correlation between achievement motivation and academic achievement.

Sarode[147] (1999) studied the impact of socio-economic status, study habits and academic motivation on academic achievement of higher secondary students using a sample of 563 standard XII pupils and obtained that academic motivation has influence on academic achievement in case of arts and science students. Academic motivation has no influence on academic achievement in case of commerce students.

2.2. TREND REPORT

Inorder to have a closer idea of the nature of relationship in the studies the reviewed studies are tabulated as Table 1 for the nature of relationship in each.

TABLE 1

Studies Reviewed and the Nature of Relationship in Each

Relationship studied		Studies showing	
		Significant relation	No relation
A. Aptitudinal Variables with Academic Achievement	1.	Jain[2] (1979)	
	2.	Katiyar[3] (1979)	
	3.	Pillai[4] (1981)	
	4.	Consuegra[5] (1982)	
	5.	Singh[6] (1983)	
	6.	Patel[7] (1984)	
	7.	Mehna[8] (1985)	
	8.	Bhattacharya[9] (1986)	
	9.	Dubey[10] (1987)	
	10.	Tracy[11] (1987)	
	11.	Budhev[12] (1990)	
	12.	Monson & Fukui[13] (1991)	
	13.	Bastecki & Berry[14] (1992)	
	14.	Dubey & Vijayakumar[15] (1992)	
	15.	Boyd[16] (1993)	
	16.	Gustin & Corazza[17] (1994)	
	17.	Malini[18] (1995)	
	18.	Sumangala[19] (1995)	
	19.	Waxman, *et al.*[20] (1996)	
	20.	Babylatha[21] (1997)	
	21.	Goel[22] (1997)	
	22.	Seokhoon & Betty[23] (2000)	

Relationship studied		Studies showing	
		Significant relation	No relation
B. Inductive-Deductive Reasoning with Academic Achievement	1.	Malhotra[24] (1982)	
	2.	Kumari[25] (1985)	
	3.	Niaz[26] (1993)	
	4.	Singh[27] (1994)	
	5.	Watters & English[28] (1995)	
	6.	Klauers[29] (1996)	
	7.	Mathews[30] (1996)	
	8.	Kral[31] (1997)	
C. Problem Solving Ability with Academic Achievement	1.	Das[32] (1978)	
	2.	Consuegra[5] (1982)	
	3.	Caballos & Esteban[33] (1988)	
	4.	Haridasan[34] (1989)	
	5.	Monson & Fukui[13] (1991)	
	6.	Montague, *et al.*[35] (1991)	
	7.	Hembree[36] (1992)	
	8.	Montague & Applegate[37] (1993)	
	9.	Byrnes & Takahira[38] (1994)	
	10.	Lawson & Chinnappan[39] (1994)	

Relationship studied		Studies showing	
		Significant relation	No relation
D. Creativity with Academic Achievement	1.	Dhaliwal & Saini[41] (1976)	
	2.	Panicker[42] (1979)	1. Kapoor (1996)
	3.	Asha[43] (1980)	2. Rajyalakshmi[56] (1976)
	4.	Gakhar[44] (1985)	3. Rani[59] (1997)
	5.	Tuli[45] (1985)	
	6.	Malini[46] (1990)	
	7.	Carroll & Howieson[47] (1991)	
	8.	Subramoniyam & Remadevi[48] (1991)	
	9.	Bhawalkar[49] (1992)	
	10.	Mondal[50] (1992)	
	11.	Padhi[51] (1992)	
	12.	Kim[52] (1993)	
	13.	Thampuratti[53] (1994)	
	14.	Bawa & Kaur[54] (1995)	
	15.	Chaturvedi[57] (1997)	
	16.	Khare & Grewal[58] (1997)	
	17.	Rani[59] (1997)	
	18.	Sunitha[60] (1997)	
	19.	Behera[61] (1998)	
	20.	Ronna & George[62] (1999)	

Relationship studied		Studies showing			
		Significant relation		No relation	
E.	Interest with Academic Achievement	1.	Balasubrahmaniam & Visveswara[63] (1970)	1.	Pathak[64] (1974)
				2.	Vishnoi[66] (1977)
		2.	Lalithamma[65] (1975)		
		3.	Sreekumaran[67] (1981)		
		4.	Varghese[68] (1986)		
		5.	Sujatha[69] (1987)		
		6.	Prameela[70] (1993)		
		7.	Gafoor[71] (1994)		
F.	Self-Concept with Academic Achievement	1.	Goswami[72] (1980)		
		2.	Pal, *et al.*[73] (1985)	1.	Mishra[78] (1992)
		3.	Hashain & Panwar[74] (1989)	2.	Prameela[70] (1993)
		4.	Bevli[75] (1990)	3.	Sujatha[85] (1994)
		5.	Muralidharan[76] (1990)	4.	Pande[91] (1997)
		6.	Wheat, *et al.*[77] (1991)		
		7.	Payne[79] (1992)		
		8.	Williams[80] (1992)		
		9.	Wong[81] (1992)		
		10.	Daniel[82] (1993)		
		11.	Krishnakumar[83] (1993)		
		12.	Rangappa[84] (1994)		
		13.	Evans & Goodman[86] (1995)		
		14.	Sumangala[19] (1995)		

Relationship studied	Studies showing Significant relation	No relation
	15. Tartre & Fennema[87] (1995)	
	16. Ali[88] (1996)	
	17. Pal, *et al.*[89] (1996)	
	18. Minnalkodi[90] (1997)	
	19. Sojourner & Kushner[92] (1997)	
	20. Anilkumar[93] (1998)	
	21. Dubey & Mishra[94] (1999)	
	22. Deshmukh[95] (2000)	
G. Attitude towards Mathematics with Academic Achievement	1. Reidesal & Burns[96] (1973)	1. Mishra[97] (1980)
	2. Jain[2] (1979)	
	3. Montague, *et al.*[35] (1991)	
	4. Thorndike[98] (1991)	
	5. Wong[81] (1992)	
	6. Ibe[99] (1994)	
	7. Sumangala[19] (1995)	
	8. Wangu & Thomas[100] (1995)	
	9. Carmen[101] (1996)	
	10. Pal, *et al.*[89] (1996)	
	11. Kumar[102] (1998)	
H. Attitude towards Academic Work with Academic Achievement	1. Nair[105] (1984)	1. Gopinathan[103] (1981)
	2. Baby[106] (1987)	2. Rahiman[104] (1981)
	3. Sreemanunni[107] (1987)	3. Nambiar[109] (1990)
	4. Madhavan[108] (1990)	

Relationship studied		Studies showing			
		Significant relation		No relation	
		5.	Raj[110] (1991)	4.	Sreelathamma[112] (1992)
		6.	Rejani[111] (1991)		
		7.	Grisay[113] (1994)		
		8.	Anilkumar[93] (1998)		
I.	Anxiety with Academic Achievement	1.	Tewari & Rai[115] (1976)		
		2.	Somasundaram[116] (1980)		
		3.	Ganguli[117] (1981)		
		4.	Sood[118] (1981)		
		5.	Siddiqui & Akhtar[119] (1983)		
		6.	Verma[120] (1984)		
		7.	Shekhar & Chaddha[121] (1991)		
		8.	Gupta[122] (1992)		
		9.	Hadfield, *et al.*[123] (1992)		
		10.	Williams[80] (1992)		
		11.	Singh & Broota[124] (1995)		
		12.	Trivedi[125] (1995)		
		13.	Patel[126] (1996)		
		14.	Verma[127] (1996)		
		15.	Jayasree[128] (1997)		
		16.	Patel[129] (1997)		
		17.	Rajathi, *et al.*[130] (2000)		
J.	Achievement Motivation with Academic Achievement	1.	Christian[131] (1979)		
		2.	Rai[132] (1980)		
		3.	Gopinathan[103] (1981)	1.	Rajput[134] (1984)

Relationship studied	Studies showing: Significant relation		Studies showing: No relation	
	4.	Jha[133] (1981)	2.	Valsamma[135] (1984)
	5.	Narayanan[136] (1987)	3.	Sundararajan & Gnanaguru[140] (1992)
	6.	Sinha[137] (1990)	4.	Sarode[147] (1999)
	7.	Bennett, *et al.*[138] (1991)		
	8.	Reynolds & Herbert[139] (1992)		
	9.	Prameela[70] (1993)		
	10.	Salimkumar[141] (1994)		
	11.	Singh & Varma[142] (1995)		
	12.	Varghese[143] (1995)		
	13.	Pramod[144] (1996)		
	14.	Mavi & Patel[145] (1997)		
	15.	Minnalkodi[91] (1997)		
	16.	Rao & Rao[146] (1997)		
	17.	Sarode[147] (1999)		

Studies reviewed and tabulated in Table 1 helped to arrive at the following.

1. All the studies reviewed on the relation of Academic Achievement with Aptitudinal variables, Inductive-Deductive Reasoning and Problem Solving Ability indicated significant relationship suggesting the possibility of these three variables as significant predictors of Academic Achievement.

2. In the area of Creativity, majority of studies showed significant relation with Academic Achievement. Only few studies showed no relation between Creativity and Achievement. As majority of the studies showed significant relation, Creativity can be considered as a facilitating factor of Achievement.
3. Limited number of studies are available in the area of Interest and Academic Achievement. Among these, majority indicated positive relationship.
4. Of the 26 studies reviewed by the investigator exploring the relation between Self-Concept and Academic Achievement, majority revealed positive relation. Only four studies showed no relation and only one showed negative relation.
5. Studies relating to Attitudinal Variables and Academic Achievement are comparatively less. All the studies, except one, in the area of Attitude towards Mathematics and Achievement revealed significant relationship. In the case of Attitude towards Academic Work and Achievement, out of the 12 studies, four showed no relation and the remaining studies showed significant relation.
6. Of the 17 studies reviewed under the area of Anxiety with Academic Achievement, majority of the studies showed negative relationship. Of the 20 studies in the area of Achievement Motivation and Achievement, only four studies showed no relation between the variables whereas most of the remaining studies showed positive relation.

2.3. CONCLUSION

By the review of works related with the present study, the investigator found that a good number of studies were done in the area of Academic Achievement relating with the cognitive and non cognitive variables Aptitude, Creativity, Self-Concept, Anxiety and Achievement Motivation. But it was found that studies on the relation of variables like Inductive-Deductive Reasoning, Problem Solving Ability, Interest and Attitudinal Variables with Achievement are very few. It was also found that studies on the relation of the above variables with Achievement in Mathematics are limited.

The review further found that eventhough the available studies are on the relation of either cognitive variables with Achievement or non-cognitive variables with Achievement, comprehensive studies on the relation of both cognitive and non-cognitive variables (psychological variables) with Achievement especially in Mathematics are rare. Majority of the reviewed studies shows the relation of two or three variables with Achievement at correlational level only. Also there is a lack of attempts to find the combined influence or predictive ability of a set of psychological variables using multivariate statistical techniques such as multiple regression analysis, discriminant function analysis and factor analysis. Eventhough there are a large number of studies on the relation of Creativity and Achievement, studies that focus on the relation of Achievement with the components of Creativity are rare. By considering all these the investigator makes humble attempt to estimate the predictive efficiency of select psychological variables and hence to identify the significant predictors of Achievement in Mathematics. The investigator thereby hopes that the present study may help the educators in understanding the significance and predictive ability of the select psychological variables in boosting Achievement in Mathematics.

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CHAPTER III

METHODOLOGY

- Variables
- Tools Used
- Sample
- Data Collection Procedure
- Scoring and Consolidation
- Statistical Techniques Used for Analysis

The method followed in the conduct of an investigation is of utmost importance in deciding the validity of its findings. It is the strategy followed in collecting and analysing the data necessary for the solution of the problem. The method used in a study is dictated by the nature of the problem and the type of data required for answering the questions posed by the problem.

The method followed for the present study is described under six major headings viz.,

(i) Variables
(ii) Tools used
(iii) Sample
(iv) Data collection procedure
(v) Scoring and consolidation
(vi) Statistical techniques used for analysis

3.1. VARIABLES

The study being a correlational one, two types of variables are involved viz., criterion or dependent and predictor or independent variables. The criterion (dependent) and predictor (independent) variables of the study are listed below with rationale for the selection of the particular predictor variables.

3.1.1. Criterion (dependent) Variable

As the major objective of the study is to identify the psychological variables which are capable of predicting significantly Achievement in Mathematics, the criterion or dependent variable of the study is Achievement in Mathematics.

For the present study Achievement in Mathematics refers to the tangible accomplishment or proficiency of performance in secondary school Mathematics as measured by a standardised test of Achievement in Mathematics developed by the investigator.

3.1.2. Predictor (independent) Variables

As the major objective is to identify the psychological variables capable of predicting significantly Achievement in Mathematics, the predictor or independent variables of the study are the psychological variables. The psychological variables used for the prediction purpose are:

i) Numerical Reasoning
ii) Ability to use Symbols
iii) Spatial Ability
iv) Abstract Reasoning
v) Inductive Reasoning
vi) Deductive Reasoning
vii) Problem Solving Ability in Mathematics
viii) Fluency
ix) Flexibility
x) Originality
xi) Mathematics Interest
xii) Self-Concept in Mathematics
xiii) Attitude towards Mathematics

xiv) Attitude towards Academic Work

xv) Mathematics Anxiety

xvi) Achievement Motivation in Mathematics

3.1.2.1 Rationale for the selection of the predictor (independent) variables in the study

The predictor (independent) variables of the study were decided by an initial review of literature in the area of academic achievement. The literature suggested that academic achievement of a student is associated or linked with a number of variables of the dimensions like cognitive, affective, environmental, socio-familial etc. In the present study, the investigator gave prominence to the cognitive and affective dimensions, the areas in which a good number of studies were done and are the areas to be studied in depth. As the study intended to identify the significant predictors with relative efficiency of each in predicting Achievement in Mathematics, the variables used are those which may have high relation with Achievement in Mathematics.

Students enter school with some background characteristics and these influence their performance. Such characteristics constitute in a sense, the raw material in which the institution has to work and produce the required man power. Student's personal characteristics basically initiate performance either as short term or long term academic achievement. Student characteristics has a good deal in determining who would do what in the academic field and later in life. By the review of literature, the investigator found that Inductive Reasoning and Deductive Reasoning are two fundamental ways of reasoning (Greeno[1], 1978; Monroe[2], 1990; Husen & Postlethwaite[3], 1994) and hence they may possess high predictive ability of Achievement in Mathematics. Problem Solving Ability is a means of mathematics education as well as a result of education. As such it is a variable having high relation with Achievement in Mathematics (Consuegra[4], 1982; Monson & Fukui[5],1991; Lawson & Chinnappan[6], 1994 etc.). Mathematics Aptitude, which is the inherent potential of an individual to learn or work in the area of Mathematics, is another significant predictor of Achievement in Mathematics (Dubey[7], 1987; Budhev[8], 1990; Sumangala[9], 1995) and is composed of several abilities like Numerical Ability, Numerical Reasoning, Ability to use Symbols, Spatial Ability and Abstract Reasoning (Lennon[10], 1980; Minke[11], 1996 etc.). Hence each of these component abilities may be good predictors of Achievement in Mathematics. Mathematical Creativity is another variable having high relation with achievement as studied by many researchers (Tuli[12], 1985; Carroll & Howieson[13], 1991; Ronna & George[14], 1999 etc.). Now there seems a trend to study the nature of the relationship of the component characteristics of creativity viz., Fluency, Flexibility and Originality with academic achievement (Bawa & Kaur[15], 1995; Rani[16], 1997; Ronna & George[14], 1999) and hence the investigator tried this trend. Thus the cognitive variables viz., Numerical Reasoning, Ability to use Symbols, Spatial Ability, Abstract Reasoning, Inductive Reasoning, Deductive Reasoning, Problem Solving Ability in Mathematics, Fluency, Flexibility and Originality were selected for the study as predictors or independent variables.

Affective variables occupy a position not less than that of the cognitive variables in effecting high Achievement in Mathematics. Attitudes, interests, anxiety, self-concept and achievement motivation are the key affective variables to the educative process which serve both as ends and as means. Depending on whether these are positively or negatively directed towards the educative process, these are considered to promote or inhibit student behaviour in the classroom, at home and in the peer groups and ultimately to learning and achievement. The investigator therefore decided to incorporate the affective variables like Mathematics Interest, Self-Concept in Mathematics, Attitude towards Mathematics, Attitude towards Academic Work, Mathematics Anxiety and

Achievement Motivation in Mathematics for studying their predictive ability and the relative role of each for higher Achievement in Mathematics.

Thus, a set of psychological variables consisting of ten cognitive and six affective variables are used as the predictors (independent variables) of Achievement in Mathematics in the study.

3.2. TOOLS USED

Tools used for the measurement of the criterion and predictor variables are listed in Table 2 along with the psychometric characteristics of each.

TABLE 2

Details of the Tools Used

Sl. No.	Tools used	Reliability	Validity
i.	Test of Achievement in Mathematics (Investigator, 1998)	0.79 (Test-retest)	0.73 (Criterion related validity)
ii.	Test of Numerical Reasoning (Sumangala & Malini, 1993)	0.73 (Test-retest)	0.67 (Construct validity)
iii.	Test of Ability to use Symbols (Sumangala & Malini, 1993)	0.70 (Test-retest)	0.65 (Construct validity)
iv.	Test of Spatial Ability (Sumangala & Malini, 1993)	0.72 (Test-retest)	0.62 (Construct validity)
v.	Test of Abstract Reasoning (Sumangala & Malini, 1993)	0.72 (Test-retest)	0.60 (Construct validity)
vi.	Test of Inductive Reasoning (Investigator, 1998)	0.80 (Test-retest)	0.75 (Concurrent validity)
vii.	Test of Deductive Reasoning (Investigator, 1998)	0.74 (Test-retest)	0.78 , 0.65 (Construct validity)
viii.	Test of Problem Solving Ability in Mathematics (Sumangala & Vijayakumari, 1996)	0.76 (Test-retest)	0.58 (Criterion related validity)

Table contd.....

Sl. No.	Tools used	Reliability	Validity
ix.	Test of Mathematical Creativity (Sumangala, 1993)	0.77 (Test-retest) 0.77 (Cronbach's Alpha coefficient)	0.62 (Criterion related validity)
x.	Mathematics Interest Inventory (Sumangala & Vijayakumari, 1996)	0.76 (Test-retest)	0.58, 0.46, 4.45 (Construct validity)
xi.	Scale of Self-Concept in Mathematics (Sumangala & Malini, 1993)	0.82 (Test-retest) 0.81 (Cronbach's Alpha coefficient)	37.36, 0.67, 0.60 (Construct validity) 0.73 (Criterion related validity)
xii.	Scale of Attitude towards Mathematics (Sumangala & Sunny, 1987)	0.73 (Test-retest)	0.60 (Criterion related validity)
xiii.	Scale of Attitude towards Academic Work (Investigator, 1998)	0.83 (Test-retest)	0.79 (Criterion related validity)
xiv.	Scale of Mathematics Anxiety (Sumangala & Malini, 1993)	0.86 (Test-retest) 0.80 (Cronbach's Alpha coefficient)	0.57, 0.64 (Construct validity)
xv.	Scale of Achievement Motivation in Mathematics (Sumangala & Vijayakumari, 1996)	0.80 (Test-retest) 0.83 (Cronbach's Alpha coefficient)	0.72 (Construct validity) 0.66 (Concurrent validity)

Each of the above tools is described below incorporating the essential details like authority of the tool, variables measured by each, definition of the variable and format of the tool, procedure of test development, nature of items/statements with examples, scoring scheme and psychometric characteristics like reliability and validity.

3.2.1. Test of Achievement in Mathematics

This test was developed and standardised by the investigator for the present study to measure Achievement in Mathematics of standard IX pupils. For the purpose, Achievement in Mathematics is defined as the tangible accomplishment or proficiency of performance in Mathematics as a subject of study.

3.2.1.1. Details of development of the test

Construction and standardisation of an achievement test involves processes like planning, preparation, try out and finalisation, and hence the details of the test development are presented under these headings.

3.2.1.1.1. *Planning*

As a preliminary to test preparation, the investigator took decision on matters like the content and objectives of the test, type of items to be used, item difficulty, number of items and the duration of the test.

As the period of data collection was decided during the initial phase of the academic year, the investigator decided to have the content of the test as that of 8th standard Mathematics.

For the format of the test items, number of items and for the test objectives, the investigator decided to have the pattern of SSLC Examination as it is the summative evaluation students are to face at the end of secondary schooling. For this, the investigator reviewed previous SSLC question papers to understand the structure of the test with regard to type of questions, educational objectives etc. It was thus decided to have both objective (covering multiple choice, matching type and completion type) and descriptive (short answer and essay) test items in the test, following the patterns of SSLC Examination testing.

According to Ebel and Frisbie[17] (1991), norm referenced tests that are too easy or too difficult will produce score distributions that make hard to identify reliable inter individual differences. Investigator therefore decided that the test items be of moderate difficulty.

As there are a number of tools to be administered for data collection, duration of the test was limited to one hour with 24 items of 25 marks.

Blue print of the test incorporating the above decisions is given as Table 3.

TABLE 3

Blue-print of the Test of Achievement in Mathematics

Objectives / Item format / Content	Knowledge			Understanding			Application			Skill			Total
	O	SA	E	O	SA	E	O	SA	E	0	SA	E	
Sets	½ (1)			2½ (5)									3
Proportion									2½ (1)				2½
Geometrical constructions												3 (1)	3
Areas & principles	2 (4)				1½ (1)								3½
Polynomials	½ (1)			½ (1)	3 (2)								4
True equations				1 (2)		5½ (2)							6½
Square root				1 (2)				1½ (1)					2½
Total	3			15			4			3			25

Note: i) O - objective type SA - short answer type E - essay type

ii) Numbers outside the brackets indicate marks and those inside indicate the number of questions.

3.2.1.1.2 Preparation of the test

Based on the criteria for preparing objective and descriptive items suggested by Ebel and Frisbie[17] (1991), the investigator prepared double the number of items under each category of the blue print so as to have the desired number of test items in the final test.

Examples of test items are given below.

1. What is the measure of an angle inscribed in a semi circle?

   [90°, 60°, 45°, 30°] (Knowledge)

2. What is the number of digits in the square root of 657666025?

   [8, 6, 5, 4] (Understanding)

3. A work can be completed by 3 men or 6 women in 20 days. If so how many days will be required for 12 men and 8 women together to complete the same work?

   (Application)

4. If AB = 7 cm, BC = 5 cm, $\angle A = 75^\circ$, $\angle B = 95^\circ$ and $\angle C = 100^\circ$, construct a quadrilateral ABCD (Skill)

3.2.1.1.3. Scoring procedure

The scoring scheme of the test is as follows.

i) For every objective type item, one score for the correct response and zero score for the incorrect response.

ii) For the descriptive test items, scoring is as per the scheme prepared and produced as Appendix III.

3.2.1.1.4. *Try out of the test*

The draft test was tried out, for finding the item validity, on a sample of 100 pupils of standard IX selected by stratified sampling technique from two districts Kozhikode and Malappuram.

3.2.1.1.4.1. *Item analysis*

Item analysis is the process of finding out facility value (difficulty index) and discrimination power of the test items. The two indices were worked out separately for objective type items and for descriptive type items.

The discrimination power (DP)and the facility value (F.V) of each objective type item were found by using the formulae

$$DP = \frac{U-L}{N} \quad \text{and} \quad F.V = \frac{U+L}{2N}$$

respectively (Ebel's procedure) in which,

U is the number of right responses for the item in the upper group.
L is the number of right responses for the item in the lower group.
and N is the number of pupils in the upper or lower group.

The upper and lower groups were identified using the 27 percent cut off to the scores of Achievement in Mathematics.

For descriptive type items discrimination power (DP) was estimated in terms of critical ratios (CR) of the two tailed test of significance of difference between means for small independent samples. The DP (CR) of the items were estimated by using the formula

$$DP = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left(\frac{(N_1 - 1) S_1^2 + (N_2 - 1) S_2^2}{N_1 + N_2 - 2}\right)\left(\frac{1}{N_1} + \frac{1}{N_2}\right)}}$$

(Best & Kahn[18], 1992)

in which,

$\bar{X}_1$ is the mean score of the upper group on a given item,

$\bar{X}_2$ is the mean score of the lower group on the same item,

S_1^2 is the variance of the distribution of responses of the upper group to the item,

S_2^2 is the variance of the distribution of responses of the lower group to the item,

N_1 and N_2 are the number of pupils in upper and lower group respectively.

Facility value (FV) of the descriptive items were calculated using the formula

$$FV = \frac{\text{Sum of marks by all students on the question}}{\text{Sum of maximum marks obtainable on that question}}$$

(A.I.U. Monograph[19], 1977)

The indices of discrimination power and of facility value of the draft test items are presented as Table 4.

TABLE 4

Discrimination Power and Facility Value of Items in the Draft Test of Achievement in Mathematics

Objective type Items						Descriptive type Items		
Item No.	Discrimination Power	Facility Value	Item No.	Discrimination Power	Facility Value	Item No.	Discrimination Power	Facility Value
1	0.15	0.67	17*	0.60	0.59	33*	2.66	0.32
2*	0.33	0.50	18*	0.37	0.52	34*	17.00	0.46
3	0.11	0.61	19*	0.48	0.39	35	3.25	0.15
4	0.26	0.80	20*	0.56	0.57	36	3.58	0.17
5*	0.30	0.63	21*	0.37	0.41	37*	5.75	0.33
6*	0.37	0.52	22*	0.37	0.63	38*	8.31	0.61
7*	0.48	0.61	23	0.37	0.52	39	2.59	0.04
8	0.26	0.54	24*	0.66	0.59	40	2.15	0.26
9	0.19	0.76	25	0.15	0.81	41	3.75	0.18
10*	0.37	0.63	26*	0.41	0.46	42	2.00	0.28
11	0.07	0.78	27	0.26	0.50	43*	2.68	0.48
12*	0.56	0.54	28	0.15	0.52	44*	6.00	0.56
13*	0.41	0.54	29	0.26	0.20	45	5.00	0.13
14*	0.41	0.61	30	0.22	0.33	46*	6.67	0.37
15	0.26	0.43	31	0.11	0.17	47*	2.68	0.48
16	0.22	0.33	32	0.19	0.20	48	2.50	0.35

Note: * denotes the items selected for the final test.

*3.2.1.1.5. **Finalisation of the test***

For a norm-referenced objective type achievement test, items having discrimination indices of 0.30 or more are considered as good (Ebel and Frisbie[17], 1991). Hence objective items which possess the discrimination index of 0.30 or more and having facility value (difficulty index) around 0.50 (of average difficulty) were selected as items for the final test.

In the case of descriptive type items, items having discrimination index of 2.01 or more (t-value required for significance of difference between means at 0.01 level for $N_1 + N_2$-2 df) and facility value around 0.50 were selected for the final test.

Thus, as per the blue print, the final test has 24 items, of which 16 are objective type items and eight are descriptive type items. The test is of 25 marks and the time duration to answer the test is one hour.

Malayalam and English versions of the draft and final test are given as Appendices I, II, IV and V respectively.

3.2.1.2. Reliability

Reliability of the test was estimated by test-retest method with an interval of two weeks between the two testings. The obtained reliability coefficient (Pearson's r) is 0.79 (N=40). This suggests that the test is highly reliable to measure Achievement in Mathematics of secondary school pupils.

3.2.1.3. Validity

The test was constructed with adequate coverage of the content and instructional objectives of the subject (vide Blue print) which are evidences of the content validity of the test.

Empirical (criterion related) validity of the test is determined by correlating (Pearson's r) the test scores with that of a concurrent criterion viz., marks obtained by students in Mathematics for the first terminal examination for a sample of 35 pupils on the assumption that high achievers in Mathematics in school examination will be high achievers in the test of Achievement in Mathematics. The coefficient of validity thus obtained is 0.73.

The values of reliability and validity of the test thus suggests that 'Test of Achievement in Mathematics' is a valid tool for measuring Achievement in Mathematics of secondary school pupils.

3.2.2. Test of Numerical Reasoning

Test of Numerical Reasoning is a part of the 'Test of Mathematics Aptitude' developed and standardised by Sumangala and Malini in 1993. The test was developed by finding Numerical Reasoning as a major component of mathematics aptitude and by defining it as the ability of students to reason out in finding solutions to numerical situations. It is the reasoning ability of students for doing mathematical verbal problems and hence is an essential requisite of mathematics aptitude, the ability to learn. A problem situation necessitates clear understanding of the problem, processing of the data mentally as to what, how and why of the problem and then applying the reasoning ability for reaching out the solution required.

This test is with ten objective type items and is to be worked out in ten minutes time.

Example:

When the radius of a circle is reduced by half, its area is

A. reduced to half B. doubled

C. reduced to one fourth D. not changed

3.2.2.1. Scoring procedure

As all the items are of objective type, the scoring scheme is 'one score for each correct answer and zero score for every incorrect answer'.

3.2.2.2. Reliability

Test-retest reliability coefficient of the test is 0.73 (N = 40) which suggests that the test is highly reliable to measure the Numerical Reasoning of pupils.

3.2.2.3. Validity

The construct validity of the test was estimated by setting hypothesis that the Numerical Reasoning scores will be positively and highly correlated with the school examination marks in mathematics. The so obtained coefficient of correlation (Pearson's r) with the first term examination marks in mathematics is 0.67 (N=40), suggesting that the hypothesis is highly validated.

A copy of the test is given as Appendix VI.

3.2.3. Test of Ability to use Symbols

This test is also a part of the 'Test of Mathematics Aptitude' developed and standardised by Sumangala and Malini in 1993. The test was developed by defining Ability to use Symbols as the ability of students in handling mathematical symbols with speed and accuracy in appropriate situations and as an essential element of mathematics aptitude.

The test has five objective type items on the use of mathematical symbols to solve problems and is to be answered in five minutes.

Example:

If + denotes multiplication, * denotes division and 0 denotes addition, what is the value of the following?

12 + (14 * 7) 02 + 4

A. 40	B. 20
C. 32	D. 64

3.2.3.1. Scoring procedure

As all the items are of objective type, the scoring scheme is 'one score for each correct answer and zero score for every incorrect answer'.

3.2.3.2. Reliability

Test-retest reliability coefficient of the test is 0.70 (N=40) which suggests that the test is highly reliable to measure Ability to use Symbols.

3.2.3.3. Validity

Construct validity of the test was estimated by setting hypothesis that the scores of the test of 'Ability to use Symbols' will be positively and highly correlated with the school examination marks in mathematics. The so obtained coefficient of correlation (Pearson's r) is 0.65 (N=40) suggesting that the hypothesis is highly validated.

A copy of the test is given as Appendix VII.

3.2.4. Test of Spatial Ability

Test of Spatial Ability is another subtest of 'Test of Mathematics Aptitude' developed and standardised by Sumangala and Malini in 1993. The test was developed by finding Spatial Ability as a major component of mathematics aptitude and by defining it as the ability of an individual to understand differences and relationships between objects in space and to perceive the spatial properties of an object. It is the ability to manipulate things mentally, to create a structure in one's mind and to visualise objects in three dimension. In short, the test is to test the pupil's ability to visualise geometric patterns in space and then arriving at the correct solution.

The test has eight objective type items and are to be answered in seven minutes.

Example:

A cube is to be painted. Two adjacent faces should not be of the same colour. Then the number of minimum colours required to paint the cube is

A. 6	B. 3
C. 4	D. 5

3.2.4.1. Scoring procedure

As all the items are of objective type, the scoring scheme is 'one score for each correct answer and zero score for every incorrect answer'.

3.2.4.2. Reliability

Test-retest reliability coefficient of the test is 0.72 (N=40) which suggests that the test is highly reliable to measure Spatial Ability.

3.2.4.3. Validity

Construct validity of the test was estimated by setting hypothesis that the Spatial Ability scores will be positively and highly correlated with the school examination marks in mathematics. The so obtained coefficient of correlation (Pearson's r) with the first term examination marks in mathematics is 0.62 (N=40), suggesting that the hypothesis is highly validated.

A copy of the test is given as Appendix VIII.

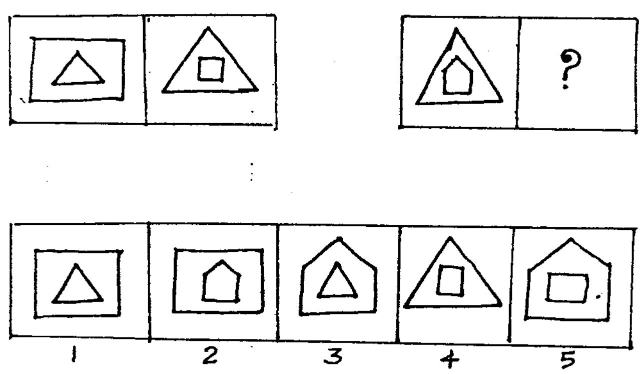
3.2.5. Test of Abstract Reasoning

This test is also a component test of 'Test of Mathematics Aptitude' developed and standardised by Sumangala and Malini in 1993. For the purpose, Abstract Reasoning is defined as the act or process of arriving at conclusion through the use of symbols or generalizations rather than by concrete data. That is, it is the ability of students to reason out abstract ideas in problem solving. This test has three types of items viz., analogy, series and classification which often forms part of intelligence testing. In these items, students are to arrive at answers using reasoning ability rather than using rote memory or simple associations.

The test has 15 objective type items and are to be answered in eight minutes.

Example:

In the following test item, determine the relationship between the first part of the item. Then apply this relationship to the second part and select the right answer from the given choices 1, 2, 3, 4 and 5.



3.2.5.1. Scoring procedure

As all the items are of objective type, the scoring scheme is 'one score for each correct answer and zero score for every incorrect answer'.

3.2.5.2. Reliability

The test-retest reliability coefficient of the test is 0.72 (N=40) which suggests that the test is highly reliable to measure Abstract Reasoning.

3.2.5.3. **Validity**

Construct validity of the test was estimated by setting hypothesis that the Abstract Reasoning scores will be positively and highly correlated with the school examination marks in mathematics. The so obtained coefficient of correlation (Pearson's r) with the first term examination marks in mathematics is 0.60 (N=40), suggesting that the hypothesis is well validated.

A copy of the test is given as Appendix IX.

3.2.6. Test of Inductive Reasoning

This test is constructed and standardised by the investigator for the present study. This is developed to measure the inductive ability of secondary school pupils.

Inductive Reasoning is the reasoning that proceeds from the specific to the general or from parts to the whole. It is the ability of generalization on the basis of known facts and observations. That is, the individual is presented with a set of elements and the task is to induce the rule structure relating the elements so that the pattern can be completed or extended.

The draft test of Inductive Reasoning contains 40 multiple choice test items. All the items are based on the concepts of mathematics taught at secondary school level. Thus it is a content-based ability test. Time set for answering the test was 30 minutes.

Example:

A prism with 3 base edges has 5 faces.
A prism with 4 base edges has 6 faces.
A prism with 5 base edges has 7 faces.
Then, how many faces does a prism with 'n' base edges have?

A.	n - 2	B.	n - 1
C.	n + 1	D.	n + 2

3.2.6.1. Scoring procedure

As all the items are objective type, scoring scheme of the test is to give one score for each correct response and zero score for every incorrect response.

3.2.6.2. Standardisation of the test

Items for the final test were decided on the basis of item analysis - the process of finding out the discrimination power (DP) and of facility value (FV) or difficulty index of each item. As the present test is a power test, only discrimination power of the items were estimated and considered as the index of selection. This was done using a sample of 100 pupils.

The discrimination power of each item was calculated using the formula $DP = (U - L)/N$ (Ebel's procedure) where U is the number of correct responses in the upper group; L is the number of correct responses in the lower group; N is the number of pupils in the upper or lower group. The upper and lower groups were identified using the 27 percent cut off to the scores of Inductive Reasoning.

The estimated discrimination power of the draft test items are given as Table 5.

TABLE 5

Discrimination Power of
Items in the Draft Test of Inductive Reasoning

Item Number	Discrimination Power	Item Number	Discrimination Power	Item Number	Discrimination Power
1*	0.52	14*	0.48	28*	0.48
2*	0.52	15*	0.72	29*	0.80
3*	0.60	16*	0.44	30*	0.60
4*	0.60	17*	0.64	31*	0.40
5*	0.80	18*	0.72	32*	0.68
6*	0.68	19*	0.64	33	0.36
7*	0.48	20*	0.84	34*	0.52
8*	0.68	21*	0.60	35*	0.68
9*	0.68	22*	0.56	36*	0.52
10*	0.68	23*	0.84	37*	0.52
11*	0.64	24	0.28	38*	0.68
12*	0.56	25*	0.48	39*	0.64
13*	0.56	26*	0.60	40*	0.76
		27*	0.60		

Note: * denotes the items selected for the final test.

According to Ebel and Frisbie[17] (1991), items with discrimination index greater than or equal to 0.40 are very good items. So for the present test, items with discrimination index greater than or equal to 0.40 were drawn as items for the final test.

Thus, the final test of Inductive Reasoning contains 38 items. The time limit for answering the final test is decided as 30 minutes, on the basis of the performance of the majority of students.

Malayalam and English version of the draft and final test are given as Appendices X, XI, XII and XIII respectively.

3.2.6.3. Reliability

Reliability of the test was found by test-retest method with an interval of two weeks between the two testings. The obtained reliability coefficient (Pearson's r) is 0.80 (N=40). This suggests that the test is highly reliable to measure Inductive Reasoning of secondary school pupils.

3.2.6.4. Validity

The test is face valid as it was accepted by a number of experienced subject teachers the apparent ability of the test to measure the variable Inductive Reasoning.

The concurrent validity of the test was established by correlating scores of this test with the scores of the subtest on Inductive Reasoning of an available standardised test 'Test of Mathematical Abilities' (Sumangala and Menon, 1995). The obtained validity coefficient (Pearson's r) is 0.75 (N=40), which suggests that the present test is a valid one to measure the Inductive Reasoning of secondary school pupils.

3.2.7. Test of Deductive Reasoning

This test is constructed and standardised by the investigator for the present study to measure the deductive reasoning ability of secondary school pupils.

Deductive Reasoning is the method of reasoning in which one moves from general assumption to the specific application. That is, deductive reasoning starts with generalized statements and then deduces particular instances from the generalized statements.

The draft test of Deductive Reasoning contains 40 multiple choice test items based on the concepts of mathematics at secondary school level. Time set for answering the test was 50 minutes.

Example:

"The null set is a set with no elements in it". Which among the following is a null set?

A.	{ }	B.	{ϕ }
C.	{0}	D.	{-1}

3.2.7.1. Scoring procedure

As all the items are objective type, scoring scheme of the test is 'one score for each correct answer and zero score for every incorrect answer'.

3.2.7.2. Standardisation of the test

Items of the draft test were standardised by item analysis – by estimating the discrimination power (DP) of each item. This was done using a sample of 100 pupils.

The discrimination power of each item was calculated using the formula DP = (U – L)/N where U is the number of correct responses in the upper group; L is the number of correct responses in the lower group; N is the number of pupils in the upper or lower group. The upper and lower groups were formed based on the 27 percent criteria of the sample chosen for item analysis.

The estimated discrimination power of the draft test items are given as Table 6.

TABLE 6

Discrimination Power of
Items in the Draft Test of Deductive Reasoning

Item Number	Discrimination Power	Item Number	Discrimination Power	Item Number	Discrimination Power
1*	0.52	15*	0.68	29*	0.72
2*	0.56	16*	0.44	30*	0.56
3*	0.52	17*	0.88	31*	0.60
4*	0.68	18*	0.44	32*	0.64
5	0.16	19	0.12	33*	0.84
6*	0.60	20	0.12	34*	0.72
7	0.24	21*	0.64	35*	0.56
8*	0.76	22*	0.56	36*	0.72
9*	0.36	23*	0.56	37	0.16
10	0.16	24*	0.72	38*	0.76
11*	0.72	25*	0.76	39*	0.36
12*	0.68	26*	0.44	40*	0.60
13	0.24	27*	0.64		
14*	0.56	28	0.16		

*Note: * denotes the items selected for the final test.

Items with discrimination index greater than 0.36 (0.36 in only two cases) were drawn for the final test.

Thus, the final test is with 32 items and the time set for answering it is 40 minutes which was decided on the basis of the performance of the majority of students at the try out stage.

Malayalam and English version of the draft and final test are given as Appendices XIV, XV, XVI and XVII respectively.

3.2.7.3. **Reliability**

Reliability of the test was found by test-retest method with an interval of two weeks between the two testings. The obtained reliability coefficient (Pearson's r) is 0.74 (N=40). This suggests that the test is highly reliable to measure the Deductive Reasoning of secondary school pupils.

3.2.7.4. **Validity**

The test is face valid as a number of experienced subject teachers accepted the apparent ability of the test to measure the variable Deductive Reasoning.

Construct validity of the test was examined by testing the following hypotheses viz.,

i) The scores of Deductive Reasoning will fairly correlate with the scores of Inductive Reasoning.

ii) The scores of Deductive Reasoning will fairly correlate with the scores of Abstract Reasoning.

On testing, using a sample of 35 students the correlation coefficients (Pearson's r) obtained for the variable Deductive Reasoning with Inductive Reasoning and Abstract Reasoning were found to be 0.78 and 0.65 respectively. These values suggest that the two hypotheses are well substantiated.

Thus, the 'Test of Deductive Reasoning' is a valid one to measure the Deductive Reasoning of secondary school pupils.

3.2.8. Test of Problem Solving Ability in Mathematics

This test was developed by Sumangala and Vijayakumari in 1996. This test is to measure the Problem Solving Ability in Mathematics of secondary school pupils. Problem solving is a higher order ability requiring abilities like analysis, synthesis and evaluation. Problem Solving Ability in Mathematics is the ability to arrive at solutions to problems which involve the use of mathematics. To solve a problem, the student must draw upon previously learned piece of knowledge, skills and understanding in new situations.

The present test contains 26 problems, which are arranged under three parts - Part I, Part II and Part III. Part I has 19 multiple choice items; Part II has two faulty proofs as test items and Part III is with five descriptive type items. The time allotted for answering the three parts are 30 minutes, four minutes and ten minutes respectively. Hence the duration of the total test is 44 minutes.

Examples:

(Part I): 1. $2a+2b+2c = 9$. If $c = 1$, what is $a + b + c$?

A. 8 B. 4

C. 3 D. 2

(Part II): 2.

i) $25 - 25 = 0$

ii) $5 - 5 = 0$

iii) $25 - 25 / 5 - 5 = 0$

iv) $5^2 - 5^2 / 5 - 5 = 0$

v) $(5 + 5)(5 - 5)/ 5 - 5 = 0$

vi) $5 + 5 = 0$

vii) $10 = 0$

Find out the step at which error is committed first.

(Part III): 3. A man has one 5 litre and one 3 litre buckets. How can he take 7 litre of water correctly using the two buckets.

A copy of the test is given as Appendix XVIII.

3.2.8.1. Scoring procedure

In Part I, student has to select the correct answer from the four given choices A, B, C and D for each item. As all the items are of objective type the scoring scheme is, one score for each correct answer and zero score for every incorrect one, providing a maximum score of 19 under Part I.

In Part II as the student has to detect the step at which error takes place, the scoring scheme is, one score for each correct detection of error and zero score for every incorrect ones. The maximum score possible under this part is two.

As Part III is of descriptive type, value points are predetermined to make the scoring objective and for each value point, one score is assigned giving a maximum score of 10.

The total score of Problem Solving Ability in Mathematics of an individual is the sum of the scores obtained under Part I, Part II and Part III of the test.

3.2.8.2. Reliability

Reliability of the test was established by test-retest method on a sample of 40 students, the interval between administrations being three weeks. The reliability coefficient obtained is 0.76, indicating that the test is satisfactorily reliable.

3.2.8.3. Validity

The test has construct validity as the component abilities and the test items are prepared on theoretical basis.

The criterion related validity of the test was estimated by correlating the scores of the test with the scores of the 'Test of Mathematical Abilities' (Sumangala and Menon, 1995). The correlation coefficient (Pearson's r) obtained is 0.58, indicating that the test is valid.

3.2.9. Test of Mathematical Creativity

This test was developed and standardised by Sumangala in 1993. This test is to measure the extent of creative ability in dealing with mathematical problems of secondary school pupils of Kerala. The working definition evolved in the development of the test is that mathematical creativity is the ability of pupils to think divergently and to produce a number of original and rational responses to specific stimulus situations. The test has seven such situations. The test is to be responded in 32 minutes.

For the present study, this test is used to measure the variables Fluency, Flexibility and Originality, which are the components of creativity. Fluency is the ability to handle ideas in a rapid, flexible and logical way. It stands for the number of relevant, rational responses excluding those repeated in an identical form to given stimulus situations. Flexibility refers to the number of relevant categories or ways in which the responses of the individual to an item fall. Originality is the degree of novelty or unusualness in the responses made by an individual.

Example:

Write as many numbers as possible so that the sum of the digits is seven (five minutes).

Students are expected to write as many numbers as possible within the time limit (five minutes) prescribed for the item.

A copy of the test is given as Appendix XIX.

3.2.9.1. Scoring procedure

Each test item, and hence, the test is to be scored for the three component abilities of creativity, viz., Fluency, Flexibility and Originality. Each item of the test therefore receives three scores. The scores obtained for the components Fluency, Flexibility and Originality of all the items are summated to get the total score on Fluency, Flexibility and Originality.

For scoring, Fluency stands for the number of relevant, rational responses (excluding those repeated in an identical form). One score each is then assigned for each such rational response.

Flexibility refers to the number of relevant categories in which the responses to an item falls. The responses are classified into categories and one score is assigned to a category if at least one response comes under it. No additional score is assigned for more than one response in a category.

The scheme for scoring Originality is based on differing degrees of uncommonness of the responses as shown in Table 7.

TABLE 7

Scoring Scheme of Originality

Sl. No.	Grouping in terms of uncommonness of responses	Scores
1	Responses given by less than 1 percent in the sample	5
2	Responses given by 1 to 2 percent in the sample	4
3	Responses given by 2 to 4 percent in the sample	3
4	Responses given by 4 to 7 percent in the sample	2
5	Responses given by 7 to 12 percent in the sample	1
6	Responses more than 12 percent in the sample	0

3.2.9.2. Reliability

Test-retest reliability of the test is 0.77 (N = 35) and Cronbach's Alpha coefficient of reliability is 0.77 (N=100), which implies that the test is highly reliable.

3.2.9.3. Validity

Validity of the test was estimated empirically (criterion related validity) by estimating its correlation coefficient (Pearson's r) with school examination marks in mathematics as the external criterion. This coefficient was found to be 0.62 for N=40.

3.2.10. Mathematics Interest Inventory

This inventory was developed by Sumangala and Vijayakumari in 1996. For developing this inventory, Mathematics Interest is defined as pupil's interest in dealing with mathematics as a subject of study. Interest is the disposition to engage in activities. That is, the present inventory is to measure secondary school pupil's interest in dealing with mathematics as a subject of study.

Each item of the inventory comprises of three similar activities (A, B and C) of which one is a mathematical activity. Selection of a mathematical activity from the three, as the preference for working will reveal the interest in mathematics. This inventory contains 32 such sets of activities.

Example of an item:

A. Reading biography of the mathematician Sreenivasa Ramanuja

B. Reading biography of the great leader Mahatma Gandhi

C. Reading biography of the poet Rabindranath Tagore.

A copy of the inventory is given as Appendix XX.

3.2.10.1. Scoring procedure

Each item is presented in the form of a set of three activities A, B, C and the subject has to select the activity he/she likes most to do. If the selected activity is related to mathematics, give a score of 'one'; otherwise give a zero score.

3.2.10.2. Reliability

Test-retest reliability of the inventory was estimated using a sample of 40 students with an interval of two weeks between the two administrations. The correlation coefficient obtained is 0.76 which indicates that the inventory is considerably reliable.

3.2.10.3. Validity

The inventory has face validity as each item of the inventory is a set of three similar activities of which one is mathematical and the student is to mark the activity he or she likes to do most.

The construct validity of the inventory was examined by setting the following hypotheses –

i) The measures of the inventory will be positively related to measures of the Scale of Attitude towards Mathematics.

ii) The measures of the inventory will be positively related to measures of Mathematics Aptitude.

iii) Score on the inventory will be high for the members of Mathematics Club compared to those who are not members of the club.

On testing, using a sample of 40 students the correlation coefficients (Pearson's r) obtained for the variable Mathematics Interest with Attitude towards Mathematics and Mathematics Aptitude are 0.58 and 0.46 respectively. These values suggest that the first two hypotheses are substantiated. The critical ratio obtained for the difference between mean scores on Mathematics Interest of the members and non-members of Mathematics Club is 4.45, implying that the third hypothesis is also validated.

Hence the inventory has construct validity and can be used to measure the interest in mathematics of secondary school pupils.

3.2.11. Scale of Self-Concept in Mathematics

This scale was developed and standardised by Sumangala and Malini in 1993. The working definition set for the preparation of the scale is that Self-Concept in Mathematics is one's estimation of himself/herself for his/her abilities and weaknesses as a student of mathematics.

The scale is in the form of Likert's Attitude Scale and consists of 24 statements of which 18 are positive and six negative.

Example:

I always stand first in mathematics examinations.

A copy of the scale is given as Appendix XXI.

3.2.11.1. Scoring procedure

As each statement of the scale is to be responded in either of the five ways viz., Very much like this (A), Like this (B), Uncertain (C), Not like this (D) and Not at all like this (E), the accepted scoring scheme of the scale is as follows. For positive statements assign scores 5, 4, 3, 2 and 1 and for negative statements assign scores 1, 2, 3, 4 and 5 to responses A, B, C, D and E respectively. The sum of scores for all the statements is one's measure of Self-Concept in Mathematics.

3.2.11.2. Reliability

Reliability of the scale is established by both test-retest method and by Cronbach's Alpha coefficient. The indices are respectively 0.82 (N=35) and 0.81 (N=100), which suggests that the scale is highly reliable.

3.2.11.3. Validity

Construct validity of the scale was examined by setting hypotheses viz.,

i) The measures of the scale will discriminate significantly between groups viz., high-achievers in Mathematics and low-achievers in Mathematics.

ii) The measures of the scale will be positively related to measures of the scale Attitude towards Mathematics.

iii) The measures of the scale will be positively related to measures on Mathematics Aptitude.

On testing, using a sample of 30 students, the critical ratio for the first hypothesis is 37.36 and the coefficient of correlations (Pearson's r's) for second and third hypotheses are 0.67 and 0.60 respectively, which suggests that the three hypotheses are confirmed, indicating the construct validity of the scale.

The criterion related validity of the scale was established by correlating the scores of the scale with that of Kerala Self-Concept Scale developed by Nair (1980). The validity coefficient obtained is 0.73 (N=40).

3.2.12. Scale of Attitude towards Mathematics

This scale was developed and standardised by Sumangala and Sunny in 1987. For the development of the scale, Attitude towards Mathematics is defined as the specific mental state of the individual towards the subject mathematics according to which his behaviour towards it is moulded. It designates a measure of one's attitude towards various affective components of mathematics like value of mathematics in society, awareness of oneself in dealing with modern mathematics, motivation of mathematics, anxiety towards mathematics, perception of mathematics teachers, enjoyment in mathematics and universalism of mathematics. This is a five-point Likert type scale, having 30 statements consisting of equal number of positive and negative statements.

Example:

Achievements due to the advancement of mathematics are beneficial to society.

A copy of the scale is given as Appendix XXII.

3.2.12.1. Scoring procedure

For a positive statement, scores 5, 4, 3, 2 and 1 respectively are to be given to the responses Strongly Agree (SA), Agree (A), Undecided (U), Disagree (DA) and Strongly Disagree (SD). For a negative statement, the scoring is in the reverse order. The total score on the scale is obtained by summing up the scores for all the statements.

3.2.12.2. Reliability

Test-retest reliability coefficient of the scale is 0.73, which suggests that the scale is highly reliable to measure the Attitude towards Mathematics of secondary school pupils.

3.2.12.3. Validity

In establishing the criterion related validity, the external criterion taken is the scores obtained on a standardised achievement test (since cognitive and affective behaviours are interrelated as found from studies). The coefficient of correlation (Pearson's r), so obtained is 0.60, indicating that the scale is valid to measure the Attitude towards Mathematics of secondary school pupils.

3.2.13. Scale of Attitude towards Academic Work

This scale is prepared by the investigator to measure Attitude towards Academic Work of secondary school pupils.

Attitudes are roughly defined as feelings for or against something. That is, attitudes are related to what one thinks or believes about any object. In 1935, Allport[20] defined attitude as a mental or neural state of readiness organised through experience upon the individual's response to all objects and situations with which it is related.

For the development of the scale, Academic Work is defined as the work done in schools or at home that involve abstract, theoretical, bookish, non-practical and speculative learning activities. Therefore, to measure the extent of favourableness or unfavourableness towards academic work, the investigator found the dimensions of academic work as love or hate towards school as an institution, teachers, academic subjects, classmates, home work, examinations, theoretical pursuits, academic pursuits, academic aspirations, time management, parental involvement in learning etc.

The tool is a Likert type five point scale developed using conventional procedures of attitude scale construction. The draft scale is with 55 statements, of which 28 are positive and 27 are negative. The statements are written following the criteria evolved by Edwards[21] (1957) and by referring to relevant literature in the area.

To each statement the respondent has to mark the responses which may reveal the degree of agreement or disagreement towards each statement in a five point continuum viz., Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D) and Strongly Disagree (SD).

Examples:

1. Opportunities to participate in discussions on academic subjects should not be wasted (positive statement).
2. The success in examination depends largely on luck than on learning (negative statement).

3.2.13.1. Scoring procedure

For a positive statement allot scores 5, 4, 3, 2 and 1 respectively to responses SA, A, U, D and SD. For a negative statement, scoring is in the reverse order. The total score for all the statements of the scale is the score of a student for his/her Attitude towards Academic Work.

3.2.13.2. Standardisation of the scale

For the standardisation of the scale, item analysis was done by calculating critical ratio (of two tailed t-test) to each statement which is an index of the ability of the statement to discriminate between students of high level attitude towards academic work and of low level attitude towards academic work. That is, the discrimination power (DP) of each statement was found by testing for significance of difference between mean scores of upper and lower groups of Attitude towards Academic work. The upper and lower groups were formed on the 27 percent criteria of the sample chosen for item analysis. The critical ratio (t-value) of each statement was found by using the formula,

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left(\frac{(N_1 - 1) S_1^2 + (N_2 - 1) S_2^2}{N_1 + N_2 - 2}\right)\left(\frac{1}{N_1} + \frac{1}{N_2}\right)}} \quad \text{for } N_1+N_2-2 \text{ df}$$

(Best & Kahn[18], 1992)

where,

$\bar{X}_1$ is the mean score of the upper group on a given statement,

$\bar{X}_2$ is the mean score of the lower group on the same statement,

S_1^2 is the variance of the distribution of responses of the upper group to the statement,

S_2^2 is the variance of the distribution of responses of the lower group to the statement,

N_1 and N_2 are the number of pupils in upper and lower group respectively.

Discrimination indices of the statements of the draft scale are given as Table 8.

TABLE 8

Discrimination Indices of the Statements of the Draft Scale of Attitude towards Academic Work

Item Number	Discrimination Index	Item Number	Discrimination Index	Item Number	Discrimination Index
1*	2.53	20*	2.71	38*	2.33
2	-0.93	21*	2.63	39	2.00
3*	2.74	22*	2.06	40*	6.43
4*	4.12	23	2.00	41*	3.56
5*	2.38	24	-0.11	42*	4.24
6*	2.19	25	1.71	43*	4.24
7*	2.48	26*	3.09	44*	8.00
8	1.03	27*	4.53	45*	7.85
9*	5.16	28	1.23	46*	6.14
10*	2.88	29	0.23	47*	3.36
11*	3.86	30	0.74	48*	4.57
12	1.83	31*	3.66	49*	5.14
13	-1.71	32*	3.11	50	1.40
14	0.76	33*	4.85	51*	3.78
15*	3.54	34*	5.47	52*	4.13
16	1.97	35*	4.96	53*	6.32
17*	4.86	36*	2.27	54*	5.86
18*	10.20	37	-0.12	55*	4.69
19*	4.26				

Note: * denotes the statements selected for the final scale.

Statements with t-values greater than or equal to 2.01, the tabled value of t required for significance at 0.05 level for 52 df ($N_1 = N_2 = 27$) were selected for the final scale.

Thus, the final scale of Attitude towards Academic Work consists of 40 statements in which 19 are positive and 21 are negative.

Malayalam and English version of the draft and final scale are given as Appendices XXIII, XXIV, XXV and XXVI respectively.

3.2.13.3. Reliability

Reliability of the scale was found by test-retest method with an interval of two weeks between the two administrations. The obtained reliability coefficient is 0.83 (N=45), which suggests that the scale is highly reliable to measure Attitude towards Academic Work of secondary school pupils.

3.2.13.4. Validity

Validity of the scale is established empirically by correlating the scores obtained for the scale with the sum of the marks obtained by the students in the first terminal school examinations for all subjects. The coefficient of validity (Pearson's r) thus obtained is 0.79 (N=35). This suggests that the scale is highly valid to measure the Attitude towards Academic Work of secondary school pupils.

3.2.14. Scale of Mathematics Anxiety

This five point Likert type scale was developed and standardised by Sumangala and Malini in 1993 to measure the feeling of apprehension in working with mathematics. For the scale, Mathematics Anxiety is defined as the fearful concern, distress, nervousness, restlessness or a disturbed state of mind that arises when working with mathematics. The scale is constructed on the assumption that a feeling of apprehension could possibly spur a student into working hard and hence improve his performance (anxiety in this case is facilitating) and if the apprehension is so intense that normal reasoning process is inhibited, then it is fear and hence debilitating anxiety.

The scale consists of 29 statements among which 23 are for debilitating and six are for facilitating anxiety.

Example:

I feel upset if I do not follow reading mathematics lessons.

A copy of the scale is given as Appendix XXVII.

3.2.14.1. Scoring procedure

To each statement students are to respond in either of the five ways viz., Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D) and Strongly Disagree (SD). For a debilitating anxiety statement the scores assigned are 5, 4, 3, 2 and 1, and for a facilitating anxiety statement the scores assigned are 1, 2, 3, 4 and 5 for responses SA, A, U, D and SD. Sum of the scores for all the statements gives the total score on the scale.

3.2.14.2. Reliability

Test-retest reliability coefficient of the scale is 0.86 (N=36). Reliability estimated as Cronbach's Alpha coefficient is 0.80 (N=100).

3.2.14.3. Validity

Construct validity of the scale is examined by testing the hypotheses viz.,

i) The measures of this scale will discriminate significantly between high- and low-achievers in mathematics.

ii) The measures of this scale will be negatively related to measures of the Scale of Self-Concept in Mathematics.

By testing, using a sample of 30 students, the above two hypotheses were found confirmed (t-value = 38.21 and r = -0.63 respectively).

Validity of the scale is further estimated empirically by comparing the test scores with the scores of the Kerala Examination Anxiety Scale (Nair, 1976) and by correlating with Achievement scores in Mathematics. In the first case the coefficient of correlation is 0.57 (N=40) and in the second case the coefficient of correlation is -0.64 (N=40) indicating the scale as reasonably valid.

3.2.15. Scale of Achievement Motivation in Mathematics

This scale was developed by Sumangala and Vijayakumari in 1996 to measure the striving of secondary school pupils to attain expected goals by learning mathematics. For the development of the scale, Achievement Motivation in Mathematics is defined as the striving of pupils to attain expected goals by learning mathematics. The scale consists of 42 statements on seven constructs viz., Work ethic (the desire to work hard and excel in mathematics), Acquisitiveness (motivation based on the reinforcing properties of position or possession), Dominance (desire to become a dominant member of the group), Pursuit of excellence (competition with a standard of excellence in making the best performance), Competitiveness (the satisfaction obtained while competing with others), Status aspiration (reinforcement in improving the social status hierarchy) and Mastery (the satisfaction obtained when succeeding in the study of difficult matters). Out of these 42 statements 36 statements are positive and six are negative to measure the construct.

Examples:

1. I like to do mathematical problems which others cannot (Positive statement).
2. I prefer easy problems to hard and lengthy ones (Negative statement).

A copy of the scale is given as Appendix XXVIII.

3.2.15.1. Scoring procedure

Students can respond to the statements in any of the three ways viz., Always, Sometimes and Never. For a positive statement the respective scores to the three responses are 3, 2 and 1. For a negative statement the scores to be assigned are 1, 2 and 3 for responses Always, Sometimes and Never.

3.2.15.2. Reliability

Reliability of the scale was established by test-retest method and the value obtained is 0.80 (N=40). Reliability estimated as Cronbach's Alpha coefficient is 0.83 (N=52).

3.2.15.3. Validity

Construct validity of the scale was examined by testing the hypothesis that the scores on the scale will be significantly related to the scores on the Test of Achievement in Mathematics.

On testing, using a sample of 40 students it was found that the hypothesis is confirmed (r=0.72), indicating the scale is construct valid.

Concurrent validity of the scale was also established by correlating (Pearson's r) the scores of the scale with that of Achievement Motivation Scale developed by Pillai and Salimkumar in 1993. The validity coefficient obtained is 0.66 (N=40), suggesting the scale is concurrently valid.

All these indices indicate that the scale is reasonably valid to measure Achievement Motivation in Mathematics.

3.3. SAMPLE

The results of any research study is to have universal application for which the whole population has to be studied, which often is impractical and impossible. But the process of relevant sampling and inferential statistics makes it possible to draw valid inferences of the parameters on the basis of careful and apt measurement of the variables involved in the study.

For the present study, the population is secondary school pupils of Kerala. Huge size of this population warranted the necessity of studying the population through an adequate representative sample. Therefore a representative sample of the population was drawn by looking into three major aspects viz., technique of sampling, factors considered in the sampling and size of the sample.

3.3.1. Technique of Sampling

The population consists of large number of pupils belonging to different strata like gender, locale of the school, type of school management etc. Because of this stratification in the population, the investigator decided to adopt stratified sampling method for drawing the sample by which a good representative of the population will be obtained. When the population is composed of subgroups or strata of different sizes Garrett[22] (1966) suggested stratified sampling method.

3.3.2. Factors Considered in the Sampling

The following factors, which are the characteristics of the population were taken into consideration while drawing the sample.

i) Gender

ii) Locale of the schools

iii) Type of management of schools

The rationale for considering each of these strata or factor in the sample is discussed below.

3.3.2.1. Gender

Gender difference is often observed and reported in many of the psychological variables and in academic achievement (Driver[23], 1993; Gillespie[24], 1994; Malini[25], 1995). So the investigator considered gender as a factor for sample selection. Since the number of boys and girls in secondary schools is almost equal (Fifth All India Educational Survey[26], 1992), the investigator gave almost equal representation to boys and girls in the proposed sample.

3.3.2.2. Locale of the schools

Often student's performance in examinations differ between rural and urban school children and hence locale of the schools was considered as a factor for sample selection. In Kerala, the ratio of rural and urban secondary schools is approximately 5:1 (Fifth All India Educational Survey[26], 1992). Hence the investigator selected schools for the sample in the ratio 5:1.

3.3.2.3. Type of management of school

Many studies revealed that private and government school pupils differ in their academic achievement (Sethumadhavan[27], 1993; Saleena[28], 1997). The ratio of private and government schools in Kerala is approximately 3:2 (Fifth All India Educational Survey[26], 1992). Hence the investigator selected Private and Government Schools for the sample in the ratio 3:2.

3.3.3. Size of the Sample

While deciding the size of the sample, the investigator considered the following:

i) a sample should be large enough to reduce the magnitude of sampling error within admissible limit (Best and Kahn[18], 1992).

Krech and Crutchfield[29] (1968) have observed that sample size of 500 would yield reasonably good results which would keep the error less than five percent.

ii) Sample should be small enough to be selected economically (Best and Kahn[18], 1992).

For the present study there are fifteen tools to be administered to the sample, which requires much time and effort of the test takers.

Considering all these, the investigator decided to have a sample of size 530 belonging to six districts of Kerala viz., Thiruvananthapuram, Kollam, Thrissur, Malappuram, Kozhikode and Kannur, drawn by stratified method.

The break-up of this proposed sample of size 530 is given as Table 9.

TABLE 9

Break-up of the Initial Sample

Gender		Locale of Schools		Type of School Management	
Boys	Girls	Rural	Urban	Private	Government
265	265	442	88	318	212
(N = 530)		(N = 530)		(N = 530)	

3.4. DATA COLLECTION PROCEDURE

After fixing the sample, adequate copies of the tools and response sheets were got printed. Then a schedule for administering the tools was prepared by visiting the Heads of the proposed schools. The investigator at this time sought the cooperation of the concerned class teachers for the successful completion of data collection. As there were fifteen tools to be administered for measuring the variables, the investigator had to go to each school thrice for fully administering the tools.

A uniform procedure was followed in administering the tools in the selected schools. At the time of administration all the students were informed about the nature of each test and the purpose for which these were given. The question booklets and the response sheets were distributed to the pupils as sets one after one. As the tools are of different nature, the method of responding are different and hence the investigator explained the procedure of marking responses of each tool at the time of administration. Time limits were strictly kept wherever necessary and doubts were cleared then and there. All the test materials and response sheets were collected back after the due time.

3.5. SCORING AND CONSOLIDATION

After the data collection, response sheets were checked for personal details and for completeness of the data. During this, incomplete response sheets were rejected primarily and response sheets that are complete in all respects were retained for scoring.

Rejection of the incomplete response sheets resulted in a reduction of the size of the sample from 530 to 500. The break-up of this final sample of 500 pupils is given as Table 10.

TABLE 10

Break-up of the Final Sample

Gender		Locale of Schools		Type of School Management	
Boys	Girls	Rural	Urban	Private	Government
244	256	413	87	297	203
Total (N) = 500					

School-wise distribution of the final sample is given as Appendix XXIX.

Response sheets of the fifteen tools were then scored using the scoring scheme of each. All the test scores were then consolidated incorporating student's personal data. The data was so entered and consolidated as to facilitate statistical analyses by means of computer.

3.6. STATISTICAL TECHNIQUES USED FOR ANALYSIS

Computer facilities were adopted (by using the software programme SPSS) to do the major statistical analysis of the data. The inferential statistics employed in the study are as follows.

3.6.1 One-way Analysis of Variance (Best and Kahn[18], 1992)

Analysis of variance is an effective way to determine whether the means of more than two samples are too different to attribute the sampling error. The procedure of one-way ANOVA is through the following stepwise calculations.

Step 1: Total sum of squares, $SS_t = \sum X^2 - (\sum X)^2/N$

Step 2: Between groups sum of squares

$$SS_b = (\sum X_1)^2/n_1 + (\sum X_2)^2/n_2 + \ldots - (\sum X)^2/N$$

Step 3 : Within groups sum of squares, $SS_w = SS_t - SS_b$

Step 4 : Mean square between, $MS_b = SS_b/df_b$ and

Mean square within, $MS_w = SSw/dfw$

Step 5 : F-ratio, $F = MS_b/MS_w$

If for a required level of significance and for(k-1, N-k) degrees of freedom, the obtained value of F is higher than the tabled value of F, the difference in the group means is said to be significant for that level of significance.

3.6.2. Scheffe's Test for Multiple Comparison (Ferguson[30], 1976)

The procedure of Scheffe's test for multiple comparison which is often used as a follow up of the ANOVA test is as follows:

Step 1 : Calculate F-ratio between the pairs of means by using the within-group variance estimate.

Step 2 : Consult a table of F and obtain the value of F required for significance at 0.05 or 0.01 level for $df_1 = k-1$ and $df_2 = N-k$.

Step 3 : Calculate F' where $F' = (k-1)F$

Step 4 : Compare the values of F and F'.

For any difference to be significant at the required level, F must be greater than or equal to F'.

3.6.3. Pearson's Product Moment Coefficient of Correlation (Garrett[22], 1966)

Coefficient of correlation between relevant pair of variables is computed by means of the following formula which is in terms of raw scores or measures.

$$r_{xy} = \frac{N\Sigma XY - \Sigma X \Sigma Y}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2]\,[N\Sigma Y^2 - (\Sigma Y)^2]}} \quad \text{where ,}$$

ΣX is sum of the X scores;

ΣY is sum of the Y scores;

ΣX^2 is sum of the squared X scores;

ΣY^2 is sum of the squared Y scores;

ΣXY is sum of the products of paired X and Y scores, and

N is number of paired scores.

3.6.3.1. ***Test of significance of the correlations by Fisher's t-test*** *(Best and Khan[18], 1992)*

This is done by checking whether the t-value obtained by the formula

$$t = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}}$$

exceeds 1.96 or 2.58, for significance at 0.05 level and 0.01 level respectively where 'r' is the obtained correlation coefficient in each case.

3.6.3.2. ***The 0.99 confidence interval of r*** *[Garrett[22], 1966)*

The limits within which the population r may lie with 99 percent confidence (0.99 confidence interval of r) are calculated using the formula

$$[r \pm 2.58\ SEr]$$

where SEr, the standard error of r, is computed by the formula

$$SEr = \frac{1 - r^2}{\sqrt{N-1}}$$

r being the obtained coefficient of correlation.

*3.6.3.3. **Verbal descriptions of r** [Garrett[22], 1966]*

The magnitude of each r is described for the degree of relationship using the below given explanations.

r from 0.00 to $\pm$ 0.20 : indifferent or negligible relationship

r from $\pm$ 0.20 to $\pm$ 0.40 : low or slight relation

r from $\pm$ 0.40 to $\pm$ 0.70 : substantial or marked relationship

r from $\pm$ 0.70 to $\pm$ 1.00 : high to very high relationship.

*3.6.3.4. **Shared variance** [Fox[31], 1969]*

Shared variance, the percentage of the variance of the criterion variable accounted by the predictor variable, is calculated using the formula $r^2 \times 100$, r being the obtained correlation coefficient between the criterion and predictor variables.

*3.6.3.5. **The coefficient of predictive efficiency** [Garrett[22], 1966]*

The coefficient of predictive efficiency is calculated using the formula $E = 1 - k$ where $k = \sqrt{1 - r^2}$, r being the obtained correlation coefficient.

3.6.4. Step-wise Regression Analysis (by ANOVA approach) [Cohen & Manion,[32] 1989]

This is a statistical technique to select the set of variables that best predicts the criterion variable and that eliminates superfluous predictor variables.

In regression analysis, the predictor variables are entered one by one on the basis of the size of the partial correlation to see the extent of contribution of each variable in predicting the criterion variable. Hence, as the first step, predictor variable having the highest correlation with the criterion variable is entered. Then, the variable having the next highest partial correlation is entered second and so on. Proceeding like this, a stage may come that further entering of variables won't make significant change either in the percentage variance or in R. It is an indication that the variable entered last and the remaining variables are not significant predictors of the criterion variable.

A model Table of step-wise regression analysis is given as Table 11.

TABLE 11

Model Table of Step-wise Regression Analysis

Variable entered	-			
Multiple R	=	SE_R =	B =	SE_B =
Percentage variance =		Beta =		
Source	DF	SS	MSS	F
Total				
Regression				
Residual				

3.6.4.1. *The coefficient of determination R^2*

The coefficient of determination, R^2 in terms of β and r which gives the efficiency of each predictor variable in predicting the criterion variable is calculated using the formula

$$R_1{}^2{}_{(2,3,\ldots\ldots n)} = \beta_{12.34\ldots.n}\, r_{12} + \beta_{13.24\ldots.n}\, r_{13} + \beta_{14.23\ldots n}\, r_{14} + \ldots. + \beta_{1n.23\ldots(n-1)}\, r_{1n}$$

where 1 stands for the criterion variable and 2, 3, ... for the significant predictor variables as found by regression analysis.

The product of β and r is used as the index of the predictive efficiency.

3.6.5. Discriminant Function Analysis [Tacq[33], 1997]

To discriminate the population groups, discriminant function analysis by direct method was used, which involves mainly three steps.

Step 1 : Prior classification of the sample into defined groups which are proposed to be discriminated.

Step 2 : Analysis by means of the many discriminating characteristics which results in two functions (in the case of three groups situation) which are linear combinations of the selected variables in the form of $D = B_0 + B_1X_1 + B_2X_2 + \ldots + B_rXr$ where B's are the linear coefficients estimated from the data and $X_1, X_2, \ldots X_r$ are the predictor variables used in the study.

Step 3 : Testing the effectiveness of the discriminant functions to discriminate groups and the estimation of the canonical coefficients for the classification of new cases into the three groups.

3.6.6. Factor Analysis [Kim and Mueller[34], 1978]

Given an array of correlation coefficients for a set of variables, factor analytic technique enable us to see whether some underlying pattern of relationships exists such that the data may be rearranged or reduced to a smaller set of factors or components that may be taken as source variables accounting for the observed interrelations in the data.

In order to make a meaningful patterning of variables, the factors obtained through Principal Component Analysis was undergone varimax rotation.

The nature and content of the rotated factors were identified using the following criteria:

i) Locate the group of variables on which the factor has the highest loadings.

ii) Locate the group of variables on which the factor has the lowest loadings.

iii) Examine the possibility of different factors becoming independent.

iv) Treat factor loadings with absolute values greater than 0.30 as significant and other factor loadings as not significant.

v) Factor loadings above $\pm$ 0.90 - extremely high presence/absence of the variable.

vi) Factor loadings between $\pm$ 0.70 and $\pm$ 0.90 - very high presence/ absence of the variable.

vii) Factor loadings between $\pm$ 0.55 and $\pm$ 0.69 - considerable presence/ absence of the variable.

viii) Factor loadings between $\pm$ 0.40 and $\pm$ 0.54 - somewhat presence/ absence of the variable.

ix) Factor loadings between $\pm$ 0.30 and $\pm$ 0.39 – slight presence/absence of the variable.

x) Factor loadings below $\pm$ 0.30 – negligible presence/absence of the variable.

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CHAPTER IV

ANALYSIS

- Preliminary Analysis
- Effect of the Psychological Variables on Achievement in Mathematics
- Relation of Psychological Variables with Achievement in Mathematics
- Identification of the Significant Predictors of Achievement in Mathematics by Regression Analysis and Estimation of their Predictive Efficiency
- Effectiveness of the Significant Predictors in Predicting Group Membership like High-, Average- and Low-Achievers in Mathematics
- Significant Predictors in the Psychological Factor Structures of High-, Average- and Low-Achievers in Mathematics
- Findings of the Study
- Tenability of Hypotheses

Statistical analysis is the mathematical process of organizing, analysing and interpreting numerical data and is one of the basic phases of the research process. The primary interest in studying a sample is to infer the population characteristics by the use of inferential statistics. In this study also, the investigator has made use of inferential statistics for hypothesis testing and hence for arriving at answers to the questions posed or stated.

Details of the statistical analyses done to test the hypotheses and hence to tackle the objectives are discussed in this chapter with the findings of each.

The study is done with the major hypothesis viz., "Achievement in Mathematics of secondary school pupils can be significantly predicted by means of the select set of psychological variables."

The major hypothesis was tested by means of the following hypotheses, the testing of each of which is analogous to the testing of the major hypothesis of the study.

i) Each select psychological variable has significant effect on Achievement in Mathematics.

ii) Significant relationship exists between each psychological variable and Achievement in Mathematics.

iii) Achievement in Mathematics can be significantly predicted by a combination of the predictor variables.

iv) Group membership as High-, Average- and Low- Achievers in Mathematics can be effectively predicted using linear discriminant functions in terms of the significant predictor variables of Achievement in Mathematics.

v) The position of significant predictors of Achievement in Mathematics in the psychological factor structure of the groups High-, Average- and Low-Achievers will be different in terms of factor loadings and hence of communalities.

Details of the statistical analyses and discussion of results are presented under six major heads viz.,

1. Preliminary Analysis
2. Effect of the psychological variables on Achievement in Mathematics.
3. Relation of psychological variables with Achievement in Mathematics.
4. Identification of the significant predictors of Achievement in Mathematics by regression analysis and estimation of their predictive efficiency.
5. Effectiveness of the significant predictors (identified by regression analysis) in predicting group membership like High-, Average- and Low- Achievers in Mathematics.
6. Significant predictors (identified by regression analysis) in the psychological factor structures of High-, Average- and Low- Achievers in Mathematics.

4.1. PRELIMINARY ANALYSIS

As a preliminary to the inferential statistics, the investigator had worked out certain essential descriptive statistics like mean, median, mode, range, standard deviation, skewness, kurtosis and standard error of means of all the select psychological variables for the whole sample (N=500).

These essential descriptive statistics are presented in Table 12.

TABLE 12

Basic Statistics of all the Variables

Sl. No.	Variables	Mean	Median	Mode	Range	Standard deviation	Skewness	Kurtosis	Standard error of means
	Criterion Variable								
1.	Achievement in Mathematics	8.31	8.00	6.50	18.50	4.30	0.27	-0.67	0.19
	Predictor Variables								
2.	Numerical Reasoning	3.07	3.00	3.00	13.00	1.63	1.01	3.22	0.07
3.	Ability to use Symbols	2.91	3.00	5.00	5.00	1.81	-0.29	-1.14	0.08
4.	Spatial Ability	2.56	3.00	3.00	7.00	1.29	0.27	0.31	0.06
5.	Abstract Reasoning	7.71	8.00	7.00	32.00	2.66	-0.03	-0.40	0.12
6.	Inductive Reasoning	23.65	24.00	28.00	32.00	8.74	-0.16	-1.13	0.39
7.	Deductive Reasoning	16.95	16.00	11.00	31.00	7.49	0.48	-0.83	0.34
8.	Problem Solving Ability in Mathematics	8.69	8.00	9.00	28.00	4.51	0.76	0.44	0.20
9.	Fluency	34.21	33.00	28.00	66.00	16.35	0.77	-0.15	0.73
10.	Flexibility	28.21	26.00	26.00	72.00	14.69	0.63	-0.04	0.66
11.	Originality	14.36	15.00	16.00	29.00	5.11	-0.04	-0.11	0.23
12.	Mathematics Interest	8.84	9.00	9.00	26.00	4.56	0.83	0.98	0.20
13.	Self-Concept in Mathematics	75.91	75.00	70.00	76.00	12.85	0.10	-0.14	0.58
14.	Attitude towards Mathematics	112.39	113.00	105.00	86.00	15.07	-0.18	-0.41	0.67
15.	Attitude towards Academic Work	137.20	136.00	144.00	95.00	20.86	0.15	-0.84	0.93
16.	Mathematics Anxiety	83.33	84.00	89.00	76.00	14.65	-0.19	-0.17	0.66
17.	Achievement Motivation in Mathematics	91.00	91.00	91.00	79.00	11.61	0.04	0.16	0.52

From the Table 12, it can be seen that there is not much variation between values of the three measures of central tendencies viz., mean, median and mode of the psychological variables.

The range and standard deviation of each of the psychological variables shows the scattering of scores in each variable.

Indices of skewness suggest that the distributions of the variables like Achievement in Mathematics, Numerical Reasoning, Spatial Ability, Deductive Reasoning, Problem Solving Ability in Mathematics, Fluency, Flexibility, Mathematics Interest, Self-Concept in Mathematics, Attitude towards Academic Work and Achievement Motivation in Mathematics are slightly positively skewed. For the variables Ability to use Symbols, Abstract Reasoning, Inductive Reasoning, Originality, Attitude towards Mathematics and Mathematics Anxiety, the distribution is slightly negatively skewed.

The indices of kurtosis of the variables Achievement in Mathematics, Ability to use Symbols, Abstract Reasoning, Inductive Reasoning, Deductive Reasoning, Fluency, Flexibility, Originality, Self-Concept in Mathematics, Attitude towards Mathematics, Attitude towards Academic Work and Mathematics Anxiety are less than zero. This indicates that these distributions are slightly platykurtic. The distribution is leptokurtic for the variables Numerical Reasoning, Spatial Ability, Problem Solving Ability in Mathematics, Mathematics Interest and Achievement Motivation in Mathematics.

In general, the distribution of the psychological variables do not depart appreciably from normality.

4.2. EFFECT OF THE PSYCHOLOGICAL VARIABLES ON ACHIEVEMENT IN MATHEMATICS

The first objective set for the study is to test whether the select psychological variables have significant effect on Achievement in Mathematics, that is, to test for the ability of each select psychological variable to discriminate significantly between the three groups of Achievers in Mathematics viz., High-, Average- and Low-, the technique of one-way analysis of variance was used. Further, Scheffe's test of multiple comparison of mean scores was used to study pairwise group differences in the case of variables having significant effect on Achievement in Mathematics.

The computation of analysis of variance theoretically warrants that some basic assumptions are to be met. The basic assumptions underlying the use and interpretation of analysis of variance according to Wiersma (1986) are:

i) Measurement of dependent variable, the variable whose data are being analysed, is on atleast an interval scale.

ii) The scores (criterion or dependent variable) are selected from a population distribution that is normally distributed.

iii) When two or more populations are being studied, they have homogeneous variance.

iv) The observations or scores are independent, which means that the score of one individual is not influenced by the score of any other.

As the test of Achievement in Mathematics (criterion or dependent variable) was constructed in such a way that the scores of the test possess the characteristics equality, magnitude and equal interval, the first assumption for analysis of variance is satisfied.

For the verification of the second assumption, the investigator computed statistics like mean, median, mode, standard deviation, skewness and kurtosis of the criterion (dependent) variable Achievement in Mathematics. Values of these statistics are presented as Table 13.

TABLE 13

Descriptive Statistics of the Variable Achievement in Mathematics

Mean	Median	Mode	Standard Deviation	Skewness	Kurtosis
8.31	8.00	6.50	4.30	0.27	-0.67

The indices obtained for the two measures of central tendency viz., mean and median are approximately equal but not of mode. The coefficients of skewness and kurtosis suggest that the distribution is slightly positively skewed and slightly platykurtic. The investigator therefore prepared smoothed frequency curve of the measures of the variable Achievement in Mathematics for the total sample and this is presented as Figure 1.

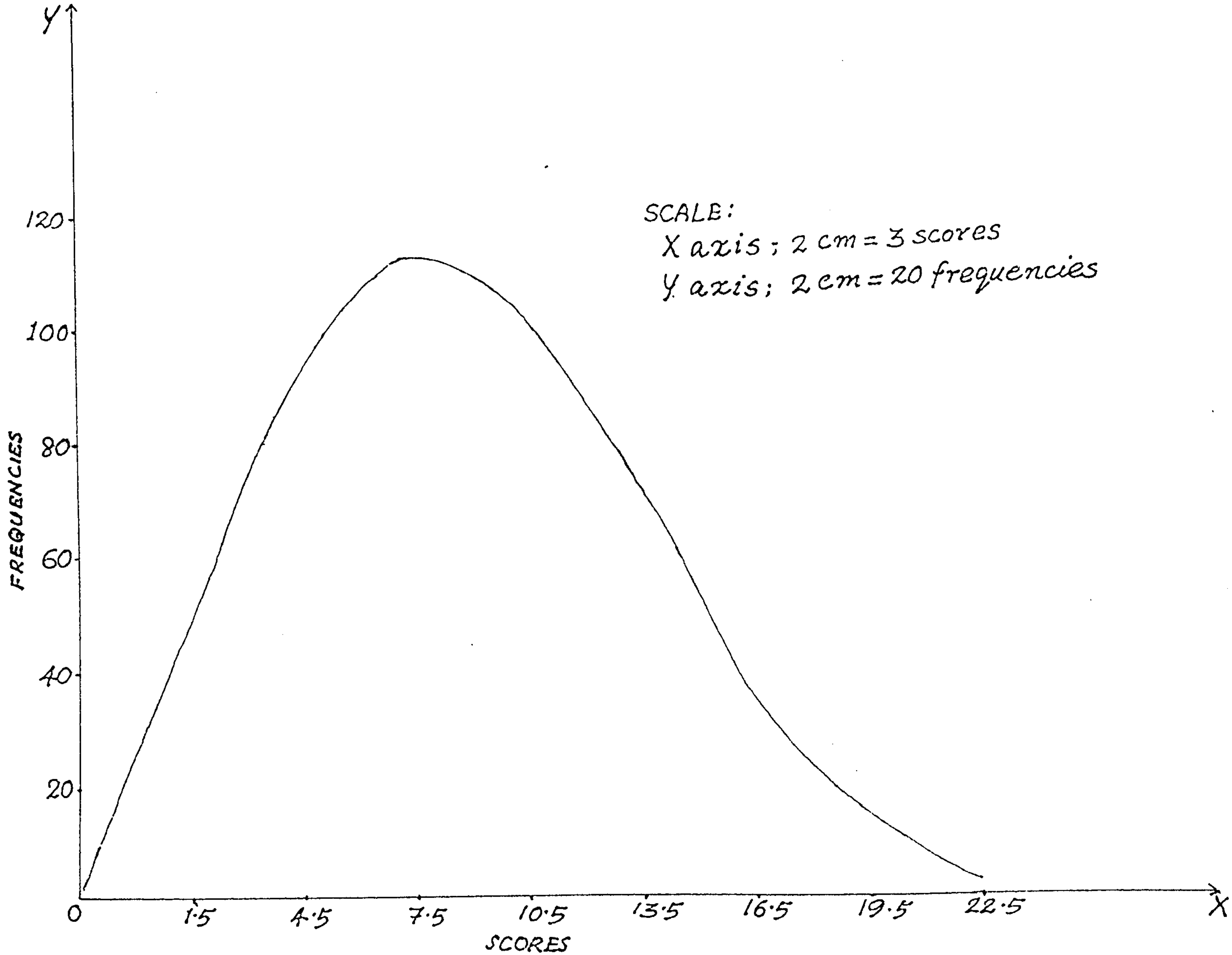

FIGURE 1. Smoothed frequency curve of Achievement in Mathematics

The statistical constants and the graphical representation reveals that the distribution of the variable Achievement in Mathematics is not badly skewed and follows approximately a normal distribution.

Third assumption for analysis of variance is homogeneity of variances across the different groups or samples of study. Studies with large samples are sufficient reasons for the statistical acceptance of homogeneity of variance. Here the size of the total sample is 500 and of the subsamples are 108 for High-Achievers, 289 for Average- Achievers and 103 for Low- Achievers. Hence the third assumption is satisfied.

Fourth assumption for analysis of variance is that samples drawn should be independent. Here, the three groups of achievers viz., High-, Average- and Low- were framed following the conventional procedure of 'σ' distance from mean 'M'. By this, 108 subjects who obtained achievement scores of 12.5 and above (mean = 8.31, SD = 4.30) were treated as High- Achievers; 103 subjects who obtained scores of 4 and below were treated as Low- Achievers and 289 subjects who obtained achievement scores between 4 and 12.5 were treated as Average-Achievers. This implies that the three groups or the three subsamples subjected to study are independent.

As all the four assumptions of analysis of variance are nearly satisfied, the investigator decide to go ahead with the computer application of analysis of variance. The results obtained by the one-way analysis of variance technique with regard to the select psychological variables are presented in Table 14.

TABLE 14

Results of Analysis of Variance for the Effect of Psychological Variables on Achievement in Mathematics

Sl. No.	Psychological Variables	Source of Variance	Sum of Squares	Mean squares	F-ratio
1.	Numerical Reasoning	Between groups Within groups	69.40 1261.42	34.70 2.54	13.67**
2.	Ability to use Symbols	Between groups Within groups	173.81 1468.32	86.91 2.95	29.42**
3.	Spatial Ability	Between groups Within groups	17.21 816.11	8.60 1.64	5.24**
4.	Abstract Reasoning	Between groups Within groups	515.26 3022.11	257.63 6.08	42.37**
5.	Inductive Reasoning	Between groups Within groups	11614.82 26512.63	5807.41 53.35	108.86**
6.	Deductive Reasoning	Between groups Within groups	7202.20 20764.65	3601.10 41.78	86.19**
7.	Problem Solving Ability in Mathematics	Between groups Within groups	2774.27 7380.30	1387.14 14.85	93.41**
8.	Fluency	Between groups Within groups	26497.95 106812.42	13248.98 214.91	61.65**
9.	Flexibility	Between groups Within groups	20584.02 87070.35	10292.01 175.19	58.75**
10.	Originality	Between groups Within groups	1531.89 11509.86	765.94 23.16	33.07**
11.	Mathematics Interest	Between groups Within groups	482.27 9903.56	241.14 19.93	12.10**
12.	Self-Concept in Mathematics	Between groups Within groups	2368.26 80013.04	1184.13 160.99	7.36**
13.	Attitude towards Mathematics	Between groups Within groups	7582.81 105659.92	3791.40 212.60	17.83**
14.	Attitude towards Academic Work	Between groups Within groups	40032.58 177082.02	20016.29 356.30	56.18**
15.	Mathematics Anxiety	Between groups Within groups	10446.75 96639.80	5223.37 194.45	26.86**
16.	Achievement Motivation in Mathematics	Between groups Within groups	2303.96 64969.02	1151.98 130.72	8.81**

Note: N = 500

Degrees of freedom for between groups is 2 and for within groups is 497.

** indicates P <0.01

The results of analysis of variance given in Table 14 indicates that the F-ratios obtained of all the sixteen psychological variables exceed 4.65, the tabled value of F required for significance at 0.01 level for (2, 497) degrees of freedom. This suggests that the mean scores of all the psychological variables are significantly different between High-, Average- and Low- Achievers in Mathematics. This implies that each psychological variable is able to discriminate significantly between the three groups of achievers viz. High-, Average- and Low-Achievers in Mathematics. This further suggests that all the sixteen psychological variables have significant effect on Achievement in Mathematics.

The psychological variables having significant effect, that is, showing significant difference between the three groups of achievers in the order of the magnitude of F-ratio are Inductive Reasoning, Problem Solving Ability in Mathematics, Deductive Reasoning, Fluency, Flexibility, Attitude towards Academic Work, Abstract Reasoning, Originality, Ability to use Symbols, Mathematics Anxiety, Attitude towards Mathematics, Numerical Reasoning, Mathematics Interest, Achievement Motivation in Mathematics, Self-Concept in Mathematics and Spatial Ability.

As it was found that the means of all the psychological variables differ significantly between High-, Average- and Low- Achievers in Mathematics, the investigator tested for pairwise group differences of each variable by means of Scheffe's test of multiple comparison of means for large independent samples.

As there are three groups for comparison, the test was done for group pairs like High- and Average- Achievers in Mathematics, High- and Low- Achievers in Mathematics and for Average- and Low- Achievers in Mathematics. Necessary statistics of these tests and the obtained F's are given in Table 15.

TABLE 15

Results of the Scheffe's Test of Multiple Comparison of the Means of the Psychological Variables Between High-, Average- and Low- Achievers in Mathematics

Sl. No.	Psychological Variables	Mean score of the psychological variable			Mean squares of within group (MS_w)	F-value obtained for the comparison		
		High-Group (N=108)	Average-Group (N=289)	Low-Group (N=103)		High- and Average-Achievers	High- and Low-Achievers	Average- and Low-Achievers
1.	Numerical Reasoning	3.75	2.94	2.69	2.54	22.00**	22.40**	2.00
2.	Ability to use Symbols	3.80	2.91	1.98	2.95	19.75**	55.17**	21.50**
3.	Spatial Ability	2.90	2.50	2.37	1.64	8.00**	9.33**	1.00
4.	Abstract Reasoning	9.57	7.37	6.69	6.08	69.14**	69.08**	5.75
5.	Inductive Reasoning	31.96	22.74	17.49	53.35	132.83**	207.31**	39.94**
6.	Deductive Reasoning	23.71	16.00	12.54	41.78	118.88**	157.94**	22.17**
7.	Problem Solving Ability in Mathematics	12.81	8.18	5.80	14.85	119.11**	175.50**	29.79**
8.	Fluency	48.38	35.21	26.25	214.91	67.23**	120.03**	28.77**
9.	Flexibility	38.96	27.30	19.48	175.19	64.74**	113.95**	26.82**
10.	Originality	17.60	13.75	12.68	23.16	52.93**	55.02**	3.80
11.	Mathematics Interest	10.68	8.47	7.96	19.93	20.33**	19.47**	1.00
12.	Self-Concept in Mathematics	80.04	75.21	74.62	160.99	12.09**	9.60**	0.17
13.	Attitude towards Mathematics	119.68	110.87	109.00	212.60	30.44**	28.23**	1.27
14.	Attitude towards Academic work	150.56	137.27	123.01	356.30	41.27**	112.11**	43.92**
15.	Mathematics Anxiety	89.32	84.11	75.53	194.45	11.65**	51.53**	29.10**
16.	Achievement Motivation in Mathematics	95.05	90.07	89.33	130.72	15.80**	13.19**	0.32

Note: F-value needed for significance at 0.01 level is 9.30 and at 0.05 level is 6.02.
** indicates $p<0.01$.

The results given in Table 15 are described below under three headings of group difference.

4.2.1. Comparison of High- and Average- Achievers in Mathematics for the Mean Scores of Psychological Variables

The F-values obtained for the High-Average group comparison of mean scores of all the sixteen psychological variables are greater than 9.30, the value of F' required for significance at 0.01 level. This suggests that there exists significant difference in the mean scores of each psychological variable between High- and Average- Achievers in Mathematics. Stated differently each psychological variable is capable of differentiating High- Achievers in Mathematics from Average- Achievers in Mathematics.

4.2.2. Comparison of High- and Low- Achievers in Mathematics for the Mean Scores of Psychological Variables

Comparison of the mean scores of all the sixteen psychological variables between High- and Low-Achievers in Mathematics revealed that the obtained F-values of all the psychological variables exceed 9.30, the value of F' required for significance at 0.01 level. This suggests that there exists significant difference in the mean scores of all the psychological variables between High- and Low-Achievers in Mathematics. Stated differently all psychological variables are able to discriminate significantly between High- Achievers in Mathematics and Low-Achievers in Mathematics.

4.2.3. Comparison of Average- and Low- Achievers in Mathematics for the Mean Scores of Psychological Variables

Comparison of the mean scores of the psychological variables between Average- and Low- Achievers in Mathematics suggests that the F-values of only eight variables viz., Ability to use Symbols, Inductive Reasoning, Deductive Reasoning, Problem Solving Ability in Mathematics, Fluency, Flexibility, Attitude towards Academic Work and Mathematics Anxiety are greater than 9.30, the value of F' required for significance at 0.01 level. That is, there exists significant difference in the mean scores of only these eight psychological variables between Average- and Low- Achievers in Mathematics.

But difference in the mean scores of the remaining eight variables viz., Numerical Reasoning, Spatial Ability, Abstract Reasoning, Originality, Mathematics Interest, Self-Concept in Mathematics, Attitude towards Mathematics and Achievement Motivation in Mathematics are not significant between Average- and Low- Achievers in Mathematics. Average- and Low-Achievers in Mathematics can be considered as alike in these eight variables.

Findings

1. Analysis of variance revealed that all the sixteen psychological variables have significant effect on Achievement in Mathematics. That is, High-, Average- and Low- Achievers in Mathematics differ significantly in the mean scores of all the sixteen psychological variables viz.,

    i) Numerical Reasoning
    ii) Ability to use Symbols
    iii) Spatial Ability
    iv) Abstract Reasoning
    v) Inductive Reasoning
    vi) Deductive Reasoning
    vii) Problem Solving Ability in Mathematics
    viii) Fluency

ix) Flexibility

x) Originality

xi) Mathematics Interest

xii) Self-Concept in Mathematics

xiii) Attitude towards Mathematics

xiv) Attitude towards Academic Work

xv) Mathematics Anxiety and

xvi) Achievement Motivation in Mathematics

2. Scehffe's test of multiple comparison showed that

a) Significant difference exists between all the three group pairs viz.,

High- and Average- Achievers;

High- and Low- Achievers; and

Average- and Low- Achievers in the mean scores of the eight psychological variables viz.,

i) Ability to use Symbols

ii) Inductive Reasoning

iii) Deductive Reasoning

iv) Problem Solving Ability in Mathematics

v) Fluency

vi) Flexibility

vii) Attitude towards Academic Work and

viii) Mathematics Anxiety

b) Significant difference exists between the group pairs viz.,

High- and Average- Achievers and ,

High- and Low- Achievers in the mean scores of the remaining eight psychological variables viz.,

i) Numerical Reasoning
ii) Spatial Ability
iii) Abstract Reasoning
iv) Originality
v) Mathematics Interest
vi) Self-Concept in Mathematics
vii) Attitude towards Mathematics and
viii) Achievement Motivation in Mathematics

4.3. RELATION OF PSYCHOLOGICAL VARIABLES WITH ACHIEVEMENT IN MATHEMATICS

The analysis of variance revealed that all the psychological variables have significant effect on Achievement in Mathematics. That is, they are capable of differentiating significantly between the three groups of achievers viz., High-, Average- and Low- Achievers in Mathematics. This implies the possibility of significant relationship of Achievement in Mathematics with all the sixteen psychological variables. In this section, the investigator therefore estimated the extent and nature of relationship between Achievement in Mathematics and each of the sixteen psychological variables by means of Pearson's product moment coefficient of correlation 'r'.

The investigator could use Pearson's product moment coefficient of correlation 'r' as all the variables involved in this study are continuous and of the interval type by their measurement. Besides, in using r, the basic assumptions to be met are,

i) The distribution of the criterion (dependent) variable should be normal or atleast not badly skewed. (This was understood by studying the distribution graphically and by estimating measures of skewness and kurtosis in the earlier section).

ii) The relationship between the two variables is to be rectilinear. (This was understood by preparing scatter diagrams in the case of each psychological variable with Achievement in Mathematics.

iii) The condition of equal scattering (homoscedasticity). (This was assumed as a large sample was used for the study).

As all the three assumptions are satisfied, the investigator proceeded with the computation of Pearson's r. The value of 'r' obtained in the case of each psychological variable is described below in terms of

i) statistical significance of the coefficient (by Fisher's t-test)

ii) the size of 'r'

iii) direction of 'r'

iv) 99 percent confidence interval of 'r'

v) shared variance which a variable has in common with the variable associated, and

vi) The coefficient of predictive efficiency, E.

Details of these are presented in Table 16.

TABLE 16

Coefficient of Correlations and Other Details of Relation of Psychological Variables with Achievement in Mathematics

Sl. No.	Psychological Variables	Correlation coefficient 'r'	Fisher's t	Standard error of estimate (SEr)	99% Confidence interval	Shared variance	Predictive efficiency of 'r'
1.	Numerical Reasoning	0.23**	5.29	0.04	(0.13, 0.33)	5.29	0.03
2.	Ability to use Symbols	0.42**	10.30	0.04	(0.32, 0.52)	17.64	0.09
3.	Spatial Ability	0.16**	3.64	0.04	(0.06, 0.26)	2.56	0.01
4.	Abstract Reasoning	0.44**	10.91	0.03	(0.34, 0.54)	19.36	0.10
5.	Inductive Reasoning	0.62**	17.52	0.03	(0.54, 0.70)	38.44	0.22
6.	Deductive Reasoning	0.54**	14.35	0.03	(0.46, 0.62)	29.16	0.16
7.	Problem Solving Ability in Mathematics	0.59**	16.26	0.03	(0.51, 0.67)	34.81	0.19
8.	Fluency	0.55**	14.62	0.03	(0.47, 0.63)	30.25	0.16
9.	Flexibility	0.54**	14.35	0.03	(0.46, 0.62)	29.16	0.16
10.	Originality	0.45**	11.28	0.04	(0.35, 0.55)	20.25	0.11
11.	Mathematics Interest	0.23**	5.29	0.04	(0.13, 0.33)	5.29	0.03
12.	Self-Concept in Mathematics	0.17**	3.87	0.04	(0.07, 0.27)	2.89	0.01
13.	Attitude towards Mathematics	0.30**	7.05	0.04	(0.20, 0.40)	9.00	0.05
14.	Attitude towards Academic work	0.45**	11.28	0.04	(0.35, 0.55)	20.25	0.11
15.	Mathematics Anxiety	-0.34**	-8.07	0.04	(-0.44, -0.24)	11.56	0.06
16.	Achievement Motivation in Mathematics	0.20**	4.55	0.04	(0.10, 0.30)	4.00	0.02

Note: ** indicates significance at 0.01 level (P<0.01)

From Table 16, the coefficient of correlations obtained between Achievement in Mathematics and each of the sixteen psychological variables revealed that all the sixteen psychological variables have significant correlation (beyond 0.01 level as the Fisher's t-value exceeds 2.58, the limit set up for significance at 0.01 level) with Achievement in Mathematics. The significant 'r' is indicative of a true relationship and hence it can be understood that there exists real relationship between Achievement in Mathematics and each of the sixteen psychological variables.

The magnitude of r's of the sixteen psychological variables with Achievement in Mathematics reveal that the relation of nine of the psychological variables (Ability to use Symbols, Abstract Reasoning, Inductive Reasoning, Deductive Reasoning, Problem Solving Ability in Mathematics, Fluency, Flexibility, Originality and Attitude towards Academic Work) are substantial; relation of the five variables (Numerical Reasoning, Mathematics Interest, Attitude towards Mathematics, Mathematics Anxiety and Achievement Motivation in Mathematics) are low and of the remaining two variables (Spatial Ability and Self-Concept in Mathematics) are negligible.

Further it was found that relation of Achievement in Mathematics with fifteen of the psychological variables (except Mathematics Anxiety) are positive. Of these fifteen variables, the nine variables viz., Ability to use Symbols, Abstract Reasoning, Inductive Reasoning, Deductive Reasoning, Problem Solving Ability in Mathematics, Fluency, Flexibility, Originality and Attitude towards Academic Work have substantial and positive relationship with Achievement in Mathematics, which means that an increase in these predictor psychological variables is accompanied by a substantial increase in Achievement in Mathematics. Four variables (Numerical Reasoning, Mathematics Interest, Attitude towards Mathematics and Achievement Motivation in Mathematics) have positive but low correlation with Achievement in Mathematics. That is, an increase in these four predictor variables is accompanied by a slight increase in Achievement in Mathematics. But two variables viz., Spatial Ability and Self-Concept in Mathematics have only negligible (but positive) relation with Achievement in Mathematics, which means that these variables contribute very little to Achievement in Mathematics. The relation of Achievement in Mathematics with Mathematics Anxiety is negative and low. That is, increase in Mathematics Anxiety is accompanied by slight decrease in Achievement in Mathematics.

Ninetynine percent confidence interval of r's estimated between Achievement in Mathematics and each of the sixteen psychological variables are presented in Table 16 and these give the limits within which the population r may be in the case of each variable, the probability being 0.99.

Table 16 also shows the shared variance, indicating the percentage of the variance of the criterion variable 'Achievement in Mathematics' accounted by each predictor variable. The shared variance estimated varies between 2.56 (Spatial Ability) and 38.44 (Inductive Reasoning).

The coefficient of predictive efficiency, E (in terms of r), of the variables varies from 0.01 to 0.22, which indicates that the efficiency of the psychological variables under study in predicting Achievement in Mathematics ranges from one percent to 22 percent. The psychological variables in the order of the magnitude of predictive efficiency are Inductive Reasoning, Problem Solving Ability in Mathematics, Deductive Reasoning, Fluency, Flexibility, Originality, Attitude towards Academic Work, Abstract Reasoning, Ability to use Symbols, Mathematics Anxiety, Attitude towards Mathematics, Numerical Reasoning, Mathematics Interest, Achievement Motivation in Mathematics, Spatial Ability and Self-Concept in Mathematics.

Findings

All the sixteen psychological variables have significant correlation with Achievement in Mathematics, at 0.01 level. All the psychological variables except Mathematics Anxiety are positively correlated with Achievement in Mathematics.

4.4. IDENTIFICATION OF THE SIGNIFICANT PREDICTORS OF ACHIEVEMENT IN MATHEMATICS BY REGRESSION ANALYSIS AND ESTIMATION OF THEIR PREDICTIVE EFFICIENCY (IN TERMS OF β AND THE PARTIAL r's)

The third objective of the study is the identification of the significant psychological predictors of Achievement in Mathematics and thereby estimation of the predictive efficiency of each psychological variable in predicting Achievement in Mathematics. As all the psychological variables were found to have significant effect on Achievement in Mathematics and are significantly related to Achievement in Mathematics (r ranges from -0.34 to 0.62), it became apt to conduct regression analysis to know the psychological variables which are significant predictors of Achievement in Mathematics. The technique followed for this is stepwise regression analysis (ANOVA approach) for which computation was by means of the SPSS programme of computer.

The basic statistics, mean and standard deviation of the criterion and predictor variables are given in Table 17 as a preliminary to the regression analysis.

TABLE 17

Means and Standard Deviations of the Select Psychological Variables as Input Data for Stepwise Regression Analysis

Sl. No.	Psychological variables	Mean	Standard deviation
	Criterion Variable		
1.	Y Achievement in Mathematics	8.31	4.30
	Predictor Variables		
2.	X_1 Numerical Reasoning	3.07	1.63
3.	X_2 Ability to use Symbols	2.91	1.81
4.	X_3 Spatial Ability	2.56	1.29
5.	X_4 Abstract Reasoning	7.71	2.66
6.	X_5 Inductive Reasoning	23.65	8.74
7.	X_6 Deductive Reasoning	16.95	7.49
8.	X_7 Problem Solving Ability in Mathematics	8.69	4.51
9.	X_8 Fluency	34.21	16.35
10.	X_9 Flexibility	28.21	14.69
11.	X_{10} Originality	14.36	5.11
12.	X_{11} Mathematics Interest	8.84	4.56
13.	X_{12} Self-Concept in Mathematics	75.91	12.85
14.	X_{13} Attitude towards Mathematics	112.39	15.07
15.	X_{14} Attitude towards Academic Work	137.20	20.86
16.	X_{15} Mathematics Anxiety	83.33	14.65
17.	X_{16} Achievement Motivation in Mathematics	91.00	11.61

The correlation matrix of the criterion variable Achievement in Mathematics with the predictor psychological variables which is also an input data of the regression analysis is given as Table 18.

TABLE 18

Correlation Matrix of the Criterion Variable with the Predictor Variables

Sl. No.	Psychological Variables	Y	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}
	Criterion Variable																	
1.	Achievement in Mathematics (Y)	1.00																
	Predictor Variables																	
2.	Numerical Reasoning (X_1)	0.23**	1.00															
3.	Ability to use Symbols (X_2)	0.42**	0.23**	1.00														
4.	Spatial Ability (X_3)	0.16**	0.16**	0.10*	1.00													
5.	Abstract Reasoning (X_4)	0.44**	0.15**	0.35**	0.19**	1.00												
6	Inductive Reasoning (X_5)	0.62**	0.17**	0.38**	0.16**	0.47**	1.00											
7	Deductive Reasoning (X_6)	0.54**	0.15**	0.28**	0.13**	0.40**	0.76**	1.00										
8	Problem Solving Ability in Mathematics (X_7)	0.59**	0.21**	0.27**	0.23**	0.42**	0.51**	0.44**	1.00									
9	Fluency (X_8)	0.55**	0.22**	0.44**	0.25**	0.52**	0.47**	0.46**	0.53**	1.00								
10	Flexibility (X_9)	0.54**	0.21**	0.45**	0.21**	0.49**	0.48**	0.42**	0.52**	0.95**	1.00							
11	Originality (X_{10})	0.45**	0.16**	0.36**	0.17**	0.48**	0.43**	0.40**	0.43**	0.74**	0.74**	1.00						
12	Mathematics Interest (X_{11})	0.23**	0.03	0.14**	0.01	0.14**	0.27**	0.20**	0.14**	0.06	0.06	0.05	1.00					
13	Self-Concept in Mathematics (X_{12})	0.17**	0.04	0.14**	0.04	0.20**	0.22**	0.15**	0.15**	0.18**	0.19**	0.18**	0.34**	1.00				
14	Attitude towards Mathematics (X_{13})	0.30**	0.05	0.22**	0.06	0.31**	0.37**	0.26**	0.22**	0.25**	0.25**	0.32**	0.27**	0.48**	1.00			
15	Attitude towards Academic Work (X_{14})	0.45**	0.09*	0.14**	0.03	0.16**	0.36**	0.27**	0.30**	0.18**	0.15**	0.10*	0.20**	0.26**	0.38**	1.00		
16	Mathematics Anxiety(X_{15})	-0.34**	-0.16**	-0.23**	-0.10*	-0.22**	-0.33**	-0.29**	-0.24**	-0.27**	-0.22**	-0.26**	-0.28**	-0.41**	-0.44**	-0.33**	1.00	
17	Achievement Motivation in Mathematics (X_{16})	0.20**	0.08	0.15**	-0.02	0.18**	0.25**	0.14**	0.12**	0.07	0.08	0.12**	0.35**	0.56**	0.43**	0.31**	-0.41**	1.00

Note: N = 500 * indicates significance of r at 0.05 level
** indicates significance of r at 0.01 level.

The indices of correlations reported in Table 18 indicates that the predictor variable Inductive Reasoning (X_5) has the highest correlation ($r = 0.62$) with the criterion variable, and hence it was selected to enter first in the analysis.

Step I

The result of the step I analysis is given as Table 19.

TABLE 19

Results of Step I Regression Analysis

Variable entered : X_5 (Inductive Reasoning)

Correlation(r) = 0.616 — $SE_r = 0.03$

Percentage variance ($r^2 \times 100$) = 37.91

Beta$_5$(β_5) = 0.62 — $B_5 = 0.30$ — $SE_{B5} = 0.02$

Constant = 1.14

Source	DF	SS	MSS	F
Total	499			
Regression	1	3502.77	3502.77	304.09 ($p<0.01$)
Residual	498	5736.49	11.52	

The result shown in Table 19 suggests that the F-value 304.09 highly exceeds the F-value for significance at 0.01 level for (1, 498) df and hence the regressor X_5 (Inductive Reasoning) is highly significant in predicting the criterion variable Achievement in Mathematics.

The percentage variance accounted for by the variable Inductive Reasoning (X_5) in predicting Achievement in Mathematics is 37.91.

Step II

The second predictor input variable is the one which has the highest partial correlation with the criterion variable. In this case the variable is Problem Solving Ability in Mathematics (X_7).

The results of this analysis are shown as Table 20.

TABLE 20

Results of Step II Regression Analysis

Variables entered : X_5 and X_7		
Multiple Correlation(R) = 0.692		SE_R = 0.02
Percentage variance (R^2 x 100) = 47.85		
$Beta_5(\beta_5)$ = 0.43	B_5 = 0.21	SE_{B5} = 0.02
$Beta_7$ (β_7) = 0.37	B_7 = 0.35	SEB_7 = 0.04
Constant = 0.29		

Source	DF	SS	MSS	F
Total	499			
Regression	2	4420.67	2210.33	227.98 ($p<0.01$)
Residual	497	4818.60	9.70	

The result shown in Table 20 suggests that the obtained F-value 227.98 highly exceeds the F-value for significance at 0.01 level for (2,497) df. The regressor X_7 therefore also is highly significant in predicting the criterion variable Achievement in Mathematics.

Here the index of predictability, 'R' is 0.692 and the percentage variance accounted for by the variables Inductive Reasoning (X_5) and Problem Solving Ability in Mathematics (X_7) in predicting Achievement in Mathematics is 47.85.

This further suggests that by adding X_7 to X_5, R the index of prediction has changed from 0.616 to 0.692 and that the percentage variance raised from 37.91 to 47.85. The increase in R is 0.076 and that in percentage variance is 9.94.

Step III

The third variable entered having highest partial correlation with the criterion variable is Attitude towards Academic Work (X_{14}).

The results of this analysis is shown as Table 21.

TABLE 21

Results of Step III Regression Analysis

Variables entered : X_5, X_7 and X_{14}		
Multiple Correlation(R) = 0.721		$SE_R = 0.02$
Percentage variance ($R^2 \times 100$) = 51.98		
Beta5 (β_5) = 0.37	$B_5 = 0.18$	$SE_{B5} = 0.02$
Beta7 (β_7) = 0.33	$B_7 = 0.32$	$SE_{B7} = 0.04$
Beta14 (β_{14}) = 0.22	$B_{14} = .0.05$	$SE_{B14} = 0.01$
Constant = -4.94		

Source	DF	SS	MSS	F
Total	499			
Regression	3	4802.60	1600.87	178.97 ($p<0.01$)
Residual	496	4436.66	8.95	

The result shown in Table 21 suggests that the obtained F-value 178.97 exceeds the F-value for significance at 0.01 level for (3, 496) df and hence the regressor X_{14} (Attitude towards Academic Work) also is significant in predicting the criterion variable Achievement in Mathematics.

Table 21 also reveals that when the third variable viz., Attitude towards Academic work was entered, R became 0.721 with percentage variance 51.98. That is, the multiple correlation of the three variables with Achievement in Mathematics is 0.721 and that the percentage variance accounted for by the three variables Inductive Reasoning, Problem Solving Ability in Mathematics and Attitude towards Academic Work in predicting Achievement in Mathematics is 51.98.

This further suggests that by adding X_{14} to X_5 and X_7, the multiple correlation R has increased from 0.692 to 0.721 and percentage variance has increased from 47.85 to 51.98. The increase in R and percentage variance are 0.029 and 4.13 respectively.

Step IV

The fourth variable entered is Flexibility (X_9). Results of this analysis is shown as Table 22.

TABLE 22

Results of Step IV Regression Analysis

Variables entered : X_5, X_7, X_{14} and X_9				
Multiple Correlation(R) = 0.748				SE_R = 0.02
Percentage variance (R^2 x 100) = 55.96				
Beta5 (β_5) = 0.30		B_5 = 0.15		SE_{B5} = 0.02
Beta7 (β_7) = 0.24		B_7 = 0.23		SE_{B7} = 0.04
Beta14 (β_{14}) = 0.24		B_{14} =0.05		SE_{B14} = 0.01
Beta9 (β_9) = 0.24		B_9 = 0.07		SE_{B9} = 0.01
Constant = -5.90				

Source	DF	SS	MSS	F
Total	499			
Regression	4	5170.05	1292.51	157.23 (p<0.01)
Residual	495	4069.21	8.22	

The result shown in Table 22 suggests that the obtained F-value 157.23 exceeds the F-value for significance at 0.01 level for (4, 495) df and that the regressor X_9 (Flexibility) is also significant in predicting the criterion variable Achievement in Mathematics.

Table 22 also reveals that when the fourth variable Flexibility was entered R became 0.748 with percentage variance 55.96. That is, the multiple correlation of the four variables with Achievement in Mathematics is 0.748 and that the percentage variance accounted for by the four variables Inductive Reasoning, Problem Solving Ability in Mathematics, Attitude towards Academic Work and Flexibility in predicting Achievement in Mathematics is 55.96.

This further suggests that by adding X_9 to X_5, X_7 and X_{14}, the multiple correlation R has increased from 0.721 to 0.748 and percentage variance from 51.98 to 55.96. The increase in R and percentage variance are 0.027 and 3.98 respectively.

Step V

The fifth variable entered is Ability to use Symbols (X_2). Results of this analysis is shown as Table 23.

TABLE 23

Results of Step V Regression Analysis

Variables entered : X_5, X_7, X_{14}, X_9 and X_2		
Multiple Correlation(R) = 0.758		$SE_R = 0.02$
Percentage variance ($R^2 \times 100$) = 57.43		
$Beta_5$ (β_5) = 0.26	$B_5 = 0.13$	$SE_{B5} = 0.02$
$Beta_7$ (β_7) = 0.25	$B_7 = 0.23$	$SE_{B7} = 0.04$
$Beta_{14}$ (β_{14}) = 0.24	$B_{14} = 0.05$	$SE_{B14} = 0.01$
$Beta_9$ (β_9) = 0.19	$B_9 = 0.06$	$SE_{B9} = 0.01$
$Beta_2$ (β_2) = 0.14	$B_2 = 0.33$	$SE_{B2} = 0.08$
Constant = -6.06		

Source	DF	SS	MSS	F
Total	499			
Regression	5	5305.84	1061.17	133.27 ($p<0.01$)
Residual	494	3933.42	7.96	

The result shown in Table 23 suggests that the F-value 133.27 exceeds the F-value for significance at 0.01 level for (5, 494) df and that the regressor X_2 (Ability to use Symbols) is also significant in predicting the criterion variable Achievement in Mathematics.

Table 23 again reveals that when the fifth variable Ability to use Symbols was entered, R became 0.758 with percentage variance 57.43. That is, the multiple correlation of the five variables with Achievement in Mathematics is 0.758 and that the percentage variance accounted for by the five variables Inductive Reasoning, Problem Solving Ability in Mathematics, Attitude towards Academic Work, Flexibility and Ability to use Symbols in Predicting Achievement in Mathematics is 57.43.

This further suggests that by adding X_2 to X_5, X_7, X_{14} and X_9, the multiple correlation R has increased from 0.748 to 0.758 and percentage variance from 55.96 to 57.43. The increase in R and percentage variance are 0.010 and 1.47 respectively.

Step VI

The sixth variable entered is Deductive Reasoning (X_6). Results of this analysis is shown as Table 24.

TABLE 24

Results of Step VI Regression Analysis

Variables entered : X_5, X_7, X_{14}, X_9, X_2 and X_6		
Multiple Correlation(R) = 0.762		$SE_R = 0.02$
Percentage variance ($R^2 \times 100$) = 58.10		
$Beta_5$ (β_5) = 0.17	$B_5 = 0.08$	$SE_{B5} = 0.03$
$Beta_7$ (β_7) = 0.24	$B_7 = 0.23$	$SE_{B7} = 0.04$
$Beta_{14}$ (β_{14}) = 0.24	$B_{14} = 0.05$	$SE_{B14} = 0.01$
$Beta_9$ (β_9) = 0.18	$B_9 = 0.06$	$SE_{B9} = 0.01$
$Beta_2$ (β_2) = 0.14	$B_2 = 0.34$	$SE_{B2} = 0.08$
$Beta_6$ (β_6) = 0.13	$B_6 = 0.07$	$SE_{B6} = 0.03$
Constant = -6.20		

Source	DF	SS	MSS	F
Total	499			
Regression	6	5368.15	894.69	113.94 ($p<0.01$)
Residual	493	3871.12	7.85	

The result shown in Table 24 suggests that the F-value 113.94 exceeds the F-value for significance at 0.01 level for (6, 493) df and that the regressor X_6

(Deductive Reasoning) is also significant in predicting the criterion variable Achievement in Mathematics.

When the sixth variable Deductive Reasoning was entered, R became 0.762 with percentage variance 58.10. That is, the multiple correlation of the six variables with Achievement in Mathematics is 0.762 and that the percentage variance accounted for by the six variables Inductive Reasoning, Problem Solving Ability in Mathematics, Attitude towards Academic Work, Flexibility, Ability to use Symbols and Deductive Reasoning in predicting Achievement in Mathematics is 58.10

This further suggests that by adding X_6 to X_5, X_7, X_{14}, X_9 and X_2, the multiple correlation R has changed from 0.758 to 0.762 and percentage variance from 57.43 to 58.10. The increase in R and percentage variance are 0.004 and 0.67 respectively.

After step VI analysis, it was found that further addition of predictor variables has not much to contribute to R or for the percentage variance. When sixth variable X_6 was entered, R increased only by 0.004 which is negligible and the percentage variance increased only by 0.67.

Thus it was found that among the sixteen psychological variables which have significant effect and relation with Achievement in Mathematics, only six are significant predictors. These six predictors in the order as found in the stepwise regression analysis, the successive R's, percentage variance, and, increase in R and the percentage variance, are reported in Table 25.

TABLE 25

Summary of Results of Stepwise Regression Analysis

Step	Variables entered	R	Increase in R	Percentage variance (R^2 x 100)	Increase in percentage variance
I	X_5 (Inductive Reasoning)	0.616	--	37.91	--
II	X_7 (Problem Solving Ability in Mathematics)	0.692	0.076	47.85	9.94
III	X_{14} (Attitude towards Academic Work)	0.721	0.029	51.98	4.13
IV	X_9 (Flexibility)	0.748	0.027	55.96	3.98
V	X_2 (Ability to use Symbols)	0.758	0.010	57.43	1.47
VI	X_6 (Deductive Reasoning)	0.762	0.004	58.10	0.67

The successive regression equations for predicting Achievement in Mathematics by means of the above six predictor variables are:

i) $Y^1 = 0.30\, X_5 + 1.14$

ii) $Y^1 = 0.21\, X_5 + 0.35\, X_7 + 0.28$

iii) $Y^1 = 0.18\, X_5 + 0.32\, X_7 + 0.05\, X_{14} - 5.02$

iv) $Y^1 = 0.15\, X_5 + 0.23\, X_7 + 0.05\, X_{14} + 0.07\, X_9 - 5.88$

v) $Y^1 = 0.13\, X_5 + 0.23\, X_7 + 0.05\, X_{14} + 0.06\, X_9 + 0.33\, X_2 - 6.11$

vi) $Y^1 = 0.08\, X_5 + 0.23\, X_7 + 0.05\, X_{14} + 0.06\, X_9 + 0.34\, X_2 + 0.07\, X_6 -6.19$,

where Y^1 denotes predicted values of Y, the criterion variable 'Achievement in Mathematics' and X_5, X_7, X_{14}, X_9, X_2 and X_6 are the significant predictors viz., Inductive Reasoning, Problem Solving Ability in Mathematics, Attitude towards Academic Work, Flexibility, Ability to use Symbols and Deductive Reasoning respectively.

4.4.1. Predictive Efficiency of the Significant Predictors

The multiple correlation R between the criterion variable Y and of the six significant predictors [Inductive Reasoning (X_5), Problem Solving Ability in Mathematics (X_7), Attitude towards Academic Work (X_{14}), Flexibility (X_9). Ability to use Symbols (X_2) and Deductive Reasoning (X_6)] is 0.762 and this index of prediction is highly significant as $SE_R = 0.02$. This suggests that Achievement in Mathematics can be significantly predicted by means of the six predictors X_5, X_7, X_{14}, X_9, X_2 and X_6.

In order to find the predictive efficiency of each of these six significant predictor variables, the coefficient of determination R^2 as $\Sigma\beta r$ is computed and presented in Table 26.

TABLE 26

Relative Weights of the Six Significant Predictor Variables

Variable Number	Variables	Regression coefficients (β)	Coefficient of correlation (r)	β x r
X_5	Inductive Reasoning	0.17	0.62	0.105
X_7	Problem Solving Ability in Mathematics	0.24	0.59	0.142
X_{14}	Attitude towards Academic Work	0.24	0.45	0.108
X_9	Flexibility	0.18	0.54	0.097
X_2	Ability to use Symbols	0.14	0.42	0.059
X_6	Deductive Reasoning	0.13	0.54	0.070
			$\Sigma\beta r = R^2 = 0.581$	

The results in Table 26 thus suggests that,

i) 10.50 percent of the variance of Achievement in Mathematics is accountable by the predictor variable Inductive Reasoning

ii) 14.20 percent of the variance of Achievement in Mathematics is accountable by the predictor variable Problem Solving Ability in Mathematics.

iii) 10.80 percent of the variance of Achievement in Mathematics is accountable by the predictor variable Attitude towards Academic Work.

iv) 9.70 percent of the variance of Achievement in Mathematics is accountable by the predictor variable Flexibility.

v) 5.90 percent of the variance of Achievement in Mathematics is accountable by the predictor variable Ability to use Symbols.

vi) 7.00 percent of the variance of Achievement in Mathematics is accountable by the predictor variable Deductive Reasoning.

vii) $R^2 = \Sigma\beta r = 0.581$. This indicates that 58.10 percent of whatever makes students differ in Achievement in Mathematics is attributable to difference in the six predictor variables viz., Inductive Reasoning (X_5), Problem Solving Ability in Mathematics (X_7), Attitude towards Academic Work (X_{14}), Flexibility (X_9), Ability to use Symbols (X_2) and Deductive Reasoning (X_6). That is, around 58 percent of the variance in Achievement in Mathematics is attributable to the variation in the six variables obtained as best predictors by stepwise regression analysis. This also means that the remaining 42 percent of the variance in Achievement in Mathematics is attributable to the variation in the variables other than those studied.

Findings

Six variables were found to be significant predictors of Achievement in Mathematics. These variables are listed below on the basis of the extent of predictability of Achievement in Mathematics.

i) Problem Solving Ability in Mathematics
ii) Attitude towards Academic Work
iii) Inductive Reasoning
iv) Flexibility
v) Deductive Reasoning
vi) Ability to use Symbols

4.5. EFFECTIVENESS OF THE SIGNIFICANT PREDICTORS (IDENTIFIED BY REGRESSION ANALYSIS) IN PREDICTING GROUP MEMBERSHIP LIKE HIGH-, AVERAGE- AND LOW- ACHIEVERS IN MATHEMATICS

The fourth objective of the study is to derive the linear discriminant functions in terms of the significant predictors and hence to estimate their effectiveness in predicting group membership like High-, Average- and Low-Achievers in Mathematics. As such discriminant function analysis (Direct method and computer analysis) was done to estimate the effectiveness of the six significant predictors (as found by regression analysis) in predicting group membership like High-, Average- and Low- Achievers in Mathematics. Details of this analysis and discussion of results are presented below.

4.5.1. Analysis of Group Difference

As a preliminary step to discriminant function analysis, difference between the groups High-, Average- and Low- Achievers in Mathematics in each of the significant predictor was examined by estimating Wilk's Lambda and F-values (eventhough the same was done by means of one-way ANOVA in section 4.2). These values along with the preliminary data viz., means and standard deviations of the six predictor variables for the three groups High-, Average- and Low-Achievers in Mathematics and for the total sample are presented in Table 27.

TABLE 27

Univariate Statistics of Significant Predictor Variables

Predictor variables	High-Achievers		Average-Achievers		Low-Achievers		Total sample		Wilks' Lambda	F-value
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D		
Ability to use Symbols	3.80	1.48	2.91	1.78	1.98	1.78	2.91	1.81	0.89	29.42
Inductive Reasoning	31.96	5.56	22.74	8.06	17.49	6.63	23.65	8.74	0.70	108.86
Deductive Reasoning	23.71	7.08	16.00	6.76	12.54	4.71	16.95	7.49	0.74	86.19
Problem Solving Ability in Mathematics	12.81	5.02	8.18	3.72	5.80	2.63	8.69	4.51	0.73	93.41
Flexibility	38.96	14.37	27.30	14.13	19.48	8.54	28.21	14.69	0.81	58.75
Attitude towards Academic Work	150.56	19.06	137.27	17.82	123.01	21.40	137.20	20.86	0.82	56.18

When tested for significance of difference using the univariate statistic Wilk's Lambda, the values of Lambda for the six predictor variables viz., Ability to use Symbols, Inductive Reasoning, Deductive Reasoning, Problem Solving Ability in Mathematics, Flexibility and Attitude towards Academic Work were found to be 0.89, 0.70, 0.74, 0.73, 0.81 and 0.82 respectively, suggesting a significant difference in the mean scores of the three groups. The F-test also revealed that significant difference exists in the mean scores of the predictor variables between the groups High-, Average- and Low- Achievers in Mathematics, as the obtained F-values exceeded the F-value for (2, 497) degrees of freedom.

Hence the null hypothesis that the three group means are equal is rejected. This finding is almost the same as the finding obtained by one-way ANOVA under section 4.2.

4.5.2. Interdependencies Among the Six Predictor Variables

Interdependencies among the predictor variables affect most multivariate analysis and hence a pooled correlation matrix, by averaging the correlation matrices of the three groups High-, Average- and Low- Achievers in Mathematics was estimated to examine interdependencies. This matrix is presented as Table 28.

TABLE 28

Pooled Correlation Matrix of the Six Predictor Variables

Predictor variables	X_2	X_5	X_6	X_7	X_9	X_{14}
Ability to use Symbols (X_2)	1.00					
Inductive Reasoning (X_5)	0.26	1.00				
Deductive Reasoning (X_6)	0.15	0.66	1.00			
Problem Solving Ability in Mathematics (X_7)	0.12	0.31	0.24	1.00		
Flexibility (X_9)	0.36	0.29	0.24	0.37	1.00	
Attitude towards Academic Work (X_{14})	0.00	0.18	0.08	0.11	-0.04	1.00

Table 28 reveals that the value of correlation coefficients (r's) range from 0.00 to 0.66, with r greater than 0.50 in one case only. Thus low relationships were observed for majority of the variables, indicating not much interdependencies between the predictor variables.

4.5.3. Discriminant Functions

For the discriminant functions which serves as the basis for classification of the population into groups High-, Average- and Low- Achievers to be optimal (minimizing the probability of misclassification), two assumptions about the data must be met. These are,

i) Each group must be a sample from a multivariate normal population.

ii) The population covariance matrices of the groups must all be equal.

The normality of each predictor variable is a necessary condition for multivariate normality of the population and this was verified in section 4.1. This analysis resulted that the distribution of the six predictor variables do not deviate markedly from normality.

To test the equality of the group covariance matrices Box's M test was done which is based on the determinants of the group covariance matrices.

The values of Box's M-test are presented in Table 29.

TABLE 29

Box's M test for Equality of Group Covariance Matrices

Groups	Rank	Log determinant
High- Achievers	6	21.40
Average-Achievers	6	21.30
Low-Achievers	6	19.10
Pooled within group covariance matrix	6	21.33
Box's M	Approximate F	Degrees of freedom
209.98	4.89**	(42, 272631.80)

** $P < 0.01$

Box's M test gives that the value of F is 4.89 which is greater than 1.78, the tabled value of F required for significance at 0.01 level for (42, 272631.80) degrees of freedom, suggesting a significant difference in the covariance matrices of the groups. But the small value of F and the small difference between obtaind and tabled F's suggests that the difference found in the covariance matrices of the groups may be due to the sensitivity of the test. This further suggested that the two assumptions were not perfectly satisfied but will not badly affect.

By discriminant function analysis, two linear combinations of the six predictor variables were formed, which helps to assign cases to groups High-, Average- and Low- Achievers in Mathematics. The so worked out unstandardised and standardised canonical discriminant function coefficients are presented in Table 30.

TABLE 30

Unstandardised and Standardised Canonical Discriminant Function Coefficients

Predictor variables	Unstandardised canonical discriminant function coefficients		Standardised canonical discriminant function coefficients	
	Function 1	Function 2	Function 1	Function 2
Ability to use Symbols (X_2)	0.08	0.27	0.14	0.47
Inductive Reasoning (X_5)	0.03	0.00	0.24	-0.01
Deductive Reasoning (X_6)	0.04	-0.09	0.28	-0.56
Problem Solving Ability in Mathematics (X_7)	0.10	-0.19	0.38	-0.40
Flexibility (X_9)	0.02	0.02	0.22	0.22
Attitude towards Academic work (X_{14})	0.02	0.04	0.42	0.67
Constant,	-6.15	-3.76	--	--

From Table 30, the first and second linear discriminant equations formed on the basis of unstandardised discriminant function coefficients are $D_1 = 0.08\ X_2 + 0.03\ x_5 + 0.04\ X_6 + 0.10\ X_7 + 0.02\ X_9 + 0.02\ X_{14} - 6.15$ and $D_2 = 0.27\ X_2 - 0.00\ X_5 - 0.09\ X_6 - 0.19\ X_7 + 0.02\ X_9 + 0.04\ X_{14} - 3.76$ where X_2, X_5, X_6, X_7, X_9 and X_{14} are the individual's scores obtained for the six significant predictor variables viz., Ability to use Symbols, Inductive Reasoning, Deductive Reasoning, Problem Solving Ability in Mathematics, Flexibility and Attitude towards Academic Work respectively.

The same first and second discriminant functions in terms of the standardised discriminant function coefficients are:

$D_1 = 0.14\ Z_2 + 0.24\ Z_5 + 0.28\ Z_6 + 0.38\ Z_7 + 0.22\ Z_9 + 0.42\ Z_{14}$ and

$D_2 = 0.47\ Z_2 - 0.01\ Z_5 - 0.56\ Z_6 - 0.40\ Z_7 + 0.22\ Z_9 + 0.67\ Z_{14}$ where Z_2, Z_5, Z_6, Z_7, Z_9 and Z_{14} are the respective standard scores of the predictor variables X_2, X_5, X_6, X_7, X_9 and X_{14}.

Group centroids of the two discriminant functions (Function 1 and Function 2) for the three groups High-, Average- and Low- Achievers in Mathematics are given in Table 31.

TABLE 31

Group Centroids of the Discriminant Functions for High-, Average- and Low- Achievers in Mathematics

Group	Function 1	Function 2
High- Achievers	1.53	-0.13
Average- Achievers	-0.13	0.13
Low- Achievers	-1.22	-0.21

An examination of group centroids suggests that the first function distinguishes High- Achievers from Average- and Low- Achievers in Mathematics and the second function distingushes Low- Achievers from High- and Average- Achievers in Mathematics.

4.5.4. Significance of the Discriminant Functions

The related discriminant statistics like the eigen values (an indicator of the effectiveness of the function), percent of variances, cumulative percentages, canonical correlations (a measure of the degree of association between the discriminate scores and the groups), Wilk's Lambda (λ) and the chi-square values are presented in Table 32.

TABLE 32

Statistical Indicators of the Effectiveness of the Discriminant Functions

Functions	Eigen value	Percent of variances	Cumu-lative percent	Canonical correlation	Wilk's Lambda	Chi-square	DF
Function 1	0.83	97.34	97.34	0.67	0.54	308.89**	12
Function 2	0.02	2.66	100.00	0.15	0.98	11.03*	5

* $p < 0.05$ and ** $p < 0.01$

For the first discriminant function, the eigen value is 0.83 indicating the function derived is an effective one for discriminating High- Achievers from Average- and Low- Achievers in Mathematics and that the coefficient of effectiveness is 97.65. The percent of variance being 97.34. The value of canonical correlation (0.67) indicates that the discriminant scores and the group variables are substantially related. Further the chi-square value (308.89, $p<0.01$) suggested that the first function is significant to discriminate High- Achievers from Average- and Low- Achievers in Mathematics.

For the second discriminant function, the eigen value is only 0.02 suggesting that the index of effectiveness of this function is only 2.35. The percent of variance and cumulative percent are 2.66 and 100 respectively. The value of canonical correlation (0.15) indicates that the discriminant scores have a low relationship with the group variables. The chi-square value (11.03, $p<0.05$) suggested that the second function is significant at 0.05 level to distinguish Low- Achievers from High- and Average- Achievers in Mathematics.

4.5.5. Classification of the Cases Using the Discriminant Functions

Using the discriminant function equations, the discriminant scores for each case in the sample and hence to the most likely group each case falls was determined. This led to the calculation of cases as correctly classified and misclassified into the three groups High-, Average- and Low- Achievers in Mathematics.

The number and percentage of pupils correctly classified and misclassified as belonging to the three groups High-, Average- and Low- Achievers in the study using the discriminant functions are given in Table 33 named 'Confusion Matrix.'

TABLE 33

Confusion Matrix of the Cases Correctly Classified and Misclassified

Actual Group	No. of cases	Predicted group membership		
		High- Achievers	Average- Achievers	Low- Achievers
High- Achievers in Mathematics	108	81 (75.00%)	27 (25%)	0 (0%)
Average- Achievers in Mathematics	289	60 (20.76%)	143 (49.48%)	86 (29.76%)
Low- Achievers in Mathematics	103	2 (1.94%)	28 (27.18%)	73 (70.87%)

Table 33 shows that of the 108 cases classified under High- Achievers, 81 cases (75 percent) were correctly classified and 27 cases (25 percent) were misclassified. Of the 289 cases classified as Average- Achievers, 143 cases (49.48 percent) were correctly classified and 146 cases (50.52 percent) were misclassified. Of the 103 cases classified as Low- Achievers, 73 cases (70.87 percent) were correctly classified and 30 cases (29.13 percent) were misclassified. That is, High-Achievers are the most accurately classified with 75 percent of the cases correct, Low- Achievers next with 70.87 percent and Average- Achievers last with 49.48 percent.

The total percent of cases thus correctly classified is 59.40, which is an index of the effectiveness of the discriminant functions. This implies that if the two functions are used to assign new cases to the three groups High-, Average- and Low- Achievers in Mathematics, the functions will classify the cases with the misclassification rate 40.60 percent.

4.5.6. Correlation Between Predictor (Discriminating) Variables and Canonical Discriminant Functions

The contribution of each of the predictor variables to the discriminant functions was examined by estimating correlation between the values of the functions and the values of each variable. The so estimated pooled within-groups correlations between predictor variables and canonical discriminant functions in the order of magnitude of correlations within functions are presented in Table 34.

TABLE 34

Pooled Within-Groups Correlations Between Predictor Variables and Canonical Discriminant Functions

Predictor variables	Function 1	Function 2
Inductive Reasoning	0.73*	-0.21
Problem Solving Ability in Mathematics	0.67*	-0.33
Deductive Reasoning	0.64*	-0.49
Flexibility	0.54*	0.07
Attitude towards Academic Work	0.51	0.58*
Ability to use Symbols	0.37	0.40*

Table 34 shows that among the six significant predictor variables, the four variables viz., Inductive Reasoning (0.73), Problem Solving Ability in Mathematics (0.67), Deductive Reasoning (0.64) and Flexibility (0.54) have high association with Function 1 and the two variables viz., Attitude towards Academic Work (0.58) and Ability to use Symbols (0.40) have high association with Function 2.

4.5.7. Classification Function Coefficients

Fisher's linear discriminant function coefficients derived to assign new cases into the three groups High-, Average- and Low- Achievers in Mathematics are given in Table 35.

TABLE 35

Fisher's Linear Discriminant Function Coefficients of High-, Average- and Low- Achievers in Mathematics

Variables	High- Achievers	Average- Achievers	Low- Achievers
Ability to use Symbols	0.54	0.48	0.30
Inductive Reasoning	0.09	0.04	0.00
Deductive Reasoning	0.27	0.18	0.16
Problem Solving Ability in Mathematics	0.26	0.06	-0.01
Flexibility	0.16	0.13	0.11
Attitude towards Academic Work	0.41	0.38	0.34
Constant	-42.23	-31.84	-24.62

Using the Fisher's coefficients, a case is assigned to the group for which it has the largest discriminant score.

Findings

The two discriminant functions in terms of the six significant predictors viz.,

$D_1 = 0.14\ Z_2 + 0.24\ Z_5 + 0.28\ Z_6 + 0.38\ Z_7 + 0.22\ Z_9 + 0.42\ Z_{14}$ and

$D_2 = 0.47\ Z_2 - 0.01\ Z_5 - 0.56\ Z_6 - 0.40\ Z_7 + 0.22\ Z_9 + 0.67\ Z_{14}$ are efficient enough to discriminate significantly the three groups of achievers with 59.40 percent of correct classification. The coefficient of effectiveness of the first function for discriminating High- Achievers from Average- and Low- Achievers in Mathematics is 97.65 and the coefficient of effectiveness of the second function for discriminating Low- Achievers from High- and Average- Achievers in Mathematics is 2.35.

4.6. SIGNIFICANT PREDICTORS (IDENTIFIED BY REGRESSION ANALYSIS) IN THE PSYCHOLOGICAL FACTOR STRUCTURES OF HIGH-, AVERAGE- AND LOW-ACHIEVERS IN MATHEMATICS

This part of the analysis is to find out the position of the six significant predictors in terms of loadings and communalities in the factor structures of High-, Average- and Low-Achievers in Mathematics.

For this purpose, factor structures of the three groups were derived by the Principal Components Method and the obtained factors were rotated by varimax rotation using the SPSS package. The rotated factor structures are described below for their nature and extent.

4.6.1. Psychological Factor Structure of High-Achievers in Mathematics

The correlation matrix used for extracting factors and the derived unrotated and rotated factor matrices are presented in Table 36 and Table 37 respectively.

TABLE 36

Correlation Matrix of the Sixteen Psychological Variables for High-Achievers in Mathematics

Sl. No.	Psychological variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Numerical Reasoning	1.00															
2.	Ability to use Symbols	0.26	1.00														
3.	Spatial Ability	0.30	-0.13	1.00													
4.	Abstract Reasoning	0.24	0.14	0.17	1.00												
5.	Inductive Reasoning	0.11	-0.12	0.23	0.26	1.00											
6.	Deductive Reasoning	0.06	0.00	0.18	0.27	0.70	1.00										
7.	Problem Solving Ability in Mathematics	0.21	-0.18	0.38	0.28	0.31	0.29	1.00									
8.	Fluency	0.12	0.10	0.22	0.46	0.28	0.30	0.39	1.00								
9.	Flexibility	0.09	0.06	0.18	0.37	0.27	0.23	0.37	0.92	1.00							
10.	Originality	0.13	0.00	0.14	0.37	0.28	0.31	-0.15	0.66	0.58	1.00						
11.	Mathematics Interest	0.00	-0.08	-0.07	-0.11	0.09	-0.01	-0.32	-0.14	-0.18	0.07	1.00					
12.	Self-Concept in Mathematics	0.06	0.01	0.08	0.17	0.12	-0.07	-0.51	0.19	0.17	0.19	0.30	1.00				
13.	Attitude towards Mathematics	0.02	-0.09	-0.13	0.10	0.13	-0.07	-0.49	-0.08	-0.07	0.04	0.39	0.53	1.00			
14.	Attitude towards Academic Work	0.06	0.00	0.03	0.14	0.20	0.08	0.12	-0.07	-0.13	-0.01	0.26	0.43	0.61	1.00		
15.	Mathematics Anxiety	-0.14	-0.06	-0.10	-0.17	-0.36	-0.22	-0.10	-0.02	0.03	-0.15	-0.32	-0.51	-0.49	-0.44	1.00	
16.	Achievement Motivation in Mathematics	0.10	0.11	-0.09	0.12	0.11	-0.08	-0.05	-0.08	-0.12	-0.05	0.36	0.51	0.47	0.42	-0.50	1.00

TABLE 37

Unrotated and Rotated Factor Matrices of the Sixteen Psychological Variables for High-Achievers in Mathematics

Sl. No.	Psychological Variables	Unrotated factors					h^2 (commu-nality)	Rotated factors					h^2 (commu-nality)
		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	
1.	Numerical Reasoning	0.31	-0.03	0.16	0.73	0.21	0.70	0.07	0.02	-0.01	0.59	0.59	0.70
2.	Ability to use Symbols	0.03	-0.01	0.57	0.53	-0.45	0.81	-0.03	0.07	-0.04	-0.22	0.87	0.81
3.	Spatial Ability	0.37	-0.22	-0.30	0.36	0.53	0.69	-0.05	0.09	0.10	0.82	-0.05	0.69
4.	Abstract Reasoning	0.61	-0.15	0.22	0.18	-0.08	0.48	0.13	0.52	0.20	0.21	0.34	0.48
5.	Inductive Reasoning	0.63	-0.02	-0.55	0.04	-0.34	0.82	0.19	0.20	0.84	0.17	-0.07	0.82
6.	Deductive Reasoning	0.53	-0.22	-0.53	0.10	-0.51	0.87	-0.05	0.20	0.91	0.07	0.03	0.87
7.	Problem Solving Ability in Mathematics	0.56	-0.25	-0.26	0.05	0.41	0.62	0.02	0.37	0.19	0.64	-0.20	0.62
8.	Fluency	0.73	-0.48	0.33	-0.23	0.01	0.91	-0.06	0.94	0.10	0.13	0.06	0.91
9.	Flexibility	0.64	-0.50	0.33	-0.28	0.03	0.86	-0.12	0.91	0.05	0.09	0.00	0.86
10.	Originality	0.66	-0.29	0.19	-0.27	-0.07	0.64	0.07	0.77	0.19	0.04	-0.02	0.64
11.	Mathematics Interest	0.13	0.58	-0.07	-0.19	-0.05	0.39	0.57	-0.11	0.06	-0.15	-0.15	0.39
12.	Self-Concept in Mathematics	0.49	0.56	0.27	-0.17	0.19	0.69	0.76	0.29	-0.16	0.05	0.00	0.69
13.	Attitude towards Mathematics	0.34	0.73	0.04	-0.18	0.11	0.70	0.83	0.02	-0.04	-0.02	-0.12	0.70
14.	Attitude towards Academic work	0.36	0.64	-0.09	0.06	0.07	0.56	0.72	-0.08	0.12	0.13	0.01	0.56
15.	Mathematics Anxiety	-0.51	-0.59	0.10	-0.12	0.13	0.65	-0.72	-0.02	-0.32	-0.09	-0.15	0.65
16.	Achievement Motivation in Mathematics	0.27	0.71	0.19	0.09	-0.05	0.62	0.75	-0.06	-0.03	-0.06	0.22	0.62
	Latent Roots (Eigen Values)							3.28	2.91	1.82	1.64	1.38	11.03
	Percent of Variance							29.74	26.38	16.50	14.87	12.51	100

4.6.6.1. About the factor structure

By factor analysis, five significant factors were derived to this group. Variables which have significant loadings ($\geq \pm 0.30$) on the factors are represented schematically as Figure 2.

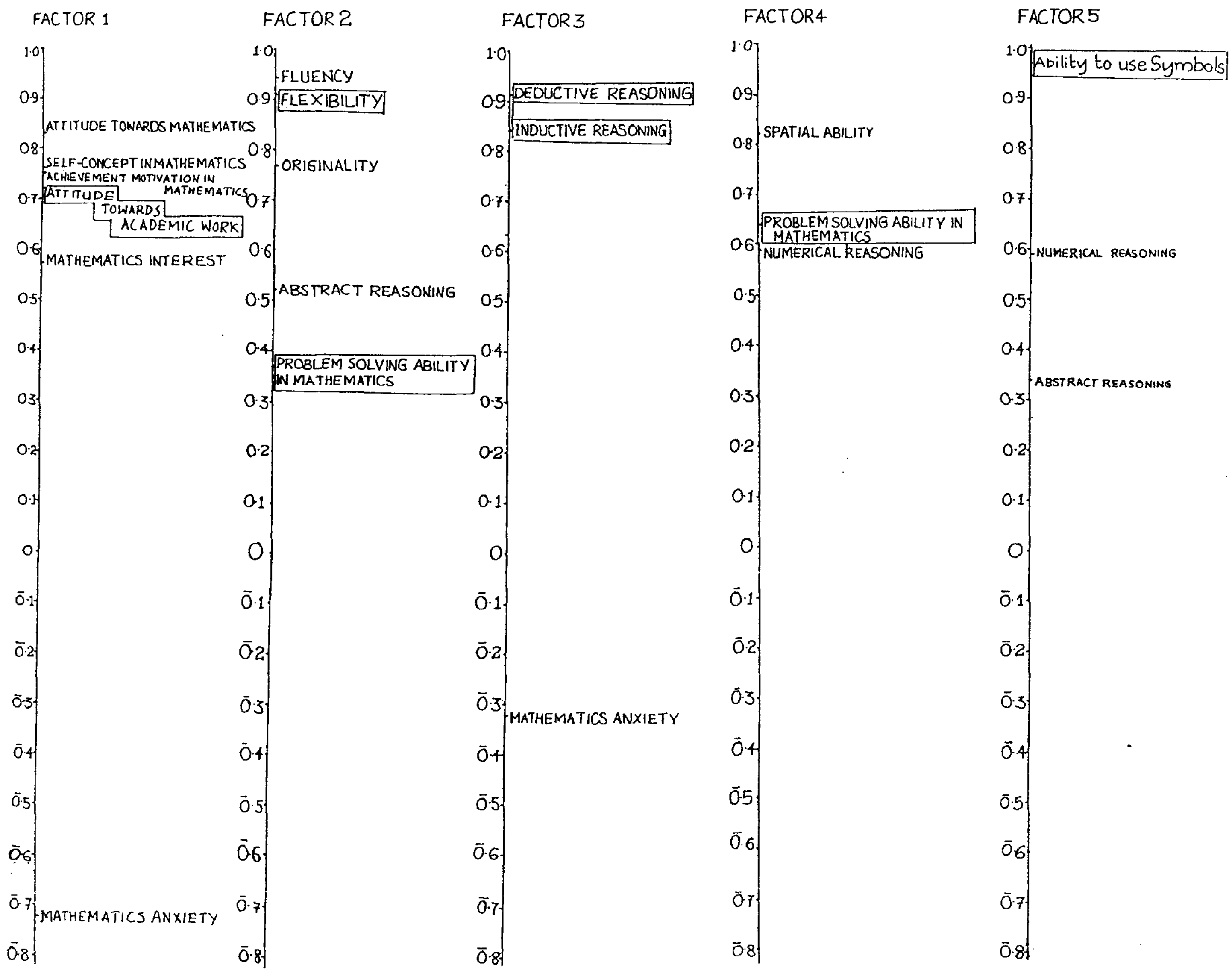

FIGURE 2. Schematic representation of the psychological factor structure of High-Achievers, showing the variables with significant loadings on the factors.

Note: Variables enclosed in rectangles are identified significant predictor variables.

Factor 1, accounted by nearly 30 percent of variance of the battery of psychological variables, has significant loadings on six variables viz., Attitude towards Mathematics (0.83), Self-Concept in Mathematics (0.76), Achievement Motivation in Mathematics (0.75), Attitude towards Academic Work (0.72), Mathematics Interest (0.57) and Mathematics Anxiety (-0.72) and hence is characterised by these six variables.

Factor 2, accounted by nearly 26 percent of variance of the battery of psychological variables, has significant loadings on five variables viz., Fluency (0.94), Flexibility (0.91), Originality (0.77), Abstract Reasoning (0.52) and Problem Solving Ability in Mathematics (0.37) and hence is characterised by the presence of these variables.

Factor 3, accounted by nearly 16 percent of variance of the battery of psychological variables, has significant loadings on three variables viz., Deductive Reasoning (0.91), Inductive Reasoning (0.84) and Mathematics Anxiety (-0.32) and hence is characterised by these three variables.

Factor 4, accounted by nearly 15 percent of variance of the battery of psychological variables, has significant loadings on three variables viz., Spatial Ability (0.82), Problem Solving Ability in Mathematics (0.64) and Numerical Reasoning (0.59) and hence is characterised by the presence of these three variables.

Factor 5, accounted by nearly 13 percent of variance of the battery of psychological variables, has significant loadings on three variables viz., Ability to use Symbols (0.87), Numerical Reasoning (0.59) and Abstract Reasoning (0.34) and hence is characterised by the presence of these three variables.

4.6.1.2. *Significant predictors in the factor structure*

In Factor 1, only one of the identified six significant predictors of Achievement in Mathematics viz., Attitude towards Academic Work has high loading, indicating very high presence in the factor.

In Factor 2, of the identified six significant predictors of Achievement in Mathematics, only two are significantly present - Flexibility with an extremely high presence and Problem Solving Ability in Mathematics with low presence.

In Factor 3, of the identified six predictors, two variables have significant loadings and these are Deductive Reasoning with extremely high presence and Inductive Reasoning with very high presence.

In Factor 4, only one significant predictor viz., Problem Solving Ability in Mathematics has considerable presence.

In Factor 5, only one significant predictor viz., Ability to use Symbols has very high presence.

4.6.1.3. *Communalities of the Significant Predictors*

The communalities obtained for the six significant predictor variables are given below in the order of magnitude.

i) Deductive Reasoning (0.87) [Factor 3*]
ii) Flexibility (0.86) [Factor 2*]
iii) Inductive Reasoning (0.82) [Factor 3*]
iv) Ability to use Symbols (0.81) [Factor 5*]
v) Problem Solving Ability in Mathematics (0.62) [Factor 2,4]
vi) Attitude towards Academic Work (0.56) [Factor 1*]

[Note: * indicates very high presence in the factor]

The above results suggests that each significant predictor except Problem Solving Ability in Mathematics finds a place with high loadings in at least one factor of the structure and that the communalities of these are very high ranging from 0.56 to 0.87.

4.6.2. Psychological Factor Structure of Average-Achievers in Mathematics

The correlation matrix used for extracting factors and the derived unrotated and rotated factor matrices are presented in Table 38 and Table 39 respectively.

TABLE 38

Correlation Matrix of the Sixteen Psychological Variables for Average-Achievers in Mathematics

Sl. No.	Psychological Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Numerical Reasoning	1.00															
2.	Ability to use Symbols	0.17	1.00														
3.	Spatial Ability	0.06	0.10	1.00													
4.	Abstract Reasoning	0.01	0.34	0.17	1.00												
5.	Inductive Reasoning	0.02	0.35	0.10	0.38	1.00											
6.	Deductive Reasoning	0.05	0.21	0.06	0.26	0.72	1.00										
7.	Problem Solving Ability in Mathematics	0.07	0.26	0.09	0.35	0.34	0.23	1.00									
8.	Fluency	0.13	0.41	0.19	0.46	0.33	0.32	0.43	1.00								
9.	Flexibility	0.14	0.43	0.16	0.43	0.33	0.28	0.44	0.96	1.00							
10.	Originality	0.08	0.36	0.13	0.42	0.34	0.31	0.38	0.76	0.74	1.00						
11.	Mathematics Interest	-0.05	0.18	0.03	0.09	0.26	0.20	0.10	-0.02	0.01	-0.09	1.00					
12.	Self-Concept in Mathematics	-0.03	0.19	0.06	0.21	0.17	0.12	0.07	0.20	0.20	0.21	0.34	1.00				
13.	Attitude towards Mathematics	-0.02	0.27	0.08	0.33	0.35	0.25	0.10	0.29	0.27	0.36	0.28	0.52	1.00			
14.	Attitude towards Academic Work	0.04	0.02	0.03	0.02	0.17	0.09	0.04	0.01	0.02	0.04	0.11	0.18	0.33	1.00		
15.	Mathematics Anxiety	-0.07	-0.21	-0.07	-0.11	-0.15	-0.15	-0.09	-0.19	-0.15	-0.22	-0.18	-0.35	-0.46	-0.20	1.00	
16.	Achievement Motivation in Mathematics	0.00	0.16	0.01	0.15	0.25	0.14	0.07	0.05	0.06	0.11	0.37	0.56	0.45	0.24	-0.36	1.00

TABLE 39

Unrotated and Rotated Factor Matrices of the Sixteen Psychological Variables for Average-Achievers in Mathematics

Sl. No.	Psychological Variables	Unrotated factors				h^2 (communality)	Rotated factors				h^2 (communality)
		Factor 1	Factor 2	Factor 3	Factor 4		Factor 1	Factor 2	Factor 3	Factor 4	
1.	Numerical Reasoning	0.14	-0.17	-0.18	0.82	0.76	0.15	-0.06	0.00	0.86	0.76
2.	Ability to use Symbols	0.59	-0.09	0.00	0.12	0.37	0.48	0.20	0.26	0.15	0.37
3.	Spatial Ability	0.24	-0.12	-0.13	0.05	0.09	0.29	0.05	-0.02	0.09	0.09
4.	Abstract Reasoning	0.62	-0.14	0.09	-0.24	0.47	0.55	0.15	0.31	-0.22	0.47
5.	Inductive Reasoning	0.65	0.09	0.62	0.12	0.83	0.24	0.18	0.86	0.03	0.83
6.	Deductive Reasoning	0.55	0.02	0.64	0.17	0.74	0.19	0.07	0.,83	0.08	0.74
7.	Problem Solving Ability in Mathematics	0.51	-0.26	0.20	-0.06	0.38	0.48	-0.04	0.37	-0.06	0.38
8.	Fluency	0.78	-0.46	-0.20	-0.06	0.86	0.92	0.04	0.12	0.04	0.86
9.	Flexibility	0.76	-0.47	-0.21	-0.07	0.84	0.91	0.03	0.10	0.03	0.84
10.	Originality	0.71	-0.37	-0.24	-0.08	0.70	0.83	0.10	0.06	0.02	0.70
11.	Mathematics Interest	0.28	0.54	0.27	-0.10	0.45	-0.16	0.50	0.39	-0.16	0.45
12.	Self-Concept in Mathematics	0.49	0.55	-0.29	-0.21	0.66	0.19	0.78	-0.02	-0.15	0.66
13.	Attitude towards Mathematics	0.62	0.47	-0.18	-0.03	0.64	0.27	0.74	0.16	0.01	0.64
14.	Attitude towards Academic work	0.21	0.40	-0.06	0.38	0.35	-0.09	0.44	0.13	0.37	0.35
15.	Mathematics Anxiety	-0.43	-0.40	0.32	-0.17	0.48	-0.19	-0.63	0.03	-0.23	0.48
16.	Achievement Motivaiton in Mathematics	0.40	0.66	-0.12	-0.06	0.61	-0.02	0.77	0.12	-0.04	0.61
	Latent roots (Eigen values)						3.51	2.71	1.97	1.07	9.26
	Percent of Variance						37.90	29.27	21.27	11.56	100

4.6.2.1. About the factor structure

By factor analysis, four significant factors were derived to this group. Variables which have significant loadings ($\geq \pm 0.30$) on the factors are represented schematically as Figure 3.

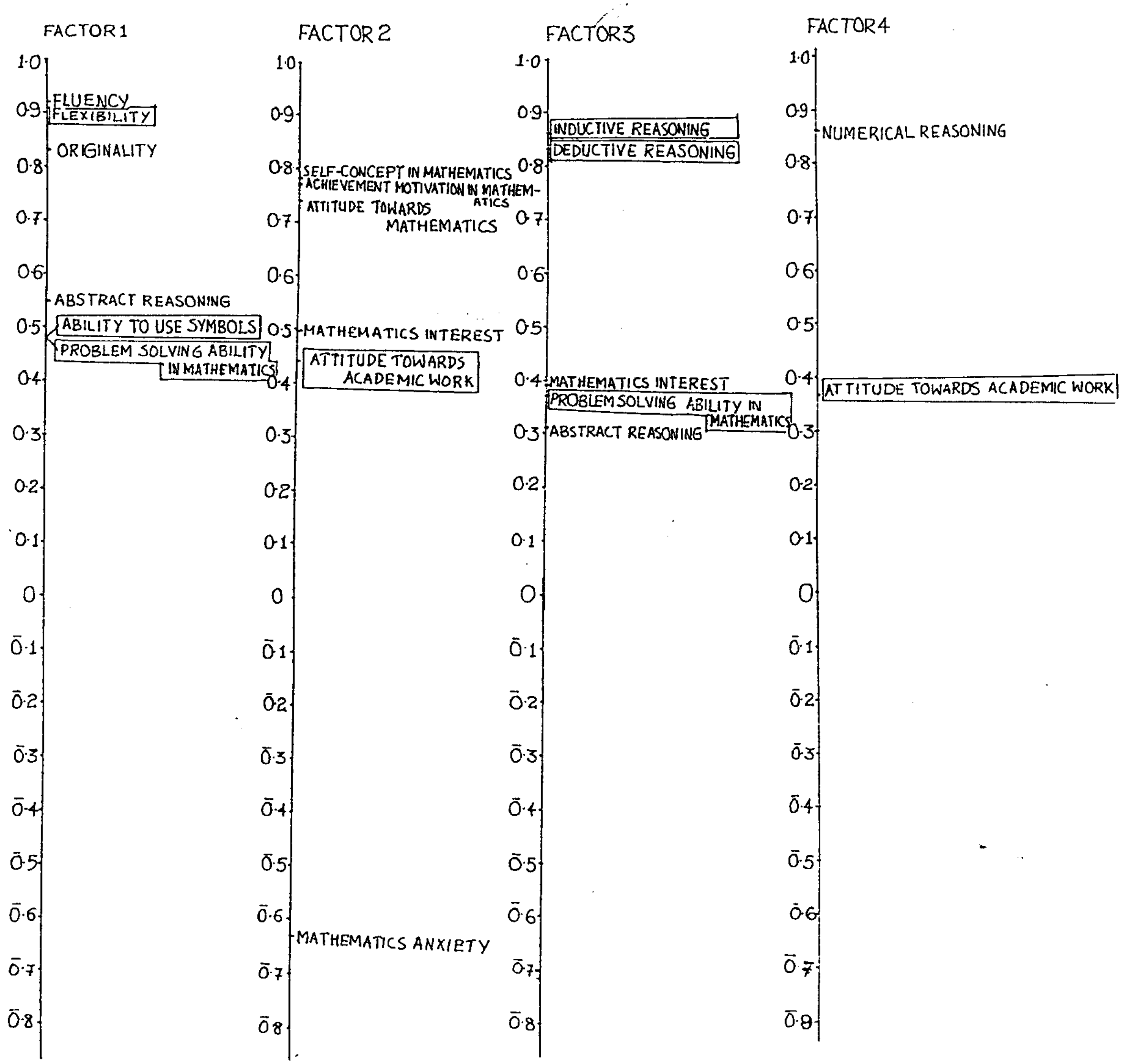

FIGURE 3. Schematic representation of the psychological factor structure of Average-Achievers, showing the variables with significant loadings on the factors.

Note: Variables enclosed in rectangles are identified significant predictor variables.

Factor 1, accounted by nearly 38 percent of variance of the battery of psychological variables, has significant loadings on six variables viz., Fluency (0.92), Flexibility (0.91), Originality (0.83), Abstract Reasoning (0.55), Ability to use Symbols (0.48) and Problem Solving Ability in Mathematics (0.48) and hence is characterised by the presence of these six variables.

Factor 2, accounted by nearly 29 percent of variance of the battery of psychological variables, has significant loadings on six variables viz., Self-Concept in Mathematics (0.78), Achievement Motivation in Mathematics (0.77), Attitude towards Mathematics (0.74), Mathematics Interest (0.50), Attitude towards Academic Work (0.44) and Mathematics Anxiety (-0.63) and hence is characterised by these six variables.

Factor 3, accounted by nearly 21 percent of variance of the battery of the psychological variables, has significant loadings on five variables viz., Inductive Reasoning (0.86), Deductive Reasoning (0.83), Mathematics Interest (0.39), Problem Solving Ability in Mathematics (0.37) and Abstract Reasoning (0.31) and hence is characterised by the presence of these five variables.

Factor 4, accounted by nearly 12 percent of variance of the battery of psychological variables, has significant loadings on two variables viz., Numerical Reasoning (0.86) and Attitude towards Academic Work (0.37) and hence is characterised by the presence of these two variables.

4.6.2.2. *Significant predictors in the factor structure*

In Factor 1, three of the identified six significant predictors have significant loadings. The three predictors are Flexibility with extremely high presence; Ability to use Symbols and Problem Solving Ability in Mathematics with low presence.

In Factor 2, only one significant predictor viz., Attitude towards Academic Work has significant loading but with low presence.

In Factor 3, of the identified six predictors, three variables have significant loadings. These are Inductive Reasoning and Deductive Reasoning with very high presence and Problem Solving Ability in Mathematics with low presence.

In Factor 4, only one significant predcitor viz., Attitude towards Academic Work has significant loading but with low presence.

4.6.2.3. *Communalities of the significant predictors*

The communalities for the six significant predictor variables obtained for the factor structure are given below in the order of magnitude.

i) Flexibility (0.84) [Factor 1*]

ii) Inductive Reasoning (0.83) [Factor 3*]

iii) Deductive Reasoning (0.74) [Factor 3*]

iv) Problem Solving Ability in Mathematics (0.38) [Factors 1 and 3]

v) Ability to use Symbols (0.37) [Factor 1]

vi) Attitude towards Academic Work (0.35) [Factors 2 and 4]

[Note: * indicates very high presence in the factor]

The above results suggests that each factor of the group is characterised by the presence of atleast one of the identified significant predictors. The communalities of these identified predictors are ranging from 0.35 to 0.84.

4.6.3. Psychological Factor structure of Low-Achievers in Mathematics

The correlation matrix used for extracting factors and the derived unrotated and rotated factor matrices are presented in Table 40 and Table 41 respectively.

TABLE 40

Correlation Matrix of the Sixteen Psychological Variables for Low-Achievers in Mathematics

Sl. No.	Psychological Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1.	Numerical Reasoning	1.00															
2.	Ability to use Symbols	0.14	1.00														
3.	Spatial Ability	0.10	0.17	1.00													
4.	Abstract Reasoning	0.11	0.14	0.05	1.00												
5.	Inductive Reasoning	0.13	0.21	-0.07	0.24	1.00											
6.	Deductive Reasoning	0.02	0.13	-0.08	0.23	0.53	1.00										
7.	Problem Solving Ability in Mathematics	0.04	0.14	0.09	0.07	0.31	0.17	1.00									
8.	Fluency	0.19	0.50	0.25	0.31	0.31	0.16	0.20	1.00								
9.	Flexibility	0.18	0.58	0.22	0.31	0.32	0.15	0.11	0.95	1.00							
10.	Originality	0.09	0.30	0.15	0.34	0.21	0.12	0.12	0.82	0.79	1.00						
11.	Mathematics Interest	0.07	-0.01	-0.13	0.16	0.08	-0.05	0.08	0.02	0.06	0.09	1.00					
12.	Self-Concept in Mathematics	0.06	-0.08	-0.20	-0.05	0.20	0.22	0.20	-0.15	-0.14	-0.14	0.28	1.00				
13.	Attitude towards Mathematics	-0.03	0.00	0.02	0.02	0.17	0.11	0.20	0.12	0.07	0.08	-0.08	0.21	1.00			
14.	Attitude towards Academic Work	-0.16	-0.06	-0.25	-0.11	0.19	0.05	0.34	-0.09	-0.08	-0.18	0.05	0.20	0.07	1.00		
15.	Mathematics Anxiety	-0.17	-0.06	0.08	-0.10	-0.25	-0.10	0.34	-0.20	-0.13	-0.08	-0.26	-0.37	-0.04	-0.09	1.00	
16.	Achievement Motivation in Mathematics	0.09	-0.05	-0.16	0.03	0.02	-0.04	0.02	-0.02	-0.02	0.01	0.15	0.53	0.18	0.20	-0.32	1.00

TABLE 41

Unrotated and Rotated Factor Matrices of the Sixteen Psychological Variables for Low-Achievers in Mathematics

Sl. No.	Psychological Variables	Unrotated factors						h^2 (communality)	Rotated factors						h^2 (communality)
		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	
1.	Numerical Reasoning	0.28	0.09	-0.35	-0.04	0.43	0.54	0.69	0.08	0.20	0.11	-0.07	0.78	-0.15	0.69
2.	Ability to use Symbols	0.63	-0.05	-0.05	0.16	-0.11	0.13	0.46	0.61	-0.07	0.07	0.21	0.19	-0.01	0.46
3.	Spatial Ability	0.32	-0.37	0.00	0.39	0.32	0.30	0.58	0.29	-0.25	-0.22	0.04	0.56	0.26	0.58
4.	Abstract Reasoning	0.48	0.10	-0.08	-0.43	0.06	-0.19	0.47	0.38	0.10	0.46	-0.28	-0.05	-0.14	0.47
5.	Inductive Reasoning	0.46	0.51	0.39	-0.28	0.10	0.11	0.72	0.21	0.13	0.75	0.31	0.07	0.02	0.72
6.	Deductive Reasoning	0.31	0.38	0.48	-0.47	0.28	-0.05	0.76	0.04	-0.01	0.86	0.06	-0.02	0.13	0.76
7.	Problem Solving Ability in Mathematics	0.23	0.43	0.40	0.32	-0.15	0.39	0.68	0.11	0.08	0.18	0.78	0.15	0.09	0.68
8.	Fluency	0.93	-0.09	-0.07	0.12	-0.12	-0.08	0.90	0.93	0.01	0.12	0.03	0.13	0.01	0.90
9.	Flexibility	0.92	-0.12	-0.06	0.12	-0.14	-0.11	0.91	0.94	-0.02	0.10	0.02	0.09	0.01	0.91
10.	Originality	0.79	-0.17	-0.13	0.03	-0.13	-0.27	0.75	0.85	-0.01	0.07	-0.16	-0.04	0.01	0.75
11.	Mathematics Interest	0.07	0.37	-0.48	-0.23	-0.35	0.14	0.56	0.07	0.48	0.01	0.04	-0.04	-0.57	0.56
12.	Self-Concept in Mathematics	-0.13	0.78	-0.20	0.09	0.17	-0.05	0.71	-0.23	0.76	0.19	0.17	0.02	0.11	0.71
13.	Attitude towards Mathematics	0.08	0.32	0.27	0.43	0.43	-0.40	0.71	0.04	0.27	0.12	0.08	-0.05	0.78	0.71
14.	Attitude towards Academic work	-0.16	0.49	0.35	0.25	-0.53	0.08	0.74	-0.11	0.17	0.01	0.74	-0.39	-0.05	0.74
15.	Mathematics Anxiety	-0.20	-0.56	0.39	0.01	-0.01	-0.14	0.53	-0.11	-0.64	-0.14	-0.11	-0.19	0.20	0.53
16.	Achievement Motivation in Mathematics	-0.06	0.58	-0.43	0.30	0.08	-0.32	0.73	0.00	0.81	-0.14	-0.02	-0.11	0.20	0.73
	Latent Roots (Eigen values)								3.22	2.12	1.73	1.46	1.22	1.16	10.91
	Percent of Variance								29.52	19.43	15.86	13.38	11.18	10.63	100

4.6.3.1. About the factor structure

By factor analysis, six significant factors were derived to this group. Variables which have significant loadings ($\geq \pm 0.30$) on the factors are represented schematically as Figure 4.

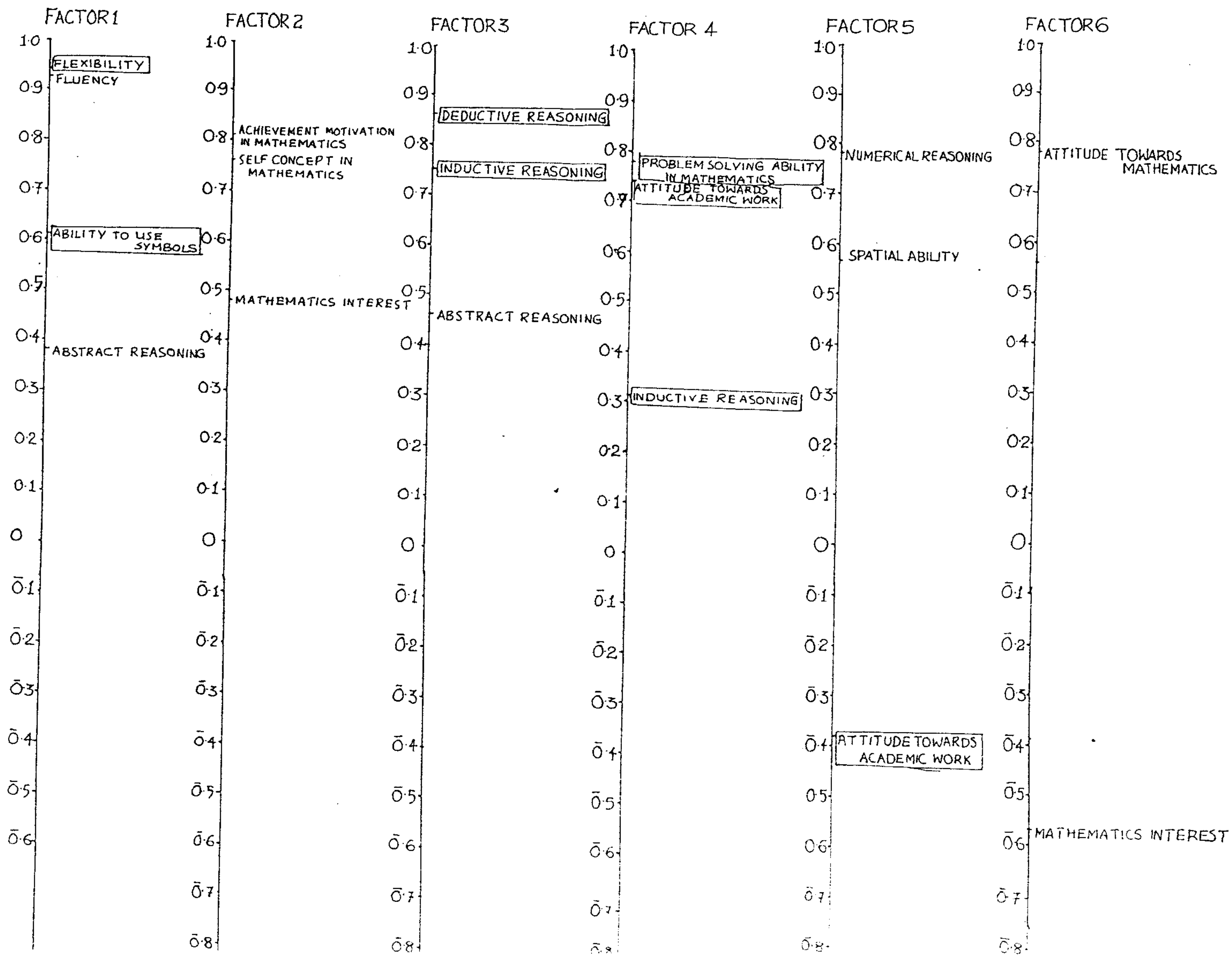

FIGURE 4. Schematic representation of the psychological factor structure of Low-Achievers, showing the variables with significant loadings on the factors.

Note: Variables enclosed in rectangles are identified significant predictor variables.

Factor 1, accounted by nearly 30 percent of variance of the battery of psychological variables, has significant loadings on five variables viz., Flexibility (0.94), Fluency (0.93), Originality (0.85), Ability to use Symbols (0.61) and Abstract Reasoning (0.38) and hence is characterised by the presence of these five variables.

Factor 2, accounted by nearly 19 percent of variance of the battery of psychological variables, has significant loadings on four variables viz., Achievement Motivation in Mathematics (0.81), Self-Concept in Mathematics (0.76), Mathematics Interest (0.48) and Mathematics Anxiety (-0.64) and hence is characterised by these four variables.

Factor 3, accounted by nearly 16 percent of variance of the battery of psychological variables, has significant loadings on three variables viz., Deductive Reasoning (0.86), Inductive Reasoning (0.75) and Abstract Reasoning (0.46) and hence is characterised by the presence of these three variables.

Factor 4, accounted by nearly 13 percent of variance of the battery of psychological variables, has significant loadings on three variables viz., Problem Solving Ability in Mathematics (0.78), Attitude towards Academic Work (0.74) and Inductive Reasoning (0.31) and hence is characterised by the presence of these three variables.

Factor 5, accounted by nearly 11 percent of variance of the battery of psychological variables, has significant loadings on three variables viz., Numerical Reasoning (0.78), Spatial Ability (0.56) and Attitude towards Academic Work (-0.39) and hence is characterised by these three variables.

Factor 6, accounted by nearly 11 percent of variance of the battery of psychological variables, has significant loadings on two variables viz., Attitude towards Mathematics (0.78) and Mathematics Interest (-0.57) and hence is characterised by these two variables.

4.6.3.2. *Significant predictors in the factor structure*

In Factor 1, of the identified six significant predictors of Achievement in Mathematics, only two are significantly present - Flexibility with extremely high presence and Ability to use Symbols with considerable presence.

In Factor 2, none of the significant predictors has significant presence.

In Factor 3, of the identified six predictors, two variables have significant loadings - Deductive Reasoning and Inductive Reasoning with very high presence.

In Factor 4, three of the identified six significant predictors have significant loadings. The three predictors are Problem Solving Ability in Mathematics and Attitude towards Academic Work with very high presence and Inductive Reasoning with low presence.

In Factor 5, only one significant predictor viz., Attitude towards Academic work has significant loading, being absent to a low extent.

In Factor 6, none of the significant predictors has significant presence.

4.6.3.3. *Communalities of the significant predictors*

The communalities obtained for six significant predictor variables are given below in the order of magnitude.

i) Flexibility (0.91) [Factor 1*]

ii) Deductive Reasoning (0.76) [Factor 3*]

iii) Attitude towards Academic Work (0.74) [Factor 4* and Factor 5]

iv) Inductive Reasoning (0.72) [Factor 3*, Factor 4]

v) Problem Solving Ability in Mathematics (0.68) [Factor 4*]

vi) Ability to use Symbols (0.46) [Factor 1]

[Note: * indicates very high presence in the factor]

To have a comprehensive view of the position of significant predictors in the psychological factor structure of High-, Average- and Low-Achievers in Mathematics, the structure of the psychological factors of High-, Average- and Low-Achievers along with the communalities are presented in Table 42.

TABLE 42

Summary of the Factor Structures Showing the Position of Significant Predictors, of High-, Average- and Low-Achievers in Mathematics

	Factor structures of		
	High-Achievers in Mathematics	Average-Achievers in Mathematics	Low-Achievers in Mathematics
Factor 1	Attitude towards Academic Work (0.72)	Flexibility (0.91) Ability to use Symbols (0.48) Problem Solving Ability in Mathematics (0.48)	Flexibility (0.94) Ability to use Symbols (0.61)
Factor 2	Flexibility (0.91) Problem Solving Ability in Mathematics (0.37)	Attitude towards Academic Work (0.44)	No identified significant predictor in Factor 2
Factor 3	Deductive Reasoning (0.91) Inductive Reasoning (0.84)	Inductive Reasoning (0.86) Deductive Reasoning (0.83) Problem Solving Ability in Mathematics (0.37)	Deductive Reasoning (0.86) Inductive Reasoning (0.75)
Factor 4	Problem Solving Ability in Mathematics (0.64)	Attitude towards Academic Work (0.37)	Problem Solving Ability in Mathematics (0.78) Attitude towards Academic Work (0.74) Inductive Reasoning (0.31)
Factor 5	Ability to use Symbols (0.87)	--	Attitude towards Academic Work (-0.39)
Factor 6	--	--	No identified significant Predictor in Factor 6
Communalities			
	Deductive Reasoning (0.87) Flexibility (0.86) Inductive Reasoning (0.82) Ability to use Symbols (0.81) Problem Solving Ability in Mathematics (0.62) Attitude towards Academic Work (0.56)	Flexibility (0.84) Inductive Reasoning (0.83) Deductive Reasoning (0.74) Problem Solving Ability in Mathematics (0.38) Ability to use Symbols (0.37) Attitude towards Academic Work (0.35)	Flexibility (0.91) Deductive Reasoning (0.76) Attitude towards Academic Work (0.74) Inductive Reasoning (0.72) Problem Solving Ability in Mathematics (0.68) Ability to use Symbols (0.46)

Table 42 reveals that the psychological factor structure of High-Achievers in Mathematics has five factors; Average-Achievers has four factors and Low-Achievers has six factors, suggesting that the structures of the three groups are different. All the five factors in the psychological factor structure of High-Achievers in Mathematics has one or more of the significant predictors as their constituents. In the case of Average-Achievers in Mathematics also, all the four factors have one or more predictor variables with significant loadings. But in the case of Low-Achievers in Mathematics, out of the six factors, two factors have no significant predictor variables with significant presence.

Out of the five factors in the psychological factor structure of High-Achievers in Mathematics, three factors viz., Factor 1, Factor 4 and Factor 5 have only one significant predictor variable in them. That is, Attitude towards Academic Work in Factor 1, Problem Solving Ability in Mathematics in Factor 4 and Ability to use Symbols in Factor 5 with respective loadings as 0.72, 0.64 and 0.87. The other two factors viz., Factor 2 and Factor 3 contain two significant predictor variables each in them.

Out of the four factors in the psychological factor structure of Average-Achievers in Mathematics, two factors viz., Factor 2 and Factor 4 have only one significant predictor variable in them. The variable Attitude towards Academic Work makes its presence independent of other significant predictor variables in both the factors. The loadings of this variable in the Factor 2 and 4 are 0.44 and 0.37 respectively. The other two factors viz., Factor 1 and Factor 3 contain three significant predictor variables each in them.

Out of the six factors in the psychological factor structure of Low-Achievers in Mathematics, Factor 5 is characterised by the single predictor variable Attitude towards Academic Work with loading-0.39 indicating absence of this predictor in the factor to a low extent.

Findings

The psychological factor structure of High-Achievers in Mathematics has five factors; Average-Achievers has four factors and Low-Achievers has six factors. Placing of the significant predictors Attitude towards Academic Work, Problem Solving Ability in Mathematics and Ability to use Symbols with significant loadings in the factor structure of High-Achievers in Mathematics makes it distinct from that of Average-Achievers in Mathematics. A factor (Factor 5) with a considerably negative loading on Attitude towards Academic Work makes the factor structure of Low-Achievers in Mathematics distinct from that of High- and Average-Achievers and thus the three factor structures are different.

4.7. FINDINGS OF THE STUDY

Findings of the study derived by all the analyses are summarised below:

1. Significant effect exists on Achievement in Mathematics, of all the sixteen psychological variables viz., Numerical Reasoning, Ability to use Symbols, Spatial Ability, Abstract Reasoning, Inductive Reasoning, Deductive Reasoning, Problem Solving Ability in Mathematics, Fluency, Flexibility, Originality, Mathematics Interest, Self-Concept in Mathematics, Attitude towards Mathematics, Attitude towards Academic Work, Mathematics Anxiety and Achievement Motivation in Mathematics.

2. Significant difference exists between all the three group pairs viz., (a) High- and Average-Achievers (b) High- and Low-Achievers (c) Average- and Low-Achievers in the mean scores of the eight psychological variables viz.,

Ability to use Symbols, Inductive Reasoning, Deductive Reasoning, Problem Solving Ability in Mathematics, Fluency, Flexibility, Attitude towards Academic Work and Mathematics Anxiety. The remaining eight variables show difference only in two group pairs viz., High- and Average-Achievers, and, High- and Low-Achievers.

3. All the sixteen psychological variables are significantly correlated with Achievement in Mathematics ($P < 0.01$). The only variable having significant negative correlation with Achievement in Mathematics is Mathematics Anxiety.

4. Six psychological variables viz., Inductive Reasoning, Problem Solving Ability in Mathematics, Attitude towards Academic Work, Flexibility, Ability to use Symbols and Deductive Reasoning were found to be significant predictors of Achievement in Mathematics. The coefficient of predictive efficiency of these six variables is 0.581 and the combined effect of these six predictors on Achievement in Mathematics is 0.762.

5. The six significant predictor variables in the order of their efficiency for predicting Achievement in Mathematics are Problem Solving Ability in Mathematics, Attitude towards Academic Work, Inductive Reasoning, Flexibility, Deductive Reasoning and Ability to use Symbols.

6. The regression equation to predict Achievement in Mathematics in terms of the six significant predictors is

   $$Y' = 0.08X_5 + 0.23X_7 + 0.05X_{14} + 0.06X_9 + 0.34X_2 + 0.07X_6 - 6.19$$

   where Y' is the predicted score of Achievement in Mathematics and X_5, X_7, X_{14}, X_9, X_2 and X_6 are individual's raw scores on the variables Inductive Reasoning, Problem Solving Ability in Mathematics, Attitude towards

Academic Work, Flexibility, Ability to use Symbols and Deductive Reasoning respectively.

7. The two discriminant functions viz.,

   $D_1 = 0.14Z_2 + 0.24Z_5 + 0.28Z_6 + 0.38Z_7 + 0.22Z_9 + 0.42Z_{14}$ and

   $D_2 = 0.47Z_2 - 0.01Z_5 - 0.56Z_6 - 0.40Z_7 + 0.22Z_9 + 0.67Z_{14}$ are efficient enough to discriminate significantly the three groups of achievers with 59.40 percent being the rate of correct classification. The coefficient of effectiveness of the first function for discriminating High-Achievers from Average- and Low-Achievers in Mathematics is 97.65 and the coefficient of effectiveness of the second function for discriminating Low-Achievers from High- and Average-Achievers in Mathematics is 2.35.

8. The psychological factor structure of High-Achievers in Mathematics has five factors, Average-Achievers has four factors and Low-Achievers has six factors, suggesting that the structures for the three groups are different.

9. In the psychological factor structure of High-Achievers in Mathematics, each significant predictor except Problem Solving Ability in Mathematics finds a place with high loadings in each factor of the structure and that the communalities of these are very high ranging from 0.56 to 0.87. Four of these predictor variables show communalities above 0.80.

10. In the psychological factor structure of Average-Achievers in Mathematics, each factor is characterised by the presence of at least one of the identified significant predictors. The communalities of these predictors are ranging from 0.35 to 0.84. Only two variables viz., Flexibility and Inductive Reasoning show communalities greater than 0.80.

11. In the psychological factor structure of Low-Achievers in Mathematics, each significant predictor except Ability to use Symbols finds a place with high loadings in the factor. The communalities are ranging from 0.46 to 0.91. Only one variable viz., Flexibility shows communality greater than 0.80.

4.8. TENABILITY OF HYPOTHESES

i) The first hypothesis states that "each select psychological variable has significant effect on Achievement in Mathematics".

One-way analysis of variance revealed that all the sixteen psychological variables have significant effect on Achievement in Mathematics. Thus, the first hypothesis is fully substantiated.

ii) Second hypothesis states that "significant relationship exists between each psychological variable and Achievement in Mathematics".

The coefficient of correlations (Pearson's r) obtained between Achievement in Mathematics and each of the sixteen psychological variables revealed that all the sixteen psychological variables have significant correlation with Achievement in Mathematics. Thus, the second hypothesis is fully substantiated.

iii) Third hypothesis states that "Achievement in Mathematics can be significantly predicted by a combination of the predictor variables".

The regression analysis showed that six out of the sixteen psychological variables are significant predictors of Achievement in Mathematics. Thus, the third hypothesis is substantiated.

iv) Fourth hypothesis states that "group membership as High-, Average- and Low-Achievers in Mathematics can be effectively predicted using linear discriminant functions in terms of the significant predictor variables of Achievement in Mathematics".

Discriminant function analysis yielded two discriminant equations for predicting group membership as High-, Average- and Low-Achievers in Mathematics in terms of the significant predictor variables of Achievement in Mathematics. The coefficient of effectiveness of first and second function is 97.65 and 2.35 respectively. Thus, fourth hypothesis is substantiated.

v) Fifth hypothesis states that "the position of significant predictors of Achievement in Mathematics in the psychological factor structure of the groups High-, Average- and Low-Achievers will be different in terms of factor loadings and hence of communalities".

Factor analysis revealed that the position of significant predictors of Achievement in Mathematics in the psychological factor structure of the groups High-, Average- and Low-Achievers in Mathematics are different in terms of their factor loadings and communalities. Thus, fifth hypothesis is fully substantiated.

Since all the five hypotheses are substantiated, the major hypothesis of the present study viz., "Achievement in Mathematics of secondary school pupils can be significantly predicted by means of the select set of psychological variables" is substantiated to a good extent.

CHAPTER V

SUMMARY, CONCLUSIONS AND SUGGESTIONS

- Study in Retrospect
- Major Findings of the Study
- Conclusion
- Educational Implications of the Study
- Suggestions for Further Research

This chapter presents the major findings emerged by the study, conclusions arrived at, educational implications of the major findings and suggestions for further research along with a perspective of the study in retrospect with details like title of the problem, variables, objectives, hypotheses and methodology of the study.

5.1. STUDY IN RETROSPECT

5.1.1. Restatement of the Problem

The study was entitled "**CERTAIN PSYCHOLOGICAL VARIABLES AS PREDICTORS OF ACHIEVEMENT IN MATHEMATICS OF SECONDARY SCHOOL PUPILS OF KERALA.**"

5.1.2. Variables

The study was designed with Achievement in Mathematics as the criterion (dependent variable) and sixteen psychological variables as predictor (independent) variables. The sixteen variables used as predictor variables were,

i) Numerical Reasoning
ii) Ability to use Symbols
iii) Spatial Ability
iv) Abstract Reasoning
v) Inductive Reasoning
vi) Deductive Reasoning

vii) Problem Solving Ability in Mathematics

viii) Fluency

ix) Flexibility

x) Originality

xi) Mathematics Interest

xii) Self-Concept in Mathematics

xiii) Attitude towards Mathematics

xiv) Attitude towards Academic work

xv) Mathematics Anxiety, and

xvi) Achievement Motivation in Mathematics

5.1.3. Objectives

The study was designed with the major objective viz., "to test for the ability of each select psychological variable in predicting significantly Achievement in Mathematics of secondary school pupils and hence to identify the significant predictors of Achievement in Mathematics."

The above major objective was tested by means of the following statistical procedures, the results of each of which led to the answering of the major objective of the study.

i) Test of significance of the effect of each psychological variable on Achievement in Mathematics which indirectly indicates the possible relation of the psychological variables with Achievement in Mathematics and hence of the possible predictability.

ii) Estimation of the relationship of each psychological variable with Achievement in Mathematics which suggests the extent of predictability of the psychological variables.

iii) Identification of the significant psychological predictors of Achievement in Mathematics by regression analysis and thereby estimation of the predictive efficiency of the significant predictors in predicting Achievement in Mathematics.

iv) Derivation of the linear discriminant functions in terms of the significant predictors and hence of their effectiveness in predicting group membership like High-, Average- and Low- Achievers in Mathematics.

v) Identification of the factor structures of High-, Average- and Low-Achievers in Mathematics and thereby a comparison of the significant predictors' standing (in terms of factor loadings and communalities) in the three factor structures.

5.1.4 Hypotheses

The major hypothesis set for the present study was "Achievement in Mathematics of secondary school pupils can be significantly predicted by means of the select set of psychological variables."

The major hypothesis was tested by framing the following hypotheses, the testing of each of which is analogous to the testing of the major hypothesis.

i) Each select psychological variable has significant effect on Achievement in Mathematics.

ii) Significant relationship exists between each psychological variable and Achievement in Mathematics.

iii) Achievement in Mathematics can be significantly predicted by a combination of the predictor variables.

iv) Group membership as High-, Average- and Low- Achievers in Mathematics can be effectively predicted using linear discriminant functions in terms of the significant predictor variables of Achievement in Mathematics.

v) The position of significant predictors of Achievement in Mathematics in the psychological factor structure of the groups High-, Average- and Low-Achievers will be different in terms of factor loadings and hence of communalities.

5.1.5 Sample

The study was conducted on a final sample of 500 secondary school pupils drawn from six different districts of Kerala by stratified sampling method.

5.1.6 Tools

The tools used were,

i) Test of Achievement in Mathematics
ii) Test of Numerical Reasoning
iii) Test of Ability to use Symbols
iv) Test of Spatial Ability
v) Test of Abstract Reasoning
vi) Test of Inductive Reasoning
vii) Test of Deductive Reasoning
viii) Test of Problem Solving Ability in Mathematics.
ix) Test of Mathematical Creativity.
x) Mathematics Interest Inventory
xi) Scale of Self-Concept in Mathematics
xii) Scale of Attitude towards Mathematics
xiii) Scale of Attitude towards Academic Work.

xiv) Scale of Mathematics Anxiety, and

xv) Scale of Achievement Motivation in Mathematics

5.1.7 Statistical Techniques Used

Major statistical techniques used in the analysis of data were the following:

i) One-way Analysis of Variance.

ii) Pearson's Product Moment Coefficient of Correlation.

iii) Stepwise Regression Analysis.

iv) Discriminant Function Analysis.

v) Factor Analysis.

5.2. MAJOR FINDINGS OF THE STUDY

Major findings of the study disclosed through the different statistical analyses are the following.

5.2.1. *One-way analysis of variance on the effect of the psychological variables on Achievement in Mathematics* revealed that all the sixteen psychological variables have significant effect on Achievement in Mathematics. That is, groups of High-, Average- and Low- Achievers in Mathematics differ significantly in the mean scores of all the sixteen psychological variables viz.,

i) Numerical Reasoning

ii) Ability to use Symbols

iii) Spatial Ability

iv) Abstract Reasoning

v) Inductive Reasoning

vi) Deductive Reasoning

vii) Problem Solving Ability in Mathematics

viii) Fluency

ix) Flexibility
x) Originality
xi) Mathematics Interest
xii) Self-Concept in Mathematics
xiii) Attitude towards Mathematics
xiv) Attitude towards Academic Work
xv) Mathematics Anxiety, and
xvi) Achievement Motivation in Mathematics

5.2.1.1. *By the Scheffe's test of multiple comparison for pairwise group difference, it was found that*

a) Significant difference exists between all the three group pairs viz., High- and Average- Achievers; High- and Low- Achievers, and Average- and Low- Achievers in the mean scores of eight psychological variables viz.,

i) Ability to use Symbols
ii) Inductive Reasoning
iii) Deductive Reasoning
iv) Problem Solving Ability in Mathematics
v) Fluency
vi) Flexibility
vii) Attitude towards Academic Work, and
viii) Mathematics Anxiety

b) Significant difference exists between the group pairs viz., High-and Average- Achievers, and, High- and Low- Achievers in the mean scores of the remaining eight psychological variables viz.,

i) Numerical Reasoning
ii) Spatial Ability

iii) Abstract Reasoning

iv) Originality

v) Mathematics Interest

v) Self-Concept in Mathematics

vii) Attitude towards Mathematics, and

viii) Achievement Motivation in Mathematics

5.2.2. *Estimation of the coefficient of correlations (Pearson's r's) between Achievement in Mathematics and each of the sixteen psychological variables* revealed that all the sixteen psychological variables have significant correlation (at 0.01 level) with Achievement in Mathematics. These variables in the order of the index of correlation are as follows.

i) Inductive Reasoning ($r = 0.62, P < 0.01$)

$$CI_{0.99} = (0.54, 0.70)$$

$$r^2 = 38.44$$

Predictive efficiency, $E = 0.22$

ii) Problem Solving Ability in Mathematics ($r = 0.59, P < 0.01$)

$$CI_{0.99} = (0.51, 0.67)$$

$$r^2 = 34.81$$

Predictive efficiency, $E = 0.19$

iii) Fluency ($r = 0.55, P < 0.01$)

$$CI_{0.99} = (0.47, 0.63)$$

$$r^2 = 30.25$$

Predictive efficiency, $E = 0.16$

iv) Deductive Reasoning ($r = 0.54, P < 0.01$)

$$CI_{0.99} = (0.46, 0.62)$$

$$r^2 = 29.16$$

Predictive efficiency, $E = 0.16$

v) Flexibility ($r = 0.54, P < 0.01$)

$$CI_{0.99} = (0.46, 0.62)$$

$$r^2 = 29.16$$

Predictive efficiency, $E = 0.16$

vi) Originality ($r = 0.45, P < 0.01$)

$$CI_{0.99} = (0.35, 0.55)$$

$$r^2 = 20.25$$

Predictive efficiency, $E = 0.11$

vii) Attitude towards Academic Work ($r = 0.45, P < 0.01$)

$$CI_{0.99} = (0.35, 0.55)$$

$$r^2 = 20.25$$

Predictive efficiency, $E = 0.11$

viii) Abstract Reasoning ($r = 0.44, P < 0.01$)

$$CI_{0.99} = (0.34, 0.54)$$

$$r^2 = 19.36$$

Predictive efficiency, $E = 0.10$

ix) Ability to use Symbols ($r = 0.42, P < 0.01$)

$$CI_{0.99} = (0.32, 0.52)$$

$$r^2 = 17.64$$

Predictive efficiency, $E = 0.09$

x) Mathematics Anxiety ($r = -0.34, P < 0.01$)

$$CI_{0.99} = (-0.44, -0.24)$$

$$r^2 = 11.56$$

Predictive efficiency, $E = 0.06$

xi) Attitude towards Mathematics ($r = 0.30$, $P < 0.01$)

$CI_{0.99}$ = (0.20, 0.40)

r^2 = 9.00

Predictive efficiency, E = 0.05

xii) Numerical Reasoning ($r = 0.23$, $P < 0.01$)

$CI_{0.99}$ = (0.13, 0.33)

r^2 = 5.29

Predictive efficiency, E = 0.03

xiii) Mathematics Interest ($r = 0.23$, $P < 0.01$)

$CI_{0.99}$ = (0.13, 0.33)

r^2 = 5.29

Predictive efficiency, E = 0.03

xiv) Achievement Motivation in Mathematics ($r=0.20$, $p<0.01$)

$CI_{0.99}$ = (0.10, 0.30)

r^2 = 4.00

Predictive efficiency, E=0.02

x v) Self-Concept in Mathematics ($r = 0.17$, $P < 0.01$)

$CI_{0.99}$ = (0.07, 0.27)

r^2 = 2.89

Predictive efficiency, E = 0.01

xvi) Spatial Ability ($r = 0.16$, $P < 0.01$)

$CI_{0.99}$ = (0.06, 0.26)

r^2 = 2.56

Predictive efficiency, E = 0.01

5.2.3. *Identification of the significant predictors of Achievement in Mathematics by regression analysis* resulted that among the sixteen psychological variables, only six variables are significant predictors. These six variables are Inductive Reasoning (X_5), Problem Solving Ability in Mathematics (X_7), Attitude towards Academic Work (X_{14}), Flexibility (X_9), Ability to use Symbols (X_2) and Deductive Reasoning (X_6). The predictor variables entered in each step of step-wise regression analysis, the value of multiple correlation R in the successive steps and the multiple regression equations developed in the successive steps are given as Table 43.

TABLE 43

Variables Entered, Multiple Correlation R and Multiple Regression Equations Developed in the Successive Steps of Step wise Regression Analysis

Variables entered	Multiple correlation 'R'	Regression Equations
Inductive Reasoning (X_5)	0.616	$Y' = 0.30X_5 + 1.14$
Problem Solving Ability in Mathematics (X_7)	0.692	$Y' = 0.21X_5 + 0.35\ X_7 + 0.28$
Attitude towards Academic Work (X_{14})	0.721	$Y' = 0.18\ X_5 + 0.32X_7 + 0.05X_{14} - 5.02$
Flexibility (X_9)	0.748	$Y' = 0.15\ X_5 + 0.23\ X_7 + 0.05\ X_{14} + 0.07\ X_9 - 5.88$
Ability to use Symbols (X_2)	0.758	$Y' = 0.13\ X_5 + 0.23X_7 + 0.05X_{14} + 0.06X_9 + 0.33X_2 - 6.11$
Deductive Reasoning (X_6)	0.762	$Y' = 0.08X_5 + 0.23X_7 + 0.05X_{14} + 0.06X_9 + 0.34X_2 + 0.07X_6 - 6.19$

Note: (i) All the values of multiple correlation R cited are significant at 0.01 level

(ii) Y' is the predicted value of Y, the Achievement in Mathematics.

5.2.3.1. *The coefficient of multiple determination,* R^2 as $\Sigma\beta r = 0.581$ suggests that 58.10 percent of variance in Achievement in Mathematics is attributable to the six psychological variables identified as significant predictors so that the contribution of each significant predictor variable is as follows:

i)	Problem Solving Ability in Mathematics	-	14.20 percent
ii)	Attitude towards Academic Work	-	10.80 percent
iii)	Inductive Reasoning	-	10.50 percent
iv)	Flexibility	-	9.70 percent
v)	Deductive Reasoning	-	7.00 percent
vi)	Ability to use Symbols	-	5.90 percent

5.2.4. *Discriminant function analysis* yielded two discriminant functions for predicting group membership as High-, Average- and Low- Achievers in Mathematics and these are,

$D_1 = 0.14Z_2 + 0.24Z_5 + 0.28\,Z_6 + 0.38Z_7 + 0.22Z_9 + 0.42Z_{14}$ and

$D_2 = 0.47Z_2 - 0.01Z_5 - 0.56\,Z_6 - 0.40Z_7 + 0.22Z_9 + 0.67Z_{14}$, which are efficient enough to discriminate significantly the three groups of achievers with 59.40 percent of correct classification. The coefficient of effectiveness of the first function for discriminating High- Achievers from Average- and Low- Achievers in Mathematics is 97.65 and the coefficient of effectiveness of the second function for discriminating Low- Achievers from High- and Average- Achievers in Mathematics is 2.35.

5.2.5. *Principal Components Factor analysis* done for evolving the factor structures of High-, Average-, and Low- Achievers in Mathematics revealed that the High-group has five factors, Average-group has four factors and the Low-group has six factors. Details of these three factor structures indicating the position of the significant predictors in each are presented in Table 44.

TABLE 44

Summary of the Factor Structures Showing the Position of Significant Predictors, of High-, Average- and Low-Achievers in Mathematics

	Factor structures of		
	High-Achievers in Mathematics	Average-Achievers in Mathematics	Low-Achievers in Mathematics
Factor 1	Attitude towards Academic Work (0.72)	Flexibility (0.91) Ability to use Symbols (0.48) Problem Solving Ability in Mathematics (0.48)	Flexibility (0.94) Ability to use Symbols (0.61)
Factor 2	Flexibility (0.91) Problem Solving Ability in Mathematics (0.37)	Attitude towards Academic Work (0.44)	No identified significant predictor in Factor 2
Factor 3	Deductive Reasoning (0.91) Inductive Reasoning (0.84)	Inductive Reasoning (0.86) Deductive Reasoning (0.83) Problem Solving Ability in Mathematics (0.37)	Deductive Reasoning (0.86) Inductive Reasoning (0.75)
Factor 4	Problem Solving Ability in Mathematics (0.64)	Attitude towards Academic Work (0.37)	Problem Solving Ability in Mathematics (0.78) Attitude towards Academic Work (0.74) Inductive Reasoning (0.31)
Factor 5	Ability to use Symbols (0.87)	--	Attitude towards Academic Work (-0.39)
Factor 6	--	--	No identified significant Predictor in Factor 6
Communalities			
	Deductive Reasoning (0.87) Flexibility (0.86) Inductive Reasoning (0.82) Ability to use Symbols (0.81) Problem Solving Ability in Mathematics (0.62) Attitude towards Academic Work (0.56)	Flexibility (0.84) Inductive Reasoning (0.83) Deductive Reasoning (0.74) Problem Solving Ability in Mathematics (0.38) Ability to use Symbols (0.37) Attitude towards Academic Work (0.35)	Flexibility (0.91) Deductive Reasoning (0.76) Attitude towards Academic Work (0.74) Inductive Reasoning (0.72) Problem Solving Ability in Mathematics (0.68) Ability to use Symbols (0.46)

Placing of the significant predictors Attitude towards Academic Work, Problem Solving Ability in Mathematics and Ability to use Symbols with significant loadings in the factor structure of High- Achievers in Mathematics makes it distinct from that of Average- Achievers in Mathematics. A factor (Factor 5) with a considerably negative loading on Attitude towards Academic Work makes the factor structure of Low- Achievers in Mathematics distinct from that of High- and Average- Achievers.

5.3. CONCLUSION

The study was designed with the major objective of testing the ability of each select psychological variable in predicting Achievement in Mathematics of secondary school pupils and hence to identify the significant predictors of Achievement in Mathematics. This was tested by framing minor objectives and these objectives were tested through different statistical techniques like one-way analysis of variance, coefficient of correlations, stepwise regression analysis, direct discriminant function analysis and principal factor analysis.

It was then found that all the sixteen psychological variables have significant effect and significant correlations with Achievement in Mathematics, indicating that all the variables are able to predict Achievement in Mathematics. But stepwise regression analysis pointed out only six of the sixteen psychological predictor variables as significant predictors of Achievement in Mathematics. These six significant predictors, contributing 58.10 percent of variation in the variance of Achievement in Mathematics, are Problem Solving Ability in Mathematics (14.20 percent), Attitude towards Academic Work (10.80 percent), Inductive Reasoning (10.50 percent), Flexibility (9.70 percent), Deductive Reasoning (7.00 percent) and Ability to use Symbols (5.90 percent). Discriminant function analysis, examining the ability of the six significant predictors in determining the group membership as High-, Average- and Low- Achievers in

Mathematics yielded two discriminant functions which are efficient enough with 59.40 percent as the index of correct classification to the three groups. The factor structures derived by factor analysis revealed that all the factors in the factor structures of High- and Average- Achievers have one or more of the identified predictors with significant loadings, while that of Low- Achievers has only four factors loaded with one or more of the identified predictors, thus making the factor structures different in terms of variables present in the factors with factor loadings and communalities.

All these findings led the investigator to conclude that out of the sixteen psychological variables put as predictor (independent) variables, only six of them viz., Problem Solving Ability in Mathematics, Attitude towards Academic Work, Inductive Reasoning, Flexibility, Deductive Reasoning and Ability to use Symbols turned to be the significant predictors of Achievement in Mathematics with 14.20 percent, 10.80 percent, 10.50 percent, 9.70 percent, 7.00 percent and 5.90 percent respectively as the percentage of variance contributable to the variation in the variance of Achievement in Mathematics.

5.4. EDUCATIONAL IMPLICATIONS OF THE STUDY

The statistical analyses done for the study led the investigator to conclude that the six variables viz., Problem Solving Ability in Mathematics, Attitude towards Academic Work, Inductive Reasoning, Flexibility, Deductive Reasoning and Ability to use Symbols are the significant predictors of Achievement in Mathematics with 14.20 percent, 10.80 percent, 10.50 percent, 9.70 percent, 7.00 percent and 5.90 percent respectively as the percentage of variance contributable to the variation in the variance of Achievement in Mathematics.

On the basis of the above findings the investigator put forward the following suggestions with regard to each significant predictor for the improvement of the present educational practices and hence for the betterment of the young pupil's Achievement in Mathematics.

Among the six identified predictors of Achievement in Mathematics, Problem Solving Ability in Mathematics has the highest predictive efficiency when compared to other five variables. Therefore, development of problem solving ability in mathematics becomes the most essential for high achievement in mathematics. Problem solving ability in mathematics is the ability of students for arriving at solutions to problems which involve the use of mathematics. Develop this ability through the following procedures.

i) To learn to solve problems, students must have an opportunity to solve problems. Therefore, educators should find time for giving problem solving experiences; find a reward system for motivating students and develop some basic problem solving approaches suitable for young children to adapt.

ii) Problem solving as a method of learning assumes that, many often, learners discover higher order rules without specific help. Therefore give every chance of solving problems by means of 'discovery method.' Instruction in subject matter areas should focus on learning the cognitive processes and strategies required for successful problem solving.

iii) Application of mathematics should be employed to stimulate students' interest in problem solving and to demonstrate the wide range of physical situation in which mathematics is used to find solutions or to reach decisions. Problems derived from real world situations may be of interest to students. Using such problems, teachers can help students to convince that mathematics is not simply a body of knowledge assembled for youngsters to learn but a modern useful tool.

iv) Teachers and the educators should know the utilisation of advance organizers in right situations which are useful in evoking previously learned concepts and principles in the learning of new principles and in better problem solving.

v) As there are different types of problems such as real life problems, abstract problems, insight problems, work problems, number theory problems, age problems, motion problems, proofs etc., ways of solving each type should be made familiar to the students.

vi) A teacher should be able to distinguish between 'problems' and 'exercises' because problems require the students to use insight and exercises provide practice in learning skills. Moreover, every teacher should have a collection of different types of problems and exercises. Then only teachers will be able to provide questions and solutions which are exercises and problems for the students.

vii) Since there are different ways of attacking a problem for solving, teaching methods employed in classrooms should have free choice of learning activities and small group co-operative activities.

Attitude towards Academic Work is the second significant predictor variable of Achievement in Mathematics. As any achievement needs a right attitude for that, for achievement in mathematics also, right attitude to academic work seemed to be essential. Therefore, develop a right attitude to academic work through the following, as right attitudes can be developed and strengthened by the earnest efforts of teachers, administrators and parents.

i) Attitude towards teachers, administrators and academic and disciplinary policies are the major factors often influencing students' attitude towards academic work. Hence educators should deal with the children psychologically and make the school activities joyful. Learning should be made pleasurable and school should become an attractive place to children. The principle of intercorrelation of subjects should be followed in classrooms while teaching so that learning can be made more meaningful and lively.

ii) The investigator feels that the so named 'tough' subject Mathematics plays a major role in determining children's attitude towards academic work. So teaching of mathematics should be related to daily life situations and hence make the subject more life oriented. Learning of mathematics should be made easier and happier by using appropriate instructional strategies. Further, organize co-curricular activities involving mathematics such as mathematics exhibitions, fairs, club activities etc. which will help the students to improve their attitude towards academic work.

iii) Parents should be made aware of their role in creating a positive attitude towards academic work in their children. They should create an awareness in children that education is the only instrument for upward social mobility and should give all the possible means of facilities for the positive involvement of children in learning activities.

Inductive and Deductive Reasoning are the next two reasoning abilities found as significant predictors of Achievement in Mathematics. Nurture these reasoning abilities which are the core of mathematics learning by doing the following.

i) As values are to be caught than taught, the skill of doing mathematical operations mentally is to be acquired by children through earnest participation in learning activities. Therefore, students should be provided with tasks requiring different mental processes and operations involving inductive and deductive reasoning abilities supplemented by enough illustrative examples.

ii) Though inductive reasoning is found as more effective and capable of predicting Achievement in Mathematics than deductive reasoning, teachers should remember that these two patterns of reasoning are complementary to each other. So teaching of concepts should start with inductive method where generalizations are drawn from a set of observed events and after generalizations students be trained to go to particular instances so that students may realise the complementary nature of inductive and deductive reasoning abilities and will use in later situations.

iii) Many of the mathematics programmes of our schools are heavily devoted to the development of computational skills and provide little opportunity to demonstrate the complex types of reasoning skills. So an understanding of developmental differences in reasoning and of the sources of reasoning errors becomes important for educational practice, because educational material can be more effective when it matches children's reasoning skills.

iv) Depending on the scope and nature of the content, teachers should adopt information processing models of teaching such as inductive thinking model and concept attainment model as major instructional strategies for developing the two reasoning abilities.

For developing and nurturing the ability of Flexibility, a component ability of mathematical creativity, suggestions are the following:

i) Teachers should provide freedom to the students to think and express freely. Make flexible every problem solving opportunity. As also, discussions should be made open and untimely judgements and evaluation should be avoided.

ii) Children should not be subjected to blind or meaningless conformity and rigidity in learning situations. While solving problems and in similar situations, teachers should seek for opportunities so that students can exercise innovative ideas and novel ways of solving problems.

iii) Different techniques such as brain storming, role playing, morphological analysis, lateral thinking, questioning etc. should be adopted for creative teaching and learning. Synectics, which is a model of teaching to develop creativity should be adopted wherever possible.

iv) Creative abilities are interrelated. Teachers should be aware that a teaching strategy which aims at developing one ability may simultaneously develop other abilities as well. Similarly, all areas of the curriculum should be regarded as instruments to develop creativity and its components. So classroom teaching and learning environment should be conducive to facilitate mathematical creativity.

For promoting the remaining significant predictor of Achievement in Mathematics 'Ability to use Symbols', following are the suggestions.

i) Teachers should be aware that ability to use symbols is the very basic ability for doing mathematical operations and is highly required for the solving of problems however complex it may be. So training should be given through sufficient exercises for the enrichment of this ability from the primary classes itself.

ii) By proper evaluation, mathematics teachers should see that ability to use symbols and symbolic representation of mathematical concepts are rightly established in each and every student of his class from the very beginning of mathematics learning.

iii) Teachers should encourage students to express mathematical ideas in terms of mathematical symbols than verbal expressions while solving mathematical problems.

In short, the relation of cognitive and affective variables with Achievement in Mathematics points out that the usual educational practices should be based on cognitive and affective outcomes. That is, teachers should be aware of the relationship of cognitive and affective variables with achievement while designing instructional experiences and evaluation techniques.

5.5. SUGGESTIONS FOR FURTHER RESEARCH

1. The study found that 58 percent of the variance in Achievement in Mathematics is attributable to the variation in the identified significant predictors. This further implies that the remaining 42 percent of variation in Achievement in Mathematics is caused by some other variables. This necessitates a study on the identification of the significant predictor variables incorporating other cognitive, affective, and socio-familial variables.

2. At present there is no comprehensive test for measuring the significant predictors and predicting Achievement in Mathematics of secondary school pupils. So it will be better to conduct a study for the development of a comprehensive test covering all the five cognitive predictors of Achievement in Mathematics and thereby studying its effectiveness in predicting Achievement in Mathematics.

3. Since the variables Inductive Reasoning, Problem Solving Ability in Mathematics, Deductive Reasoning etc. were found to be as significant predictors of Achievement in Mathematics, conduct experimental studies on the effectiveness of process oriented methods like problem solving

method, inductive-deductive method etc. on the development of these abilities.

4. Make content analysis of mathematics text books at secondary school level for determining the scope of the development of the significant predictors found in the study. By dissemination of this, teachers will be helpful for the attainment of such abilities through framing proper learning activities.

5. Better understanding of the predictors of Achievement in Mathematics necessitates parallel studies on the identification of the predictors (including cognitive, affective and socio-familial variables) of achievement in the different branches of Mathematics viz., Arithmetic, Algebra and Geometry.

6. As mathematics is the queen of sciences and the application of mathematics is highly essential for success in other sciences, replicate the study on the achievement in other science subjects so that similarities and differences in the predictors can be noticed.

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APPENDICES

20

APPENDIX I

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
TEST OF ACHIEVEMENT IN MATHEMATICS
(DRAFT)

Dr. V.Sumangala
Reader in Education

Mumthas.N.S.
Research Scholar

നിർദ്ദേശങ്ങൾ:

സമയം : 2 മണിക്കൂർ

മാർക്ക് : 50

8-ാം തരത്തിലെ ഗണിതശാസ്ത്ര പാഠപുസ്തകത്തെ ആസ്പദമാക്കിയുള്ള ചില ചോദ്യങ്ങളാണ് താഴെ കൊടുത്തിരിക്കുന്നത്. ഓരോ ചോദ്യവും ശ്രദ്ധാപൂർവ്വം വായിച്ച് ഉത്തരം എഴുതുക.

I. 1 മുതൽ 16വരെയുള്ള ചോദ്യങ്ങൾക്ക് ബ്രാക്കറ്റിൽ കൊടുത്തിട്ടുള്ളവയിൽ നിന്നും ശരിയായ ഉത്തരം തെരഞ്ഞെടുത്തെഴുതുക.

1. ഗണം എന്ന ആശയം ആദ്യമായി അവതരിപ്പിച്ച ഗണിതശാസ്ത്രജ്ഞൻ ആര്?

   (രാമാനുജൻ, ജോർജ്ജ് കാന്റർ, ആര്യഭട്ട, ഭാസ്കരാചാര്യ)

2. ഒരു ലഘുസമവാക്യത്തിലെ ചരങ്ങളുടെ എണ്ണം എത്ര?

   (0, 1, 2, 3)

3. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ ഹെറോയുടെ സൂത്രവാക്യം ഏത്?

   ($\frac{1}{2}$ bh, $\frac{\sqrt{3a^2}}{4}$, $6\frac{\sqrt{3a^2}}{4}$, $\sqrt{S(s-a)(s-b)(s-c)}$)

4. 27,000 എന്ന സംഖ്യയുടെ ഘനമൂലം എന്ത്?

   (3, 30, 300, 3000)

5. രണ്ട് പരിമിതഗണങ്ങളിലെ അംഗങ്ങളുടെ എണ്ണം തുല്യമായാൽ അവയ്ക്ക് പറയുന്ന പേരെന്ത്?

   (സമാംഗഗണം, അനന്യഗണം, ശൂന്യഗണം, സമസ്തഗണം)

6. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ കരണി ഏത്?

   [$\sqrt{49}$, $\sqrt{36}$, $\sqrt{18}$, $\sqrt{2.25}$]

7. $x = 2$ എന്ന സമവാക്യത്തിന് സമാനമായ സമവാക്യമേത്?

[$x + 5 = 6$, $3x = 5$, $x - 2 = 0$, $^{x}/_{2} = ^{1}/_{2}$]

8. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ സർവസമവാക്യം ഏത്?

[$4 + n = n + 4$, $x - 2 = 2 - x$, $5x + 2 = 11$, $5(p+2) = 5p + 2$]

9. $A = \{p, q, r, s\}$ ആയാൽ A യുടെ ഉപഗണം ഏത്?

[$\{q, s, t\}$, $\{p, r, a\}$, $\{p, q, s\}$, $\{a, r, s\}$]

10. ഒരു അർദ്ധവൃത്തത്തിൽ അന്തർലേഖനം ചെയ്തിരിക്കുന്ന കോണിന്റെ അളവ് എന്തായിരിക്കും?

[90^0, 60^0, 45^0, 30^0]

11. ശൂന്യഗണത്തിന്റെ കാർഡിനാലിറ്റി എന്ത്?

[0, 1, 2, 3]

12. ഒരു ചതുർഭുജത്തിന്റെ എതിർ ശീർഷകോണുകളുടെ അളവുകളുടെ തുക എന്ത്?

[90^0, 180^0, 270^0, 360^0]

13. 657666025 എന്ന സംഖ്യയുടെ വർഗ്ഗമൂലത്തിലെ അക്കങ്ങളുടെ എണ്ണം എത്ര?

[8, 6, 5, 4]

14. താഴെ തന്നിരിക്കുന്നവയിൽ ശൂന്യഗണം ഏത്?

[$\{0\}$, $\{\phi\}$, $\{-1\}$, $\{\ \}$]

15. ഒരു ചതുർഭുജത്തിന്റെ ഒരു ശീർഷത്തിൽ നിന്നും എതിർ ശീർഷത്തിലേക്ക് വരയ്ക്കുന്ന രേഖയുടെ പേരെന്ത്?

(വികർണ്ണം, ഉന്നതി, ലംബം, പാദം)

16. x ഉം y യും കൂട്ടിയ തുകയെ 7 കൊണ്ട് ഗുണിച്ച ഫലത്തിൽ നിന്നും 5 കുറച്ചാൽ 23 കിട്ടും. ഇതിന്റെ ബീജഗണിത രൂപം താഴെ കൊടുത്തിരിക്കുന്നവയിൽ ഏത്?

[$7(x+y) + 5 = 23$, $7(x+y) + 5 = 20$, $7x + y - 5 = 23$, $7(x + y) - 5 = 23$

[16 x $^{1}/_{2}$ = 8]

II. 17 മുതൽ 20 വരെയുള്ള ചോദ്യങ്ങളിൽ, A കോളത്തിലെ ഓരോ ഇനത്തിനും യോജിക്കുന്ന ശരിയായ ഉത്തരം B കോളത്തിൽ നിന്നും തെരഞ്ഞെടുത്തെഴുതുക

$\cup = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}, P = \{1, 2, 3, 4, 5\}, Q = \{2, 3, 8\}$ ആയാൽ

	കോളം A	കോളം B
17.	$Q - P$	$\{6, 7, 8, 9\}$
18.	$P \cup Q$	$\{8\}$
19.	$(P \cap Q)^1$	$\{1, 2, 3, 4, 5, 8\}$
20.	P^1	$\{6, 7, 9\}$
		$\{1, 4, 5, 6, 7, 8, 9\}$
		$\{6, 7, 9\}$

[4 x $^1/_2$ =2]

III. 21 മുതൽ 32 വരെയുള്ള ചോദ്യങ്ങളിൽ വിട്ടിരിക്കുന്ന ഭാഗം പൂരിപ്പിക്കുക.

21. 'n' വശങ്ങളുള്ള ഒരു ബഹുഭുജത്തിന്റെ ആന്തരകോണുകളുടെ അളവുകളുടെ തുക ———— ആകുന്നു.

22. 'r' cm ആരമുള്ള ഒരു വൃത്തത്തിന്റെ വിസ്തീർണ്ണം ———— ആയിരിക്കും

23. ഒരു ഗണത്തിലെ അംഗങ്ങളുടെ എണ്ണത്തെ ആ ഗണത്തിന്റെ ——എന്നു പറയുന്നു.

24. $5a(3a + 4)$ ന്റെ വിപുലീകരണരൂപം ———— ആണ്

25. ഒരു ത്രികോണത്തിന്റെ മൂന്നു കോണുകളുടേയും അളവുകളുടെ തുക——ആകുന്നു.

26. $x^2 + y^2 = 13$ ഉം $xy = 6$ ഉം ആണെങ്കിൽ $(x + y)^2$ ന്റെ വില ———— ആയിരിക്കും.

27. '————' എന്നത് ഏതൊരു ഗണത്തിന്റെയും ഉപഗണമാണ്.

28. A യും B യും വിയുക്തഗണങ്ങളായാൽ $A \cap B$ ————ആയിരിക്കും

29. $^x/_2 = 6$ എന്ന സമവാക്യത്തിന്റെ നിർദ്ധാരണമൂല്യം————ആണ്.

30. ഒരു സമഭുജ ത്രികോണത്തിന്റെ ഒരു കോണിന്റെ അളവ്———ഡിഗ്രി ആണ്.

31. $-4, (5x - 2b)$ യുടെ ഗുണനഫലം————ആണ്.

32. $K \times \sqrt{7} = \sqrt{63}$ ആയാൽ K യുടെ വില————ആണ്. **[12 x $^1/_2$ =6]**

IV. 33 മുതൽ 48 വരെയുള്ള ചോദ്യങ്ങൾക്ക് ആവശ്യമായ ക്രിയകൾ എഴുതണം.

33. ഒരു സംഖ്യയുടെ 5 മടങ്ങിനോട് 6 കൂട്ടിയാൽ 46 കിട്ടും. സംഖ്യ ഏത്? **($1^1/_2$)**

34. Δ ABC യിൽAB, BC, AC ഇവയുടെ മധ്യബിന്ദുക്കൾ യഥാക്രമം P,Q,R ആണ്. PQ = 3cm, QR = 4.5cm, PR = 5cm. Δ ABC യുടെ ചുറ്റളവ് കണക്കാക്കുക. $(1^1/_2)$

35. തുടർച്ചയായ മൂന്നു ഇരട്ടസംഖ്യകളുടെ തുക 90 ആയാൽ സംഖ്യകളേവ? $(1^1/_2)$

36. ΔPQR ൽ$PR = QR$. $\angle PRS$ ഒരു ബാഹ്യകോണാണ്. $\angle PRS = 100^0$ ആയാൽ $\angle P$, $\angle Q$ ഇവയുടെ അളവുകൾ കണക്കാക്കുക. $(1^1/_2)$

37. ഒരു ഓഡിറ്റോറിയത്തിൽ 4356 കുട്ടികൾ ഇരിക്കുന്നു. ഒരു വരിയിൽ എത്ര കുട്ടികൾ ഇരിക്കുന്നുവോ അത്രയും വരികളും ഉണ്ട്. എത്ര വരികളുണ്ടെന്ന് കണക്കാക്കുക $(1^1/_2)$

38. ഒരു പോളിനോമിയലിനെ 5y കൊണ്ട് ഗുണിച്ചപ്പോൾ $10y^4 + 15y^3 + 30y^2$ കിട്ടുന്നുവെങ്കിൽ പോളിനോമിയൽ ഏത്? $(1^1/_2)$

39. സമചതുരാകൃതിയിലുള്ള ഒരു കളിസ്ഥലത്തിന്റെ വിസ്തീർണ്ണം $256.6404m^2$ ആയാൽ അതിന്റെ ഒരു വശത്തിന്റെ നീളം കണക്കാക്കുക $(1^1/_2)$

40. $5a - 10b + 15c$ എന്ന പോളിനോമിയലിനെ-5 കൊണ്ട് ഹരിക്കുക. $(1^1/_2)$

41. സർവ്വസമവാക്യം ഉപയോഗിച്ച് വിപുലീകരിക്കുക.

93×68 $(2^1/_2)$

42. ഒരു ഹോസ്റ്റലിൽ 60 കുട്ടികൾക്ക് 30 ദിവസത്തേക്ക് വേണ്ട ആഹാരസാധനം കരുതി വെച്ചിട്ടുണ്ടായിരുന്നു. 10 ദിവസം കഴിഞ്ഞ് കുറച്ചു കുട്ടികൾ കൂടി വന്ന് ചേർന്നപ്പോൾ 15 ദിവസം കൊണ്ട് സാധനങ്ങൾ തീർന്നുപോയി. പുതുതായി വന്നു ചേർന്ന കുട്ടികളുടെ എണ്ണം എത്ര? $(2^1/_2)$

43. ഘടകക്രിയ ചെയ്യുക. $6x^3 - 8x^2 + 12x$ $(2^1/_2)$

44. ഒരു ജോലി 20 ദിവസം കൊണ്ട് ചെയ്ത് തീർക്കാൻ 3 പുരുഷന്മാരോ അല്ലെങ്കിൽ 6 സ്ത്രീകളോ ആവശ്യമാണ്. അങ്ങനെയെങ്കിൽ അതേ ജോലിതന്നെ 12 പുരുഷന്മാരും 8 സ്ത്രീകളും ഒരുമിച്ച് ചെയ്ത് തീർക്കാൻ എത്ര ദിവസം വേണ്ടിവരും? $(2^1/_2)$

45. ഘടകക്രിയ ചെയ്യുക $16x^2 + 24xy + 9y^2$ (3)

46. ലഘൂകരിക്കുക $(5x - 3y)^2 + (3x + 2y)^2$ (3)

47. $AB = 7cm$, $BC = 5$ cm, $\angle A = 75^0$, $\angle B = 95^0$, $\angle C = 100^0$. ചതുർഭുജം ABCD നിർമ്മിക്കുക. (3)

48. $PQ = 6$ cm, $QR = 5.5cm$, $PS = 4.5cm$, $\angle P = 65^0$, $\angle Q = 80^0$.ചതുർഭുജംPQRS നിർമ്മിക്കുക. (3)

APPENDIX II

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF ACHIEVEMENT IN MATHEMATICS
(DRAFT)

Dr. V. Sumangala
Reader in Education

Mumthas, N.S.
Research Scholar

Instructions

Time: 2 hours
Mark: 50

The following are some questions based on the VIIth standard Mathematics text book. Read the questions carefully before answering.

I. ***For questions 1 to 16, choose the correct answer from among the choices given in brackets.***

1. Name the mathematician who introduced the concept of set.

   [Ramanujan, George Cantor, Aryabhatta, Bhaskaracharya]

2. How many variables are there in a simple equation?

   [0, 1, 2, 3]

3. Which of the following is the Hero's formula?

   [$\frac{1}{2}bh$, $\sqrt{3}a^2/4$, $6\sqrt{a^2}/4$, $\sqrt{S(s-a)(s-b)(s-c)}$]

4. What is the cube root of 27000?

   [3, 30, 300, 3000]

5. If the number of elements in two finite sets are equal what are they called?

   [Equivalent sets, Identical sets, Null set, Universal set]

6. Which of the following is a surd?

   [$\sqrt{49}$, $\sqrt{36}$, $\sqrt{18}$, $\sqrt{2.25}$]

7. Which of the following is equivalent to the equation x = 2?

[x+5 = 6, 3x = 5, x-2 = 0, x/2 = ½]

8. Which of the following is a true equation?

[4+n = n+4, x-2 = 2-x, 5x+2 = 11, 5(p+2) = 5p+2]

9. If A = {p,q,r,s}, which of the following is a subset of A?

[{q,s,t}, {p,r,a}, {p,q,s}, {a,r,s}]

10. What is the measure of an angle inscribed in a semi circle?

[90°, 60°, 45°, 30°]

11. What is the cardinality of a null set?

[0, 1, 2, 3]

12. What is the sum of the measures of the opposite angles of a quadrilateral?

[90°, 180°, 270°, 360°]

13. What is the number of digits in the square root of 657666025?

[8, 6, 5, 4]

14. Which of the following is a null set?

[{o}, {ϕ}, {-1}, { }]

15. Name the line segment drawn from one vertex of the quadrilateral to its opposite vertex.

[diagonal, height, altitude, base]

16. When the sum of x and y is multiplied by 7 and then 5 is subtracted from it the result is 23. Which among the following is its algebraic form?

[7(x+y)+5=23, 7(x+y)+5 = 20, 7x+y-5=23, 7(x+y)-5=23]

(16x½=8)

II. *For the questions 17 to 20, choose the answer that matches with item in column A from column B.*

If U = {1,2,3,4,5,6,7,8,9}, P={1,2,3,4,5} and Q={2,3,8}, then

	Column A	Column B
17.	Q-P	{6,7,8,9}
18.	PUQ	{8}
19.	$(P \cap Q)^1$	{1,2,3,4,5,8} {2, 3}
20.	P^1	{1,4,5,6,7,8,9} {6,7,9}

(4x½=2)

III. *For questions 21 to 32, fill in the blanks with appropriate answers.*

21. The sum of the measures of all the interior angles of a polygon with 'n' sides is ____
22. The area of the circle of radius 'r' cm is _____
23. The number of elements of a set is called its _____
24. The expanded form of 5a(3a+4) is ______
25. The sum of the measures of the three angles of a triangle is ______
26. If $x^2+y^2 = 13$ and $xy=6$, then the value of $(x+y)^2$ is ______
27. _____ is the subset of any set.
28. If A and B are two disjoint sets, $A \cap B$ = ________
29. The solution set of the equation $x/2 = 6$ is ______
30. The measure of an angle of the equilateral triangle is ______
31. The product of -4 and (5x-2b) is ______
32. If $K \times \sqrt{7} = \sqrt{63}$, then the value of K is _____

(12 x ½=6)

IV. *For the questions 33 onwards, write the necessary steps*

33. If 6 is added to 5 times of a number, the result is 46. What is the number?

$1\frac{1}{2}$

34. In ΔABC, P, Q and R are the midpoints of the sides AB, BC and AC respectively. PQ=3 cm, QR=4.5 cm and PR=5 cm. Find the perimeter of ΔABC.

$1\frac{1}{2}$

35. The sum of three consecutive even numbers is 90. What are the numbers?

$1\frac{1}{2}$

36. In ΔPQR, PR = QR and $\angle PRS$ is an exterior angle. If $\angle PRS = 100^\circ$, what are the measures of the angles $\angle P$ and $\angle Q$?

$1\frac{1}{2}$

37. 4356 students are sitting in an auditorium. The number of students sitting in one row are equal to the number of rows. Find the number of rows?

$1\frac{1}{2}$

38. Which polynomial when multiplied by 5y gives $10y^4+15y^3+30y^2$?

$1\frac{1}{2}$

39. If the area of a playground having the shape of a square is $256.6404m^2$, what is the length of one side of the playground?

$1\frac{1}{2}$

40. Divide the polynomial 5a-10b+15c by -5.

$1\frac{1}{2}$

41. Calculate 93 x 68 by using identities.

$2\frac{1}{2}$

42. In a hostel, there was a food collection meant for 60 children for 30 days. When some more children were admitted to the hostel after 10 days, the food collection was finished after 15 days. Find out the number of newly admitted children?

$2\frac{1}{2}$

43. Factorize $6x^3-8x^2+12x$

$2\frac{1}{2}$

44. A work can be completed by 3 men or 6 women in 20 days. If so, how many days will be required for 12 men and 8 women together to complete the same work?

$2\frac{1}{2}$

45. Factorize $16x^2+24xy+9y^2$

3

46. Simplify $(5x-3y)^2 + (3x+2y)^2$

3

47. AB=7cm, BC=5cm, $\angle A=75^\circ$, $\angle B=95^\circ$ and $\angle C=100^\circ$. Construct the quadrilateral ABCD

3

48. PQ=6cm, QR=5.5 cm, PS=4.5cm, $\angle P=65^\circ$ and $\angle Q=80^\circ$. Construct the quadrilateral PQRS

3

UNIVERSITY OF CALICUT

DEPARTMENT OF EDUCATION

TEST OF ACHIEVEMENT IN MATHEMATICS

SCORING KEY AND MARKING SCHEME

For objective type questions

I. 1. ജോർജ്ജ് കാന്റർ.

2. 1

3. $\sqrt{S(s-a)(s-b)(s-c)}$

4. 30.

5. സമാംഗതണം.

6. $\sqrt{18}$

7. $x - 2 = 0$

8. $4 + n = n + 4$

9. $\{p, q, s\}$

10. 90^0

11. 0

12. 180^0

13. 5

14. $\{\ \}$

15. വികർണ്ണം.

16. $7(x + y) - 5 = 23$.

II. 17. $Q-P = \{8\}$

18. $P \cup Q = \{1, 2, 3, 4, 5, 8\}$

19. $(P \cap Q)^1 = \{1, 4, 5, 6, 7, 8, 9\}$

20. $P^1 = \{6, 7, 8, 9\}$

III. 21. (2n -4) മട്ടം

22. πr^2 cm^2

23. കാർഡിനാലിറ്റി

24. $15a^2 + 20a$

25. 180^0

26. 25

27. ശൂന്യഗണം

28. ശൂന്യഗണം

29. {12}

30. 60^0

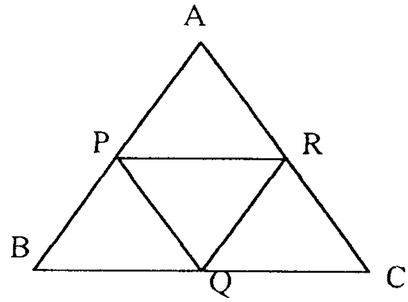
31. $-20x + 8b$

32. 3

IV. For descriptive type items

Value points	Marks	
33. സംഖ്യ $= x$		
സംഖ്യയുടെ 5 മടങ്ങ് $= 5x$	¼	1½
$\therefore 5x + 6 = 46$	½	
$5x = 46 - 6 = 40$	½	
$x = \frac{40}{5} = 8$	¼	

34.

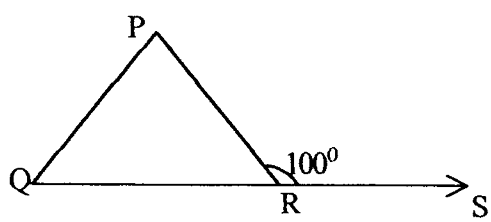


	¼	
AB = 9 cm		
BC = 10 cm	1	1 ½
AC = 6cm		
△ ABCയുടെ ചുറ്റളവ് = 25 cm	¼	

35. തുടർച്ചയായ മൂന്ന് ഇരട്ടസംഖ്യകൾ

= x, x+2, x +4	½	
x + x + 2 + x + 4 = 90	¼	
3x + 6 = 90		1½
3x = 90 - 6 = 84	½	
x = 28		
തുടർച്ചയായ ഇരട്ടസംഖ്യകൾ - 28, 30, 32.	¼	

36.



	½	
$\angle R = 80^0$	½	1½
$\angle P = \angle Q = 50^0$	½	

37.	വരികളുടെ എണ്ണം $= \sqrt{4356}$	½	1 ½
	$= 66$	1	
38.	പോളിനോമിയൽ $= 10y^4 + 15y^3 + 30y^2 \div 5y$	½	1 ½
	$= 2y^3 + 3y^2 + 6y$	1	
39.	വശത്തിന്റെ നീളം $= \sqrt{256.6404}$	½	1 ½
	$= 16.02m$	1	
40.	പോളിനോമിയൽ $= 5a - 10b + 15c \div -5$	½	1 ½
	$= -a + 2b - 3c$	1	
41.	$93 = 90 + 3,\ 68 = 70 - 2$	½	2 ½
	$93 \times 68 = (90 + 3)(70 - 2)$		
	$= 90(70) + 90(-2) + 3(70) + 3(-2)$	1	
	$= 6300 - 180 + 210 - 6$	½	
	$= 6324$	½	
42.	കുട്ടികളുടെ എണ്ണം (x) 60 ?	½	
	ദിവസങ്ങളുടെ എണ്ണം (y) 20 15		
	10 ദിവസത്തിന് ശേഷമുള്ള കുട്ടികളുടെ എണ്ണം = P		
	കുട്ടികളുടെ എണ്ണത്തിൽ വന്ന മാറ്റം = P : 60	½	
	ദിവസങ്ങളുടെ എണ്ണത്തിൽ വന്ന മാറ്റം = 15 : 20		

$P : 60 = 20 : 15$

$P = \dfrac{60 \times 20}{15} = 80$ 1

ആകെ കുട്ടികളുടെ എണ്ണം = 80

നേരത്തേ ഉണ്ടായിരുന്നവർ = 60 ½

പുതുതായി ചേർന്ന കുട്ടികളുടെ എണ്ണം= 80 - 60 = 20

2½

43. $6x^3 = 2 \times 3 \times x \times x \times x$ ¼

$8x^2 = 2 \times 2 \times 2 \times x \times x$ ¼

$12x = 2 \times 2 \times 3 \times x$ ¼

ഉ.സാ.ഘ = 2x ½

$6x^3 - 8x^2 + 12x = 2x \left(\frac{6x^3}{2x} - \frac{8x^2}{2x} + \frac{12x}{2x}\right)$ 1

$= 2x(3x^2 - 4x + 6)$ ¼

2½

44. 3 പുരുഷന്മാർ = 6 സ്ത്രീകൾ

∴ 1 പുരുഷൻ = 2 സ്ത്രീകൾ ½

12 പുരുഷന്മാർ = 12 x 2 = 24 സ്ത്രീകൾ

∴ 12 പുരുഷന്മാർ +8 സ്ത്രീകൾ = 32 സ്ത്രീകൾ ½

ആളുകളിൽ വന്ന മാറ്റം- 6 : 32

ദിവസത്തിൽവന്ന മാറ്റം - 20 : x ½

$\therefore 32 : 6 = 20 : x$ ½

$\therefore x = \dfrac{20 \times 6}{32} = 3.75$ ½

ജോലി തീർക്കാൻ ആവശ്യമായ ദിവസങ്ങളുടെ എണ്ണം = $3\frac{3}{4}$ ദിവസം

2½

9

45. $16x^2 + 24xy + 9y^2 = (4x)^2 + 2(4x)(3y) + (3y)^2$ 1

$= (4x + 3y)^2$ 1

$= (4x + 3y)(4x + 3y)$ ½

$\therefore$ ഘടകങ്ങൾ = $(4x + 3y), (4x + 3y)$ ½

3

46. $(5x - 3y)^2 = 25x^2 - 30xy + 9y^2$ 1

$(3x + 2y)^2 = 9x^2 + 12xy + 4y^2$ 1

$(5x - 3y)^2 + (3x + 2y)^2 = 25x^2 - 30xy + 9y^2 +$

$= 9x^2 + 12xy + 4y^2$ ½

$= 34x^2 - 18xy + 13y^2$ ½

3

47. 7cm നീളത്തിൽ AB വരയ്ക്കുക. ¼

B യിൽ 95^0കോൺ വരച്ച് അതിൽ5 cm അകലെയായി

C അടയാളപ്പെടുത്തുക. 1

C യിൽ 100^0യിലുംA യിൽ 75^0യിലും കോണുകൾ വരയ്ക്കുക. 1

അവയുടെ സംഗമബിന്ദു യോജിപ്പിച്ച് Dഎന്ന് പേര് കൊടുക്കുക ¼

വൃത്തിയ്ക്ക്. ½

3

48. 6cm നീളത്തിൽ PQ വരയ്ക്കുക. ¼

Pയിൽ 65^0കോൺവരച്ച് 4.5cm അകലത്തിൽ

S അടയാളപ്പെടുത്തുക. 1

Q വിൽ 80^0കോൺവരച്ച്5.5cm അകലത്തിൽ

R അടയാളപ്പെടുത്തുക 1

RS വരയ്ക്കുക ¼

വൃത്തിയ്ക്ക് ½

3

APPENDIX IV

UNIVERSITY OF CALICUT

DEPARTMENT OF EDUCATION

TEST OF ACHIEVEMENT IN MATHEMATICS

Dr. V.Sumangala | **Mumthas.N.S.**
Reader in Education | **Research Scholar**

നിർദ്ദേശങ്ങൾ:

സമയം : 1 മണിക്കൂർ

മാർക്ക് : 25

8-ാം തരത്തിലെ ഗണിതശാസ്ത്ര പാഠപുസ്തകത്തെ ആസ്പദമാക്കിയുള്ള ചില ചോദ്യങ്ങളാണ് താഴെ കൊടുത്തിരിക്കുന്നത്. ഓരോ ചോദ്യവും ശ്രദ്ധാപൂർവ്വം വായിച്ച് ഉത്തരം എഴുതുക.

I. 1 മുതൽ 8 വരെയുള്ള ചോദ്യങ്ങൾക്ക് ബ്രാക്കറ്റിൽ കൊടുത്തിട്ടുള്ളവയിൽ നിന്നും ശരിയായ ഉത്തരം തെരഞ്ഞെടുത്തെഴുതുക.

1. ഒരു ലഘുസമവാക്യത്തിലെ ചരങ്ങളുടെ എണ്ണം എത്ര?

   [0, 1, 2, 3]

2. രണ്ട് പരിമിതഗണങ്ങളിലെ അംഗങ്ങളുടെ എണ്ണം തുല്യമായാൽ അവയ്ക്ക് പറയുന്ന പേരെന്ത്?

   [സമാംഗഗണം, അനന്യഗണം, ശൂന്യഗണം, സമസ്തഗണം]

3. താഴെ കൊടുത്തിരിക്കുന്നവയിൽ കരണി ഏത്?

   [$\sqrt{49}$, $\sqrt{36}$, $\sqrt{18}$, $\sqrt{2.25}$]

4. $x = 2$ എന്ന സമവാക്യത്തിന് സമാനമായ സമവാക്യമേത്?

   [$x + 5 = 6$, $3x = 5$, $x - 2 = 0$, $x/_2 = 1/_2$]

5. ഒരു അർദ്ധവൃത്തത്തിൽ അന്തർലേഖനം ചെയ്തിരിക്കുന്ന കോണിന്റെ അളവ് എന്തായിരിക്കും?

   [90^0, 60^0, 45^0, 30^0]

6. ഒരു ചതുർഭുജത്തിന്റെ എതിർശീർഷകോണുകളുടെ അളവുകളുടെ തുക എന്ത്?

[90^0, 180^0, 270^0, 360^0]

7. 657666025 എന്ന സംഖ്യയുടെ വർഗ്ഗമൂലത്തിലെ അക്കങ്ങളുടെ എണ്ണം എത്ര?

[8, 6, 5, 4]

8. താഴെ തന്നിരിക്കുന്നവയിൽ ശൂന്യഗണം ഏത്?

[{0}, {ϕ}, {-1}, { }] **[$8 \times {}^1/_2 = 4$]**

II. 9 മുതൽ 12 വരെയുള്ള ചോദ്യങ്ങളിൽ, A കോളത്തിലെ ഓരോ ഇനത്തിനും യോജിക്കുന്ന ശരിയായ ഉത്തരം B കോളത്തിൽ നിന്നും തെരഞ്ഞെടുത്തെഴുതുക.

$U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$, $P = \{1, 2, 3, 4, 5\}$, $Q = \{2, 3, 8\}$ ആയാൽ

	കോളം A	കോളംB
9.	$Q - P$	$\{6, 7, 8, 9\}$
10.	$P \cup Q$	$\{8\}$
11.	$(P \cap Q)^1$	$\{1, 2, 3, 4, 5, 8\}$
12.	P^1	$\{6, 7, 9\}$
		$\{1, 4, 5, 6, 7, 8, 9\}$
		$\{6, 7, 9\}$

[$4 \times {}^1/_2 = 2$]

III. 13 മുതൽ 16 വരെ ചോദ്യങ്ങളിൽ വിട്ടിരിക്കുന്ന ഭാഗം പൂരിപ്പിക്കുക.

13. 'n' വശങ്ങളുള്ള ഒരു ബഹുഭുജത്തിന്റെ ആന്തരകോണുകളുടെ അളവുകളുടെ തുക ———— ആകുന്നു.

14. 'r' cm ആരമുള്ള ഒരു വൃത്തത്തിന്റെ വിസ്തീർണ്ണം ———— ആയിരിക്കും

15. $5a(3a + 4)$ ന്റെ വിപുലീകരണരൂപം ———— ആണ്

16. $x^2 + y^2 = 13$ ഉം $xy = 6$ ഉംആണെങ്കിൽ $(x + y)^2$ ന്റെ വില ———— ആയിരിക്കും.

[$4 \times {}^1/_2 = 2$]

IV. 17 മുതലുള്ള ചോദ്യങ്ങൾക്ക് ആവശ്യമായ ക്രിയകൾ എഴുതണം.

17. ഒരു സംഖ്യയുടെ 5 മടങ്ങിനോട് 6 കൂട്ടിയാൽ 46 കിട്ടും. സംഖ്യ ഏത്? **($1^1/_2$)**

36

18. $\triangle$ ABC യിൽAB, BC, AC ഇവയുടെ മധ്യബിന്ദുക്കൾ യഥാക്രമം P,Q,R ആണ്.
PQ = 3cm, QR = 4.5cm, PR = 5cm. $\triangle$ ABC യുടെ ചുറ്റളവ് കണക്കാക്കുക. **($1^1/_2$)**

19. ഒരു ഓഡിറ്റോറിയത്തിൽ 4356 കുട്ടികൾ ഇരിക്കുന്നു. ഒരു വരിയിൽ എത്ര കുട്ടികൾ ഇരിക്കുന്നുവോ അത്രയും വരികളുമുണ്ട്. എത്ര വരികളുണ്ടെന്ന് കണക്കാക്കുക. **($1^1/_2$)**

20. ഒരു പോളിനോമിയലിനെ 5y കൊണ്ട് ഗുണിച്ചപ്പോൾ $10y^4 + 15y^3 + 30y^2$ കിട്ടുന്നുവെങ്കിൽ പോളിനോമിയൽ ഏത്? **($1^1/_2$)**

21. ഘടകക്രിയ ചെയ്യുക.

$6x^3 - 8x^2 + 12x$ **($2^1/_2$)**

22. ഒരു ജോലി 20 ദിവസം കൊണ്ട് ചെയ്ത് തീർക്കാൻ 3 പുരുഷന്മാരോ അല്ലെങ്കിൽ 6 സ്ത്രീകളോ ആവശ്യമാണ്. അങ്ങനെയെങ്കിൽ അതേ ജോലിതന്നെ 12 പുരുഷന്മാരും 8 സ്ത്രീകളും ഒരുമിച്ച് ചെയ്ത് തീർക്കാൻ എത്ര ദിവസം വേണ്ടിവരും? **($2^1/_2$)**

23. ലഘൂകരിക്കുക

$(5x - 3y)^2 + (3x + 2y)^2$ **(3)**

24. $AB = 7$ cm, $BC = 5$cm, $\angle A = 75^0$, $\angle B = 95^0$, $\angle C = 100^0$. ചതുർഭുജം ABCD നിർമ്മിക്കുക. **(3)**

APPENDIX V

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF ACHIEVEMENT IN MATHEMATICS

Dr. V. Sumangala
Reader in Education

Mumthas, N.S.
Research Scholar

Instructions

Time: 1 hours
Mark: 25

The following are some questions based on the VII[th] standard Mathematics text book. Read the questions carefully before answering.

I. *For questions 1 to 8, choose the correct answer from among the choices given in brackets.*

1. How many variables are there in a simple equation?

   [0, 1, 2, 3]

2. If the number of elements in two finite sets are equal what are they called?

   [Equivalent sets, Identical sets, Null set, Universal set]

3. Which of the following is a surd?

   [$\sqrt{49}$, $\sqrt{36}$, $\sqrt{18}$, $\sqrt{2.25}$]

4. Which of the following is equivalent to the equation $x = 2$?

   [$x+5 = 6$, $3x = 5$, $x-2 = 0$, $x/2 = ½$]

5. What is the measure of an angle inscribed in a semi circle?

   [90°, 60°, 45°, 30°]

6. What is the sum of the measures of the opposite angles of a quadrilateral?

   [90°, 180°, 270°, 360°]

7. What is the number of digits in the square root of 657666025?

[8, 6, 5, 4]

8. Which of the following is a null set?

[{o}, {ϕ}, {-1}, { }]

(8x½=4)

II. *For the questions 9 to 12, choose the answer that matches with item in column A from column B.*

If U = {1,2,3,4,5,6,7,8,9}, P={1,2,3,4,5} and Q={2,3,8}, then

	Column A	Column B
9.	Q-P	{6,7,8,9}
10.	PUQ	{8}
11.	$(P \cap Q)^1$	{1,2,3,4,5,8} {2,3}
12.	P^1	{1,4,5,6,7,8,9} {6,7,9}

(4x½=2)

III. *For questions 13 to 16, fill in the blanks with appropriate answers.*

13. The sum of the measures of all the interior angles of a polygon with 'n' sides is ____

14. The area of the circle of radius 'r' cm is _____

15. The expanded form of 5a(3a+4) is ______

16. If $x^2+y^2 = 13$ and xy=6, then the value of $(x+y)^2$ is ______

(4 x ½=2)

IV. *For the questions 17 onwards, write the necessary steps*

17. If 6 is added to 5 times of a number, the result is 46. What is the number?

1½

18. In ΔABC, P, Q and R are the midpoints of the sides AB, BC and AC respectively. PQ=3 cm, QR=4.5 cm and PR=5 cm. Find the perimeter of ΔABC.

1½

19. 4356 students are sitting in an auditorium. The number of students sitting in one row are equal to the number of rows. Find the number of rows?

1½

20. Which polynomial when multiplied by 5y gives $10y^4+15y^3+30y^2$?

1½

21. Factorize $6x^3-8x^2+12x$

2½

22. A work can be completed by 3 men or 6 women in 20 days. If so, how many days will be required for 12 men and 8 women together to complete the same work?

2½

23. Simplify $(5x-3y)^2 + (3x+2y)^2$

3

24. AB=7cm, BC=5cm, $\angle A=75^\circ$, $\angle B=95^\circ$ and $\angle C=100^\circ$. Construct the quadrilateral ABCD

3

APPENDIX VI to IX

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION 1993

TEST OF MATHEMATICS APTITUDE

Dr. V. Sumangala
Reader in Education
University of Calicut

Mrs. Malini P.M.
Research Scholar
Dept. of Education

General Instructions

This test is to examine your aptitude in Mathematics. It is different from your class tests. This includes five different tests, with separate instructions to each test. Each test should be completed within the given time. Find out the correct answer of each item and mark the corresponding alphabet of that answer, in the separate answer sheet given with the test. Do the questions correctly and quickly.

If you find that you have incorrectly marked the response, you can cancel the earlier one marked and can mark again the right answer by an 'X' mark inside the circle meant for that.

** Please turn the page only after getting instruction to do so **

APPENDIX VI

TEST 2 - NUMERICAL (MATHEMATICAL) REASONING

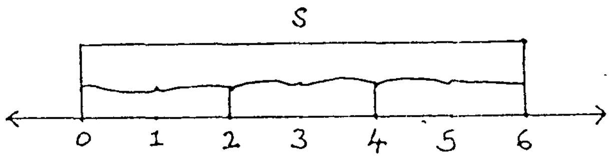
Time: 10 mts

** Start answering only when told to do so **

1. In a class there are ´r´ rows of desks with d desks in each row and each student occupies one desk. On a day when all the students are present, 3 desks were found vacant. Then the number of students in the class are

   A. rd-3 B. r+d-3 C. rd D. (r/d)-3

2. Look at the following picture.



   The best explanation to denote S is

   A. 2 x 3 B. 2 + 3 C. 3 x 2 D. 3 + 3

3. When the radius of a circle is reduced by half, its area is

   A. reduced to half B. doubled
   C. reduced to one fourth D. not changed

4. In a class, when 5 tests of 25 marks each were given, John obtained an average of 15 marks for the first four tests. If he were to obtain an overall average of 16 marks how many marks should John obtain in the fifth test?

   A. 15 B. 16 C. 17 D. 20

5. All the houses in a lane are marked with even numbers commencing from 56 and ending with 140. How many houses are there in the lane?

   A. 70 B. 43 C. 42 D. 84

6. If Suresh is sitting in the fifteenth position in a row of boys of a class, when viewed either from the left side or right side, then the number of boys in the class is

   A. 30 B. 31 C. 29 D. 28

7. A father told his son "when you were born, I was your present age". If father's present age is 36, what was the age of the son 5 years ago?

A. 18 B. 13 C. 15 D. 23

8. Marks obtained by 5 students A, B, C, D, E in 5 examinations are given below:

	I	II	III	IV	V
A	69	71	75	75	79
B	84	79	69	79	80
C	64	67	74	74	79
D	53	54	61	60	62
E	56	58	62	63	68

The mark obtained by which student showed regular progress?

A. C B. D C. E D. A

9. A train running at 30 m/sec speed crosses a 600 m platform in 30 seconds. What is the length of the train?

A. 120 m B. 150 m C. 900 m D. 300 m

10. What is the total length of all edges of a cube having a volume of 1 cubic cm.

A. 1/16 cm B. 16 cm C. 1/12 cm D. 12 cm

43

2

APPENDIX VII

TEST 3. ABILITY TO USE SYMBOLS

Instructions

The conventional symbols of fundamental operations are replaced by some new symbols. Understand the new symbols and do the operations asked.

Time: 5 mts

** Start answering only when told to do **

Answer the following if, ´0´ indicates the operation addition; ´+´ multiplication and ´*´ division.

		A	B	C	D
1.	(608) + 7 + 2	100	42	28	196
2.	(6 * 3) 0 8	10	25	16	63
3.	12 + (14 * 7) 0 2 + 4	40	20	22	64
4.	(13 + 5) * 5 0 25	115	350	95	38
5.	(18 * 6) + (24 * 2) + 12	27	48	168	3

APPENDIX VIII

TEST 4 - SPATIAL ABILITY

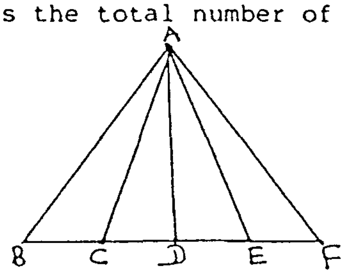
Instructions:

This section contains 8 questions. Answer them within the time given.

Time: 6 mts

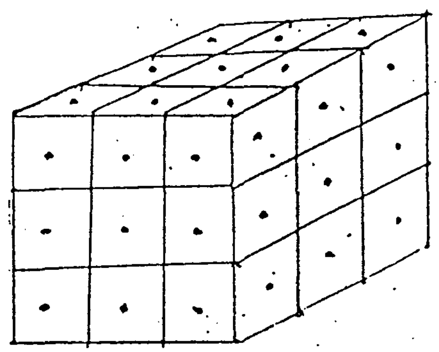
** Start answering only when told to do **

1. What is the total number of triangles in the given picture?



A. 10 B. 8 C. 12 D. 9

A wooden solid cube is divided into 27 small equal cubes and dots are placed on the faces of each cube as shown in the figure.



2. What is the number of cubes on which there is one dot.

A. 4 B. 6 C. 8 D. 10

A2

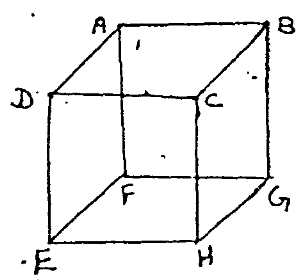
3. What is the number of cubes on which there are two dôts?

A. 4 B. 8 C. 12 D. 16

4. What is the number of cubes on which there are three dots?

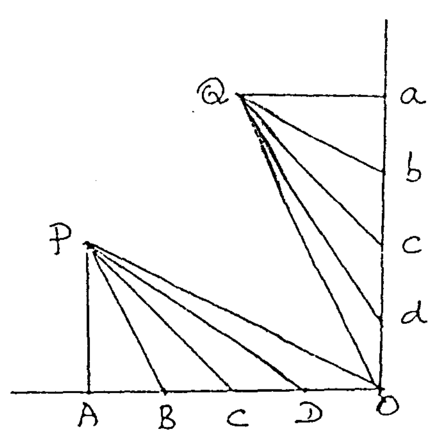
A. 4 B. 6 C. 8 D. 10

5. In the cube ABCDEFGH, how many paths are there to reach H from A, passing through the 8 vertices (Each path should be through each vertex only once)?



A. 8 B. 6 C. 4 D. 2

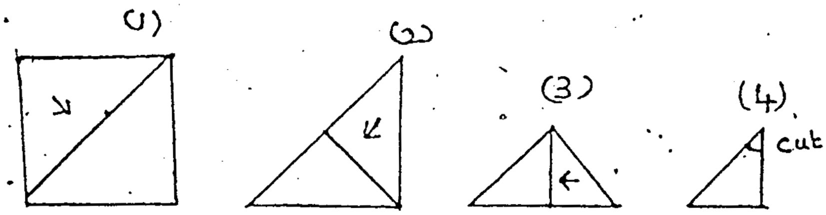
6.

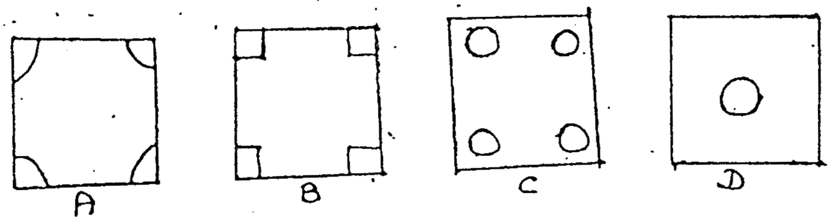


In the above figure, what is the shortest distance from P to Q?

A6

7. A square paper is folded consecutively as shown in the picture, and is cut in the position marked ´cut´ in the fourth picture. When it is unfolded, what will be the shape of the paper?





8. A cube is to be painted. Two adjacent faces should not be of the same colour. The number of minimum colours required to paint the cube is

A. 6 B. 3 C. 4 D. 5

APPENDIX IX

TEST 5 - ABSTRACT REASONING

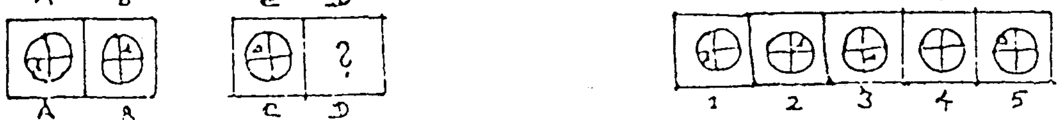
Time: 8 mts

** Start answering only when told to do **

I. Pictures A and B has a particular relationship. Select D from the answer figures such as C and D has the same relationship as A to B.

1. 

2. 

3. 

4. 

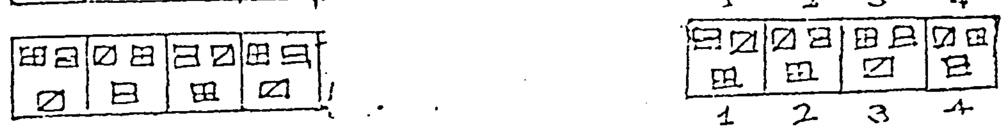
II. The following pictures are in a particular order. Select the answer figure which follows the same order.

1. 

2. 

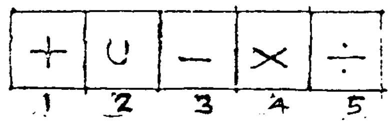
3. 

4. 

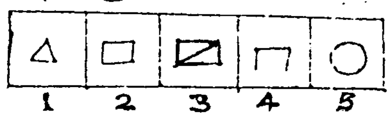
5. 

III. In the following five figure series, four belongs to one category and one stands out. Find the different one.

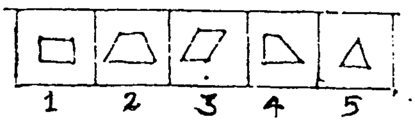
1



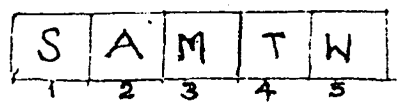
2



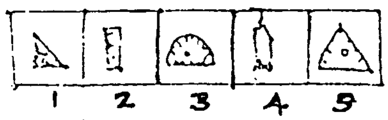
3



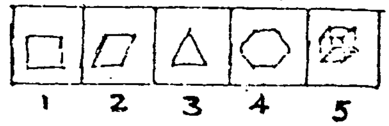
4.



5.



6.



APPENDIX IX (a)

TEST OF MATHEMATICS APTITUDE

SCORE SHEET

പേര്: സ്കൂളിന്റെ പേര്:

സ്റ്റാന്റേർഡ്: ആൺകുട്ടി/പെൺകുട്ടി.

TEST - 2

	A	B	C	D
1.	○	○	○	○
2.	○	○	○	○
3.	○	○	○	○
4.	○	○	○	○
5.	○	○	○	○
6.	○	○	○	○
7.	○	○	○	○
8.	○	○	○	○
9.	○	○	○	○
10.	○	○	○	○

TEST - 3

	A	B	C	D
1	○	○	○	○
2	○	○	○	○
3	○	○	○	○
4	○	○	○	○
5	○	○	○	○

TEST - 4

1	○	○	○	○
2	○	○	○	○
3	○	○	○	○
4	○	○	○	○
5	○	○	○	○
6	○	○	○	○
7	○	○	○	○
8	○	○	○	○

TEST - 5

I	1	2	3	4	5	**II**	1	2	3	4	5	**III**	1	2	3	4	5
1	○	○	○	○	○	1	○	○	○	○	○	1	○	○	○	○	○
2	○	○	○	○	○	2	○	○	○	○	○	2	○	○	○	○	○
3	○	○	○	○	○	3	○	○	○	○	○	3	○	○	○	○	○
4	○	○	○	○	○	4	○	○	○	○	○	4	○	○	○	○	○
5	○	○	○	○	○	5	○	○	○	○	○	5	○	○	○	○	○
												6	○	○	○	○	○

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
TEST OF INDUCTIVE REASONING
(DRAFT)

Dr. V.Sumangala
Reader in Education

Mumthas.N.S.
Research Scholar

നിർദ്ദേശങ്ങൾ:

സമയം : 30 മിനിറ്റ്

ഗണിതശാസ്ത്രസംബന്ധിയായ **40** ചോദ്യങ്ങളാണ് താഴെ കൊടുത്തിരിക്കുന്നത്. ഓരോ ചോദ്യത്തിനും A,B,C,D എന്നീ നാല് തരം ഉത്തരങ്ങൾ നൽകിയിരിക്കുന്നു. ഓരോ ചോദ്യവും വായിച്ചശേഷം ശരിയുത്തരം തെരഞ്ഞെടുത്ത് അതാത് ചോദ്യനമ്പരിനെതിരെ ഇതോടൊപ്പം നൽകിയിരിക്കുന്ന ഉത്തരക്കടലാസ്സിൽ A,B,C,Dഎന്നീ അക്ഷരങ്ങൾക്ക് താഴെ നൽകിയിട്ടുള്ള വൃത്തത്തിൽ"X" അടയാളം കൊണ്ട് രേഖപ്പെടുത്തുക.

രേഖപ്പെടുത്തിയത് തെറ്റായ വൃത്തത്തിലാണെന്ന് തോന്നിയാൽ ആ വൃത്തത്തെ "□" ചിഹ്നം കൊണ്ട് വലയം ചെയ്തശേഷം ശരിയായ വൃത്തത്തിൽ വീണ്ടും "X"അടയാളമിടുക.

ഉദാഹരണം:

1. $2 \times 1 = 2$ ആകുന്നു
   $3 \times 1 = 3$ ആകുന്നു
   $4 \times 1 = 4$ ആകുന്നു

എങ്കിൽ, $a \times 1$ ന്റെ വിലയെന്ത്?

A. $2a$ C. a
B. $3a$ D. a^0

(ഇവിടെ ശരിയുത്തരം a ആണല്ലോ. ആയതിനാൽ ശരിയുത്തരത്തെ സൂചിപ്പിക്കുന്ന C എന്ന അക്ഷരത്തിനു താഴെയുള്ള വൃത്തത്തിൽ "X"എന്ന അടയാളം രേഖപ്പെടുത്തിയിരിക്കുന്നു.)

ഉത്തരക്കടലാസ്

	A	B	C	D
1)	○	○	⊗	○

1. $2^4 = x$ എന്നതിന്റെ ലോഗരിതരൂപമാണ് $\log_2 x = 4$

$6^3 = y$ എന്നതിന്റെ ലോഗരിതരൂപമാണ് $\log_6 y = 3$

$4^{-3/2} = P$ എന്നതിന്റെ ലോഗരിതരൂപമാണ് $\log_4 P = -3/2$

എങ്കിൽ, $N^a = x$ എന്നതിന്റെ ലോഗരിതരൂപമെന്ത്?

A. $\log_a x = N$ C. $\log_x N = a$

B. $\log_N x = a$ D. $\log_x a = N$

2. $7C_3$ അർത്ഥമാക്കുന്നത് $\frac{7!}{3!\,(7-3)!}$ എന്നാണ്

$2c_2$ അർത്ഥമാക്കുന്നത് $\frac{2!}{2!\,(2-2)!}$ എന്നാണ്

$4C_3$ അർത്ഥമാക്കുന്നത് $\frac{4!}{3!(4-3)!}$ എന്നാണ്.

എങ്കിൽ, nc_r അർത്ഥമാക്കുന്നതെന്ത്?

A. $^{r!}/_{n!(n-r)!}$ C. $^{n!}/_{r!(n-r)!}$

B. $^{n!}/_{r!n!}$ D. $^{r!}/_{n!\,(r-n)!}$

3. A,B എന്ന ഗണങ്ങളെ സംബന്ധിച്ച് $n(A)=2$, $n(B)=2$ ആയാൽ $n(A\times B)=4$ ആകുന്നു.

M,N എന്ന ഗണങ്ങളെ സംബന്ധിച്ച് $n(M)=3$, $n(N)=3$ ആയാൽ $n(M\times N)=9$ ആകുന്നു.

P,Q എന്ന ഗണങ്ങളെ സംബന്ധിച്ച് $n(P)=4$, $n(Q)=2$ ആയാൽ $n(P\times Q)=8$ ആകുന്നു.

എങ്കിൽ, x, y എന്ന ഗണങ്ങളെ സംബന്ധിച്ച് $n(x)=c$, $n(y)=d$ ആയാൽ $n(X\times Y)$ എത്ര?

A. c + d C. c - d

B. cd D. c/d

4. 1ന്റെ വർഗ്ഗമൂലം, $(\sqrt{1}) = 1$

100ന്റെ വർഗ്ഗമൂലം, $(\sqrt{100}) = 10$

10000 ന്റെ വർഗ്ഗമൂലം $(\sqrt{10000}) = 100$

എന്നാൽ 100000000 ന്റെ വർഗ്ഗമൂലം എത്ര?

A. 100 C. 10000

B. 1000 D. 100000

5. $5^8 \div 5^2 = 5^6$ ആകുന്നു.

$7^4 \div 7^2 = 7^2$ ആകുന്നു.

$3^1 \div 3^1 = 3^0$ ആകുന്നു.

എങ്കിൽ, $a^m \div a^n$ എന്തായിരിക്കും?

A. a^{m-n} C. m-n

B. $a^{m/n}$ D. $^m/_n$

6. $2^3=8$ ആയാൽ $\sqrt[3]{8}=2$ ആകുന്നു

$4^4 = 256$ ആയാൽ $\sqrt[4]{256} = 4$ ആകുന്നു.

$9^2 = 81$ ആയാൽ $\sqrt[2]{81} = 9$ ആകുന്നു.

എങ്കിൽ, $7^4 = 2401$ ആയാൽ $\sqrt[4]{2401}$ എത്ര?

A. 4 C. 2401

B. 7 D. 4^7

7. $x+2=5$ എന്നത് ഒരു ലഘുസമവാക്യമാണ്.

$2y+1=0$ എന്നത് ഒരു ലഘുസമവാക്യമാണ്

$-4z+1=2z$ എന്നത് ഒരു ലഘുസമവാക്യമാണ്.

എങ്കിൽ, ഒരു ലഘുസമവാക്യത്തിലെ ചരങ്ങളുടെ എണ്ണം എത്ര ആയിരിക്കും?

A. 1 B. 2 C. 3 D. 4

8. $\cos\pi = -1$

$\cos 2\pi = 1$

$\cos 3\pi = -1$

$\therefore$ n ഒരു ഇരട്ടസംഖ്യയായാൽ $\cos n\pi$ എന്തായിരിക്കും?

A. -1 C. 1

B. 0 D. ∞

9. ആദ്യപദം 'a'യും പൊതുവ്യത്യാസം 'd' യുമായ ഒരു സമാന്തരപ്രോഗ്രഷന്റെ.

രണ്ടാം പദം $a+d$ ആണ്.

മൂന്നാം പദം $a+2d$ ആണ്.

നാലാംപദം $a+3d$ ആണ്.

എങ്കിൽ, 10- ാംപദം എന്തായിരിക്കും?

A. $a-10d$ C. $a+10d$

B. $a-9d$ D. $a+9d$

10. o O ഇവ സദൃശങ്ങളാണ്

✣ ♣ ഇവ സദൃശരൂപങ്ങളാണ്

□ ▭ ഇവ സദൃശരൂപങ്ങളാണ്.

എങ്കിൽ, സദൃശരൂപങ്ങൾ എന്നാൽ എന്ത്?

A. ഒരേ ആകൃതിയുള്ളവ C. ഒരേ ആകൃതിയും വലിപ്പവുമുള്ളവ

B. ഒരേ വലിപ്പമുള്ളവ D. യാതൊരു സാമ്യവുമില്ലാത്തവ

11. 3 പാദവക്കുകളുള്ള ഒരു സ്തംഭത്തിന് 5 മുഖങ്ങളുണ്ട്

4 പാദവക്കുകളുള്ള ഒരു സ്തംഭത്തിന് 6 മുഖങ്ങളുണ്ട്.

5 പാദവക്കുകളുള്ള ഒരു സ്തംഭത്തിന് 7 മുഖങ്ങളുണ്ട്.

എങ്കിൽ, n പാദവക്കുകളുള്ള ഒരു സ്തംഭത്തിന്റെ മുഖങ്ങളുടെ എണ്ണം എത്ര ആയിരിക്കും?

A. $n-2$ C. $n+1$

B. $n-1$ D. $n+2$

12. കൃതി 1 ആയ പോളിനോമിയലിന്റെ സാമാന്യരൂപം a_1x+a_0; $a_1 \neq 0$ ആണ്.

കൃതി 2 ആയ പോളിനോമിയലിന്റെ സാമാന്യരൂപം $a_2x^2+a_1x+a_0$; $a_2 \neq 0$ ആണ്

കൃതി 3 ആയ പോളിനോമിയലിന്റെ സാമാന്യരൂപം $a_3x^3 + a_2x^2 + a_0$; $a_3 \neq 0$ ആണ്.

എങ്കിൽ, കൃതി 'P' ആയ പോളിനോമിയലിന്റെ സാമാന്യരൂപം താഴെ തന്നിരിക്കുന്നവയിൽ ഏത്?

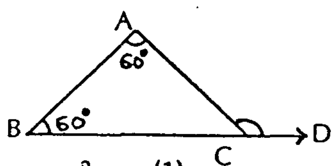
A. $a_p x^p + a_{p-1} x^{p-1} + \ldots\ldots + a_0$; $a_p \neq 0$
B. $a_p x^p + a_{p-1} x^{p-1} + \ldots\ldots + a_0$; $a_0 \neq 0$
C. $a_p x^{p-1} + a_{p-1} x^{p-2} + \ldots\ldots + a_0$; $a_p \neq 0$
D. $a_{p-1} x^p + a_{p-2} x^{p-1} + \ldots\ldots + a_0$; $a_{p-1} \neq 0$

13. ഒരു ശൂന്യഗണത്തിന്റെ ഉപഗണങ്ങളുടെ എണ്ണം = 2^0
ഒരംഗമുള്ള ഗണത്തിന്റെ ഉപഗണങ്ങളുടെ എണ്ണം = 2^1
രണ്ടംഗമുള്ള ഒരു ഗണത്തിന്റെ ഉപഗണങ്ങളുടെ എണ്ണം = 2^2

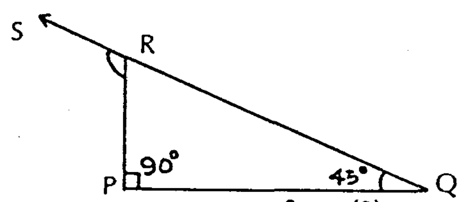
എങ്കിൽ, 12 അംഗങ്ങളുള്ള ഒരു ഗണത്തിന്റെ ഉപഗണങ്ങളുടെ എണ്ണം എന്തായിരിക്കും?

A. 2^0 C. 2^2
B. 2^1 D. 2^{12}

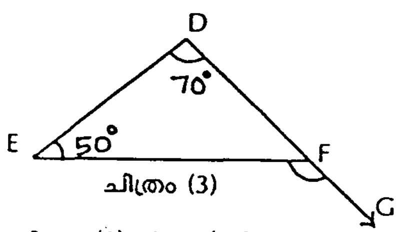
14.



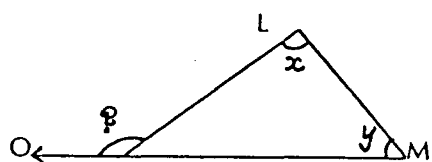
ചിത്രം (1)



ചിത്രം (2)



ചിത്രം (3)



ചിത്രം (4)

ചിത്രം (1) ൽ $\angle ACD = \angle A + \angle B = 120^0$
ചിത്രം (2) ൽ $\angle PRS = \angle P + \angle Q = 135^0$
ചിത്രം (3) ൽ $\angle EFG = \angle D + \angle E = 120^0$

എങ്കിൽ ചിത്രം (4)ൽ $\angle ONL$ ന്റെ അളവ് എന്തായിരിക്കും?

A. x-y B. x+y C. 2x D. 2y

15. 200 രൂപയ്ക്ക് 2 വർഷത്തേക്ക് 4% നിരക്കിൽ പലിശ =16 രൂപ
200 രൂപക്ക് 2 വർഷത്തേക്ക് 5% നിരക്കിൽ പലിശ = 20 രൂപ
200 രൂപക്ക് 2 വർഷത്തേക്ക് 6% നിരക്കിൽ പലിശ = 24 രൂപ
എങ്കിൽ, 200 രൂപക്ക് 2 വർഷത്തേക്ക് 10% നിരക്കിൽ പലിശ എത്ര?

A. 100 രൂപ C. 32 രൂപ
B. 40 രൂപ D. 28 രൂപ

16. $a \times a$ എന്നതിനെ a^2 എന്ന് സൂചിപ്പിക്കുന്നു.

$a \times a \times a$ എന്നതിനെ a^3 എന്ന് സൂചിപ്പിക്കുന്നു.

$a \times a \times a \times a$ എന്നതിനെ a^4 എന്ന് സൂചിപ്പിക്കുന്നു.

എങ്കിൽ, $a \times a \times a \times a \times$.............. n പ്രാവശ്യം എന്നതിനെ എങ്ങനെ സൂചിപ്പിക്കാം?

A. a^{n+1} C. na

B. a^n D. a^{n-1}

17. 1! എന്നത് 1 ആകുന്നു.

2! എന്നത് 1x2 ആകുന്നു.

3! എന്നത് 1x2x3 ആകുന്നു.

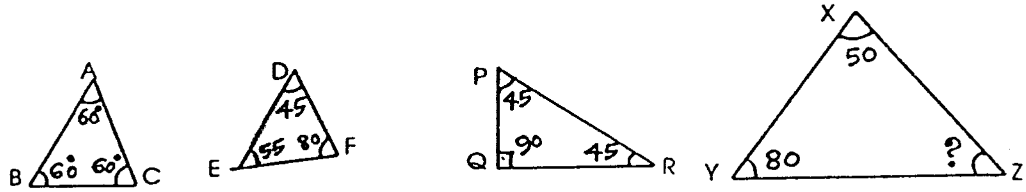
എങ്കിൽ, 8 ! എന്നത് എന്ത്?

A. 1x 2 x 3 x 4 x 5 x 6 x 7 x 8! C. 1 x 2 x 3 x 4 x 5 x 6 x 7 x 8

B. 1 x 2 x 3 x 4 x 5 x 6 x 7! x 8 D. 1 x 2 x 3 x 4 x 5 x 6 x 7

18.

D



ചിത്രം (1) ചിത്രം (2) ചിത്രം (3) ചിത്രം (4)

ചിത്രം (1) ൽ $\angle A + \angle B + \angle C = 180^0$

ചിത്രം (2) ൽ $\angle D + \angle E + \angle F = 180^0$

ചിത്രം (3) ൽ $\angle P + \angle Q + \angle R = 180^0$

എങ്കിൽ, ചിത്രം (4) ൽ $\angle Z$ന്റെ അളവെത്ര?

A. 130° C. 50°

B. 80° D. 30°

19. $\sqrt{1x4}$ എന്നത് 1x2 എന്ന് ലഘൂകരിക്കാം

$\sqrt{9x16}$ എന്നത് 3x4 എന്ന് ലഘൂകരിക്കാം

$\sqrt{25x36}$ എന്നത് 5x6 എന്ന് ലഘൂകരിക്കാം.

എങ്കിൽ താഴെ പറയുന്നവയിൽ $\sqrt{x^2 xy^2}$ ന്റെ ലഘുരൂപം ഏത്?

A. X x Y C. $X/_2 \times Y/_2$

B. $\sqrt{X} \times \sqrt{Y}$ D. $X^2 \times Y^2$

20. $(\sqrt[2]{4})^2$ ന്റെ വില 4 ആകുന്നു

$(\sqrt[3]{5})^3$ ന്റെ വില 5 ആകുന്നു.

$(\sqrt[4]{6})^4$ ന്റെ വില 6 ആകുന്നു.

എങ്കിൽ, $(\sqrt[a]{b})^a$ യുടെ വില എന്ത്?

A. $a\sqrt{b}$ C. a

B. $\sqrt{a}\, b$ D. b

21. A= {1,2}, B= {3, 4} ആയാൽ AUB = {1,2,3,4} ആയിരിക്കും.

P = {l,m}, Q= {n} ആയാൽ PUQ = {l,m,n} ആയിരിക്കും

X = {+, -, x}, Y= {+, +} ആയാൽ XUY = {+, -, x, +} ആയിരിക്കും.

എങ്കിൽ, C= { □, O}, D = {Δ,O} ആയാൽ CUD എന്തായിരിക്കും?

A. {O}　　C. {□,O, Δ, }

B. { □, Δ}　　D. {□,O, Δ,O }

22. $^1/_{10} = 0.1$

$^1/_{100} = 0.01$

$^1/_{1000} = 0.001$

എങ്കിൽ, $^1/_{100000}$ ന്റെ വിലയെന്ത്?

A. 0.000001　　C. 0.0001

B. 0.00001　　D. 0.001

23. $^1/_2 + ^1/_3 = ^1/_2 \times ^3/_1$ ആകുന്നു

$^{-1}/_7 + ^2/_{11} = ^{-1}/_7 \times ^{11}/_2$ ആകുന്നു

$^3/_{10} + ^{-4}/_{15} = ^3/_{10} \times ^{-15}/_4$ ആകുന്നു

എങ്കിൽ, $^{-a}/_b + ^{-c}/_d$ എന്നത് എന്ത്?

A. $^{-a}/_b \times ^{-d}/_c$　　C. $^{-a}/_b \times ^c/_d$

B. $^{-a}/_b \times ^{-c}/_d$　　D. $^{-a}/_b \times ^d/_c$

24. 4cm വ്യാസമുള്ള ഒരു വൃത്തത്തിന്റെ ആരം 2cm ആണ്

6 cm വ്യാസമുള്ള ഒരു വൃത്തത്തിന്റെ ആരം 3cm ആണ്.

9 cm വ്യാസമുള്ള ഒരു വൃത്തത്തിന്റെ ആരം 4.5cm ആണ്

എങ്കിൽ, $^P/_2$cm വ്യാസമുള്ള ഒരു വൃത്തത്തിന്റെ ആരം എന്ത്?

A. p - 2 cm　　C. Pcm

B. $^P/_4$ cm　　D. $^P/_2$ cm

25. {1, 2}, {3, 4} ഇവ സമാംഗഗണങ്ങളാണ്.

{a, c}, {-7, 0} ഇവ സമാംഗഗണങ്ങളാണ്.

{-1}, {0} ഇവ സമാംഗഗണങ്ങളാണ്.

എങ്കിൽ, താഴെ പറയുന്നവയിൽ സമാംഗഗണങ്ങളേത്?

A. {a, e, i}, {o, u}　　C. {1, 0}, {1}

B. { } {0}　　D. { +, -}, { ÷, x}

26. 8, 12, 24, 12, 3, 12, 3 എന്നീ പ്രാപ്താങ്കങ്ങളുടെ മോഡ് 12 ആകുന്നു.

29, 27, 32, 27, 32, 27, 26 എന്നീ പ്രാപ്താങ്കങ്ങളുടെ മോഡ് 27 ആകുന്നു.

49, 50, 49, 49, 51, 53, 54 എന്നീ പ്രാപ്താങ്കങ്ങളുടെ മോഡ് 49 ആകുന്നു.

എങ്കിൽ, 25, 24, 40, 37, 40, 40, 24 എന്നീ പ്രാപ്താങ്കങ്ങളുടെ മോഡ് എന്ത്?

A. 40　　C. 25

B. 37　　D. 24

27. വക്കിന്റെ നീളം 2cm ആയ ക്യൂബിന്റെ വ്യാപ്തം 8cm^3 ആകുന്നു.

വക്കിന്റെ നീളം 4 cm ആയ ക്യൂബിന്റെ വ്യാപ്തം 64 cm^3 ആകുന്നു.

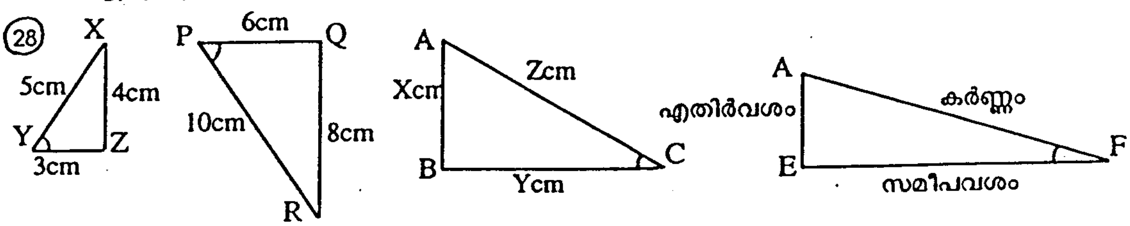
വക്കിന്റെ നീളം 5 cm ആയ ക്യൂബിന്റെ വ്യാപ്തം 125 cm^3 ആകുന്നു.

എങ്കിൽ, വക്കിന്റെ നീളം Pcm ആയ ക്യൂബിന്റെ വ്യാപ്തം എന്തായിരിക്കും?

A. $3P\ cm^3$ C. $(\sqrt{P}cm)^3$

B. $P^3\ Cm^3$ D. $P^2\ Cm^3$

(28)



ചിത്രം (1) ചിത്രം (2) ചിത്രം (3) ചിത്രം (4)

ചിത്രം (1) ൽ $\cos Y = {}^3/_5$

ചിത്രം (2) ൽ $\cos P = {}^6/_{10}$

ചിത്രം (3) ൽ $\cos C = {}^Y/_Z$

എങ്കിൽ, ചിത്രം (4)ൽ COS F എന്തായിരിക്കും?

A. $\dfrac{\text{എതിർവശം}}{\text{സമീപവശം}}$ C. $\dfrac{\text{കർണ്ണം}}{\text{സമീപവശം}}$

B. $\dfrac{\text{സമീപവശം}}{\text{കർണ്ണം}}$ D. $\dfrac{\text{സമീപവശം}}{\text{എതിർവശം}}$

29. $\log 3^3 = 3\ \log\ 3$ ആകുന്നു.

$\log 7^6 = 6\ \log\ 7$ ആകുന്നു.

$\log 5^3 = 3\ \log\ 5$ ആകുന്നു.

എങ്കിൽ, $\log a^r$ എന്തായിരിക്കും?

A. $r\ \log\ a$ C. $a^r \log a$

B. $r\ \log\ a^r$ D. $r \log r$

30. $2x^2 + 5x - 12 = 0$ എന്ന ദ്വിമാനസമവാക്യത്തിന്റെ മൂല്യഗണത്തിലെ അംഗങ്ങളുടെ തുക $^{-5}/_2$ ആണ്.

$x^2 - 10x + 16 = 0$ എന്ന ദ്വിമാനസമവാക്യത്തിന്റെ മൂല്യഗണത്തിലെ അംഗങ്ങളുടെ തുക $^{10}/_1$ ആണ്.

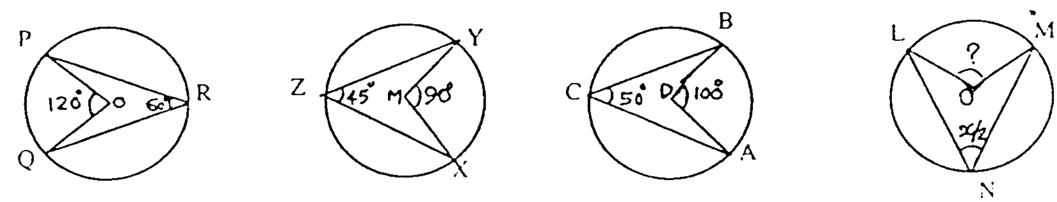
$-y^2 + 6y + 8 = 0$ എന്ന ദ്വിമാനസമവാക്യത്തിന്റെ മൂല്യഗണത്തിലെ അംഗങ്ങളുടെ തുക $-6/-1$ ആണ്.

എങ്കിൽ, $Px^2 + qx + r = 0$ എന്ന ദ്വിമാനസമവാക്യത്തിന്റെ മൂല്യഗണത്തിലെ അംഗങ്ങളുടെ തുക എന്തായിരിക്കും?

A. $^{-p}/_q$ C. $^q/_p$

B. $^p/_q$ D. $^{-q}/_p$

31.



ചിത്രം (1) ചിത്രം (2) ചിത്രം (3) ചിത്രം (4)

ചിത്രം (1)ൽ $\angle R = 60^0$ ആയാൽ $\angle POQ = 120^0$ ആകുന്നു

ചിത്രം (2) ൽ $\angle Z = 45^0$ ആയാൽ $\angle XMY = 90^0$ ആകുന്നു.

ചിത്രം (3) ൽ $\angle C = 50^0$ ആയാൽ $\angle ADB = 100^0$ ആകുന്നു.

എങ്കിൽ, ചിത്രം (4) ൽ $\angle N = x/2^0$ ആയാൽ $\angle LOM$ ന്റെ അളവെത്ര?

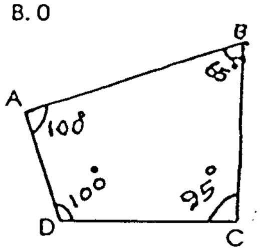
A. x° B. $2x^{\circ}$ C. $x^{2\circ}$ D. $x/2^{\circ}$

32. 13നും 15നും ഇടക്കുള്ള എണ്ണൽസംഖ്യകളുടെ ഗണം ഏകാംഗഗണത്തിനുദാഹരണമാണ്.
30 ൽ കുറവ് ദിവസങ്ങളുള്ള മാസങ്ങളുടെ ഗണം ഏകാംഗഗണത്തിനുദാഹരണമാണ്
പോസിറ്റീവോ നെഗറ്റീവോ അല്ലാത്ത സംഖ്യകളുടെ ഗണം ഏകാംഗഗണത്തിനുദാഹരണമാണ്.
എങ്കിൽ ഏകാംഗഗണത്തിലെ അംഗങ്ങളുടെ എണ്ണം എത്ര?

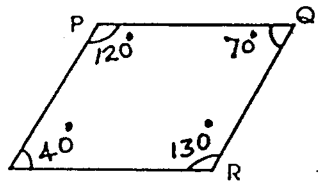
A. -1 C. 1

B. 0 D. 2

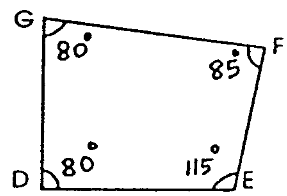
33.



ചിത്രം (1)

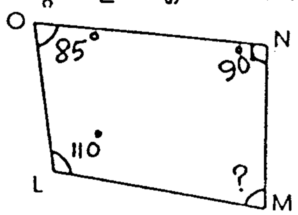


ചിത്രം (2)



ചിത്രം (3)

ചതുർഭുജം 1, 2, 3 ഇവയിലെ കോണളവുകൾ തമ്മിലുള്ള ബന്ധം ശ്രദ്ധിക്കുക. അതുപയോഗിച്ച് ചിത്രം (4)ൽ $\angle M$ന്റെ അളവ് എന്തായിരിക്കും എന്നെഴുതുക.



ചിത്രം (4)

A. 85^0 C. 110^0

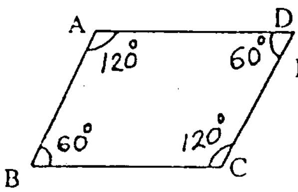
B. 90^0 D. 75^0

34. 1 cm ആരമുള്ള വൃത്തത്തിന്റെ വിസ്തീർണ്ണം π cm^2 ആകുന്നു
2 cm ആരമുള്ള വൃത്തത്തിന്റെ വിസ്തീർണ്ണം 4π cm^2 ആകുന്നു.
3cm ആരമുള്ള വൃത്തത്തിന്റെ വിസ്തീർണ്ണം 9π cm^2 ആകുന്നു.
എങ്കിൽ, x cm ആരമുള്ള ഒരു വൃത്തത്തിന്റെ വിസ്തീർണ്ണം എന്ത്?

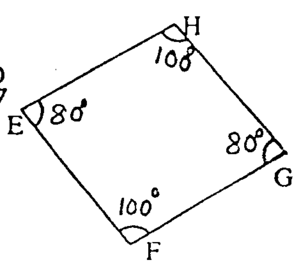
A. πcm^2 C. $\pi x^2 cm^2$

B. $\pi X\ cm^2$ D. $\pi/x^2\ cm^2$

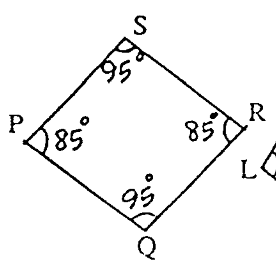
35.



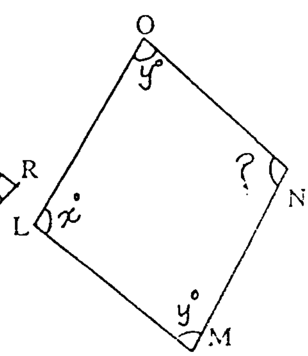
ചിത്രം (1)



ചിത്രം (2)



ചിത്രം (3)



ചിത്രം (4)

സാമാന്തരികം 1, 2, 3 ഇവയിൽ കോണുകൾ തമ്മിലുള്ള ബന്ധം ശ്രദ്ധിക്കുക. അതുപയോഗിച്ച് ചിത്രം (4)ൽ $\angle N$ ന്റെ അളവെത്ര?

A. Y^0 C. $x + y^0$

B. x^0 D. $x - y^0$

36. $(2a + b)^2 = 4a^2 + 4ab + b^2$ ആകുന്നു.

$(l + 3m)^2 = l^2 + 6lm + 9m^2$ ആകുന്നു.

$(2x + 4y)^2 = 4x^2 + 16xy + 16y^2$ ആകുന്നു.

എങ്കിൽ $(2p+q)^2$ എന്തായിരിക്കും?

A. $2p^2 + 2pq + q^2$ B. $4p + 4pq + q^2$ C. $4p^2 + 4pq + q^2$ D. $4p^2 + 2pq + q^2$

37. $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ എന്നത് ഓർഡർ 2 ആയ ഒരു യൂണിറ്റ് മെട്രിക്സ് ആണ്.

$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ എന്നത് ഓർഡർ 3 ആയ ഒരു യൂണിറ്റ് മെട്രിക്സ് ആണ്.

$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ എന്നത് ഓർഡർ 4 ആയ ഒരു യൂണിറ്റ് മെട്രിക്സ് ആണ്.

എങ്കിൽ, ഓർഡർ 5 ആയ ഒരു യൂണിറ്റ് മെട്രിക്സിന് ഉദാഹരണം താഴെ പറയുന്നവയിൽ ഏത്?

A. $\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$ B. $\begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ C. $\begin{bmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}$ D. $\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$

38. $(p + q)(p - q) = p^2 - q^2$ ആകുന്നു.

$(a + b)(a - b) = a^2 - b^2$ ആകുന്നു

$(l + m)(l - m) = l^2 - m^2$ ആകുന്നു.

എങ്കിൽ. $(2x+y)(2x-y)$യുടെ വിലയെന്ത്?

A. $(2x)^2 - y^2$ C. $(2x)^2 + y^2$

B. $2x^2 - y^2$ D. $2x^2 + y^2$

39. $(\sqrt{5})^2 = 5$ ആകുന്നു.

$(\sqrt{100})^2 = 100$ ആകുന്നു.

$(\sqrt{1024})^2 = 1024$ ആകുന്നു.

എങ്കിൽ. $(\sqrt{X})^2$ എന്താകുന്നു?

A. $\sqrt{x}$ C. $\sqrt{2x}$

B. x^2 D. x

40. $I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ ആയാൽ $2I = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}$ ആകുന്നു.

$I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ ആയാൽ $4I = \begin{bmatrix} 4 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 4 \end{bmatrix}$ ആകുന്നു.

$I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ ആയാൽ $8I = \begin{bmatrix} 8 & 0 & 0 \\ 0 & 8 & 0 \\ 0 & 8 & 0 \end{bmatrix}$ ആകുന്നു

എങ്കിൽ P I എന്തായിരിക്കും?

A. $\begin{bmatrix} P & O & O \\ P & O & O \\ P & O & O \end{bmatrix}$ B. $\begin{bmatrix} P & O & O \\ O & P & O \\ O & O & P \end{bmatrix}$ C. $\begin{bmatrix} O & P & O \\ P & O & O \\ O & O & P \end{bmatrix}$ D. $\begin{bmatrix} O & P & O \\ O & P & O \\ O & P & O \end{bmatrix}$

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF INDUCTIVE REASONING
(DRAFT)

Dr. V. Sumangala
Reader in Education

Mumthas, N.S.
Research Scholar

Instructions *Time: 30 minutes*

This is a test of Mathematics with 40 questions. All the questions are objective type and each question carries four possible answers A, B, C and D. After reading each question choose the correct answer and mark the correct answer in the given response sheet by putting an 'X' symbol in the circle below the letter A,B,C or D which represents your answer.

If you feel that the answer marked is wrong, envelope that circle by a rectangle (▭) and again put the 'X' mark in the circle representing your answer.

Example:

i) 2x1 = 2
3x1 = 3
4x1 = 4

Then, what is the value of a x 1 ?

A. 2a C. a
B. 3a D. a^o

(Here, the correct answer is 'a'. Hence, the circle below the letter C, which represents the correct answer is marked using the symbol 'X' in the response sheet).

Response sheet				
	A	B	C	D
i)	O	O	X	O

1. The logarithmic form of $2^4 = x$ is $\log_2 x = 4$
The logarithmic form of $6^3 = y$ is $\log_6 y = 3$
The logarithmic form of $4^{-3/2} = p$ is $\log_4 p = -3\backslash 2$
Then, what is the logarithmic form of $N^a = x$

A. $\log_a x = N$ C. $\log_x N = a$
B. $\log_N x = a$ D. $\log_x a = N$

2. $7C_3$ means $\dfrac{7!}{3!\,(7-3)!}$

$2C_2$ means $\dfrac{2!}{2!\,(2-2)!}$

$4C_3$ means $\dfrac{4!}{3!\,(4-3)!}$

Then, what does nCr mean?

A. $\dfrac{r!}{n!(n-r)!}$ C. $\dfrac{n!}{r!(n-r)!}$

B. $\dfrac{n!}{r!n!}$ D. $\dfrac{r!}{n!\,(r-n)!}$

3. For any two sets A and B, if n(A) = 2 and n(B) = 2, then n (AxB) = 4
For any two sets M and N, if n(M) = 3 and n(N)=3, then n(MxN) = 9
For any two sets P and Q, if n(P) = 4 and n(Q) = 2, then n (PxQ)= 8
∴ For any two sets X and Y, if n(X) = C and n(Y)=d, then what is n(XxY) ?

A. c+d C. c-d
B. cd D. c/d

4. The square roof of 1, ie., $(\sqrt{1}) = 1$
The square root of 100, ie., $(\sqrt{100}) = 10$
The square root of 1000, ie., $(\sqrt{1000}) = 100$
Then, what is the square root of 1000000 ?

62

A. 100
B. 1000
C. 10000
D. 100000

5. $5^8 \div 5^2 = 5^6$
$7^4 \div 7^2 = 7^2$
$3^1 \div 3^1 = 3^0$

Then, what will be $a^m \div a^n$?

A. a^{m-n}
B. $a^{m/n}$
C. m-n
D. m/n

6. If $2^3 = 8$ then $\sqrt[3]{8} = 2$

If $4^4 = 256$ then $\sqrt[4]{256} = 4$

If $9^2 = 81$ then $\sqrt[2]{81} = 9$

Then, what is the value of $\sqrt[4]{2401}$ if $7^4 = 2401$?

A. 4
B. 7
C. 2401
D. 4^7

7. $x+2 = 5$ is a simple equation
$2y+1=0$ is a simple equation
$-4z+1 = 2z$ is a simple equation

Then, what about the number of variables in a simple equation?

A. 1
B. 2
C. 3
D. 4

8. $\cos \pi = -1$
$\cos 2\pi = 1$
$\cos 3\pi = -1$

$\therefore$ If 'n' is an even number, then what will be $\cos n\pi$?

A. -1
B. 0
C. 1
D. ∞

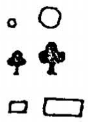
9. Let 'a' be the first term and 'd' the common difference of an Arithmetic Progression. Then its

Second term = a+d

Third term = a+2d
Fourth term = a+3d

Then, what will be the 10^{th} term ?

A.	a-10d	C.	a+10d
B.	a-9d	D.	a+9d

10. 

These are similar figures
These are similar figures
These are similar figures

Then, what are similar figures ?

A. Figures of same shape
B. Figures of same size
C. Figures of same shape and size
D. Figures which are not alike

11. A prism with 3 base edges has 5 faces
A prism with 4 base edges has 6 faces
A prism with 5 base edges has 7 faces

Then, how many faces does a prism with 'n' base edges have ?

A.	n-2	C.	n+1
B.	n-1	D.	n+2

12. The general form of a polynomial of first degree is $a_{1x}+a_o$; $a_1\neq o$
The general form of a polynomial of second degree is $a_2x^2+a_1x+a_o$; $a_2\neq o$
The general form of a polynomial of third degree is $a_3x^3+a_2x^2+a_1x+a_o$; $a_3\neq o$

Then, which of the following is the general form of a polynomial of degree 'p'?

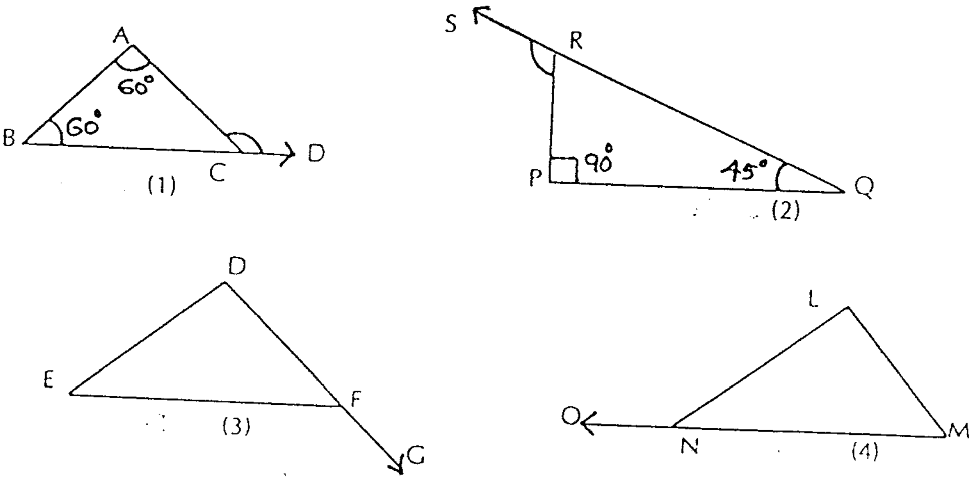
A. $a_px^p+a_{p-1}x^{p-1}$ ...... $+ a_o;a_p\neq o$
B. $a_px^p+a_{p-1}x^{p-1}$ ...... $+ a_o;a_o\neq o$
C. $a_px^{p-1}+a_{p-1}x^{p-2}+ \dots +a_o;\ a_p\neq o$
D. $a_{p-1}x^p+a_{p-2}x^{p-1}$ ..... $+ a_o;a_{p-1}\neq o$

13. The number of subsets of a null set = 2^o
The number of subsets of a set with one elment = 2^1
The number of subsets of a set with two elements = 2

Then, what will be the number of subsets of a set with 12 elements?

A.	2^o	C.	2^2
B.	2^1	D.	2^{12}

14.



In fig. (1), $\angle ACD = \angle A + \angle B = 120°$
In fig. (2), $\angle PRS = \angle P + \angle Q = 135°$
In fig. (3), $\angle EFG = \angle D + \angle E = 120°$

Then, in fig. (4), what is the measure of $\angle ONL$?

A. x-y C. 2x
B. x+y D. 2y

15. The interest for Rs.200 for 2 years at 4% rate = Rs.16
The interest for Rs.200 for 2 years at 5% rate = Rs.20
The interest for Rs.200 for 2 years at 6% rate = Rs.24

Then, what is the interest on Rs.200 for 2 years at 10% rate?

A. Rs.100 C. Rs. 32
B. Rs.40 D. Rs.28

16. axa is represented as a^2
axaxa is represented as a^3
axaxaxa is represented as a^4

Then how can axaxax .... n times be represented ?

A. a^{n+1} C. na
B. a^n D. a^{n-1}

17. 1! is 1
2! is 1x2
3! is 1x2x3

Then, what is 8! ?

A. 1x2x3x4x5x6x7x8! C. 1x2x3x4x5x6x7x8
B. 1x2x3x4x5x6x7!x8 D. 1x2x3x4x5x6x7

18.

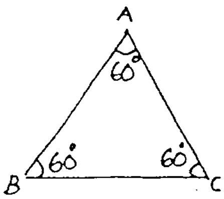


Fig. (1)

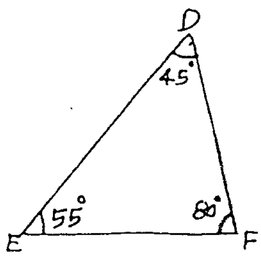


Fig. (2)

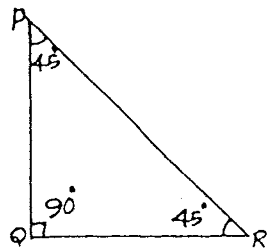


Fig. (3)

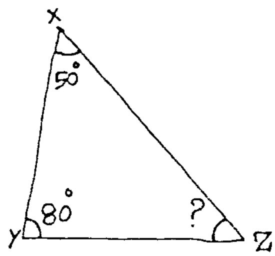


Fig.(4)

In fig. (1) , $\angle A+\angle B+\angle C = 180°$
In fig. (2) , $\angle D+\angle E+\angle F = 180°$
In fig. (3) , $\angle P+\angle Q+\angle R = 180°$

Then, what is the measure of $\angle Z$ in fig. (4) ?

A. 130° C. 50°
B. 80° D. 30°

19. $\sqrt{1x4}$ can be simplified as 1x2
$\sqrt{9x16}$ can be simplified as 3x4
$\sqrt{25x36}$ can be simplified as 5x6

Then, which of the following is the simplified form of $\sqrt{x^2y^2}$?

A. x x y C. x/2 x y/2
B. $\sqrt{x}$ x $\sqrt{y}$ D. x^2 x y^2.

20. The value of $(2\sqrt{4})^2$ is 4
The value of $(3\sqrt{5})^3$ is 5
The value of $(4\sqrt{6})^4$ is 6

Then, what is the value of $(a\sqrt{b})^a$?

A. $a\sqrt{b}$ C. a
B. $\sqrt{ab}$ D. b

21. If A = {1,2} and B = {3,4} then A∪B = {1,2,3,4}
If P = {l,m} and Q = {n} then P∪Q = {1,m,n}
If x = {+,–,×} and Y = {+,÷} then X∪Y = {+, –,×,÷}

∴ If C = {□,O} and D = {Δ,O}, then what is C ∪ D?

A. {O} C. {□, O, Δ}
B. {□,Δ} D. {□, O, Δ, O}

22. 1/10 = 0.1
1/100 = 0.01
1/1000 = 0.001

Then, what is the value of 1/100000 ?

A. 0.000001 C. 0.0001
B. 0.00001 D. 0.001

23. 1/2 ÷ 1/3 = 1/2 x 3/1
-1/7 ÷ 2/11 = -1/7 x 11/2
3/10 ÷ -4/15 = 3/10 x -15/4

Then, what is -a/b ÷ -c/d ?

A. -a/b x -d/c C. -a/b x c/d
B. -a/b x -c/d D. -a/b x d/c

24. The radius of a circle of diameter 4 cm is 2 cm.
The radius of a circle of diameter 6 cm is 3 cm.
The radius of a circle of diameter 9 cm is 4.5 cm.

Then, what is the radius of a circle whose diameter is P/2 cm?

A. P-2 cm B. P cm
B. P/4 cm D. P/2 cm

25. {1,2} and {3,4} are equivalent sets.
{a,b} and {-7,0} are equivalent sets.
{-1} and {0} are equivalent sets.

Then, which of the following are equivalent sets?

A. {a,e,i}, {0. u} C. {1,0}, {1}
B. { }, {0} D. {+, 1}, {÷, x}

26. The mode of the observations 8, 12, 24, 12, 3, 12 and 3 is 12.
The mode of the observations 29, 27, 32, 27, 32, 27 and 26 is 27.
The mode of the observations 49, 50, 49, 49, 51, 53 and 54 is 49.

Then, what is the mode of the observations 25, 24, 40, 37, 40, 40 and 24?

A. 40 C. 25
B. 37 D. 24

27. Volume of a cube of edge 2 cm is 8 cm^3.
Volume of a cube of edge 4 cm is 64 cm^3.
Volume of a cube of edge 5 cm is 125 cm^3.

Then, what will be the volume of a cube of edge p cm?

A. $3p\ cm^3$ C. $(\sqrt{p}\ cm)^3$
B. $p^3\ cm^3$ D. $p^2\ cm^3$

28.

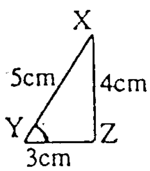


Fig. (1)

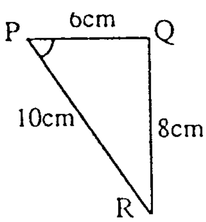


Fig. (2)

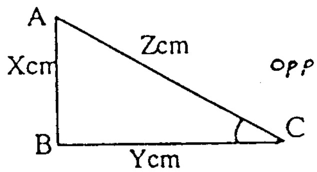


Fig. (3)

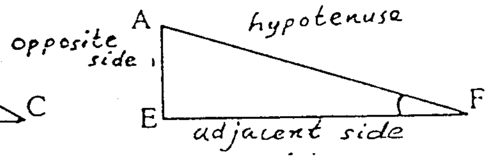


Fig. (4)

In fig. (1), Cos y = 3/5
In fig. (2), Cos p = 6/10
In fig. (3), Cos c = y/z

Then, what is cos F in fig. (4)?

A. Opposite side/Adjacent side C. Hypotenuse/Adjacent side
B. Adjacent side/Hypotenuse D. Adjacent side/Opposite side

29. $\log 3^3 = 3 \log 3$
$\log 7^6 = 6 \log 7$
$\log 5^3 = 3 \log 5$

Then, what is $\log a^r$?

A. $r \log a$ C. $a^r \log a$
B. $r \log a^r$ D. $r \log r$

30. In the quadratic equation $2x^2 + 5x - 12 = 0$, the sum of the terms of the truth set is -5/2

In the quadratic equation $x^2 - 10x + 16 = 0$, the sum of the terms of the truth set is 10/1

In the quadratic equation $-y^2 + 6y + 8 = 0$, the sum of the terms of the truth set is -6/-1.

Then, what will be the sum of terms of the truth set of the quadratic equation $px^2 + qx + r = 0$?

A. -p/q
B. p/q
C. q/p
D. -q/p

31.

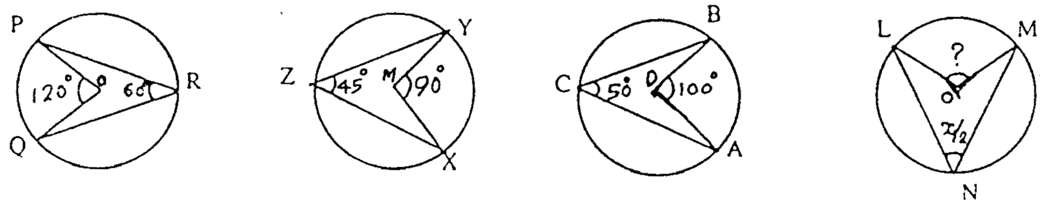


Fig. (1) Fig. (2) Fig. (3) Fig. (4)

In Fig. (1), if ∠R = 60° then ∠POQ = 120°
In Fig. (2), if ∠Z = 45° then ∠XMY = 90°
In Fig. (3), if ∠C = 50° then ∠ADB = 100°

Then, in Fig. (4) if $\angle N = \left(\frac{x}{2}\right)^{\circ}$ then what is the measure of ∠LOM?

A. x°
B. $2x^{\circ}$
C. $x^{2\circ}$
D. $\left(\frac{x}{2}\right)^{\circ}$

32. The set of counting members between 13 and 15 is an example for a singleton set.

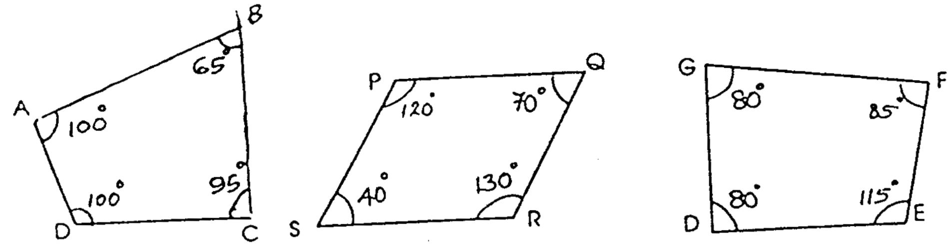
The set of months having days less than 30 is an example for a single set.

The set of numbers other than positive and negative numbers is an example for a singleton set.

Then, what is the number of elements in a singleton set?

A. -1
B. 0
C. 1
D. 2

33.



Notice the relation between the angles of the quadrilaterals (1), (2) & (3). Using this,write the measure of $\angle M$ in fig. (4).

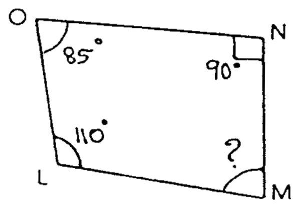


Fig. (4)

A. 85°
B. 90°
C. 110°
D. 75°

34. The area of a circle of radius 1 cm is π cm^2.
The area of a circle of radius 2 cm is 4π cm^2.
The area of a circle of radius 3 cm is 9π cm^2.

Then, what is the area of a circle of radius 'x' cm?

A. π cm^2 B. πx cm^2 C. πx^2 cm^2 D. π/x^2 cm^2

35.

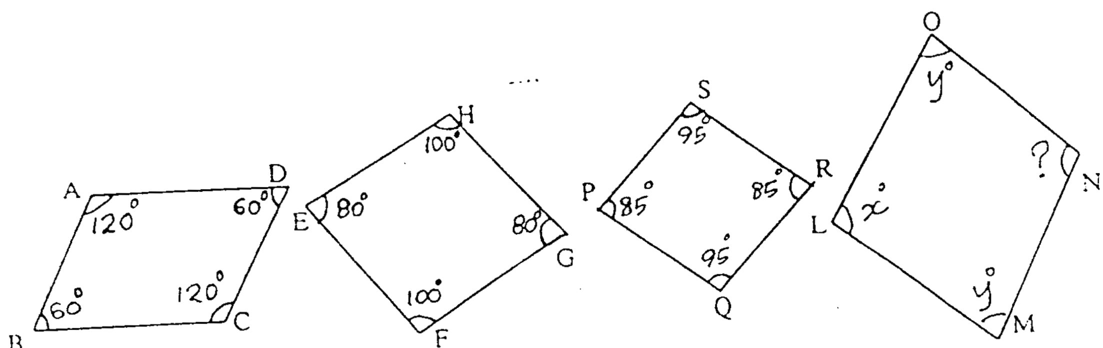


Fig. (1) Fig. (2) Fig. (3) Fig. (4)

Notice the relation between the angles of the parallelograms (1), (2) and (3). Using this, what is the measure of $\angle N$ in fig. (4)?

A. y°
B. x°
C. x+y°
D. x-y°

36. $(2a+b)^2 = 4a^2 + 4ab + b^2$
$(l+3m)^2 = l^2 + 6lm + 9m^2$
$(2x+4y)^2 = 4x^2 + 16xy + 16y^2$

Then, what will be $(2p+q)^2$?

A. $2p^2 + 2pq + q^2$
B. $4p + 4pq + q^2$
C. $4p^2 + 4pq + q^2$
D. $4p^2 + 2pq + q^2$

37. $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ is a unit matrix of order 2.

$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ is a unit matrix of order 3.

$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ is a unit matrix of order 4.

Then, which of the following is an example for a unit matrix of order 5?

A. $\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$
B. $\begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$
C. $\begin{bmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}$
D. $\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$

38. $(p+q)(p-q) = p^2 - q^2$
$(a+b)(a-b) = a^2 - b^2$
$(l+m)(l-m) = l^2 - m^2$

Then, what is the value of $(2x+y)(2x-y)$?

A. $(2x)^2 - y^2$
B. $2x^2 - y^2$
C. $(2x)^2 + y^2$
D. $2x^2 + y^2$

39. $(\sqrt{5})^2 = 5$
$(\sqrt{100})^2 = 100$
$(\sqrt{1024})^2 = 1024$

Then, what is $(\sqrt{x})^2$?

A. $\sqrt{x}$
B. x^2
C. $\sqrt{2x}$
D. x

40. If $I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ then $2I = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}$

If $I = \begin{vmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{vmatrix}$ then $4I = \begin{bmatrix} 4 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 4 \end{bmatrix}$

If $I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ then $8I = \begin{bmatrix} 8 & 0 & 0 \\ 0 & 8 & 0 \\ 0 & 0 & 8 \end{bmatrix}$

Then, what will be PI?

A. $\begin{bmatrix} P & O & O \\ P & O & O \\ P & O & O \end{bmatrix}$

C. $\begin{bmatrix} O & P & O \\ P & O & O \\ O & O & P \end{bmatrix}$

B. $\begin{bmatrix} P & O & O \\ O & P & O \\ O & O & P \end{bmatrix}$

D. $\begin{bmatrix} O & P & O \\ O & P & O \\ O & P & O \end{bmatrix}$

-12-

APPENDIX XI (a)

UNIVERSITY OF CALICUT

DEPARTMENT OF EDUCATION

TEST OF INDUCTIVE REASONING

SCORING KEY

1.	B	21.	C
2.	C	22.	B
3.	B	23.	A
4.	C	24.	B
5.	A	25.	D
6.	B	26.	A
7.	A	27.	B
8.	C	28.	B
9.	D	29.	A
10.	A	30.	D
11.	D	31.	A
12.	A	32.	C
13.	D	33.	D
14.	B	34.	C
15.	B	35.	B
16.	B	36.	C
17.	C	37.	A
18.	C	38.	A
19.	A	39.	D
20.	D	40.	B

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
TEST OF INDUCTIVE REASONING

Dr. V.Sumangala
Reader in Education

Mumthas.N.S.
Research Scholar

നിർദ്ദേശങ്ങൾ: സമയം : 30 മിനിറ്റ്

ഗണിതശാസ്ത്രസംബന്ധിയായ 38 ചോദ്യങ്ങളാണ് താഴെ കൊടുത്തിരിക്കുന്നത്. ഓരോ ചോദ്യത്തിനും A,B,C,D എന്നീ നാല് തരം ഉത്തരങ്ങൾ നൽകിയിരിക്കുന്നു. ഓരോ ചോദ്യവും വായിച്ചശേഷം ശരിയുത്തരം തെരഞ്ഞെടുത്ത് അതാത് ചോദ്യനമ്പരിനെതിരെ ഇതോടൊപ്പം നൽകിയിരിക്കുന്ന ഉത്തരക്കടലാസ്സിൽ A,B,C,Dഎന്നീ അക്ഷരങ്ങൾക്ക് താഴെ നൽകിയിട്ടുള്ള വൃത്തത്തിൽ"X" അടയാളം കൊണ്ട് രേഖപ്പെടുത്തുക.

രേഖപ്പെടുത്തിയത് തെറ്റായ വൃത്തത്തിലാണെന്ന് തോന്നിയാൽ ആ വൃത്തത്തെ "□" ചിഹ്നം കൊണ്ട് വലയം ചെയ്തശേഷം ശരിയായ വൃത്തത്തിൽ വീണ്ടും "X"അടയാളമിടുക.

ഉദാഹരണം:

1. $2 \times 1 = 2$ ആകുന്നു
   $3 \times 1 = 3$ ആകുന്നു
   $4 \times 1 = 4$ ആകുന്നു

എങ്കിൽ, $a \times 1$ ന്റെ വിലയെന്ത്?

A. 2a C. a
B. 3a D. a^0

(ഇവിടെ ശരിയുത്തരം a ആണല്ലോ. ആയതിനാൽ ശരിയുത്തരത്തെ സൂചിപ്പിക്കുന്ന C എന്ന അക്ഷരത്തിനു താഴെയുള്ള വൃത്തത്തിൽ "X"എന്ന അടയാളം രേഖപ്പെടുത്തിയിരിക്കുന്നു.)

ഉത്തരക്കടലാസ്

	A	B	C	D
1)	○	○	⊗	○

5. $5^8 \div 5^2 = 5^6$ആകുന്നു

$7^4 \div 7^2 = 7^2$ആകുന്നു

$3^1 \div 3^1 = 3^0$ആകുന്നു

എങ്കിൽ, $a^m \div a^n$ എന്തായിരിക്കും?

A. a^{m-n} C. m-n

B. $a^{m/n}$ D. m/n

6. $2^3 = 8$ ആയാൽ $\sqrt[3]{8} = 2$ആകുന്നു

$4^4 = 256$ആയാൽ $\sqrt[4]{256} = 4$ ആകുന്നു

$9^2 = 81$ആയാൽ $\sqrt[2]{81} = 9$ ആകുന്നു

എങ്കിൽ, $7^4 = 2401$ ആയാൽ $\sqrt[4]{2401}$ എത്ര?

A. 4 C. 2401

B. 7 D. 4^7

7. x+2 = 5എന്നത് ഒരു ലഘുസമവാക്യമാണ്.

2y +1 =0എന്നത് ഒരു ലഘുസമവാക്യമാണ്.

-4z + 1 = 2zഎന്നത് ഒരു ലഘുസമവാക്യമാണ്.

എങ്കിൽ, ഒരു ലഘുസമവാക്യത്തിലെ ചരങ്ങളുടെ എണ്ണം എത്ര ആയിരിക്കും?

A. 1 C. 3

B. 2 D. 4

8. $\cos \pi = -1$

$\cos 2\pi = 1$

$\cos 3\pi = -1$

$\therefore$ n ഒരു ഇരട്ടസംഖ്യയായാൽ $\cos n\pi$എന്തായിരിക്കും?

A. -1 C. 1

B. 0 D. ∞

9. ആദ്യപദം 'a'യും പൊതുവ്യത്യാസം 'd'യുമായ ഒരു സമാന്തരപ്രോഗ്രഷന്റെ

രണ്ടാം പദം a+d ആണ്

മൂന്നാം പദം a+2d ആണ്

നാലാം പദം a+3d ആണ്

എങ്കിൽ 10-ാം പദം എന്തായിരിക്കും?

A. a-10d   C. a+10d

B. a-9d   D. a+9d.

10. ○ ◯ ഇവ സദൃശരൂപങ്ങളാണ്

♣ ♣ ഇവ സദൃശരൂപങ്ങളാണ്

□ ▭ ഇവ സദൃശരൂപങ്ങളാണ്

എങ്കിൽ സദൃശരൂപങ്ങൾ എന്നാൽ എന്ത്?

A. ഒരേ ആകൃതിയുള്ളവ   C.ഒരേ ആകൃതിയും വലിപ്പവുമുള്ളവ

B. ഒരേ വലിപ്പമുള്ളവ   D. യാതൊരു സാമ്യവുമില്ലാത്തവ

11. 3 പാദവക്കുകളുള്ള ഒരു സ്തംഭത്തിന് 5 മുഖങ്ങളുണ്ട്

4 പാദവക്കുകളുള്ള ഒരു സ്തംഭത്തിന് 6 മുഖങ്ങളുണ്ട്

5 പാദവക്കുകളുള്ള ഒരു സ്തംഭത്തിന് 7 മുഖങ്ങളുണ്ട്

എങ്കിൽ,n പാദവക്കുകളുള്ള ഒരു സ്തംഭത്തിന്റെ മുഖങ്ങളുടെ എണ്ണം എത്ര ആയിരിക്കും?

A. n-2   C. n+1

B. n-1   D. n+2

12. കൃതി 1 ആയ പോളിനോമിയലിന്റെ സാമാന്യരൂപം $a_1x+a_0;\ a_1\neq 0$ ആണ്

കൃതി 2 ആയ പോളിനോമിയലിന്റെ സാമാന്യരൂപം $a_2x^2+a_1x+a_0;a_2\neq 0$ ആണ്

കൃതി 3 ആയ പോളിനോമിയലിന്റെ സാമാന്യരൂപം $a_3x^3+a_2x^2+a_1x+a_0;a_3\neq 0$ആണ്

എങ്കിൽ, കൃതി 'P'ആയ പോളിനോമിയലിന്റെ സാമാന്യരൂപം താഴെ തന്നിരിക്കുന്നവയിൽ ഏത്?

A. $a_p x^p+a_{p-1}x^{p-1}+......+a_0;a_p\neq 0$ C. $a_p x^{p-1}+a_{p-1}x^{p-2}+......+a_0;a_p\neq 0$

B. $a_p x^p+a_{p-1}x^{p-1}+......+a_0;a_0\neq 0$ D. $a_{p-1} x^p+a_{p-2}x^{p-1}+......+a_0;a_{p-1}\neq 0$

13. ഒരു ശൂന്യഗണത്തിന്റെ ഉപഗണങ്ങളുടെ എണ്ണം$=2^0$

ഒരംഗമുള്ള ഗണത്തിന്റെ ഉപഗണങ്ങളുടെ എണ്ണം$=2^1$

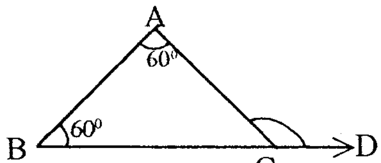
രണ്ടംഗമുള്ള ഗണത്തിന്റെ ഉപഗണങ്ങളുടെ എണ്ണം$=2^2$

എങ്കിൽ, 12 അംഗങ്ങളുള്ള ഒരു ഗണത്തിന്റെ ഉപഗണങ്ങളുടെ എണ്ണം എന്തായിരിക്കും?

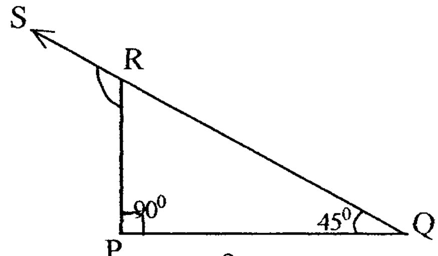
A. 2^0 C. 2^2

B. 2^1 D. 2^{12}

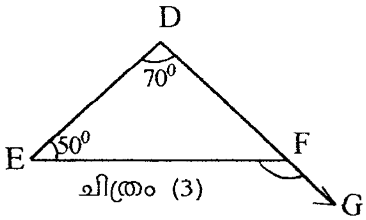
14.



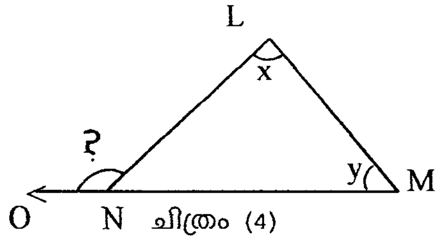
ചിത്രം (1)



ചിത്രം (2)



ചിത്രം (3)



ചിത്രം (4)

ചിത്രം (1)ൽ $\angle ACD = \angle A + \angle B = 120^0$

ചിത്രം (2)ൽ $\angle PRS = \angle P + \angle Q = 135^0$

ചിത്രം(3)ൽ $\angle EFG = \angle D + \angle E = 120^0$

എങ്കിൽ ചിത്രം (4)ൽ $\angle LNO$ന്റെ അളവ് എന്തായിരിക്കും?

A. x-y C. 2x

B. x+y D. 2y

15. 200 രൂപയ്ക്ക് 2 വർഷത്തേക്ക് 4% നിരക്കിൽ പലിശ = 16 രൂപ

200 രൂപയ്ക്ക് 2 വർഷത്തേക്ക് 5% നിരക്കിൽ പലിശ = 20 രൂപ

200 രൂപയ്ക്ക് 2 വർഷത്തേക്ക് 6% നിരക്കിൽ പലിശ = 24 രൂപ

എങ്കിൽ, 200 രൂപക്ക് 2 വർഷത്തേക്ക് **10%** നിരക്കിൽ പലിശ എത്ര?

A. 100 രൂപ C. 32 രൂപ

B. 40 രൂപ D. 28 രൂപ

16. a x a എന്നതിനെ a^2എന്ന് സൂചിപ്പിക്കുന്നു

a x a x aഎന്നതിനെ a^3 എന്ന് സൂചിപ്പിക്കുന്നു

a x a x a x aഎന്നതിനെ a^4 എന്ന് സൂചിപ്പിക്കുന്നു

എങ്കിൽ, a x a x a x a x............nപ്രാവശ്യം എന്നതിനെ എങ്ങനെ സൂചിപ്പിക്കാം?

A. a^{n+1} C. na

B. a^n D. a^{n-1}

17. 1! എന്നത് 1 ആകുന്നു

2! എന്നത് 1x2 ആകുന്നു

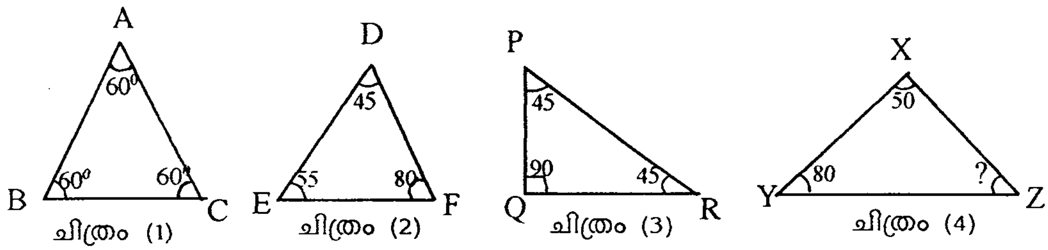
3! എന്നത് 1x2x3 ആകുന്നു

എങ്കിൽ, 8! എന്നത് എന്ത്?

A. 1 x 2 x 3 x 4 x 5 x 6 x 7 x 8! C. 1 x 2 x 3 x 4 x 5 x 6 x 7 x 8

B. 1 x 2 x 3 x 4 x 5 x 6 x 7! x 8 D. 1 x 2 x 3 x 4 x 5 x 6 x 7

18.



ചിത്രം (1)ൽ $\angle A + \angle B + \angle C = 180^0$

ചിത്രം (2)ൽ $\angle D + \angle E + \angle F = 180^0$

ചിത്രം (3)ൽ $\angle P + \angle Q + \angle R = 180^0$

എങ്കിൽ ചിത്രം (4) ൽ $\angle Z$ ന്റെ അളവെത്ര?

A. 130^0 C. 50^0

B. 80^0 D. 30^0

19. $\sqrt{1 \times 4}$ എന്നത് 1 x 2 എന്ന് ലഘൂകരിക്കാം

$\sqrt{9 \times 16}$ എന്നത് 3 x 4 എന്ന് ലഘൂകരിക്കാം

$\sqrt{25 \times 36}$ എന്നത് 5 x 6 എന്ന് ലഘൂകരിക്കാം

എങ്കിൽ താഴെ പറയുന്നവയിൽ $\sqrt{X^2 \times Y^2}$ ന്റെ ലഘു രൂപം ഏത്?

A. X x Y C. $X/_2 \times Y/_2$

B. $\sqrt{X} \times \sqrt{Y}$ D. $X^2 \times Y^2$

20. $({}^2\sqrt{4})^2$ന്റെ വില 4 ആകുന്നു

$({}^3\sqrt{5})^3$ന്റെ വില 5 ആകുന്നു

$({}^4\sqrt{6})^4$ന്റെ വില 6 ആകുന്നു

എങ്കിൽ, $({}^a\sqrt{b})^a$യുടെ വില എന്ത്?

A. $a\sqrt{b}$ C. a

B. $\sqrt{a}\ b$ D. b

21. $A = \{1,2\}$, $B = \{3,4\}$ആയാൽ $A \cup B = \{1,2,3,4\}$ആയിരിക്കും

$P = \{l,m\}$, $Q = \{n\}$ ആയാൽ$P \cup Q = \{l,m,n\}$ ആയിരിക്കും

$X = \{+, -, x\}$, $Y = \{+, \div\}$ ആയാൽ$X \cup Y = \{+, -, x, \div\}$ ആയിരിക്കും

എങ്കിൽ, $C = \{\square, \bigcirc\}$, $D = \{\triangle, \bigcirc\}$ആയാൽ $C \cup D$ എന്തായിരിക്കും?

A. $\{\bigcirc\}$

B. $\{\square, \triangle\}$

C. $\{\square, \bigcirc, \triangle\}$

D. $\{\square, \bigcirc, \triangle, \bigcirc\}$

22. $^1/10 = 0.1$

$^1/100 = 0.01$

$^1/1000 = 0.001$

എങ്കിൽ $^1/100000$ ന്റെ വിലയെന്ത്?

A. 0.000001

B. 0.00001

C. 0.0001

D. 0.001

23. $\frac{1}{2} \div \frac{1}{3} = \frac{1}{2} \times \frac{3}{1}$ ആകുന്നു

$\frac{-1}{7} \div \frac{2}{11} = \frac{-1}{7} \times \frac{11}{2}$ ആകുന്നു

$\frac{3}{10} \div \frac{-4}{15} = \frac{3}{10} \times \frac{-15}{4}$ ആകുന്നു

എങ്കിൽ, $^{-a}/b \div {}^{-c}/d$ എന്നത് എന്ത്?

A. $\frac{-a}{b} \times \frac{-d}{c}$

B. $\frac{-a}{b} \times \frac{-c}{d}$

C. $\frac{-a}{b} \times \frac{c}{d}$

D. $\frac{-a}{b} \times \frac{d}{c}$

24. $\{1,2\}$, $\{3,4\}$ ഇവ സമാംഗഗണങ്ങളാണ്

$\{a,c\}$, $\{-7,0\}$ഇവ സമാംഗഗണങ്ങളാണ്

$\{-1\}$, $\{0\}$ഇവ സമാംഗഗണങ്ങളാണ്

എങ്കിൽ, താഴെ പറയുന്നവയിൽ സമാംഗഗണങ്ങളേത്?

A. $\{a,e,i\}, \{o,u\}$

B. $\{\ \}\ \{0\}$

C. $\{1,0\}, \{1\}$

D. $\{+,-\}, \{\div, x\}$

25. 8,12 24, 12, 3, 12, 3 എന്നീ പ്രാപ്താങ്കങ്ങളുടെ മോഡ് 12 ആകുന്നു.

29, 27, 32, 27, 32, 27, 26 എന്നീ പ്രാപ്താങ്കങ്ങളുടെ മോഡ് 27 ആകുന്നു.

49, 50, 49, 49, 51, 53, 54 എന്നീ പ്രാപ്താങ്കങ്ങളുടെ മോഡ് 49 ആകുന്നു.

എങ്കിൽ,25, 24, 40, 37, 40, 40, 24 എന്നീ പ്രാപ്താങ്കങ്ങളുടെ മോഡ് എന്ത്?

A. 40 C. 25

B. 37 D. 24

26. വക്കിന്റെ നീളം2cm ആയ ക്യൂബിന്റെ വ്യാപ്തം8cm^3 ആകുന്നു.

വക്കിന്റെ നീളം 4cm ആയ ക്യൂബിന്റെ വ്യാപ്തം64cm^3 ആകുന്നു.

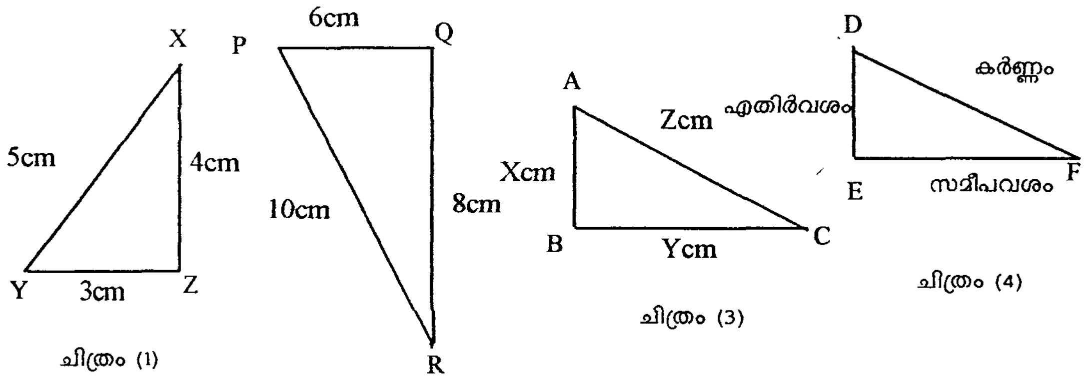
വക്കിന്റെ നീളം 5cm ആയ ക്യൂബിന്റെ വ്യാപ്തം 125cm^3ആകുന്നു.

എങ്കിൽ, വക്കിന്റെ നീളം Pcm ആയ ക്യൂബിന്റെ വ്യാപ്തം എന്തായിരിക്കും?

A. $3P\ cm^3$ C. $(\sqrt{P}cm)^3$

B. $P^3\ cm^3$ D. $P^2\ cm^3$

27.



ചിത്രം (1) ചിത്രം (2) ചിത്രം (3) ചിത്രം (4)

ചിത്രം (1) ൽCos Y = $^3/_5$

ചിത്രം (2) ൽ Cos P = $^6/_{10}$

ചിത്രം (3) ൽCos C = $^Y/_Z$

എങ്കിൽ, ചിത്രം(4) ൽCOSF എന്തായിരിക്കും?

A. $\frac{\text{എതിർവശം}}{\text{സമീപവശം}}$ C $\frac{\text{കർണ്ണം}}{\text{സമീപവശം}}$

B. $\frac{\text{സമീപവശം}}{\text{കർണ്ണം}}$ D $\frac{\text{സമീപവശം}}{\text{എതിർവശം}}$

28. $\log 3^3 = 3 \log 3$ ആകുന്നു

$\log 7^6 = 6 \log 7$ ആകുന്നു

$\log 5^3 = 3 \log 5$ ആകുന്നു

എങ്കിൽ, $\log a^r$ എന്തായിരിക്കും?

A. $r \log a$ C. $a^r \log a$

B. $r \log a^r$ D. $r \log r$

29. $2x^2 + 5x - 12 = 0$ എന്ന ദ്വിമാന സമവാക്യത്തിന്റെ മൂല്യഗണത്തിലെ അംഗങ്ങളുടെ തുക $^{-5}/_{2}$ ആണ്

$x^2 - 10x + 16 = 0$ എന്ന ദ്വിമാന സമവാക്യത്തിന്റെ മൂല്യഗണത്തിലെ അംഗങ്ങളുടെ തുക $^{10}/_{1}$ ആണ്

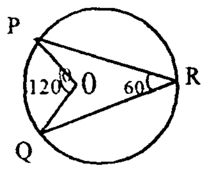
$-y^2 + 6y + 8 = 0$ എന്ന ദ്വിമാന സമവാക്യത്തിന്റെ മൂല്യഗണത്തിലെ അംഗങ്ങളുടെ തുക $^{-6}/_{-1}$ ആണ്

എങ്കിൽ, $px^2 + qx + r = 0$എന്ന ദ്വിമാന സമവാക്യത്തിന്റെ മൂല്യഗണത്തിലെ അംഗങ്ങളുടെ തുക എന്തായിരിക്കും?

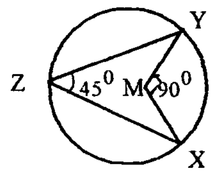
A. $^{-p}/_{q}$ C. $^{q}/_{p}$

B. $^{p}/_{q}$ D. $^{-q}/_{p}$

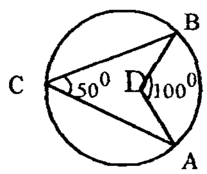
30.



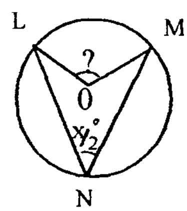
ചിത്രം (1)



ചിത്രം (2)



ചിത്രം (3)



ചിത്രം (4)

ചിത്രം (1)ൽ $\angle R = 60^0$ ആയാൽ $\angle POQ = 120^0$ ആകുന്നു

ചിത്രം (2)ൽ $\angle Z = 45^0$ ആയാൽ $\angle XMY = 90^0$ആകുന്നു

ചിത്രം (3)ൽ $\angle C = 50^0$ആയാൽ $\angle ADB = 100^0$ആകുന്നു

എങ്കിൽ, ചിത്രം (4)ൽ $\angle N = {x/2}^0$ ആയാൽ$\angle LOM$ ന്റെ അളവെത്ര?

A x^0 C. x^{20}

B. $2x^0$ D.${x/2}^0$

31. 13നും 15നും ഇടക്കുള്ള എണ്ണൽ സംഖ്യകളുടെ ഗണം ഏകാംഗഗണത്തിനുദാഹരണമാണ്.
30ൽ കുറവ് ദിവസങ്ങളുള്ള മാസങ്ങളുടെ ഗണം ഏകാംഗഗണ ത്തിനുദാഹരണമാണ്
പോസിറ്റീവോ നെഗറ്റീവോ അല്ലാത്ത സംഖ്യകളുടെ ഗണം ഏകാംഗഗണത്തിനുദാഹരണമാണ്.
എങ്കിൽ ഏകാംഗഗണത്തിലെ അംഗങ്ങളുടെ എണ്ണം എത്ര?

A. -1 C. 1

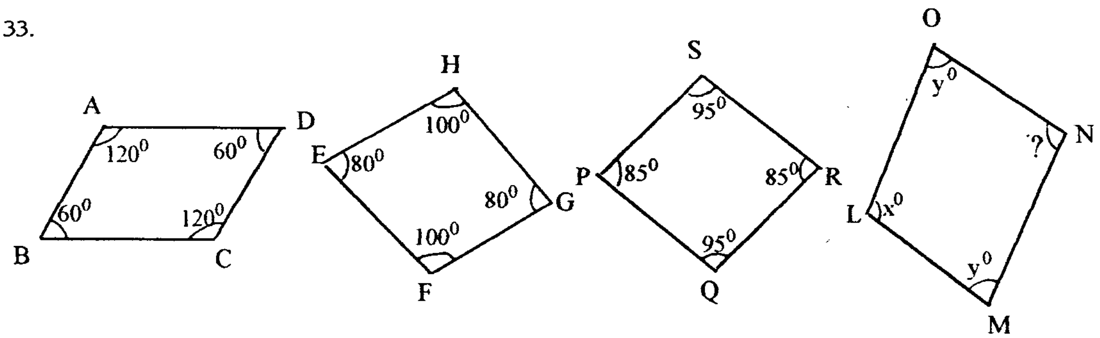
B. 0 D. 2

32. 1 cm ആരമുള്ള വൃത്തത്തിന്റെ വിസ്തീർണ്ണം πcm^2ആകുന്നു
2cm ആരമുള്ള വൃത്തത്തിന്റെ വിസ്തീർണ്ണം $4\pi cm^2$ആകുന്നു
3cm ആരമുള്ള വൃത്തത്തിന്റെ വിസ്തീർണ്ണം $9\pi cm^2$ആകുന്നു
എങ്കിൽ 'x' cm ആരമുള്ള ഒരു വൃത്തത്തിന്റെ വിസ്തീർണ്ണം എന്ത്?

A. πcm^2 C. $\pi x^2 cm^2$

B. $\bar{\Lambda}\, x\, cm^2$ D. $\pi/x^2 cm^2$

33.



ചിത്രം (1) ചിത്രം (2) ചിത്രം (3) ചിത്രം (4)

സാമാന്തരികം 1,2,3 ഇവയിൽ കോണുകൾ തമ്മിലുള്ള ബന്ധം ശ്രദ്ധിക്കുക.
അതുപയോഗിച്ച് ചിത്രം (4) ൽ ∠Nന്റെ അളവെത്ര?

A. Y^0 C. $x + y^0$

b. x^0 D. $x - y^0$

34. $(2a + b)^2 = 4a^2 + 4ab + b^2$ ആകുന്നു
$(1 + 3m)^2 = 1^2 + 61m + 9m^2$ആകുന്നു
$(2x + 4y)^2 = 4x^2 + 16xy + 16y^2$ആകുന്നു
എങ്കിൽ $(2p + q)^2$എന്തായിരിക്കും?

A. $2p^2 + 2pq + q^2$ C. $4p^2 + 4pq + q^2$

B. $4p + 4pq + q^2$ D. $4p^2 + 2pq + q^2$

35.

$\begin{bmatrix} 10 \\ 01 \end{bmatrix}$ എന്നത് ഓർഡർ 2 ആയ ഒരു യൂണിറ്റ് മെട്രിക്സ് ആണ്

$\begin{bmatrix} 100 \\ 010 \\ 001 \end{bmatrix}$ എന്നത് ഓർഡർ 3 ആയ ഒരു യൂണിറ്റ് മെട്രിക്സ് ആണ്

$\begin{bmatrix} 1000 \\ 0100 \\ 0010 \\ 0001 \end{bmatrix}$ എന്നത് ഓർഡർ 4 ആയ ഒരു യൂണിറ്റ് മെട്രിക്സ് ആണ്

എങ്കിൽ, ഓർഡർ 5 ആയ ഒരു യൂണിറ്റ് മെട്രിക്സിന് ഉദാഹരണം താഴെ പറയുന്നവയിൽ ഏത്?

A $\begin{bmatrix} 10000 \\ 01000 \\ 00100 \\ 00010 \\ 00001 \end{bmatrix}$ B $\begin{bmatrix} 1001 \\ 0100 \\ 0010 \\ 0001 \end{bmatrix}$ C $\begin{bmatrix} 0001 \\ 0010 \\ 0100 \\ 1000 \end{bmatrix}$ D $\begin{bmatrix} 10000 \\ 00100 \\ 00010 \\ 00001 \end{bmatrix}$

36. $(p + q)(p - q) = p^2 - q^2$ ആകുന്നു

$(a + b)(a - b) = a^2 - b^2$ ആകുന്നു

$(1 + m)(1 - m) = 1^2 - m^2$ ആകുന്നു

എങ്കിൽ,$(2x + y)(2x - y)$ യുടെ വിലയെന്ത്?

A. $(2x)^2 - y^2$ C. $(2x)^2 + y^2$

B. $2x^2 - y^2$ D. $2x^2 + y^2$

37. $(\sqrt{5})^2 = 5$ ആകുന്നു

$(\sqrt{100})^2 = 100$ ആകുന്നു

$(\sqrt{1024})^2 = 1024$ ആകുന്നു

എങ്കിൽ $(\sqrt{X})^2$എന്താകുന്നു.

A. $\sqrt{X}$ C. $\sqrt{2X}$

B. X^2 D. X

38.

$I = \begin{bmatrix} 100 \\ 010 \\ 001 \end{bmatrix}$ ആയാൽ $2I = \begin{bmatrix} 200 \\ 020 \\ 002 \end{bmatrix}$ ആകുന്നു

$I = \begin{bmatrix} 100 \\ 010 \\ 001 \end{bmatrix}$ ആയാൽ $4I = \begin{bmatrix} 400 \\ 040 \\ 004 \end{bmatrix}$ ആകുന്നു

$I = \begin{bmatrix} 100 \\ 010 \\ 001 \end{bmatrix}$ ആയാൽ $8I = \begin{bmatrix} 800 \\ 080 \\ 008 \end{bmatrix}$ ആകുന്നു

എങ്കിൽ PI എന്തായിരിക്കും?

A $\begin{bmatrix} POO \\ POO \\ POO \end{bmatrix}$ B $\begin{bmatrix} POO \\ OPO \\ OOP \end{bmatrix}$ C $\begin{bmatrix} OPO \\ POO \\ OOP \end{bmatrix}$ D $\begin{bmatrix} OPO \\ OPO \\ OPO \end{bmatrix}$

APPENDIX XIII

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF INDUCTIVE REASONING

Dr. V. Sumangala
Reader in Education

Mumthas, N.S.
Research Scholar

Instructions *Time: 30 minutes*

This is a test of Mathematics with 38 questions. All the questions are objective type and each question carries four possible answers A, B, C and D. After reading each question choose the correct answer and mark the correct answer in the given response sheet by putting an 'X' symbol in the circle below the letter A,B,C or D which represents your answer.

If you feel that the answer marked is wrong, envelope that circle by a rectangle (☐) and again put the 'X' mark in the circle representing your answer.

Example:

i) 2x1 = 2
3x1 = 3
4x1 = 4

Then, what is the value of a x 1 ?

A. 2a C. a
B. 3a D. a^{o}

(Here, the correct answer is 'a'. Hence, the circle below the letter C, which represents the correct answer is marked using the symbol 'X' in the response sheet).

Response sheet

	A	B	C	D
i)	O	O	⊗	O

1. The logarithmic form of $2^4 = x$ is $\log_2 x = 4$
The logarithmic form of $6^3 = y$ is $\log_6 y = 3$
The logarithmic form of $4^{-3/2} = p$ is $\log_4 p = -3\backslash 2$

Then, what is the logarithmic form of $N^a = x$

A. $\log_a x = N$
B. $\log_N x = a$
C. $\log_x N = a$
D. $\log_x a = N$

2. $7C_3$ means $\dfrac{7!}{3!\,(7-3)!}$

$2C_2$ means $\dfrac{2!}{2!\,(2-2)!}$

$4C_3$ means $\dfrac{4!}{3!\,(4-3)!}$

Then, what does nCr mean?

A. $\dfrac{r!}{n!(n-r)!}$

B. $\dfrac{n!}{r!n!}$

C. $\dfrac{n!}{r!(n-r)!}$

D. $\dfrac{r!}{n!\,(r-n)!}$

3. For any two sets A and B, if n(A) = 2 and n(B) = 2, then n (AxB) = 4
For any two sets M and N, if n(M) = 3 and n(N)=3, then n(MxN) = 9
For any two sets P and Q, if n(P) = 4 and n(Q) = 2, then n (PxQ)= 8

$\therefore$ For any two sets X and Y, if n(X) = C and n(Y)=d, then what is n(XxY) ?

A. c+d
B. cd
C. c-d
D. c/d

4. The square roof of 1, ie., $(\sqrt{1}) = 1$
The square root of 100, ie., $(\sqrt{100}) = 10$
The square root of 10000, ie., $(\sqrt{10000}) = 100$

Then, what is the square root of 100000000 ?

A.	100	C.	10000
B.	1000	D.	100000

5. $5^8 \div 5^2 = 5^6$

$7^4 \div 7^2 = 7^2$

$3^1 \div 3^1 = 3^0$

Then, what will be $a^m \div a^n$?

A.	a^{m-n}	C.	m-n
B.	$a^{m/n}$	D.	m/n

6. If $2^3 = 8$ then $\sqrt[3]{8} = 2$

If $4^4 = 256$ then $\sqrt[4]{256} = 4$

If $9^2 = 81$ then $\sqrt[2]{81} = 9$

Then, what is the value of $\sqrt[4]{2401}$ if $7^4 = 2401$?

A.	4	C.	2401
B.	7	D.	4^7

7. $x+2 = 5$ is a simple equation

$2y+1 = 0$ is a simple equation

$-4z+1 = 2z$ is a simple equation

Then, what about the number of variables in a simple equation?

A.	1	C.	3
B.	2	D.	4

8. $\text{Cos}\ \pi = -1$

$\text{Cos}\ 2\pi = 1$

$\text{Cos}\ 3\pi = -1$

$\therefore$ If 'n' is an even number, then what will be $\text{Cos}\ n\pi$?

A.	-1	C.	1
B.	0	D.	∞

9. Let 'a' be the first term and 'd' the common difference of an Arithmetic Progression. Then its

Second term = a+d
Third term = a+2d
Fourth term = a+3d

Then, what will be the 10^{th} term ?

A. a-10d
B. a-9d
C. a+10d
D. a+9d

10. ○ ○ These are similar figures
♦ ♣ These are similar figures
▭ ▭ These are similar figures

Then, what are similar figures ?

A. Figures of same shape
B. Figures of same size
C. Figures of same shape and size
D. Figures which are not alike

11. A prism with 3 base edges has 5 faces
A prism with 4 base edges has 6 faces
A prism with 5 base edges has 7 faces

Then, how many faces does a prism with 'n' base edges have ?

A. n-2
B. n-1
C. n+1
D. n+2

12. The general form of a polynomial of first degree is $a_{1}x+a_o$; $a_1\neq o$
The general form of a polynomial of second degree is $a_2x^2+a_1x+a_o$; $a_2\neq o$
The general form of a polynomial of third degree is $a_3x^3+a_2x^2+a_1x+a_o$; $a_3\neq o$

Then, which of the following is the general form of a polynomial of degree 'p'?

A. $a_px^p+a_{p-1}x^{p-1}+\ldots\ldots+a_o;a_p\neq o$
B. $a_px^p+a_{p-1}x^{p-1}+\ldots\ldots+a_o;a_o\neq o$
C. $a_px^{p-1}+a_{p-1}x^{p-2}+\ldots+a_o;\ a_p\neq o$
D. $a_{p-1}x^p+a_{p-2}x^{p-1}+\ldots.+a_o;a_{p-1}\neq o$

13. The number of subsets of a null set = 2^o
The number of subsets of a set with one element = 2^1
The number of subsets of a set with two elements = 2^2

Then, what will be the number of subsets of a set with 12 elements?

A.	2^0	C.	2^2
B.	2^1	D.	2^{12}

14.

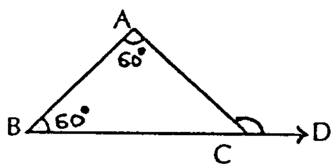


Fig. (1)

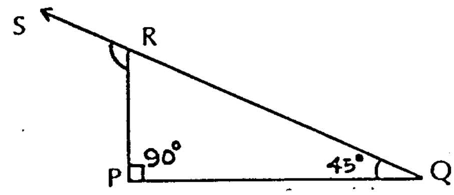


Fig. (2)

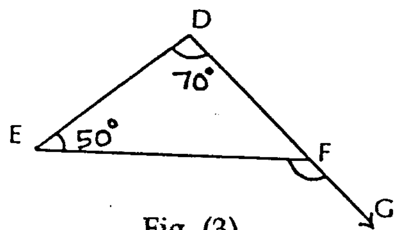


Fig. (3)

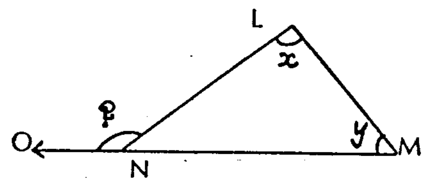


Fig. (4)

In fig. (1), $\angle ACD = \angle A + \angle B = 120^\circ$
In fig. (2), $\angle PRS = \angle P + \angle Q = 135^\circ$
In fig. (3), $\angle EFG = \angle D + \angle E = 120^\circ$

Then, in fig. (4), what is the measure of $\angle LNO$?

A.	x-y	C.	2x
B.	x+y	D.	2y

15. The interest for Rs.200 for 2 years at 4% rate = Rs.16
The interest for Rs.200 for 2 years at 5% rate = Rs.20
The interest for Rs.200 for 2 years at 6% rate = Rs.24

Then, what is the interest on Rs.200 for 2 years at 10% rate?

A.	Rs.100	C.	Rs. 32
B.	Rs.40	D.	Rs.28

16. axa is represented as a^2
axaxa is represented as a^3
axaxaxa is represented as a^4

Then how can axaxax .... 'n' times be represented ?

A. a^{n+1} C. na
B. a^n D. a^{n-1}

17. 1! is 1
2! is 1x2
3! is 1x2x3

Then, what is 8! ?

A. 1x2x3x4x5x6x7x8! C. 1x2x3x4x5x6x7x8
B. 1x2x3x4x5x6x7!x8 D. 1x2x3x4x5x6x7

18.

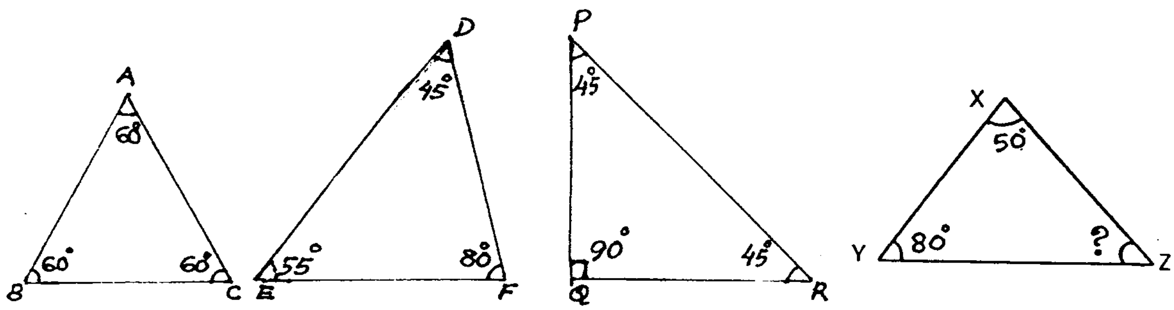


Fig. (1) Fig. (2) Fig. (3) Fig.(4)

In fig. (1), $\angle A+\angle B+\angle C = 180^\circ$
In fig. (2), $\angle D+\angle E+\angle F = 180^\circ$
In fig. (3), $\angle P+\angle Q+\angle R = 180^\circ$

Then, what is the measure of $\angle Z$ in fig. (4) ?

A. 130° C. 50°
B. 80° D. 30°

19. $\sqrt{1x4}$ can be simplified as 1x2
$\sqrt{9x16}$ can be simplified as 3x4
$\sqrt{25x36}$ can be simplified as 5x6

Then, which of the following is the simplified form of $\sqrt{x^2y^2}$?

A. x x y
B. $\sqrt{x}$ x $\sqrt{y}$
C. x/2 x y/2
D. x^2 x y^2

20. The value of $(\sqrt[2]{4})^2$ is 4
The value of $(\sqrt[3]{5})^3$ is 5
The value of $(\sqrt[4]{6})^4$ is 6

Then, what is the value of $(\sqrt[a]{b})^a$?

A. $a\sqrt{b}$
B. $\sqrt{ab}$
C. a
D. b

21. If A = {1,2} and B = {3,4} then A∪B = {1,2,3,4}
If P = {l,m} and Q = {n} then P∪Q = {1,m,n}
If x = {+,−,×} and Y = {+,÷} then X∪Y = {+, −,×,÷}

∴ If C = {□,O} and D = {Δ,O}, then what is C ∪ D?

A. {O}
B. {□,Δ}
C. {□, O, Δ}
D. {□, O, Δ, O}

22. 1/10 = 0.1
1/100 = 0.01
1/1000 = 0.001

Then, what is the value of 1/100000 ?

A. 0.000001
B. 0.00001
C. 0.0001
D. 0.001

23. 1/2 ÷ 1/3 = 1/2 x 3/1
-1/7 ÷ 2/11 = -1/7 x 11/2
3/10 ÷ -4/15 = 3/10 x -15/4

Then, what is -a/b ÷ -c/d ?

A. -a/b x -d/c
B. -a/b x -c/d
C. -a/b x c/d
D. -a/b x d/c

24. {1,2} and {3,4} are equivalent sets.
{a,b} and {-7,0} are equivalent sets.
{-1} and {0} are equivalent sets.

Then, which of the following are equivalent sets?

A. {a,e,i}, {0, u} C. {1,0}, {1}
B. { }, {0} D. {+, 1}, {÷, x}

25. The mode of the observations 8, 12, 24, 12, 3, 12 and 3 is 12.
The mode of the observations 29, 27, 32, 27, 32, 27 and 26 is 27.
The mode of the observations 49, 50, 49, 49, 51, 53 and 54 is 49.

Then, what is the mode of the observations 25, 24, 40, 37, 40, 40 and 24?

A. 40 C. 25
B. 37 D. 24

26. Volume of a cube of edge 2 cm is 8 cm^3.
Volume of a cube of edge 4 cm is 64 cm^3.
Volume of a cube of edge 5 cm is 125 cm^3.

Then, what will be the volume of a cube of edge p cm?

A. $3p\ cm^3$ C. $(\sqrt{p}\ cm)^3$
B. $p^3\ cm^3$ D. $p^2\ cm^3$

27.

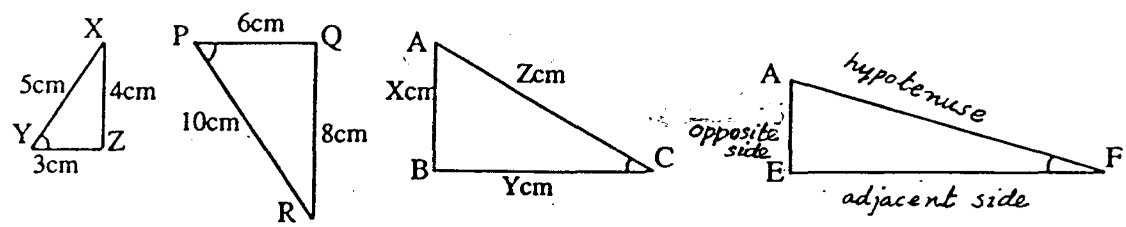


Fig. (1) Fig. (2) Fig. (3) Fig. (4)

In fig. (1), Cos y = 3/5
In fig. (2), Cos p = 6/10
In fig. (3), Cos c = y/z

Then, what is cos F in fig. (4)?

A. Opposite side/Adjacent side C. Hypotenuse/Adjacent side
B. Adjacent side/Hypotenuse D. Adjacent side/Opposite side

28. $\log 3^3 = 3 \log 3$
$\log 7^6 = 6 \log 7$
$\log 5^3 = 3 \log 5$

Then, what is log a^r?

A. r log a C. a^r log a
B. r log a^r D. r log r

29. In the quadratic equation $2x^2 + 5x - 12 = 0$, the sum of the terms of the truth set is -5/2

In the quadratic equation $x^2 - 10x + 16 = 0$, the sum of the terms of the truth set is 10/1

In the quadratic equation $-y^2 + 6y + 8 = 0$, the sum of the terms of the truth set is -6/-1.

Then, what will be the sum of terms of the truth set of the quadratic equation $px^2 + qx + r = 0$?

A. -p/q C. q/p
B. p/q D. -q/p

30.

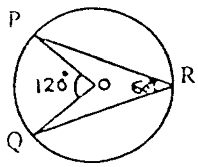


Fig. (1)

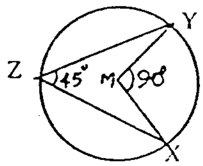


Fig. (2)

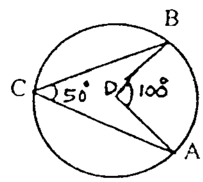


Fig. (3)

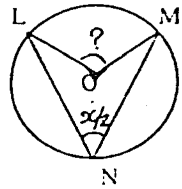


Fig. (4)

In Fig. (1), if $\angle R = 60°$ then $\angle POQ = 120°$
In Fig. (2), if $\angle Z = 45°$ then $\angle XMY = 90°$
In Fig. (3), if $\angle C = 50°$ then $\angle ADB = 100°$

Then, in Fig. (4) if $\angle N = (x/2)°$ then what is the measure of $\angle LOM$?

A. $x°$ C. x^2
B. $2x°$ D. $(x/2)°$

31. The set of counting members between 13 and 15 is an example for a singleton set.

The set of months having days less than 30 is an example for a singleton set.

The set of numbers other than positive and negative numbers is an example for a singleton set.

Then, what is the number of elements in a singleton set?

A. -1   C. 1
B. 0   D. 2

32. The area of a circle of radius 1 cm is π cm^2.
The area of a circle of radius 2 cm is 4π cm^2.
The area of a circle of radius 3 cm is 9π cm^2.

Then, what is the area of a circle of radius 'x' cm?

A. π cm^2 C. πx^2 cm^2
B. πx cm^2 D. π/x^2 cm^2

33.

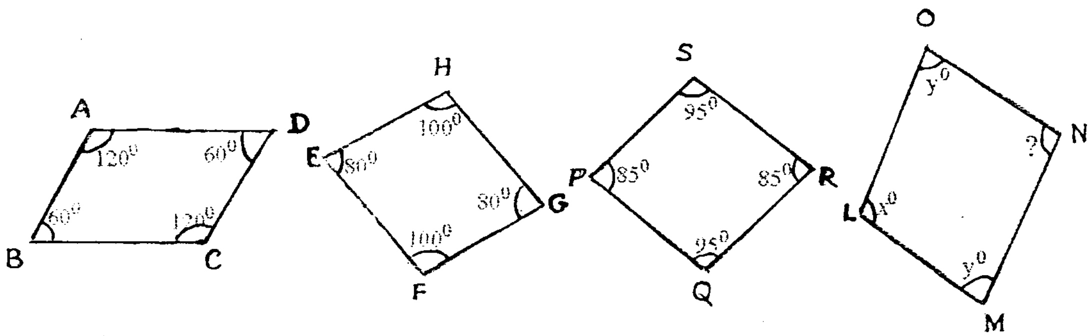


Fig. (1)   Fig. (2)   Fig. (3)   Fig. (4)

Notice the relation between the angles of the parallelograms (1), (2) and (3). Using this, what is the measure of $\angle N$ in fig. (4)?

A. y^o C. $x+y^o$
B. x^o D. $x-y^o$

34. $(2a+b)^2 = 4a^2 + 4ab + b^2$
$(l+3m^2) = l^2 + 6lm + 9\,m^2$
$(2x+4y)^2 = 4x^2 + 16xy + 16y^2$

Then, what will be $(2p+q)^2$?

A. $2p^2 + 2pq + q^2$ C. $4p^2 + 4pq + q^2$
B. $4p + 4pq + q^2$ D. $4p^2 + 2pq + q^2$

35. $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ is a unit matrix of order 2.

$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ is a unit matrix of order 3.

$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ is a unit matrix of order 4.

Then, which of the following is an example for a unit matrix of order 5?

A. $\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$ B. $\begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$ C. $\begin{bmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}$ D. $\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}$

36. $(p+q)(p-q) = p^2 - q^2$
$(a+b)(a-b) = a^2 - b^2$
$(l+m)(l-m) = l^2 - m^2$

Then, what is the value of $(2x+y)(2x-y)$?

A. $(2x)^2 - y^2$
B. $2x^2 - y^2$
C. $(2x)^2 + y^2$
D. $2x^2 + y^2$

37. $(\sqrt{5})^2 = 5$
$(\sqrt{100})^2 = 100$
$(\sqrt{1024})^2 = 1024$

Then, what is $(\sqrt{x})^2$?

A. $\sqrt{x}$
B. x^2
C. $\sqrt{2x}$
D. x

38. If $I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ then $2I = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}$

If $I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ then $4I = \begin{bmatrix} 4 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 4 \end{bmatrix}$

If $I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ then $8I = \begin{bmatrix} 8 & 0 & 0 \\ 0 & 8 & 0 \\ 0 & 0 & 8 \end{bmatrix}$

Then, what will be PI?

A. $\begin{bmatrix} P & O & O \\ P & O & O \\ P & O & O \end{bmatrix}$

C. $\begin{vmatrix} O & P & O \\ P & O & O \\ O & O & P \end{vmatrix}$

B. $\begin{bmatrix} P & O & O \\ O & P & O \\ O & O & P \end{bmatrix}$

D. $\begin{bmatrix} O & P & O \\ O & P & O \\ O & P & O \end{bmatrix}$

APPENDIX XIII (a)

TEST OF INDUCTIVE REASONING

SCORE SHEET

വിദ്യാർത്ഥിയുടെ പേര്...ക്ലാസ്സ് നമ്പർ...................

ക്ലാസ്സ് ഡിവിഷൻ...ആൺകുട്ടി/പെൺകുട്ടി

	A	B	C	D
1.	○	○	○	○
2.	○	○	○	○
3.	○	○	○	○
4.	○	○	○	○
5.	○	○	○	○
6.	○	○	○	○
7.	○	○	○	○
8.	○	○	○	○
9.	○	○	○	○
10.	○	○	○	○
11.	○	○	○	○
12.	○	○	○	○
13.	○	○	○	○
14.	○	○	○	○
15.	○	○	○	○
16.	○	○	○	○
17.	○	○	○	○
18.	○	○	○	○
19.	○	○	○	○
20.	○	○	○	○
21.	○	○	○	○
22.	○	○	○	○
23.	○	○	○	○
24.	○	○	○	○
25.	○	○	○	○
26.	○	○	○	○
27.	○	○	○	○
28.	○	○	○	○
29.	○	○	○	○
30.	○	○	○	○
31.	○	○	○	○
32.	○	○	○	○
33.	○	○	○	○
34.	○	○	○	○
35.	○	○	○	○
36.	○	○	○	○
37.	○	○	○	○
38.	○	○	○	○

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
TEST OF DEDUCTIVE REASONING
(DRAFT)

Dr. V.Sumangala
Reader in Education

Mumthas,N.S.
Research Scholar

നിർദ്ദേശങ്ങൾ: സമയം : 50 മിനിറ്റ്

ഗണിതശാസ്ത്രസംബന്ധിയായ 40 ചോദ്യങ്ങളാണ് താഴെ കൊടുത്തിരിക്കുന്നത്. ഓരോ ചോദ്യവും ആരംഭിക്കുന്നത് ഒരു ഗണിതശാസ്ത്ര സിദ്ധാന്തം കൊണ്ടാണ്. അതിനു ശേഷം ആ സിദ്ധാന്തവുമായി ബന്ധപ്പെട്ട ഒരു പ്രശ്നം നൽകിയിരിക്കുന്നു.

ഓരോ ചോദ്യവും വായിച്ച് തന്നിരിക്കുന്ന പ്രശ്നത്തിന് അനുയോജ്യമായ ഉത്തരം A,B,C,D എന്നിവയിൽ നിന്ന് തെരഞ്ഞെടുത്ത്, ഇതോടൊപ്പം നൽകിയിരിക്കുന്ന ഉത്തരക്കടലാസ്സിൽ അതാത് ചോദ്യ നമ്പരിനു നേരെ,അടയാളപ്പെടുത്തുക. ഉത്തരങ്ങൾ അടയാളപ്പെടുത്തേണ്ടത് ഉത്തരക്കടലാസിൽ A,B,C,Dഎന്നീ അക്ഷരങ്ങൾക്ക് താഴെ നൽകിയിട്ടുള്ള വൃത്തത്തിൽ "X" അടയാളം കൊണ്ടാണ്.

രേഖപ്പെടുത്തിയത് തെറ്റായ വൃത്തത്തിലാണെന്ന് തോന്നിയാൽ ആ വൃത്തത്തെ "□"ചിഹ്നം കൊണ്ട് വലയം ചെയ്തശേഷം ശരിയായ വൃത്തത്തിൽ വീണ്ടും "X" അടയാളമിടുക.

ഉദാഹരണം:

"ഒരു ത്രികോണത്തിന്റെ മൂന്ന് കോണുകളുടേയും അളവുകളുടെ തുക 180^0ആയിരിക്കും"

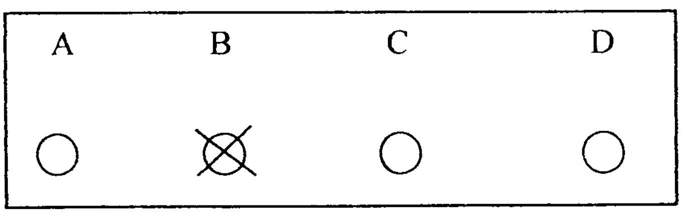
$\triangle ABC$ യിൽ $\angle A = 45^0$, $\angle B = 60^0$ എങ്കിൽ $\angle C$ എത്ര?

A. 105^0 C. 60^0

B. 75^0 D. 15^0

(ഇവിടെ ശരിയുത്തരം 75^0 ആണല്ലോ. ആയതിനാൽ ശരിയുത്തരത്തെ സൂചിപ്പിക്കുന്ന B എന്ന അക്ഷരത്തിനു താഴെയുള്ള വൃത്തത്തിൽ "X" എന്ന അടയാളം രേഖപ്പെടുത്തിയിരിക്കുന്നു.)

ഉത്തരക്കടലാസ്



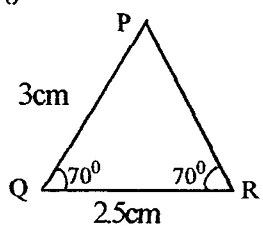
1. "ഒരു ഗണത്തിലെ അംഗങ്ങളുടെ എണ്ണമാണ് ആ ഗണത്തിന്റെ കാർഡിനാലിറ്റി"
$A = \{a,e,i,o,u\}$ ആയാൽ A യുടെ കാർഡിനാലിറ്റി എന്ത്?

A. 1 C. 3

B. 2 D. 5

2. "ഒരു ത്രികോണത്തിലെ രണ്ട് കോണുകൾ തുല്യമായാൽ അവയ്ക്കെതിരെയുള്ള വശങ്ങളും തുല്യമായിരിക്കും."

ചിത്രത്തിൽ $\angle Q = \angle R = 70^0$, PQ = 3 cm, QR = 2.5cm ആയാൽ PR എന്ന വശത്തിന്റെ നീളം എന്ത്?



A. 1.5cm C.3cm

B. 2.5cm D. 6cm

3. "ഒരു സമഭുജ ത്രികോണത്തിന്റെ കോണുകളുടെ അളവുകൾ തുല്യമായിരിക്കും"

$\triangle ABC$ ഒരു സമഭുജത്രികോണമാണ്. എങ്കിൽ $\angle A$ യുടെ അളവെന്ത്?

A. 30^0 C. 60^0

B. 45^0 D. 90^0

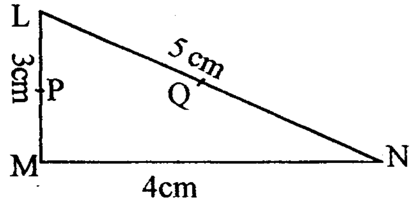
4. "R എന്ന ഗണത്തിന്റെ ഉപഗണമാണ് P എങ്കിൽ $P \cap R = P$ ആയിരിക്കും"

$X = \{1,2\}$, $Y = \{-1,0,1,2,3\}$ ആയാൽ $X \cap Y$ താഴെ പറയുന്നവയിൽ ഏതായിരിക്കും?

A. x C. Y

B. ϕ D. $X \cup Y$

5. "ഒരു ത്രികോണത്തിന്റെ ഏതെങ്കിലും രണ്ട് വശങ്ങളുടെ മധ്യബിന്ദുക്കളെ യോജിപ്പിച്ചു കിട്ടുന്ന രേഖാഖണ്ഡത്തിന്റെ നീളം മൂന്നാമത്തെ വശത്തിന്റെ നീളത്തിന്റെ പകുതിയായിരിക്കും."



$\triangle LMN$ ൽ LM എന്ന വശത്തിന്റെ മധ്യബിന്ദു Pയും LNഎന്ന വശത്തിന്റെ മധ്യ ബിന്ദു Qഉം ആണ്. LM = 3 cm, MN = 4cm, LN = 5 cm ആയാൽ PQ ന്റെ നീളം എത്ര?

A. 1.5 cm   C. 2.5cm

B. 2 cm   D. 4cm

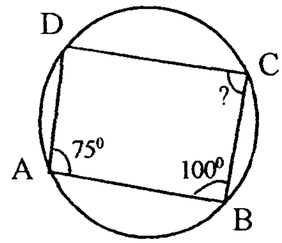
6. " 'n' വശങ്ങളുള്ള ഒരു ബഹുഭുജത്തിന്റെ ആന്തരകോണുകളുടെ അളവുകളുടെ തുക (2n - 4) മട്ടങ്ങൾ ആയിരിക്കും"

∴8 വശങ്ങളുള്ള ഒരു ബഹുഭുജത്തിലെ ആന്തര കോണുകളുടെ അളവുകളുടെ തുക എന്ത്?

A. 4മട്ടം   C.16 മട്ടം

B. 12 മട്ടം   D. 20 മട്ടം

7. "ഒരു ചക്രീയ ചതുർഭുജത്തിന്റെ എതിർശീർഷകോണുകളുടെ അളവുകളുടെ തുക 180^0ആയിരിക്കും."



ചക്രീയ ചതുർഭുജംABCDയിൽ $\angle A$,$\angle C$യും$\angle B$, $\angle D$യും എതിർശീർഷ കോണുകളാണ്. $\angle A = 75^0$, $\angle B = 100^0$ആണെങ്കിൽ $\angle C$ യുടെ അളവെന്ത്?

A. 75^0 C. 100^0

B. 80^0 D. 105^0

8. "രണ്ട് പദങ്ങളുടെ വ്യത്യാസത്തിന്റെ വർഗ്ഗം = ഒന്നാമത്തെ പദത്തിന്റെ വർഗ്ഗം -2 x ഒന്നാമത്തെ പദം x രണ്ടാമത്തെ പദം + രണ്ടാമത്തെ പദത്തിന്റെ വർഗ്ഗം"

എങ്കിൽ, $(5m - 2n)^2$എന്തായിരിക്കും?

A. $25m^2 - 20mn + 4n^2$ C. $25m^2 + 20mn + 4n^2$

B. $5m^2 - 20mn + 2n^2$ D. $5m^2 + 20mn + 2n^2$

9. "ഒരു സമഭുജത്രികോണത്തിന്റെ ഒരു വശത്തിന്റെ നീളം 'a'cm ആയാൽ വിസ്തീർണ്ണം $\frac{\sqrt{3}a^2}{4}$ cm^2 ആയിരിക്കും."

സമഭുജത്രികോണംDEF ൽ DEഎന്ന വശത്തിന്റെ നീളം 2cm ആണെങ്കിൽ അതിന്റെ വിസ്തീർണ്ണം എന്ത്?

A. $\sqrt{3}cm^2$ C. $\sqrt{12}/4cm^2$

B. $\sqrt{3}/4\ cm^2$ D. $\sqrt{6}/4\ cm^2$

10. " ഒരു സമാന്തരപ്രോഗ്രഷന്റെ പദങ്ങളുടെ എണ്ണം 'n'ആയാൽ

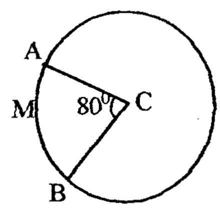
$$n = \frac{\text{അവസാനപദം - ആദ്യപദം}}{\text{പൊതുവ്യത്യാസം}} + 1 \text{ ആകുന്നു."}$$

21, 28, 35 ....,126 എന്നത് ഒരു സമാന്തരപ്രോഗ്രഷൻ ആണെങ്കിൽ അതിലെ പദങ്ങളുടെ എണ്ണം എന്ത്?

A. 14 C. 16

B. 15 D. 17

11. "ഒരു ലഘുചാപത്തിന്റെ ഡിഗ്രി അളവ് ആ ചാപത്തിന്റെ കേന്ദ്രകോണിന്റെ അളവാകുന്നു"



ചിത്രത്തിൽ $\widehat{AMB}$ ഒരു ലഘുചാപമാണ്

$\angle ACB = 80^0$ ആയാൽ $\widehat{AMB}$ യുടെ അളവെന്ത്?

A. 40^0 C. 90^0

B. 80^0 D. 160^0

12. "$\triangle ABC$യിലെ മൂന്ന്കോണുകളാണ് $\angle A, \angle B, \angle C$എങ്കിൽ $Sin^2A + Cos^2A = 1$ആയിരിക്കും"

$\triangle XYZ$ ൽ $\angle x = 80^0, \angle Y = 60^0, \angle z = 40^0$എങ്കിൽ $Sin^2 60 + Cos^2 60$ന്റെ വിലയെന്ത്?

A. -1 C. 1

B. 0 D. $\sqrt{3}$

13. "$ax^2 + bx + c = 0$ എന്ന ദ്വിമാനസമവാക്യത്തിന്റെ മൂല്യഗണം

$$\left\{ \frac{-b + \sqrt{b^2 - 4ac}}{2a}, \frac{-b - \sqrt{b^2 - 4ac}}{2a} \right\}$$ ആയിരിക്കും."

$2x^2 - 11x + 12 = 0$ എന്ന ദ്വിമാനസമവാക്യത്തിന്റെ മൂല്യഗണം എന്ത്?

A. {-3/2, -4}　　C. {4, -3/2}

B. { -4, 3/2}　　D. {4, 3/2}

.14. "ഒരേ ആകൃതിയും ഒരേ വലിപ്പവുമുള്ള രൂപങ്ങളെ സർവ്വസമരൂപങ്ങൾ എന്നു പറയുന്നു."

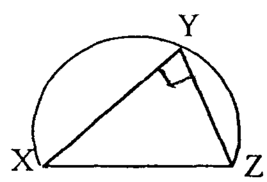
താഴെ കൊടുത്തിരിക്കുന്നവയിൽ സർവ്വസമരൂപങ്ങൾ ഏത്?

A. □□　　C. △△

B ○○.　　D. ▱ ▱

15. "ഒരു അർദ്ധവൃത്തത്തിൽ അന്തർലേഖനം ചെയ്തിട്ടുള്ള കോൺ മട്ടകോൺ ആയിരിക്കും."

ചിത്രം(1) ൽ, $\overparen{XYZ}$ ഒരു അർദ്ധവൃത്തമാണ്. അതിൽ അന്തർലേഖനം ചെയ്തിട്ടുള്ള കോൺ ആണ് $\angle XYZ$. എങ്കിൽ $\angle XYZ$ ന്റെ അളവെന്ത്?



ചിത്രം(1)

A. 30^0　　C. 60^0

B. 45^0　　D. 90^0

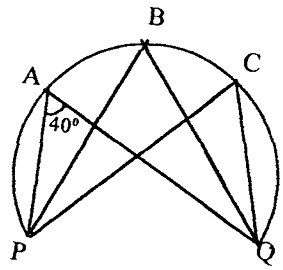
16. "'r' cm ആരവും 'h' cm ഉന്നതിയുമുള്ള ഒരു വൃത്തസ്തംഭത്തിന്റെ വ്യാപ്തം '$\pi r^2 h$' cm^3 ആകുന്നു".

4 cm വ്യാസവും 10 cm ഉന്നതിയുമുള്ള ഒരു വൃത്തസ്തംഭത്തിന്റെ വ്യാപ്തം എന്ത്?

A. $40\pi\ cm^3$　　C. $40\ cm^2$

B. $160\pi\ cm^3$　　D. $160\ cm^2$

17. "ഒരേ ചാപത്തിൽ അന്തർലേഖനം ചെയ്തിട്ടുള്ള കോണുകളുടെ അളവുകൾ തുല്യമായിരിക്കും."



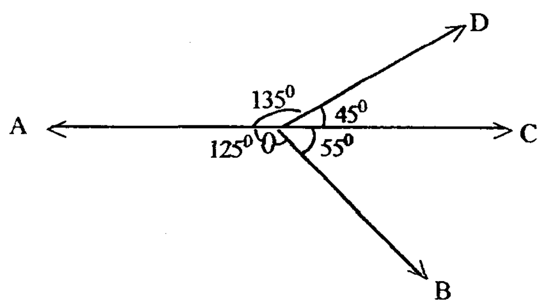
$\widehat{PAQ}$ വിൽ അന്തർലേഖനം ചെയ്തിരിക്കുന്ന മൂന്ന് കോണുകളാണ് $\angle A$, $\angle B$, $\angle C$. $\angle A = 40^0$ എങ്കിൽ $\angle B$യുടെ അളവെന്ത്?

A. 40^0 C. 80^0

B. 60^0 D. 120^0

18. "രണ്ടു കോണുകളുടെ തുക 180^0 ആയാൽ അവ അനുപൂരക കോണുകളായിരിക്കും."

ചിത്രത്തിലെ അനുപൂരക കോണുകൾ ഏവ?



A. $\angle AOD$ യും $\angle$ CODയും C. $\angle COD$ യും $\angle COB$യും

B. $\angle AOD$ യും $\angle AOB$ യും D. $\angle AOB$ യും $\angle COD$യും

19. "$P(x)$എന്ന പോളിനോമിയലിനെ $(x-a)$ കൊണ്ട് ഹരിച്ചാൽ ശിഷ്ടം $P(a)$ആയിരിക്കും"

$P(x) = 2x^3 - 7x^2 + 2x + 1$എന്ന പോളിനോമിയലിനെ $x-3$കൊണ്ട് ഹരിച്ചാൽ ശിഷ്ടം എത്ര?

A. -122 C. -2

B. -110 D.4

20. "a, b, c എന്നിവ ഒരു സമഗുണിത പ്രോഗ്രഷന്റെ തുടർച്ചയായ മൂന്നു പദങ്ങ-ളായാൽ $b = \sqrt{ac}$ ആയിരിക്കും."

12, k, 48 എന്നിവ ഒരു സമഗുണിതപ്രോഗ്രഷന്റെ തുടർച്ചയായ മൂന്ന് പദങ്ങളാണെങ്കിൽ k യുടെ വില എന്ത്?

A. 24　　C. 36

B. 60　　D. 30

21. "ഒരു ഗണത്തിലെ ഒരംഗം തന്നെ ആവർത്തിച്ചു വരികയാണെങ്കിൽ അംഗങ്ങൾ എഴുതുമ്പോൾ അത് ഒരു പ്രാവശ്യം മാത്രം എഴുതിയാൽ മതി."

Languageഎന്ന വാക്കിലെ അക്ഷരങ്ങളുടെ ഗണത്തിലെ അംഗങ്ങളുടെ എണ്ണം എത്ര?

A. 8　　C. 5

B. 6　　D. 2

22. "ഒരംഗം പോലും ഇല്ലാത്ത ഗണത്തെ ശൂന്യഗണം എന്നു പറയുന്നു."

താഴെ പറയുന്നവയിൽ ശൂന്യഗണം ഏത്?

A. { }　　C. {0}

B. $\{\phi\}$　　D. {-1}

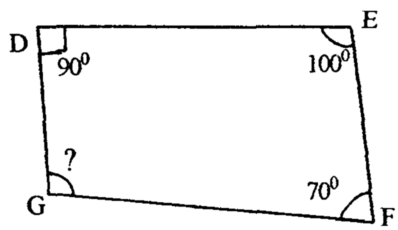
23. "ഗുണോത്തരം പൂജ്യമല്ലാത്ത പദങ്ങളിൽ ഏറ്റവും വലിയ കൃതിയുള്ള പദത്തിന്റെ കൃതിയാണ് *പോളിനോമിയലിന്റെ കൃതി*".

$0x^3 + 0x^2 + 5x + 2$ എന്ന പോളിനോമിയലിന്റെ കൃതി എന്ത്?

A. 3　　C. 1

B. 2　　D. 0

24. "ഒരു ചതുർഭുജത്തിന്റെ എല്ലാ കോണുകളുടേയും അളവുകളുടെ തുക 360^0 ആയിരിക്കും"

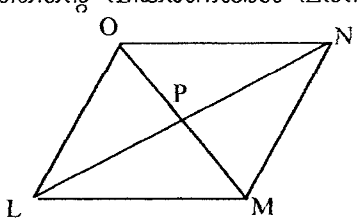


ചതുർഭുജം DEFG ൽ $\angle G$യുടെ അളവ് എത്ര?

A. 65^0　　C. 100^0

B. 70^0　　D. 125^0

25. "ഒരു സാമാന്തരികത്തിന്റെ വികർണങ്ങൾ പരസ്പരം സമഭാഗം ചെയ്യും."



സാമാന്തരികം LMNO-യിൽ LN = 8cm, OM = 5cm, ആയാൽ NP യുടെ നീളം എന്ത്?

A. 2.5cm C. 5cm

B. 4cm D. 8cm

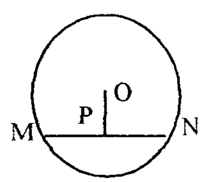
26. "പാദവക്കിന്റെ നീളം 'a' cm ഉം ഉയരം 'h' cm ഉംആയ സമചതുരസ്തൂപികയുടെ വ്യാപ്തം '1/3 a^2 h' cm^3 ആകുന്നു."

ഒരു സമചതുരസ്തൂപികയുടെ പാദവക്കിന്റെ നീളം 9cm ഉം ഉന്നതി 10cm ഉം ആയാൽ അതിന്റെ വ്യാപ്തം എന്ത്?

A. 30cm^3 C. 270cm^3

B. 90 cm^3 D. 310 cm^3

27. "ഒരു വൃത്തത്തിന്റെ കേന്ദ്രവും അതിലെ ഒരു ഞാണിന്റെ മധ്യബിന്ദുവും ഉൾക്കൊള്ളുന്ന രേഖാഖണ്ഡം ആ ഞാണിന് ലംബമായിരിക്കും."



'O' കേന്ദ്രമായ വൃത്തത്തിലെ ഞാണാണ് MN എങ്കിൽ ∠OPN ന്റെ അളവ് എത്ര?

A. 30^0 C. 60^0

B. 45^0 D. 90^0

28 "ഒന്നാം പദം 'a' യുംപൊതുവ്യത്യാസം 'd' യും ആയ ഒരു സമാന്തരപ്രോഗ്രഷന്റെ തുടർച്ചയായ 'n' പദങ്ങളുടെ തുക $s = n/2$ (ആദ്യപദം + അവസാനപദം) ആകുന്നു."

7, 14, 21,............,70 എന്നിവ ഒരു സമാന്തരപ്രോഗ്രഷൻ ആണെങ്കിൽ അതിലെ തുടർച്ചയായ ആദ്യത്തെ 8 പദങ്ങളുടെ തുക എന്തായിരിക്കും?

A. 616 C. 308

B. 504 D. 252

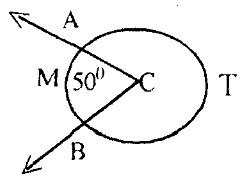
.29. "'r' cm ആരമായ ഒരു അർദ്ധഗോളത്തിന്റെ ഉപരിതലവിസ്തീർണ്ണം '$3\pi r^2$' cm^2 ആകുന്നു."

6cm ആരമുള്ള ഒരു അർദ്ധഗോളത്തിന്റെ ഉപരിതലവിസ്തീർണ്ണം എന്ത്?

A. $108\,\pi\, cm^2$ C. $108 cm^2$

B. $18\,\pi cm^2$ D. $18\, cm^2$

30. "ഒരു ദീർഘചാപത്തിന്റെ ഡിഗ്രി അളവ്= (360^0 – എതിർ ലഘുചാപത്തിന്റെ ഡിഗ്രി അളവ്)"



ചിത്രത്തിൽ $\overset{\frown}{AMB}$ ലഘുചാപവും അതിന്റെ ഡിഗ്രി അളവ് 50^0യും ആയാൽ $\overset{\frown}{ATB}$ യുടെ ഡിഗ്രി അളവ് എന്ത്?

A. 50^0 C. 310^0

B. 180^0 D. 360^0

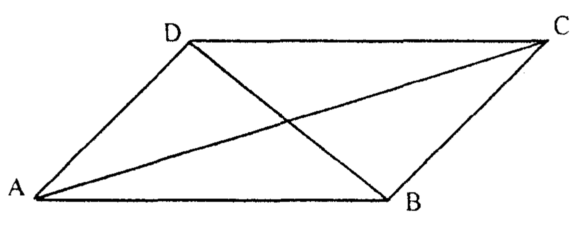
31. "സംഖ്യകൾ മാത്രം ഉൾക്കൊള്ളുന്ന വാക്യങ്ങളാണ് സംഖ്യാവാക്യങ്ങൾ"

താഴെ പറയുന്നവയിൽ സംഖ്യാവാക്യമേത്?

A. $4 + 3 = 7$ C. $5 + 4y \neq 7$

B. $3x > 7$ D. $3y + 1 < 2$

32. "ഒരു സമഭുജസാമാന്തരികത്തിന്റെ വികർണങ്ങളുടെ നീളം d_1, d_2 ആണെങ്കിൽ അതിന്റെ വിസ്തീർണ്ണം $^1/_2\, d_1\, d_2$ ച.യൂണിറ്റ് ആയിരിക്കും."

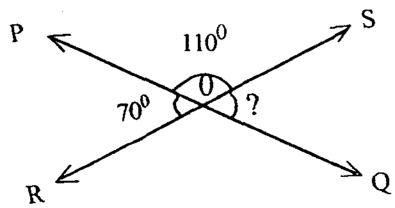


സമഭുജസാമാന്തരികം ABCD യിലെ വികർണങ്ങളാണ് AC യുംBD യും. AC = 8cm, BD = 4cm.എങ്കിൽ സമഭുജസാമാന്തരീകംABCD യുടെ വിസ്തീർണം എന്ത്?

A. $32cm^2$ C. $12cm^2$

B. $16cm^2$ D. $6cm^2$

33.. “രണ്ട് നേർരേഖകൾ ഖണ്ഡിക്കുമ്പോഴുണ്ടാകുന്ന ഏകാന്തരകോണുകൾ തുല്യമായിരിക്കും.”

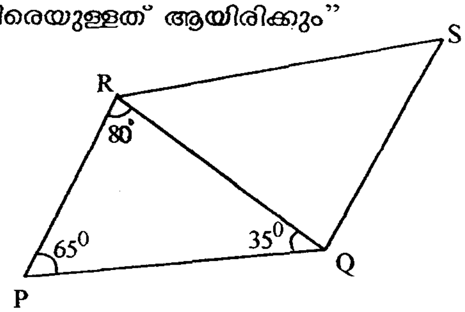


$\overleftrightarrow{PQ}$,$\overleftrightarrow{RS}$ രണ്ട് നേർരേഖകളാണ്. അവ ‘O’ എന്ന ബിന്ദുവിൽ ഖണ്ഡിക്കുന്നു. $\angle POR = 70^0$. $\angle POS = 110^0$ആയാൽ $\angle SOQ$ന്റെ അളവെന്ത്?

A. 110^0 C. 70^0

B. 180^0 D. 40^0

34. “ഒരു ത്രികോണത്തിന്റെ ഏറ്റവും ചെറിയ വശം അതിന്റെ ഏറ്റവും ചെറിയ കോണിന് എതിരെയുള്ളത് ആയിരിക്കും”

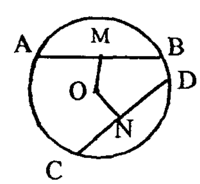


ചതുർഭുജം PQSRലെ രണ്ട് ത്രികോണങ്ങളാണ് ΔPQRഉം ΔRSQഉം. ΔPQR ൽ $\angle P = 65^0$, $\angle Q = 35^0$, $\angle R = 80^0$ആണ്. എങ്കിൽ ΔPQRൽ ഏറ്റവും ചെറിയ വശം ഏത്?

A. PQ C. QS

B. QR D. PR

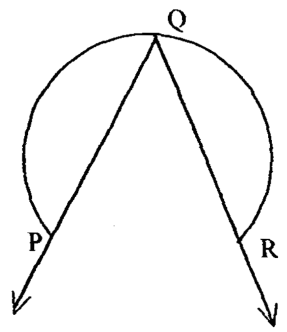
35. “വൃത്തകേന്ദ്രത്തിൽ നിന്നും തുല്യ അകലത്തിലുള്ള രണ്ട് ഞാണുകൾ തുല്യനീളമുള്ളതായിരിക്കും.”



'O'കേന്ദ്രമായ വൃത്തത്തിലെ രണ്ട് ഞാണുകളാണ് AB യുംCD യും. OM, ON എന്നിവ വൃത്ത കേന്ദ്രത്തിൽ നിന്നും ഞാണിലേക്കുള്ള അകലങ്ങൾ ആണ്. OM = ON = 2 cm ; AB = 3.5cm എങ്കിൽ CD യുടെ നീളം എത്ര?

A. 2cm
C. 4cm
B. 3.5cm
D. 7 cm

36. "ഒരു ദീർഘചാപത്തിൽ അന്തർലേഖനം ചെയ്തിരിക്കുന്ന കോൺ ന്യൂനകോൺ ആയിരിക്കും."



ചിത്രത്തിൽ $\overset{\frown}{PQR}$ ഒരു ദീർഘചാപം ആണ്. $\angle PQR$ അതിൽ അന്തർലേഖനം ചെയ്തിരിക്കുന്നു. എങ്കിൽ $\angle PQR$ ഏത് തരം കോണാണ്?

A. മട്ടകോൺ
C. ന്യൂനകോൺ
B. ബൃഹത്കോൺ
D. ബാഹ്യകോൺ

37. "$P(x_1, y_1, z_1)$ ഉം $Q(x_2, y_2, z_2)$ ഉം ഒരു തലത്തിലെ രണ്ട് ബിന്ദുക്കളായാൽ അവ തമ്മിലുള്ള അകലം $PQ = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$ ആയിരിക്കും".

എങ്കിൽ, A (1,3,4)ഉംB (-1, 6 10) ഉം ഒരു തലത്തിലെ ബിന്ദുക്കളായാൽ ABഎന്തായിരിക്കും?

A. 7
C. $\sqrt{7}$
B. 41
D. $\sqrt{41}$

38. "$d/dx(x^n) = nx^{n-1}$ ആകുന്നു."

എങ്കിൽ $d/dx(x^{10})$ എന്തായിരിക്കും?

A. $10x^{10}$
C. $10x^9$
B. x^{10}
D. $9x^{10}$

39. "A,B,C ശീർഷകങ്ങളായ ഒരു ത്രികോണമാണ് $\triangle ABC$. $\triangle ABC$യിൽ$A(x_1,y_1,z_1)$, $B(x_2,y_2,z_2)$, $C(x_3,y_3,z_3)$ ആകുന്നു. എങ്കിൽAB എന്ന വശത്തിന്റെ മധ്യബിന്ദു $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}, \frac{z_1+z_2}{2}\right)$ ആയിരിക്കും"

$\triangle PQR$ൽ$P(3,8,3)$, $Q(3,2,7)$,$R(-1,-2,1)$ ആകുന്നുവെങ്കിൽPQ ന്റെ മധ്യബിന്ദു താഴെ പറയുന്നവയിൽ ഏതായിരിക്കും?

A. (1,3,2) C. (1,0,4)

B. (3,5,5) D. (2,5,4)

40. "l,m,n എന്നിവ ഒരു സമാന്തരപ്രോഗ്രഷന്റെ തുടർച്ചയായ മൂന്ന് പദങ്ങളാണെങ്കിൽ $m = \frac{l+n}{2}$ ആയിരിക്കും."

8,q,16എന്നിവ ഒരു സമാന്തരപ്രോഗ്രഷന്റെ തുടർച്ചയായ മൂന്ന് പദങ്ങളാണെങ്കിൽ qന്റെ വിലയെന്ത്?

A.8 C.16

B.12 D. 128

110

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF DEDUCTIVE REASONING
(DRAFT)

Dr. V. Sumangala
Reader in Education

Mumthas, N.S.
Research Scholar

Instructions:

Time: 50 minutes

All the 40 questions of this test are based on some given theorems. Every question therefore consists of a theorem and a problem based on it.

Read each theorem and then based on the theorem find the answer for the problem, from among the choices A, B, C, D. Mark the correct answer in the given response sheet by putting an 'X' symbol in the circle below the letter A, B, C or D which represents your answer.

If you feel that the answer marked is wrong, envelope that circle by a rectangle (☐) and again put the 'X' mark in the circle representing your answer.

Example:

i) "The sum of the angles for a triangle is 180°". In ΔABC, if $\angle A = 45°$, $\angle B = 60°$ then what is the measure of $\angle C$?

A. 105°   C. 75°
B. 60°   D. 15°

Here, the correct answer is 75°. Hence the circle below the letter C, which represents the correct answer is marked using the symbol 'X' in the response sheet).

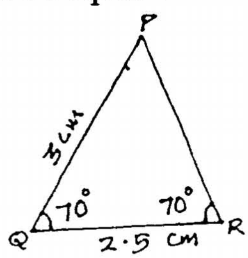
Response sheet				
	A	B	C	D
i)	O	O	X	O

1. "The number of elements in a set is called the cardinality of the set".

If A = { a,e,i,o,u}, what is the cardinality of A?

A. 1
B. 2
C. 3
D. 5

2. "If two angles of a triangle are equal, then the length of the sides opposite to these angles will also be equal".



In the given figure, ∠Q = ∠R = 70°, PQ = 3 cm and QR = 25 cm, then what is the length of the side PR?

A. 1.5 cm
B. 2.5 cm
C. 3 cm
D. 6 cm

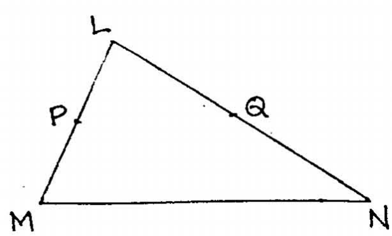
3. "The angles of an equilateral triangle are equal".
Then in the equilateral triangle ABC, what is the measure of ∠A?

A. 30°
B. 45°
C. 60°
D. 90°

4. "If set P is the subset of the set Q, then $P \cap Q = P$".
When X = {1,2} and Y = {-1, 0, 1, 2, 3}, what is $X \cap Y$?

A. X
B. ϕ
C. Y
D. $X \cup Y$

5. "The line segment joining the midpoints of any two sides of a triangle is half the third side".



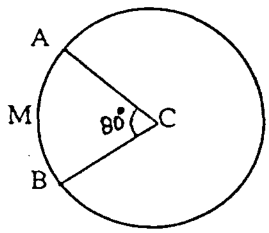
10. "If the total number of terms of an Arithmetic Progression is 'n', then

$$n = \frac{\text{last term - first term}}{\text{common difference}} + 1."$$

Then, in the Arithmetic Progression 21, 28, 35, ... 126, what is the total number of terms of it?

A. 14 C. 16
B. 15 D. 17

11. "The degree measure of a minor arc is the measure of the central angle of that arc".



In the figure $\overset{\frown}{AMB}$ is a minor arc and $\angle ACB = 80^\circ$. Then what is the measure of $\overset{\frown}{AMB}$?

A. 40° C. 90°
B. 80° D. 160°

12. "If $\angle A$, $\angle B$, $\angle C$ are the three angles of the ΔABC, then $\sin^2 A + \cos^2 A = 1$".

In ΔXYZ if $\angle X = 80^\circ$, $\angle Y = 60^\circ$, $\angle Z = 40^\circ$, then, what is the value of $\sin^2 60 + \text{Cos}^2 60$?

A. -1 C. 1
B. 0 D. $\sqrt{3}$

13. "The truth set of the quadratic equation $ax^2 + bx + c = 0$ is

$$\left\{\frac{-b + \sqrt{b^2 - 4ac}}{2a}, \frac{-b - \sqrt{b^2 - 4ac}}{2a}\right\}".$$

Then, which among the following is the truth set of $2x^2 - 11x + 12 = 0$?

A. {-3/2, -4} C. {4, -3/2}
B. {-4, 3/2} D. {4, 3/2}

14. "Figures having same shape and size are called congruent figures".

Then, which among the following are congruent figures?

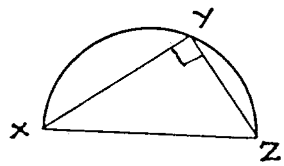
A. □□

B. o O

C. △ △

D. 

15. "The angle in a semi circle is a right angle".



In figure, $\overset{\frown}{XYZ}$ is a semi circle and $\angle XYZ$ is an angle in it. Then, what is the measure of $\angle XYZ$?

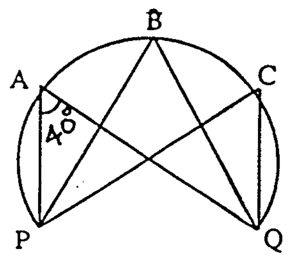
A. 30° C. 60°
B. 45° D. 90°

16. "The volume of a cylinder of radius 'r' and height 'h' is $\pi r^2 h$".

Then what is the volume of a cylinder of diameter 4 cm and height 10 cm?

A. $40\ \pi cm^3$ C. $40\ cm^3$
B. $160\ \pi cm^3$ D. $160\ cm^3$

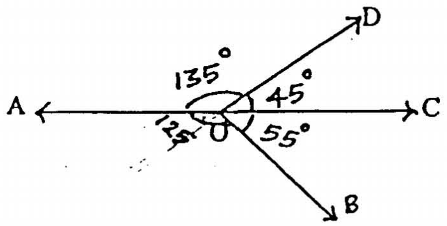
17. "The angles inscribed in the same arc are of equal measures".



In the figure, $\angle A$, $\angle B$, $\angle C$ are three angles inscribed in the $\overset{\frown}{PAQ}$. If $\angle A = 40^\circ$, then what is the measure of $\angle B$?

A. 40° C. 80°
B. 60° D. 120°

18. "If the sum of two angles is 180°, then the angles are supplementary angles".



Which are the supplementary angles of the above given figure?

A. $\angle$ AOD & $\angle$COD C. $\angle$COD & $\angle$COB
B. $\angle$AOD & $\angle$AOB D. $\angle$AOB & $\angle$COD

19. "If a polynomial p(x) is divided by (x-a), then the remainder will be p(a)".

Then, what is the remainder, when the polynomial $p(x) = 2x^3 - 7x^2 + 2x + 1$ is divided by x - 3?

A. -122 C. -2
B. -110 D. 4

20. "If a, b, c are the three consecutive terms of a geometric progression, then $b = \sqrt{ac}$".

Then what is the value of K if 12, k, 48 are the three consecutive terms of a geometric progression?

A. 24 C. 36
B. 60 D. 30

21. "Eventhough the same element is repeated in a set, when we consider the set of elements used, it is enough to include a particular element only once".
Then what is the number of elements of the set of letters of the word LANGUAGE?

A. 8 C. 5
B. 6 D. 2

22. "The null set is a set with no elements in it".

Which among the following is a null set?

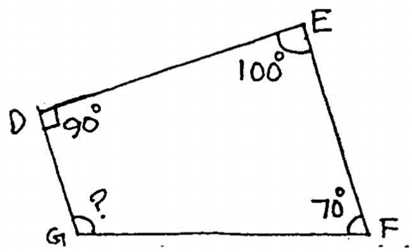
A. { } C. {O}
B. {ϕ} D. {-1}

23. "The degree of a polynomial is the same as that of the term having the highest degree and non-zero coefficient".

What is the degree of the polynomial $0x^3 + 0x^2 + 5x + 2$?

A.	3	C.	1
B.	2	D.	0

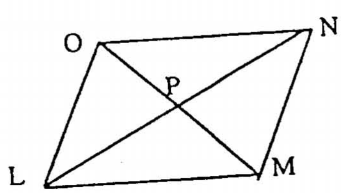
24. "The sum of the measures of all angles of a quadrilateral is 360°".



What is the measure of $\angle G$ in the quadrilateral DEFG?

A.	65°	C.	100°
B.	70°	D.	125°

25. "The diagonals of a parallelogram bisect each other".



In ▱ LMNO, if LN = 8 cm and OM = 5 cm then what is the length of NP?

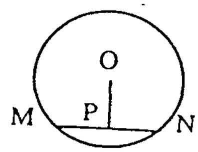
A.	2.5 cm	C.	5 cm
B.	4 cm	D.	8 cm

26. "If 'a' cm is the length of the base edge and 'h' cm is the height of a square pyramid, then its volume is $1/3\ a^2h$ cm³".

If the length of the base edge of a square pyramid is 9 cm and its height is 10 cm, what is its volume?

A.	30 cm³	C.	270 cm³
B.	90 cm³	D.	810 cm³

27. "The line segment containing the centre of a circle and the midpoint of a chord of the same circle is perpendicular to that chord".



MN is the chord of a circle with centre O. Then what is the measure of $\angle OPN$?

A. 30° B. 60°
C. 45° D. 90°

28. "If 'a' is the first term and 'd' the common difference of an Arithmetic Progression, then the sum of its first 'n' consecutive terms is S = n/2 [first term + last term]".

If 7, 14, 21, ..., 70 is an Arithmetic Progression, then what is the sum of its first 8 consecutive terms?

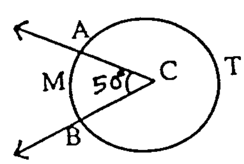
A. 616 C. 308
B. 504 D. 252

29. "If 'r' cm is the radius of a hemisphere, its total surface area is $3\pi r^2 cm^2$"

What is the total surface area of a hemisphere whose radius is 6 cm?

A. $108\ \pi cm^2$ C. $108\ cm^2$
B. $18\ \pi\ cm^2$ D. $18\ cm^2$

30. "The degree measure of a major arc = (360° - degree measure of its opposite minor arc)".



In the figure, if $\widehat{AMB}$ is a minor arc and its degree measure is 50° then what is the degree measure of $\widehat{ATB}$?

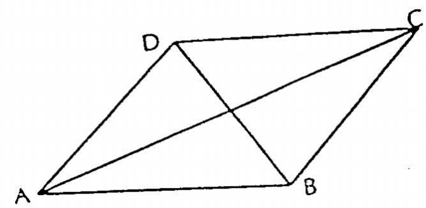
A. 50° C. 310°
B. 180° D. 360°

31. "A sentence that contains only numbers is a numerical sentence".

Which among the following is a numerical sentence?

A. $4 + 3 = 7$ C. $5 + 4Y \neq 7$
B. $3x > 7$ D. $3y + 1 < 2$.

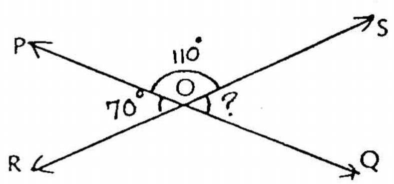
32. "If the lengths of the diagonals of a rhombus are d_1, d_2 respectively then its area is $1/2\ d_1d_2$ square units".



AC and AD are the diagonals of the rhombus ABCD. If AC = 8 cm and BD = 4 cm, then what is the area of rhombus ABCD?

A. 32 cm^2 C. 12 cm^2
B. 16 cm^2 D. 6 cm^2

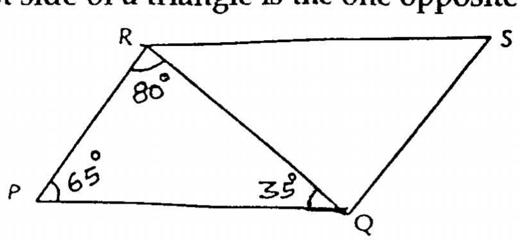
33. "If two straight lines intersect, the measures of vertical angles so formed are equal".



$\overleftrightarrow{PQ}$ & $\overleftrightarrow{RS}$ are two straight lines. They intersect at the point 'O'.
If $\angle POR = 70^\circ$ and $\angle POS = 110^\circ$, then what is the measure of $\angle SOQ$?

A. 110° C. 70°
B. 180° D. 40°

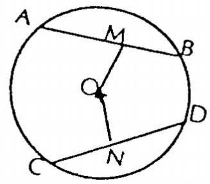
34. "The shortest side of a triangle is the one opposite to the smallest angle".



ΔPQR & ΔRSQ are two triangles in the quadrilateral PQSR. In ΔPQR, $\angle P = 65^\circ$, $\angle Q = 35^\circ$ and $\angle R = 80^\circ$, then which is the shortest side of ΔPQR?

A. PQ	C. QS
B. QR	D. PR

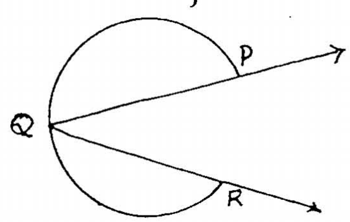
35. "Two chords, equidistant from the centre of a circle are equal in measure".



AB and CD are the two chords of a circle with centre '0'. The distances from the centre to these chords are OM and ON. If OM = ON = 2 cm and AB = 3.5 cm, then what is the length of CD?

A. 2 cm	C. 4 cm
B. 3.5 cm	D. 7 cm

36. "The angle inscribed in a major arc is an acute angle".



In the figure, $\overset{\frown}{PQR}$ is a major arc and $\angle PQR$ is inscribed in it. Then what type of angle is $\angle PQR$?

A. right angle	C. acute angle
B. obtuse angle	D. exterior angle

37. "If $P(x_1,y_1,z_1)$ and $Q(x_2,y_2,z_2)$ are two points on a plane, the distance between them is $PQ = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2 + (z_2-z_1)^2}$

If A (1,3,4) and B (-1,6,10) are two points on a plane then what is AB?

A. 7	C. $\sqrt{7}$
B. 41	D. $\sqrt{41}$

38. "$\frac{d}{dx}(x^n) = nx^{n-1}$"

Then what is $\frac{d}{dx}(x^{10})$?

A. $10\,x^{10}$
B. x^{10}
C. $10\,x^9$
D. $9x^{10}$

39. "A, B, C are the vertices of a ΔABC. In ΔABC, $A = (x_1,y_1,z_1)$, $B = (x_2,y_2,z_2)$ and $C = (x_3,y_3,z_3)$. Then the midpoint of the side AB is $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}, \frac{z_1 + z_2}{2}\right)$"

In ΔPQR, if P = (3, 8, 3), Q = (3, 2, 7) and R = (-1, -2, -1) then which among the following is the midpoint of the side PQ?

A. (1,3,2)
B. (3,5,5)
C. (1,0,4)
D. (2,5,4)

40. "If l, m, n are the 3 consecutive terms of an Arithmetic Progression, then $m = \frac{l + n}{2}$".

If 8, q, 16 are the 3 consecutive terms of an Arithmetic Progression, then what is the value of 'q'?

A. 8
B. 12
C. 16
D. 128

APPENDIX XV (a)

UNIVERSITY OF CALICUT

DEPARTMENT OF EDUCATION

TEST OF DEDUCTIVE REASONING

SCORING KEY

1.	D	21.	B
2.	C	22.	A
3.	C	23.	C
4.	A	24.	C
5.	B	25.	B
6.	B	26.	C
7.	D	27.	D
8.	A	28.	C
9.	A	29.	A
10.	C	30.	C
11.	B	31.	A
12.	C	32.	B
13.	D	33.	C
14.	A	34.	D
15.	D	35.	B
16.	A	36.	C
17.	A	37.	A
18.	A	38.	C
19.	C	39.	B
20.	A	40.	B

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
TEST OF DEDUCTIVE REASONING

Dr. V.Sumangala — **Reader in Education**

Mumthas.N.S. — **Research Scholar**

നിർദ്ദേശങ്ങൾ: സമയം : 40 മിനിറ്റ്

ഗണിതശാസ്ത്രസംബന്ധിയായ 32 ചോദ്യങ്ങളാണ് താഴെ കൊടുത്തിരിക്കുന്നത്. ഓരോ ചോദ്യവും ആരംഭിക്കുന്നത് ഒരു ഗണിതശാസ്ത്ര സിദ്ധാന്തം കൊണ്ടാണ്. അതിനു ശേഷം ആ സിദ്ധാന്തവുമായി ബന്ധപ്പെട്ട ഒരു പ്രശ്നം നൽകിയിരിക്കുന്നു.

ഓരോ ചോദ്യവും വായിച്ച് തന്നിരിക്കുന്ന പ്രശ്നത്തിന് അനുയോജ്യമായ ഉത്തരം A,B,C,D എന്നിവയിൽ നിന്ന് തെരഞ്ഞെടുത്ത്, ഇതോടൊപ്പം നൽകിയിരിക്കുന്ന ഉത്തരക്കടലാസ്സിൽ അതാത് ചോദ്യ നമ്പരിനു നേരെ,അടയാളപ്പെടുത്തുക. ഉത്തരങ്ങൾ അടയാളപ്പെടുത്തേണ്ടത് ഉത്തരക്കടലാസിൽ A,B,C,Dഎന്നീ അക്ഷരങ്ങൾക്ക് താഴെ നൽകിയിട്ടുള്ള വൃത്തത്തിൽ “X” അടയാളം കൊണ്ടാണ്.

രേഖപ്പെടുത്തിയത് തെറ്റായ വൃത്തത്തിലാണെന്ന് തോന്നിയാൽ ആ വൃത്തത്തെ “□”ചിഹ്നം കൊണ്ട് വലയം ചെയ്തശേഷം ശരിയായ വൃത്തത്തിൽ വീണ്ടും “X” അടയാളമിടുക.

ഉദാഹരണം:

“ഒരു ത്രികോണത്തിന്റെ മൂന്ന് കോണുകളുടേയും അളവുകളുടെ തുക 180^0 ആയിരിക്കും”

$\triangle ABC$ യിൽ $\angle A = 45^0$, $\angle B = 60^0$ എങ്കിൽ $\angle C$ എത്ര?

A. 105^0 C. 60^0

B. 75^0 D. 15^0

(ഇവിടെ ശരിയുത്തരം 75^0 ആണല്ലോ. ആയതിനാൽ ശരിയുത്തരത്തെ സൂചിപ്പിക്കുന്ന Bഎന്ന അക്ഷരത്തിനു താഴെയുള്ള വൃത്തത്തിൽ “X” എന്ന അടയാളം രേഖപ്പെടുത്തിയിരിക്കുന്നു.)

ഉത്തരക്കടലാസ്

A	B	C	D
○	⊗	○	○

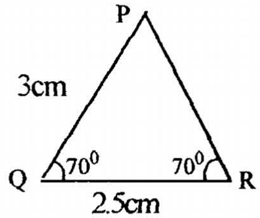
1. “ഒരു ഗണത്തിലെ അംഗങ്ങളുടെ എണ്ണമാണ് ആ ഗണത്തിന്റെ കാർഡിനാലിറ്റി”
$A = \{a,e,i,o,u\}$ ആയാൽ A യുടെ കാർഡിനാലിറ്റി എന്ത്?

A. 1 C. 3

B. 2 D. 5

2. “ഒരു ത്രികോണത്തിലെ രണ്ട് കോണുകൾ തുല്യമായാൽ അവയ്ക്കെതിരെയുള്ള വശങ്ങളും തുല്യമായിരിക്കും.”

ചിത്രത്തിൽ $\angle Q = \angle R = 70^0$, PQ = 3 cm, QR = 2.5cm ആയാൽ PR എന്ന വശത്തിന്റെ നീളം എന്ത്?



A. 1.5cm C. 3cm

B. 2.5cm D. 6cm

3. “ഒരു സമഭുജ ത്രികോണത്തിന്റെ കോണുകളുടെ അളവുകൾ തുല്യമായിരിക്കും”

$\triangle ABC$ ഒരു സമഭുജത്രികോണമാണ്. എങ്കിൽ $\angle A$ യുടെ അളവെന്ത്?

A. 30^0 C. 60^0

B. 45^0 D. 90^0

4. “R എന്ന ഗണത്തിന്റെ ഉപഗണമാണ് Pഎങ്കിൽ$P \cap R = P$ ആയിരിക്കും”

$X = \{1,2\}$, $Y = \{-1,0,1,2,3\}$ ആയാൽ $X \cap Y$താഴെ പറയുന്നവയിൽ ഏതായിരിക്കും?

A. x C. Y

B. ϕ D. $X \cup Y$

5. “ ‘n’ വശങ്ങളുള്ള ഒരു ബഹുഭുജത്തിന്റെ ആന്തരകോണുകളുടെ അളവുകളുടെ തുക (2n - 4) മട്ടങ്ങൾ ആയിരിക്കും”

$\therefore$8 വശങ്ങളുള്ള ഒരു ബഹുഭുജത്തിലെ ആന്തര കോണുകളുടെ അളവുകളുടെ തുക എന്ത്?

A. 4മട്ടം C.16 മട്ടം

B. 12 മട്ടം D. 20 മട്ടം

6. "രണ്ട് പദങ്ങളുടെ വ്യത്യാസത്തിന്റെ വർഗ്ഗം = ഒന്നാമത്തെ പദത്തിന്റെ വർഗ്ഗം -2 x ഒന്നാമത്തെ പദം x രണ്ടാമത്തെ പദം + രണ്ടാമത്തെ പദത്തിന്റെ വർഗ്ഗം"

എങ്കിൽ, $(5m -2n)^2$ എന്തായിരിക്കും?

A. $25m^2 - 20mn + 4n^2$ C. $25m^2 + 20mn + 4n^2$

B. $5m^2 - 20mn + 2n^2$ D. $5m^2 + 20mn + 2n^2$

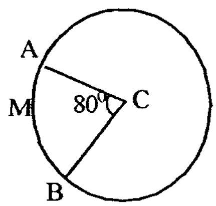
7. "ഒരു സമഭുജത്രികോണത്തിന്റെ ഒരു വശത്തിന്റെ നീളം 'a'cm ആയാൽ വിസ്തീർണ്ണം $\frac{\sqrt{3}a^2}{4}$ cm^2 ആയിരിക്കും."

സമഭുജത്രികോണം DEF ൽ DE എന്ന വശത്തിന്റെ നീളം 2cm ആണെങ്കിൽ അതിന്റെ വിസ്തീർണ്ണം എന്ത്?

A. $\sqrt{3}cm^2$ C. $\sqrt{12}/4cm^2$

B. $\sqrt{3}/4$ cm^2 D. $\sqrt{6}/4$ cm^2

8. "ഒരു ലഘുചാപത്തിന്റെ ഡിഗ്രി അളവ് ആ ചാപത്തിന്റെ കേന്ദ്രകോണിന്റെ അളവാകുന്നു"



ചിത്രത്തിൽ $\overset{\frown}{AMB}$ ഒരു ലഘുചാപമാണ്

$\angle ACB = 80^0$ ആയാൽ $\overset{\frown}{AMB}$ യുടെ അളവെന്ത്?

A. 40^0 C. 90^0

B. 80^0 D. 160^0

9. "$\triangle ABC$ യിലെ മൂന്ന് കോണുകളാണ് $\angle A, \angle B, \angle C$ എങ്കിൽ $Sin^2 A + Cos^2 A = 1$ ആയിരിക്കും"

$\triangle XYZ$ ൽ $\angle x = 80^0, \angle Y = 60^0, \angle z = 40^0$ എങ്കിൽ $Sin^2 60 + Cos^2 60$ ന്റെ വിലയെന്ത്?

A. -1 C. 1

B. 0 D. $\sqrt{3}$

10. "ഒരേ ആകൃതിയും ഒരേ വലിപ്പവുമുള്ള രൂപങ്ങളെ സർവ്വസമരൂപങ്ങൾ എന്നു പറയുന്നു."

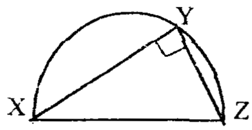
താഴെ കൊടുത്തിരിക്കുന്നവയിൽ സർവ്വസമരൂപങ്ങൾ ഏത്?

A. □□ C. △△

B ○◯. D. 

11. "ഒരു അർദ്ധവൃത്തത്തിൽ അന്തർലേഖനം ചെയ്തിട്ടുള്ള കോൺ മട്ടകോൺ ആയിരിക്കും."

ചിത്രം(1) ൽ, $\overset{\frown}{XYZ}$ ഒരു അർദ്ധവൃത്തമാണ്. അതിൽ അന്തർലേഖനം ചെയ്തിട്ടുള്ള കോൺ ആണ് $\angle XYZ$. എങ്കിൽ $\angle XYZ$ ന്റെ അളവെന്ത്?



ചിത്രം(1)

A. 30^0 C. 60^0

B. 45^0 D. 90^0

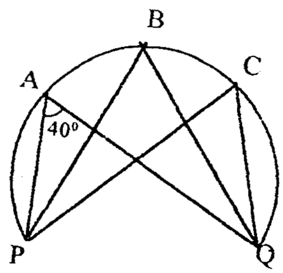
12. "'r' cm ആരവും 'h' cm ഉന്നതിയുമുള്ള ഒരു വൃത്തസ്തംഭത്തിന്റെ വ്യാപ്തം '$\pi r^2 h$' cm^3 ആകുന്നു."

4 cm വ്യാസവും 10 cm ഉന്നതിയുമുള്ള ഒരു വൃത്തസ്തംഭത്തിന്റെ വ്യാപ്തം എന്ത്?

A. $40\pi\ cm^3$ C. $40\ cm^2$

B. $160\pi\ cm^3$ D. $160\ cm^2$

13. "ഒരേ ചാപത്തിൽ അന്തർലേഖനം ചെയ്തിട്ടുള്ള കോണുകളുടെ അളവുകൾ തുല്യമായിരിക്കും."



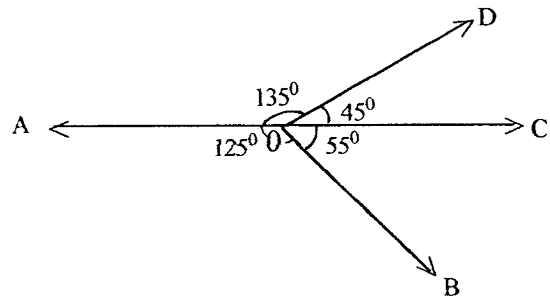
$\overset{\frown}{PAQ}$ വിൽ അന്തർലേഖനം ചെയ്തിരിക്കുന്ന മൂന്ന് കോണുകളാണ് $\angle A$, $\angle B$, $\angle C$. $\angle A = 40^0$ എങ്കിൽ $\angle B$യുടെ അളവെന്ത്?

A. 40^0 C. 80^0

B. 60^0 D. 120^0

14. "രണ്ടു കോണുകളുടെ തുക 180^0 ആയാൽ അവ അനുപൂരക കോണുകളായിരിക്കും."

ചിത്രത്തിലെ അനുപൂരക കോണുകൾ ഏവ?



A. $\angle$AOD യും $\angle$ CODയും

C. $\angle$COD യും $\angle$COBയും

B. $\angle$AOD യും $\angle$AOB യും

D. $\angle$AOB യും $\angle$CODയും

15 "ഒരു ഗണത്തിലെ ഒരംഗം തന്നെ ആവർത്തിച്ചു വരികയാണെങ്കിൽ അംഗങ്ങൾ എഴുതുമ്പോൾ അത് ഒരു പ്രാവശ്യം മാത്രം എഴുതിയാൽ മതി."

Languageഎന്ന വാക്കിലെ അക്ഷരങ്ങളുടെ ഗണത്തിലെ അംഗങ്ങളുടെ എണ്ണം എത്ര?

A. 8

C. 5

B. 6

D. 2

16. "ഒരംഗം പോലും ഇല്ലാത്ത ഗണത്തെ ശൂന്യഗണം എന്നു പറയുന്നു."

താഴെ പറയുന്നവയിൽ ശൂന്യഗണം ഏത്?

A. { }

C. {0}

B. {ϕ}

D. {-1}

17. "ഗുണോത്തരം പൂജ്യമല്ലാത്ത പദങ്ങളിൽ ഏറ്റവും വലിയ കൃതിയുള്ള പദത്തിന്റെ കൃതിയാണ് പോളിനോമിയലിന്റെ കൃതി".

$0x^3 + 0x^2 + 5x + 2$ എന്ന പോളിനോമിയലിന്റെ കൃതി എന്ത്?

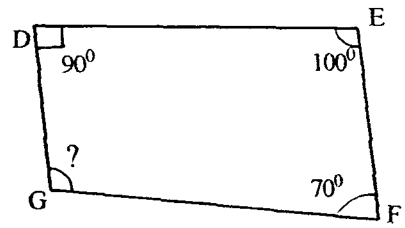
A. 3

C. 1

B. 2

D. 0

18. "ഒരു ചതുർഭുജത്തിന്റെ എല്ലാ കോണുകളുടേയും അളവുകളുടെ തുക 360^0 ആയിരിക്കും"

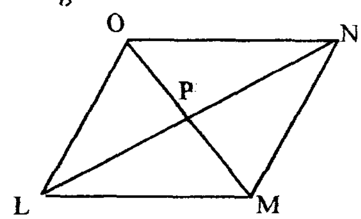


ചതുർഭുജം DEFG ൽ $\angle G$യുടെ അളവ് എത്ര?

A. 65^0 C. 100^0

B. 70^0 D. 125^0

19. "ഒരു സാമാന്തരികത്തിന്റെ വികർണങ്ങൾ പരസ്പരം സമഭാഗം ചെയ്യും."



സാമാന്തരികം LMNO-യിൽLN = 8cm, OM = 5cm, ആയാൽ NP യുടെ നീളം എന്ത്?

A. 2.5cm C. 5cm

B. 4cm D. 8cm

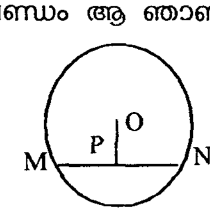
20. "പാദവക്കിന്റെ നീളം 'a'cm ഉം ഉയരം 'h'cm ഉംആയ സമചതുരസ്തൂപികയുടെ വ്യാപ്തം '1/3 a^2 h' cm^3 ആകുന്നു."

ഒരു സമചതുരസ്തൂപികയുടെ പാദവക്കിന്റെ നീളം 9cm ഉം ഉന്നതി 10cm ഉം ആയാൽ അതിന്റെ വ്യാപ്തം എന്ത്?

A. $30cm^3$ C. $270cm^3$

B. $90\ cm^3$ D. $310\ cm^3$

21. "ഒരു വൃത്തത്തിന്റെ കേന്ദ്രവും അതിലെ ഒരു ഞാണിന്റെ മധ്യബിന്ദുവും ഉൾക്കൊള്ളുന്ന രേഖാഖണ്ഡം ആ ഞാണിന് ലംബമായിരിക്കും."



'O'കേന്ദ്രമായ വൃത്തത്തിലെ ഞാണാണ് MNഎങ്കിൽ $\angle OPN$ന്റെ അളവ് എത്ര?

A. 30^0 C. 60^0

B. 45^0 D. 90^0

128

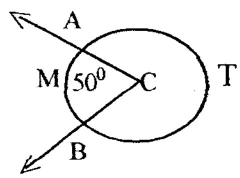
22. "'r'cm ആരമായ ഒരു അർദ്ധഗോളത്തിന്റെ ഉപരിതലവിസ്തീർണ്ണം '$3\pi r^2$'cm^2 ആകുന്നു."

6cm ആരമുള്ള ഒരു അർദ്ധഗോളത്തിന്റെ ഉപരിതലവിസ്തീർണ്ണം എന്ത്?

A. $108\,\pi\ cm^2$ C. $108cm^2$

B. $18\,\pi cm^2$ D. $18\ cm^2$

23. "ഒരു ദീർഘചാപത്തിന്റെ ഡിഗ്രി അളവ്= (360^0– എതിർ ലഘുചാപത്തിന്റെ ഡിഗ്രി അളവ്)"



ചിത്രത്തിൽ $\widehat{AMB}$ ലഘുചാപവും അതിന്റെ ഡിഗ്രി അളവ് 50^0യും ആയാൽ $\widehat{ATB}$ യുടെ ഡിഗ്രി അളവ് എന്ത്?

A. 50^0 C. 310^0

B. 180^0 D. 360^0

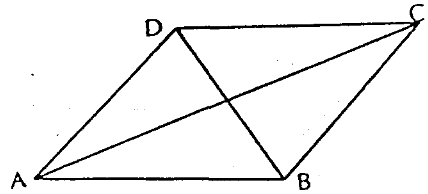
24. "സംഖ്യകൾ മാത്രം ഉൾക്കൊള്ളുന്ന വാക്യങ്ങളാണ് സംഖ്യാവാക്യങ്ങൾ"

താഴെ പറയുന്നവയിൽ സംഖ്യാവാക്യമേത്?

A. $4 + 3 = 7$ C. $5 + 4y \neq 7$

B. $3x > 7$ D. $3y + 1 < 2$

25. "ഒരു സമഭുജസാമാന്തരികത്തിന്റെ വികർണങ്ങളുടെ നീളം d_1, d_2 ആണെങ്കിൽ അതിന്റെ വിസ്തീർണ്ണം $^1/_2\ d_1\ d_2$ ച.യൂണിറ്റ് ആയിരിക്കും."

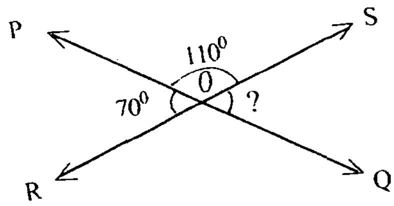


സമഭുജസാമാന്തരികം ABCD യിലെ വികർണങ്ങളാണ് AC യും BD യും. AC = 8cm, BD = 4cm. എങ്കിൽ സമഭുജസാമാന്തരീകം ABCD യുടെ വിസ്തീർണം എന്ത്?

A. $32cm^2$ C. $12cm^2$

B. $16cm^2$ D. $6cm^2$

26. "രണ്ട് നേർരേഖകൾ ഖണ്ഡിക്കുമ്പോഴുണ്ടാകുന്ന ഏകാന്തരകോണുകൾ തുല്യമായിരിക്കും."

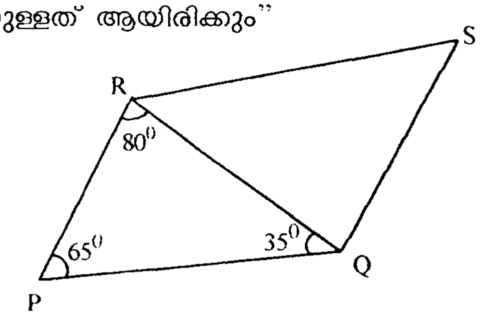


$\overleftrightarrow{PQ}, \overleftrightarrow{RS}$ രണ്ട് നേർരേഖകളാണ്. അവ 'O' എന്ന ബിന്ദുവിൽ ഖണ്ഡിക്കുന്നു. $\angle POR = 70^0$. $\angle POS = 110^0$ആയാൽ $\angle SOQ$ന്റെ അളവെന്ത്?

A. 110^0 C. 70^0

B. 180^0 D. 40^0

27. "ഒരു ത്രികോണത്തിന്റെ ഏറ്റവും ചെറിയ വശം അതിന്റെ ഏറ്റവും ചെറിയ കോണിന് എതിരെയുള്ളത് ആയിരിക്കും"

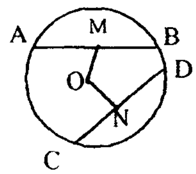


ചതുർഭുജം PQSRലെ രണ്ട് ത്രികോണങ്ങളാണ് ΔPQRഉം ΔRSQഉം. ΔPQR ൽ $\angle P = 65^0$, $\angle Q = 35^0$, $\angle R = 80^0$ആണ്. എങ്കിൽ ΔPQRൽ ഏറ്റവും ചെറിയ വശം ഏത്?

A. PQ C. QS

B. QR D. PR

28. "വൃത്തകേന്ദ്രത്തിൽ നിന്നും തുല്യ അകലത്തിലുള്ള രണ്ട് ഞാണുകൾ തുല്യനീളമുള്ളതായിരിക്കും."

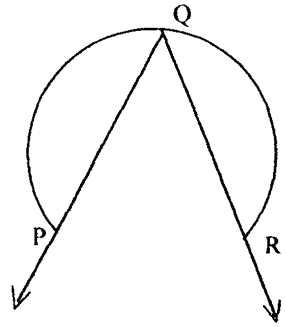


'O' കേന്ദ്രമായ വൃത്തത്തിലെ രണ്ട് ഞാണുകളാണ് AB യുംCD യും. OM, ON എന്നിവ വൃത്ത കേന്ദ്രത്തിൽ നിന്നും ഞാണിലേക്കുള്ള അകലങ്ങൾ ആണ്.OM = ON = 2 cm ; AB = 3.5cm എങ്കിൽ CD യുടെ നീളം എത്ര?

A. 2cm C. 4cm

B. 3.5cm D. 7 cm

29. "ഒരു ദീർഘചാപത്തിൽ അന്തർലേഖനം ചെയ്തിരിക്കുന്ന കോൺ ന്യൂനകോൺ ആയിരിക്കും."



ചിത്രത്തിൽ $\overparen{PQR}$ ഒരു ദീർഘചാപം ആണ്. $\angle PQR$ അതിൽ അന്തർലേഖനം ചെയ്തിരിക്കുന്നു. എങ്കിൽ $\angle PQR$ ഏത് തരം കോണാണ്?

A. മട്ടകോൺ C.ന്യൂനകോൺ

B.ബൃഹത്കോൺ D. ബാഹ്യകോൺ

30. "$d/dx\,(x^n) = nx^{n-1}$ ആകുന്നു."

എങ്കിൽ $d/dx\,(x^{10})$എന്തായിരിക്കും?

A. $10x^{10}$ C. $10x^9$

B. x^{10} D. $9x^{10}$

31. "A,B,C ശീർഷകങ്ങളായ ഒരു ത്രികോണമാണ് $\triangle ABC$. $\triangle ABC$യിൽ$A(x_1,y_1,z_1)$ $B(x_2,y_2,z_2)$, $C(x_3,y_3,z_3)$ ആകുന്നു. എങ്കിൽAB എന്ന വശത്തിന്റെ മധ്യബിന്ദു $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}, \frac{z_1+z_2}{2}\right)$ ആയിരിക്കും"

$\triangle PQR$ൽ$P(3,8,3)$, $Q(3,2,7)$,$R(-1,-2,1)$ ആകുന്നുവെങ്കിൽPQ ന്റെ മധ്യബിന്ദു താഴെ പറയുന്നവയിൽ ഏതായിരിക്കും?

A. (1,3,2) C. (1,0,4)

B. (3,5,5) D. (2,5,4)

32. "l,m,n എന്നിവ ഒരു സമാന്തരപ്രോഗ്രഷന്റെ തുടർച്ചയായ മൂന്ന് പദങ്ങളാണെങ്കിൽ$m = \frac{l+n}{2}$ ആയിരിക്കും."

8,q,16എന്നിവ ഒരു സമാന്തരപ്രോഗ്രഷന്റെ തുടർച്ചയായ മൂന്ന് പദങ്ങളാണെങ്കിൽ qന്റെ വിലയെന്ത്?

A.8 C.16

B.12 D. 128

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

TEST OF DEDUCTIVE REASONING

Dr. V. Sumangala
Reader in Education

Mumthas, N.S.
Research Scholar

Instructions:

Time: 40 minutes

All the 32 questions of this test are based on some given theorems. Every question therefore consists of a theorem and a problem based on it.

Read each theorem and then based on the theorem find the answer for the problem, from among the choices A, B, C, D. Mark the correct answer in the given response sheet by putting an 'X' symbol in the circle below the letter A, B, C or D which represents your answer.

If you feel that the answer marked is wrong, envelope that circle by a rectangle (▭) and again put the 'X' mark in the circle representing your answer.

Example:

i) "The sum of the angles for a triangle is 180°". In ΔABC, if $\angle A = 45°$, $\angle B = 60°$ then what is the measure of $\angle C$?

A. 105° C. 75°
B. 60° D. 15°

Here, the correct answer is 75°. Hence the circle below the letter C, which represents the correct answer is marked using the symbol 'X' in the response sheet).

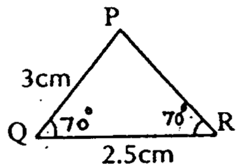
Response sheet				
	A	B	C	D
i)	O	O	⊗	O

1. "The number of elements in a set is called the cardinality of the set".

If A = { a,e,i,o,u}, what is the cardinality of A?

A. 1 C. 3
B. 2 D. 5

2. "If two angles of a triangle are equal, then the length of the sides opposite to these angles will also be equal".



In the given figure, $\angle Q = \angle R = 70°$, PQ = 3 cm and QR = 2.5 cm, then what is the length of the side PR?

A. 1.5 cm C. 3 cm
B. 2.5 cm D. 6 cm

3. "The angles of an equilateral triangle are equal".

Then in the equilateral triangle ABC, what is the measure of $\angle A$?

A. 30° C. 60°
B. 45° D. 90°

4. "If set P is the subset of the set Q, then $P \cap Q = P$".

When X = {1,2} and Y = {-1, 0, 1, 2, 3}, what is $X \cap Y$?

A. X C. Y
B. ϕ D. $X \cup Y$

5. "If a polygon has 'n' sides, the sum of the measure of all its interior angles is (2n-4) right angles".

Then, in a polygon with 8 sides, what is the sum of the measures of all its interior angles?

A. 4 right angles C. 16 right angles
B. 12 right angles D. 20 right angles

6. "The square of the differences of two terms
= (first term)^2 - 2 x first term x second term + (second term)^2."

Then, what is $(5m-2n)^2$?

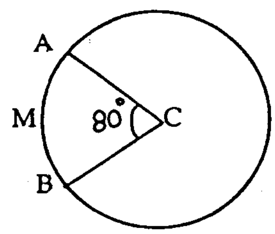
A. $25\ m^2 - 20\ mn + 4n^2$ C. $25m^2 + 20\ mn + 4n^2$
B. $5m^2 - 20\ mn + 2n^2$ D. $5m^2 + 20\ mn + 2n^2$

7. "If 'a' is the length of a side of an equilateral triangle, its area is $\sqrt{3}a^2/4$".

In the equilateral ΔDEF, if DE = 2 cm, then what is the area of that triangle?

A. $\sqrt{3}$ cm^2 C. $\sqrt{12}/4$ cm^2
B. $\sqrt{3}/4$ cm^2 D. $\sqrt{6}/4$ cm^2

8. "The degree measure of a minor arc is the measure of the central angle of that arc".



In the figure, $\overset{\frown}{AMB}$ is a minor arc and $\angle ACB = 80^\circ$. Then what is the measure of $\overset{\frown}{AMB}$?

A. 40° C. 90°
B. 80° D. 160°

9. "If $\angle A$, $\angle B$, $\angle C$ are the three angles of the ΔABC, then $\sin^2 A + \cos^2 A = 1$".

In ΔXYZ if $\angle X = 80^\circ$, $\angle Y = 60^\circ$, $\angle Z = 40^\circ$, then, what is the value of $\sin^2 60 + \cos^2 60$?

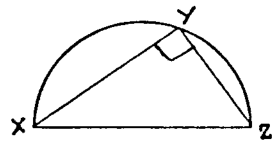
A. -1 C. 1
B. 0 D. $\sqrt{3}$

10. "Figures having same shape and size are called congruent figures".

Then, which among the following are congruent figures?

A. □□ C. △ Δ
B. o O D. ▱ ▱

11. "The angle in a semi circle is a right angle".



In figure, $\overset{\frown}{XYZ}$ is a semi circle and $\angle XYZ$ is an angle in it. Then, what is the measure of $\angle XYZ$?

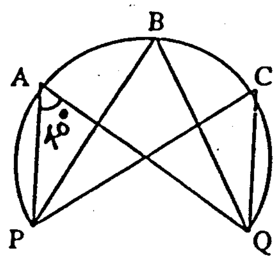
A. 30° C. 60°
B. 45° D. 90°

12. "The volume of a cylinder of radius 'r' cm and height 'h' cm is $\pi r^2 h$ cm³".

Then, what is the volume of a cylinder of diameter 4 cm and height 10 cm?

A. $40\,\pi cm^3$ C. $40\,cm^3$
B. $160\,\pi cm^3$ D. $160\,cm^3$

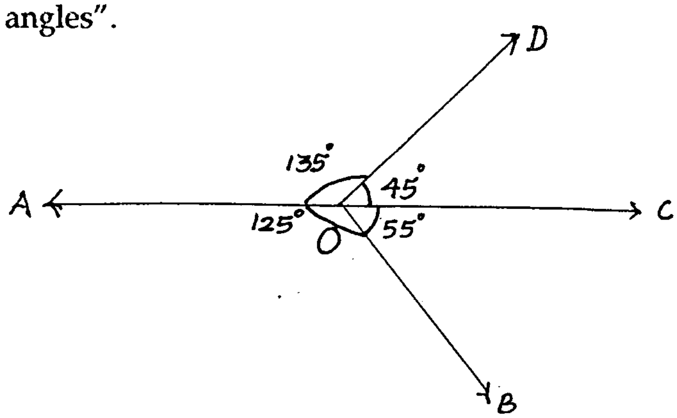
13. "The angles inscribed in the same arc are of equal measures".



In the figure, $\angle A$, $\angle B$, $\angle C$ are three angles inscribed in the $\overset{\frown}{PAQ}$. If $\angle A =$ 40°, then what is the measure of $\angle B$?

A. 40° C. 80°
B. 60° D. 120°

14. "If the sum of two angles is 180°, then the angles are supplementary angles".



Which are the supplementary angles of the above given figure?

A. $\angle$ AOD & $\angle$COD
B. $\angle$AOD & $\angle$AOB
C. $\angle$COD & $\angle$COB
D. $\angle$AOB & $\angle$COD

15. "Eventhough the same element is repeated in a set, when we consider the set of elements used, it is enough to include a particular element only once".

Then what is the number of elements of the set of letters of the word LANGUAGE?

A. 8
B. 6
C. 5
D. 2

16. "The null set is a set with no elements in it".

Which among the following is a null set?

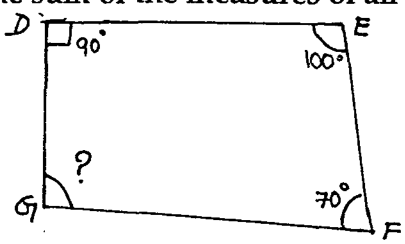
A. { }
B. {ϕ}
C. {O}
D. {-1}

17. "The degree of a polynomial is the same as that of the term having the highest degree and non-zero coefficient".

What is the degree of the polynomial $Ox^3 + 0x^2 + 5x + 2$?

A. 3
B. 2
C. 1
D. 0

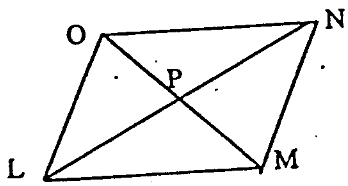
18. "The sum of the measures of all angles of a quadrilateral is 360°".



What is the measure of $\angle$G in the quadrilateral DEFG?

A. 65°
B. 70°
C. 100°
D. 125°

19. "The diagonals of a parallelogram bisect each other".



In ▱ LMNO, if LN = 8 cm and OM = 5 cm then what is the length of NP?

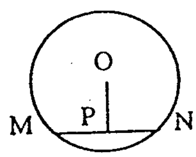
A. 2.5 cm C. 5 cm
B. 4 cm D. 8 cm

20. "If 'a' cm is the length of the base edge and 'h' cm is the height of a square pyramid, then its volume is $1/3\ a^2h\ cm^3$".

If the length of the base edge of a square pyramid is 9 cm and its height is 10 cm, what is its volume?

A. 30 cm^3 C. 270 cm^3
B. 90 cm^3 D. 810 cm^3

21. "The line segment containing the centre of a circle and the midpoint of a chord of the same circle is perpendicular to that chord".



MN is the chord of a circle with centre O. Then what is the measure of $\angle OPN$?

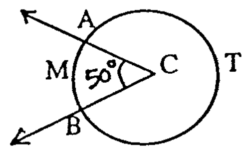
A. 30° C. 45°
B. 60° D. 90°

22. "If 'r' cm is the radius of a hemisphere, its total surface area is $3\pi r^2\ cm^2$".

What is the total surface area of a hemisphere whose radius is 6 cm?

A. 108 πcm^2 C. 108 cm^2
B. 18 π cm^2 D. 18 cm^2

23. "The degree measure of a major arc = (360° - degree measure of its opposite minor arc)".



In the figure, if $\overset{\frown}{AMB}$ is a minor arc and its degree measure is 50° then what is the degree measure of $\overset{\frown}{ATB}$?

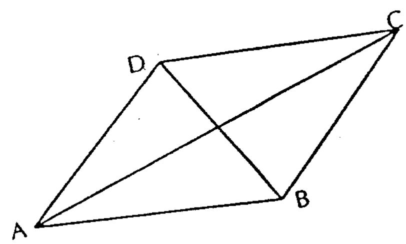
A.	50°	C.	310°
B.	180°	D.	360°

24. "A sentence that contains only numbers is a numerical sentence".

Which among the following is a numerical sentence?

A.	$4 + 3 = 7$	C.	$5 + 4Y \neq 7$
B.	$3x > 7$	D.	$3y + 1 < 2$.

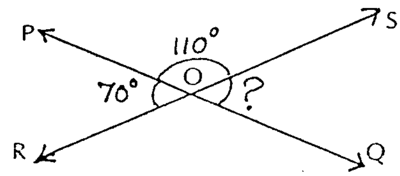
25. "If the lengths of the diagonals of a rhombus are d_1, d_2 respectively then its area is $1/2\ d_1d_2$ square units".



AC and AD are the diagonals of the rhombus ABCD. If AC = 8 cm and BD = 4 cm, then what is the area of rhombus ABCD?

A.	$32\ cm^2$	C.	$12\ cm^2$
B.	$16\ cm^2$	D.	$6\ cm^2$

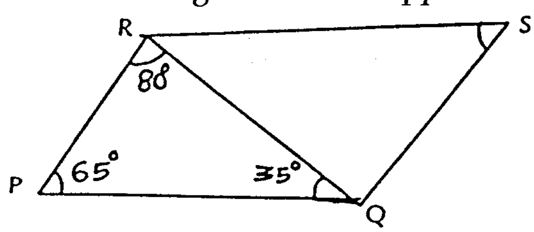
26. "If two straight lines intersect, the measures of vertical angles so formed are equal".



$\overleftrightarrow{PQ}$ & $\overleftrightarrow{RS}$ are two straight lines. They intersect at the point 'O'.
If $\angle POR = 70^\circ$ and $\angle POS = 110^\circ$, then what is the measure of $\angle SOQ$?

A. 110° C. 70°
B. 180° D. 40°

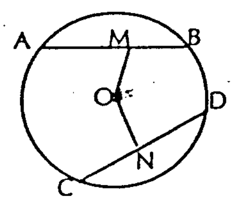
27. "The shortest side of a triangle is the one opposite to the smallest angle".



ΔPQR & ΔRSQ are two triangles in the quadrilateral PQSR. In ΔPQR, $\angle P = 65^\circ$, $\angle Q = 35^\circ$ and $\angle R = 80^\circ$, then which is the shortest side of ΔPQR?

A. PQ C. QS
B. QR D. PR

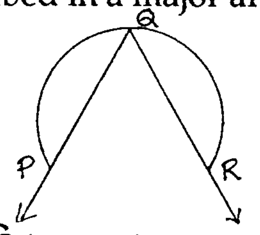
28. "Two chords, equidistant from the centre of a circle are equal in measure".



AB and CD are the two chords of a circle with centre '0'. The distances from the centre to these chords are OM and ON. If OM = ON = 2 cm and AB = 3.5 cm, then what is the length of CD?

A. 2 cm C. 4 cm
B. 3.5 cm D. 7 cm

29. "The angle inscribed in a major arc is an acute angle".



In the figure, $\overset{\frown}{PQR}$ is a major arc and $\angle PQR$ is inscribed in it. Then what type of angle is $\angle PQR$?

A. right angle
B. obtuse angle
C. acute angle
D. exterior angle

30. "$\frac{d}{dx}(x^n) = nx^{n-1}$"

Then what is $\frac{d}{dx}(x^{10})$?

A. $10\,x^{10}$
B. x^{10}
C. $10\,x^9$
D. $9x^{10}$

31. "A, B, C are the vertices of a ΔABC. In ΔABC, $A = (x_1, y_1, z_1)$, $B = (x_2, y_2, z_2)$ and $C = (x_3, y_3, z_3)$. Then the midpoint of the side AB is $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}, \frac{z_1 + z_2}{2}\right)$"

In ΔPQR, if P = (3, 8, 3), Q = (3, 2, 7) and R = (-1, -2, -1) then which among the following is the midpoint of the side PQ?

A. (1,3,2)
B. (3,5,5)
C. (1,0,4)
D. (2,5,4)

32. "If l, m, n are the 3 consecutive terms of an Arithmetic Progression, then $m = \frac{l + n}{2}$".

If 8, q, 16 are the 3 consecutive terms of an Arithmetic Progression, then what is the value of 'q'?

A. 8

B. 12

C. 16

D. 128

APPENDIX XVII (a)

TEST OF DEDUCTIVE REASONING

SCORE SHEET

വിദ്യാർത്ഥിയുടെ പേര്...ക്ലാസ്സ് നമ്പർ..................

ക്ലാസ്സ് ഡിവിഷൻ...ആൺകുട്ടി/പെൺകുട്ടി

	A	B	C	D
1.	○	○	○	○
2.	○	○	○	○
3.	○	○	○	○
4.	○	○	○	○
5.	○	○	○	○
6.	○	○	○	○
7.	○	○	○	○
8.	○	○	○	○
9.	○	○	○	○
10.	○	○	○	○
11.	○	○	○	○
12.	○	○	○	○
13.	○	○	○	○
14.	○	○	○	○
15.	○	○	○	○
16.	○	○	○	○
17.	○	○	○	○
18.	○	○	○	○
19.	○	○	○	○
20.	○	○	○	○
21.	○	○	○	○
22.	○	○	○	○
23.	○	○	○	○
24.	○	○	○	○
25.	○	○	○	○
26.	○	○	○	○
27.	○	○	○	○
28.	○	○	○	○
29.	○	○	○	○
30.	○	○	○	○
31.	○	○	○	○
32.	○	○	○	○

APPENDIX XVIII

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION 1996

TEST OF PROBLEM SOLVING ABILITY IN MATHEMATICS

Dr. V. Sumangala
Reader in Education
University of Calicut

Vijayakumari, K.
Research Scholar
Department of Education.

Direction: This is a test to measure your ability in solving problems related to Mathematics. Answer each question after careful reading and mark your response in the separate answer sheet given. There are three parts for this test viz., Part I, II and III and separate directions are given for doing these parts. Each part should be completed within the allotted time.

PART I

In this part each question has four options (A, B, C, D). You have to find the correct answer and mark 'X' on the circle corresponding to the letter carrying the correct answer in your answer sheet. If you want to change the answer after marking it, you should draw a square (□) around it and then mark the correct answer.

Time:30 mts.

1. A lily on a pond doubles its size every day. If in 15 days it covers half the pond, how long will it take to cover the whole pond?

   A. 30 B. 16 C. 15 D. 7.5

2. If a cat can kill a rat in 1 minute, how long will 60 cats take to kill 60 rats?

   A. 60 mts B. 6 mts. D. 1 mts. D. 1 hr

3. A family has seven children each boy in this family has as many sisters as his brothers, but each girl has twice as many brothers as her sisters. How many brothers and sisters are in the family?

   A. 5 sisters and 2 brothers
   B. 4 sisters and 3 brothers
   C. 1 sister and 6 brothers
   D. 3 sisters and 4 brothers

4. A father is 35 years old and his son is 2. After how many years will the father be 4 times as old as his son?

A. 5 B. 9 C. 27 D. 33

5. A train passes through a tunnel 450 m long in 45 seconds and goes past a post in 15 seconds. The length of the train is

A. 450 m B. 225 m C. 150 m D. 10 m

6. A money pouch contains Rs.700/-. There are equal number of 25 paise coins, 50 paise coins and one rupee coins. How many of each are there?

A. 700 B. 400 C. 100 D. 10

7. In an effort to motivate a student to do her home work a mathematics teacher offered to pay the student Rs.8/- for each correct answer on her assignment and to fine her Rs.5/- for each incorrect answer. After the student had worked 26 problems, (assume that no problem is omitted) it was discovered that neither person owed money to the other. How many problems did the student solve correctly.

A. 16 B. 13 C. 10 D. 8

8. What is the diameter of an automobile wheel if the distance covered by the wheel in ten rotations is 1570 cm?

A. 500 cm B. 157 cm C. 50 cm D. 25 cm

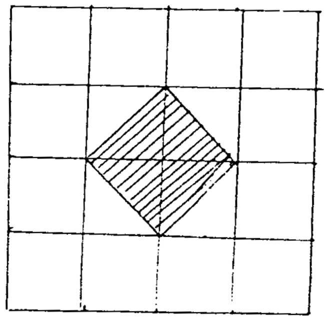
9. John can complete a job in a 4 hrs, and Ram can complete it in 5 hrs. How long will the boys take to complete it together?

A. 9/20 hrs. B. 9/2 hrs. C. 20/9 hrs. D. 9 hrs.

10. What is the greatest possible number of 1 inch cubes that can be placed into an empty box, 4 inches wide by 4 inches deep by 4 inches long.

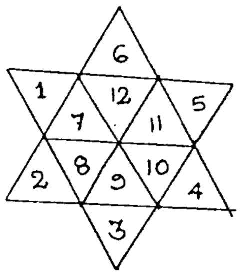
A. 4 B. 8 C. 16 D. 64

11. Each of the 16 small squares in Fig. is of side 1 unit. What is the area of the shaded square?



A. 1 Sq. units B. 2 Sq. units C. 4 Sq. units D. 16 Sq. units

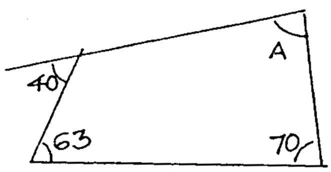
12. How many triangles are there in the figure.



A. 12 B. 14 C. 19 D. 20

13. What is the measure of the angle A in the figure (without measuring directly)?

A. 30 B. 63
C. 87 D. 140



14. Ram bought a pen. If he paid for it 2 rupee notes he would have to pay out 3 more notes than if he paid in notes of Rs.5/-. How much did the pen cost?

A. Rs.20 B. Rs.15 C. Rs.10 D. Rs.6

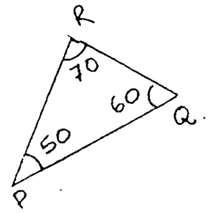
15. Age of Jim is half as that of George. John is 4 years older than Jim. If George is 4 years elder than John, what is the age of John?

A. 16 B. 12 C. 8 D. 4

16. If 2a+2b+5c = 9. If C = 1 what is a+b+c ?

A. 4 B. 3 C. 3 D. 2

17. Which is not true for the triangle given



A. PR > QR B. PQ > PR

C. PQ > RQ D. All sides are equal

18. 3x = 2y; 2y = z; which letter has highest value?

A. x B. y C. z D. Equal value for all letters.

19. A single line segment can be drawn using two points. Three line segments can be drawn using three points. Then what is the maximum number of line segments that can be drawn using 7 points?

A. 21 B. 12 C. 9 D. 7

PART II

Directions: Find out the first step at which error is committed in the following proofs and write the step number in the separate answer sheet given.

Time:4. mts.

1. i) $25 - 25 = 0$

ii) $5 - 5 = 0$

iii) $\frac{25 - 25}{5 - 5} = 0$

iv) $\frac{5^2 - 5^2}{5 - 5} = 0$

v) $\frac{(5+5)\,(5-5)}{5 - 5} = 0$

$5 + 5 = 10$

i.e. $10 = 0$

A102

2. If $\sqrt{x} = 2$ $\sqrt{y} = 3$

i) $\sqrt{x+y} = 2+3 = 5$

ii) $x+y = 5^2 = 25$

$x+y = 25$

PART III

Direction: After reading each question carefully, write the answer in the separate answer sheet provided. You should be careful in writing question numbers in the answer sheet.

Time: 10 mts

1. A man has one 5 litre and 3 litre buckets. How can he take 7 litres of water correctly using the two buckets.

2. If x and y are positive integers, $x/y = 1$ and $x+y = z$ which is the integer that cannot be value of z. Justify your answer.

   A. 36 B. 9 C. 8 D. 4

3. In a water tank there are two pipes. One fills the tank in 12 hrs and the other emplies it 9 hrs. If these two pipes are opened together, how long will it take to fill the tank? Justify your answer.

4. A box contains 8 lead balls. Seven of them weigh exactly the same, but one is just a bit heavier. Using a balance scale, how can you identify the heaviest ball in just two weighings.

5. There are 3 oranges in a bag. You have to give them to three children equally and you should not cut the orange. At the same time, one orange should be in the bag. How can you do this.

A10

TEST OF PROBLEM SOLVING ABILITY IN MATHEMATICS

SCORE SHEET

പേര്: സ്കൂളിന്റെ പേര്:

സ്റ്റാൻഡേർഡ്: ആൺകുട്ടി/പെൺകുട്ടി

	A	B	C	D		A	B	C	D
1.	○	○	○	○	14.	○	○	○	○
2.	○	○	○	○	15.	○	○	○	○
3.	○	○	○	○	16.	○	○	○	○
4.	○	○	○	○	17.	○	○	○	○
5.	○	○	○	○	18.	○	○	○	○
6.	○	○	○	○	19.	○	○	○	○
7.	○	○	○	○					
8.	○	○	○	○					
9.	○	○	○	○					
10.	○	○	○	○					
11.	○	○	○	○					
12.	○	○	○	○					
13.	○	○	○	○					

APPENDIX XIX

TEST OF MATEMATICAL CREATIVITY

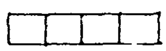
Dr. V.Sumangala
Reader in Education
Dept. of Education
University of Calicut

This is a test to measure your Creativity in Mathematics. There are seven different questions in this test. To each question, write as many possible answers as you can within the time limit specified. Your scores for creativity will increase as the number of right answers. Let your answers be unusual and novel as far as possible. Answer each question within the time limit given against each. Begin answering when the teacher says 'start' and 'stop' when the teacher says so.

1. Write as many numbers as possible so that the sum of the digits is 7.

   Time: 5 mts

2. Draw the figures of four squares arranged in different ways as possible.

   Ex.  Time: 5 mts

3. Represent the whole numbers 0, 1, 2, ... using four 4S and any mathematical operation between them.

   Time: 7 mts

   Ex: $44 - 44 = 0$
   $4/4 + 4/4 = 2$ etc.

4. Write as many paths as possible from A to H through the edges of the cube ABCDEFGH

   Time: 5 mts

5. Using the fundamental mathematical operations +, -, x, - connect the numbers 3, 4, 5 and 6 in possible ways to get the answer as 8.

   Time: 6 mts

6. Write as many equations as possible using the equation $B-C = D$, and $Z = A+D$.

   Time: 5mts

   Ex: $B = C+D$, $Z^2 = (A+D)^2$

7. Using fundamental mathematical operations +, -, x, ÷ between the digits 1, 9, 9 and 2 of the number 1992, write as many counting numbers as possible.

   Time: 5 mts

   Ex: $1 + 9 + 9 + 2 = 21$

   $-1 - 9 + 9 + 2 = 1$ etc.

P 10

APPENDIX XX

DEPARTMENT OF EDUCATION 1996
UNIVERSITY OF CALICUT

MATHEMATICS INTEREST INVENTORY

Dr. V. Sumangala
Reader in Education
University of Calicut

Vijayakumari. K.
Research Scholar
Department of Education

Instruction:

This is to find how far secondary school students are interested in activities related to Mathematics. 32 sets of activities that you would like to do usually are given under three options A, B and C. You are free to indicate your choice/preference by choosing any one activity of the three options. Mark your preferences with a cross mark (X) under the column heading A, B and C in the separate response sheet provided.

1. A. Keeping a collection of coins of differnt countries.
   B. Collecting pictures of geometrical shapes.
   C. Collecting various types of stamps

2. A. Reading children's publications like Poompatta, Balarama etc.
   B. Reading magazines on Mathematics.
   C. Reading books on Scince Fictions.

3. Listening radio programme on

   A. Mathematics
   B. Hindi lessons
   C. Non-formal education.

4. Discuss with others about

   A. Current political issues
   B. Modern scientific inventions
   C. The scope of modern Mathematics

5. Learning

   A. Rules of different games
   B. The working of machines
   C. Mathematical games.

6. In magazines and other publications
   A. Attempt word puzzles
   B. Find out answers to mathematical puzzles
   C. Colour pictures.

7. On holidays
   A. Watch films
   B. Play games
   C. Do mathematical problems.

8. A. Helping parents in preparing the family budget
   B. Purchasing the household things
   C. Helping in household chores.

9. A. Observing birds
   B. Identifying geometrical figures present in nature.
   C. Observing the sky.

10. A. Experimenting with instruments
    B. Making different patterns using geometrical figures
    C. Making card board models of different countries.

11. In the school, help in conducting
    A. Sports meet
    B. Mathematics exhibition
    C. Arts festival

12. Taking part in
    A. Literary meetings
    B. Mathematical club
    C. Political meetings

13. Preparing a chart of
    A. Mathematical formula
    B. The contributions of renowned scientists
    C. Famous writers and their works

14. To discuss with friends about
    A. The ways and means of making the learning of Mathematics interesting.
    B. Health issues
    C. The environmental issues

15. A. Making a library on literary works
    B. Making a library of Mathematics
    C. Making a library of History

16. Helping the brother/sister in learning

    A. Languages
    B. Mathematics
    C. Science

17. To see

    A. Sports meet
    B. Cultural programme
    C. Mathematical exhibitions

18. Delivering a speech on

    A. Political issues
    B. The utility of Mathematics
    C. The benefit of Science.

19. A. Understanding the working of machines by visiting a factory
    B. Understanding the relationship between production and distribution in a factory.
    C. Finding out the use of the factory products to the society

20. Taking part in

    A. Mathematics quiz
    B. Science quiz
    C. Quiz on History

21. Daily learn

    A. Science
    B. Mathematics
    C. Social Sciences

22. Understanding the usage of

    A. Language dictionary
    B. Mathematical dictionary
    C. Science dictionary

23. Doing higher studies in

A. Science
B. Literature
C. Mathematics

24. A. Solving difficult mathematical problems
B. Conducting Scientific experiments
C. Locating countries and places in the world map

25. Listening the description regarding

A. The progress of Science
B. The cultural progress of humanity
C. The contribution of Mathematics to the modern world.

26. A. Observing the procedure of conducting scientific experiments
B. Studying the use of mathematical instruments with precision
C. Observing the methods and ways of different body excercises.

27. Reading the biography of

A. The famous mathematician Srinivasa Ramanuja
B. The great leader Mahatma Gandhi
C. The poet Rabindranath Tagore

28. Reading books on

A. Ancient Indian Mathematics
B. Astronomy
C. Plants and Animals

29. Obtaining a job on

A. Teaching
B. Construction and operation of machines
C. Operating computers

30. During holidays learn

A. Typewriting
B. Computer
C. Cycling

D109

31. Learning

    A. The scientific names of the common plants found in nature.
    B. The scientific names of the things in common use (eg: Salt, Washing soda, etc)
    C. Recognize mathematical forms in the household things.

32. Being a member of

    A. Literary association
    B. Sports Club
    C. Mathematics club.

151

APPENDIX XX(a)

INTEREST INVENTORY
SCORE SHEET

പേര്:　　　　　　　　സ്കൂളിന്റെ പേര്:

സ്റ്റാൻഡേർഡ്:　　　　　　　ആൺകുട്ടി/പെൺകുട്ടി:

	A	B	C		A	B	C
1.	○	○	○	19.	○	○	○
2.	○	○	○	20.	○	○	○
3.	○	○	○	21.	○	○	○
4.	○	○	○	22.	○	○	○
5.	○	○	○	23.	○	○	○
6.	○	○	○	24.	○	○	○
7.	○	○	○	25.	○	○	○
8.	○	○	○	26.	○	○	○
9.	○	○	○	27.	○	○	○
10.	○	○	○	28.	○	○	○
11.	○	○	○	29.	○	○	○
12.	○	○	○	30.	○	○	○
13.	○	○	○	31.	○	○	○
14.	○	○	○	32.	○	○	○
15.	○	○	○				
16.	○	○	○				
17.	○	○	○				
18.	○	○	○				

155

A111

APPENDIX XXI

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION 1993

SCALE OF SELF-CONCEPT IN MATHEMATICS

Dr. V. Sumangala
Reader in Education
University of Calicut

Mrs. Malini, P.M.
Research Scholar
Department of Education

A few statements which will help you in assessing yourself in relation to Mathematics are given herewith. After reading each statement, you have to mark your response in any one of the ways, viz., 'very much like this' (A), 'like this' (B), 'uncertain' (C), 'not like this' (D), or 'not at all like this' (E). For this, separate answer sheet with markings A, B, C, D, E in 5 circles is given against each statement number. If your response to a statement is 'very much like this'; 'like this', 'uncertain', 'not like this' or 'not at all like this', put an X mark on circles A, B, C, D or E respectively. If you find that you have made a wrong entry, put a square around that entry, and then put the X mark in the correct circle. Okey, start.

---

1. I always stand first in mathematics examinations.
2. I solve mathematical problems faster than my classmates.
3. My classmates often seek my help to do their homeworks.
4. I am thorough with the basics of mathematics.
5. I solve mathematical problems with the help of others.
6. To achieve high in mathematics is my aim.
7. I solve even tough mathematical problems.
8. Participating in mathematics quiz programmes is a thrill to me.
9. It is me the teacher engages to do problems on the blackboard.
10. Mathematical knowledge helps me to learn science subjects easily.

156

11. Mathematics is a problem for me.

12. My ability in mathematics has helped me to outsmart my foes.

13. It is my ambition to do higher studies in mathematics.

14. I am often unable to answer the questions of mathematics teacher.

15. My classmates view me as the best student in the class.

16. I find it easy to memorise mathematical formulae, principles and rules.

17. My friends are the best students of my class.

18. Students like me because of my ability in mathematics.

19. Teachers entrust me the job of helping students who are poor in mathematics.

20. I have not felt that mathematics is a difficult subject.

21. I like to do mathematical problems in recess times.

22. I study mathematics only to get through the examinations.

23. Each mathematics class is a problem for me.

24. I am unhappy in my study of mathematics.

APPENDIX XXI(a)

SCALE OF SELF-CONCEPT IN MATHEMATICS
DEPARTMENT OF EDUCATION

UNIVERSITY OF CALICUT 1993

S C O R E   S H E E T

	SA	A	U	D	SD		SA	A	U	D	SD
1	O	O	O	O	O	13	O	O	O	O	O
2	O	O	O	O	O	14	O	O	O	O	O
3	O	O	O	O	O	15	O	O	O	O	O
4	O	O	O	O	O	16	O	O	O	O	O
5	O	O	O	O	O	17	O	O	O	O	O
6	O	O	O	O	O	18	O	O	O	O	O
7	O	O	O	O	O	19	O	O	O	O	O
8	O	O	O	O	O	20	O	O	O	O	O
9	O	O	O	O	O	21	O	O	O	O	O
10	O	O	O	O	O	22	O	O	O	O	O
11	O	O	O	O	O	23	O	O	O	O	O
12	O	O	O	O	O	24	O	O	O	O	O

A14

APPENDIX XXII

SCALE OF ATTITUDE TOWARDS MATHEMATICS
DEPARTMENT OF EDUCATION
UNIVERSITY OF CALICUT 1990

A few statements to know your responses about mathematics and problems in mathematics. After reading each statement, you have to mark your response in any one of the ways viz., strongly agree (SA), agree (A), undecided (U), disagree (D), strongly disagree (SD) against each statement number in the separate answer sheet. If your response to a statement is 'strongly agree', 'agree', 'undecided', 'disagree' or 'strongly disagree', put an X mark on circles SA, A, U, D or SD respctively.

Now read each statement and mark your responses.

---

1. Achievements due to the advancement of mathematics are beneficial to society.
2. Money spent for research in mathematics is a big national waste.
3. Time spent for participating in the activities of mathematics club is a real waste.
4. It is distressing for me to think of mathematics classes.
5. I won't reveal my doubts in mathematics classes thinking that others may consider that I am very poor in mathematics.
6. While dealing with any mathematical problem I will try my best to solve it.
7. Being a hard and bored subject, I won't attend classes of mathematics.
8. If the answer while doing mathematical problems, is found correct, then it is an inspiration for me to do more and more problems.
9. To the portions taught in mathematics class, learn thoroughly I do textual exercises everyday.
10. I study mathematics as a way to score high marks in examinations as it is easy to get very good marks in mathematics.

11. I think of answering to questions only whenthé turn is mine.

12. Eventhough some questions are unknown to me, I am able to do the test.

13. However interesting are mathematics classes, I find it difficult to attend the classes.

14. I do not attempt solving mathematical problems because of fear of committing mistakes.

15. However difficult a problem, I find pleasure in solving it myself.

16. Students don't like those teachers who compel students to do problems for themselves.

17. Teacher should take lead to present articles by students containing life history of mathematicians and their contributions to mathematics.

18. The teacher is to do all the problems in mathematics on the blackboard.

19. I do not care for doing extracurricular mathematics problems.

20. Constructing magic square is one of my recreational pastimes.

21. While reading periodicals my first attempt is to find solutions for crossword puzzles, picture puzzles,.mathematical games and the like.

22. To draw geometrical figures and to colour them is one of my recreational pastimes.

23. It is boring to read the life history of mathematicians.

24. Many of the theories and principles of Mathematics are applicable in our day to day life.

25. Possibilities for getting cheated are there if one goes for shopping without a knowledge of mathematics.

26. Those who have a flair for Mathematics are likely to have precision in life also.

27. The number of female mathematicians are very few as their mathematicial abilities are poor.

28. If mathematics had not been utilised our life would have progressed only slowly.

29. Researches in mathematics are only national.

30. Many scientific discoveries would not have been possible if mathematics had not progressed.

A116

APPENDIX XXII(a)

SCALE OF ATTITUDE TOWARDS MATHEMATICS
SCORE SHEET

പേര്: സ്കൂളിന്റെ പേര്:

സ്റ്റാൻഡേർഡ്: ആൺകുട്ടി/പെൺകുട്ടി

	SA	A	U	D	SD		SA	A	U	D	SD
1.	○	○	○	○	○	16.	○	○	○	○	○
2.	○	○	○	○	○	17.	○	○	○	○	○
3.	○	○	○	○	○	18.	○	○	○	○	○
4.	○	○	○	○	○	19.	○	○	○	○	○
5.	○	○	○	○	○	20.	○	○	○	○	○
6.	○	○	○	○	○	21.	○	○	○	○	○
7.	○	○	○	○	○	22.	○	○	○	○	○
8.	○	○	○	○	○	23.	○	○	○	○	○
9.	○	○	○	○	○	24.	○	○	○	○	○
10.	○	○	○	○	○	25.	○	○	○	○	○
11.	○	○	○	○	○	26.	○	○	○	○	○
12.	○	○	○	○	○	27.	○	○	○	○	○
13.	○	○	○	○	○	28.	○	○	○	○	○
14.	○	○	○	○	○	29.	○	○	○	○	○
15.	○	○	○	○	○	30.	○	○	○	○	○

APPENDIX XXIII

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
SCALE OF ATTITUDE TOWARDS ACADEMIC WORK
(DRAFT)

Dr. V. Sumangala,
Reader in Education

Mumthas. N.S
Research Scholar

നിർദ്ദേശങ്ങൾ: സ്കൂൾ പഠനത്തോടും അനുബന്ധപ്രവൃത്തികളോടും വിദ്യാർത്ഥിക്കുള്ള മനോഭാവമറിയുന്നതിനുള്ള പരീക്ഷയാണിത്. ഇതിനായി 55 പ്രസ്താവനകൾ ഇതോടൊപ്പം നൽകുന്നു. ഓരോ പ്രസ്താവനയും 'പൂർണ്ണമായും യോജിക്കുന്നു' (SA), 'യോജിക്കുന്നു' (A), 'അഭിപ്രായമില്ല' (U), 'വിയോജിക്കുന്നു' (D), "പൂർണ്ണമായും വിയോജിക്കുന്നു' (SD) എന്നിങ്ങനെ 5 തരത്തിൽ പ്രതികരിക്കത്തക്ക രീതിയിലാണ്. ഓരോ പ്രസ്താവനയും വായിച്ചതിനുശേഷം നിങ്ങളുടെ പ്രതികരണം (SA, A, U, D or SD), ഇതോടൊപ്പം നൽകിയിട്ടുള്ള ഉത്തരക്കടലാസ്സിൽ അതാത് ക്രമനമ്പരിന് നേരെ നിങ്ങളുടെ പ്രതികരണത്തെ സൂചിപ്പിക്കുന്ന വൃത്തത്തിൽ "x' അടയാളമിട്ട് രേഖപ്പെടുത്തുക.

രേഖപ്പെടുത്തിയത് തെറ്റായ വൃത്തത്തിലാണെന്ന് തോന്നിയാൽ ആ വൃത്തത്തെ "⊓' ചിഹ്നംകൊണ്ട് വലയം ചെയ്തശേഷം ശരിയായ വൃത്തത്തിൽ വീണ്ടും "x' അടയാളമിടുക.

1. പാഠ്യസംബന്ധിയായ വിഷയങ്ങളുടെ ചർച്ചകളിൽ പങ്കെടുക്കാൻ കിട്ടുന്ന ഒരവസരവും പാഴാക്കാൻ പാടില്ലാത്തതാണ്.
2. പഠനത്തെ ബാധിക്കാത്ത വിധത്തിലാണ് എന്റെ പാഠ്യേതരപ്രവൃത്തികൾ
3. പഠിക്കുന്നതിനേക്കാൾ മറ്റ് പാഠ്യേതരപ്രവൃത്തികളാണ് രസകരം
4. പഠനം പരീക്ഷയ്ക്ക് വേണ്ടി മാത്രം ചെയ്യേണ്ട ഒരു പ്രവൃത്തിയാണ്.
5. മറ്റ് കാര്യങ്ങളിലേയ്ക്ക് ശ്രദ്ധ വ്യതിചലിക്കാതെ പഠിക്കുക അസാധ്യമാണ്.
6. ഒരു നല്ല വിദ്യാർത്ഥി പഠനകാര്യങ്ങൾക്കായി ദിവസവും പ്രത്യേകസമയം നീക്കിവെക്കുന്നു.
7. പാഠ്യസംബന്ധമായ ഏതു കാര്യങ്ങളും സംശയലേശമെന്യേ പഠിക്കണമെന്ന് എനിക്ക് നിർബന്ധമാണ്.
8. പഠനത്തേക്കാൾ ഭാഗ്യമാണ് പരീക്ഷാവിജയം നിർണ്ണയിക്കുന്നത്.
9. പഠനപ്രവർത്തനങ്ങളിൽമാത്രം ശ്രദ്ധിക്കുന്ന വിദ്യാർത്ഥി പാഠ്യേതരമായ തന്റെ വിലപ്പെട്ട ജീവിതാനുഭവങ്ങൾ നഷ്ടപ്പെടുത്തുകയാണ്.
10. പുതിയ കാര്യങ്ങൾ പഠിക്കുമ്പോഴാണ് മാനസിക സംതൃപ്തിയും സന്തോഷവും അനുഭവപ്പെടുക.
11. സഹപാഠികൾക്കുണ്ടാകുന്ന പഠനസംബന്ധമായ സംശയങ്ങൾ തീർത്തുകൊടുക്കലും പഠനതുല്യമാണ്.
12. പഠനസംബന്ധമായ പ്രവർത്തനങ്ങളിൽ നേതൃത്വം ഏറ്റെടുക്കുക രസകരമാണ്.
13. പഠനപ്രവർത്തനങ്ങളിൽ മാത്രം ശ്രദ്ധിക്കുന്ന വിദ്യാർത്ഥികൾക്കാണ് ഇന്ന് ഉയർന്ന ശ്രേണിയിലെത്താൻ കഴിയുക.
14. ആറ് വിഷയങ്ങൾ ഒരേ സമയം പഠിക്കുന്ന ഇന്നത്തെ രീതിയെക്കാൾ ഇഷ്ടമുള്ള ഏതെങ്കിലും ഒന്നോ രണ്ടോ വിഷയം പഠിക്കുന്ന രീതിയാണ് നല്ലത്.
15. പഠനം ജോലിക്ക് വേണ്ടിയാണ്.
16. അറിവ് നേടുന്നതിനുപരിയായി ക്രിയാത്മകവും ഭാവനാപൂർണ്ണവും ആയ പ്രവൃത്തികൾക്ക് മുൻതൂക്കം നൽകുന്നതായിരിക്കണം പഠനം.
17. ഉടൻ ഫലം കിട്ടാത്ത ഒരു പ്രവൃത്തിയിലും (പഠനം ഉൾപ്പെടെ) എനിക്ക് താല്പര്യമില്ല.
18. പഠനം മുഷിപ്പനായ ഒരു പ്രവൃത്തിയാണ്
19. പാഠങ്ങൾ എടുക്കുന്നതിന് പുറമെ ശരിയായ പഠനത്തിന് അധ്യാപകർ മാർഗ്ഗനിർദ്ദേശം നൽകേണ്ടതാണ്.
20. കലാകായിക മത്സരങ്ങൾക്ക് ഇന്ന് ഏറെ പ്രാധാന്യമുള്ളതുകൊണ്ട് പാഠ്യപ്രങ്ങളേക്കാൾ പാഠ്യേതര പ്രവൃത്തികൾക്കാണ് സ്കൂളിൽ മുൻതൂക്കം കൊടുക്കേണ്ടത്.
21. ക്ലാസ്സ്റൂം ചർച്ചകൾ, സംവാദങ്ങൾ, ചോദ്യോത്തരവേളകൾ തുടങ്ങിയവ ദിവാസ്വപ്നങ്ങൾക്ക് പറ്റിയ സമയങ്ങളാണ്.
22. ആനുകാലിക പ്രസിദ്ധീകരണങ്ങളിൽ വരുന്ന കഥകൾ, നോവലുകൾ എന്നിവയേക്കാൾ വിജ്ഞാനപ്രദങ്ങളായ ലേഖനങ്ങൾ വായിക്കുകയാണ് രസകരം.

23. അധ്യാപനം, ഗവേഷണം, ചരിത്രാന്വേഷണം തുടങ്ങിയ വായന ആവശ്യമായ തൊഴിലുകൾ സ്വീകരിക്കുകയില്ല

24. സ്കൂൾപഠനത്തിലെ വിരസത ഒഴിവാക്കാൻ കഥകളും നോവലുകളുമടങ്ങിയ പുസ്തകങ്ങളാണ് സ്കൂൾലൈബ്രറിക്ക് വേണ്ടത്.

25. പാഠ്യേതര പ്രവർത്തനങ്ങളിൽ പ്രഥമസ്ഥാനം നൽകേണ്ടത് സ്കൂൾ ലൈബ്രറിയുടെ പരമാവധി ഉപയോഗത്തിനാണ്.

26. വായനയാവണം വിദ്യാർത്ഥികളുടെ വിശ്രമസമയവിനോദം

27. റേഡിയോ, ടെലിവിഷൻ (TV), പത്രം തുടങ്ങിയ മാധ്യമങ്ങളിൽ വരുന്ന വിജ്ഞാനപ്രദമായ കാര്യങ്ങളിലാവണം ശ്രദ്ധവേണ്ടത്.

28. സ്കൂളിലെ ചെറിയ ഒഴിവ് സമയങ്ങളിൽ പോലും പഠനസംബന്ധമായ കാര്യങ്ങളിലാവണം ശ്രദ്ധ.

29. പഠനവും അതിനോട് ബന്ധപ്പെട്ടുവരുന്ന പ്രവർത്തനങ്ങളും ആവണം വിശ്രമസമയം അപഹരിക്കേണ്ടത്.

30. അവിചാരിത അവധിദിവസങ്ങൾ എനിക്ക് സന്തോഷം ഉണ്ടാക്കുന്നവയാണ്.

31. സ്പോർട്സ്, ഗെയിംസ് ഇവകളിൽ പങ്കെടുക്കുന്നതിനേക്കാൾ ക്വിസ്, സംവാദം, ചർച്ച തുടങ്ങിയ മത്സരങ്ങളിലാണ് വിദ്യാർത്ഥികൾ പങ്കെടുക്കേണ്ടത്.

32. പഠനമാകണം ഒരു വിദ്യാർത്ഥിയുടെ പ്രധാന പ്രവൃത്തിയും വിനോദവും.

33. പഠനകാര്യങ്ങളെക്കുറിച്ച് മാത്രം സംസാരിക്കുന്നവരോട് കൂട്ടുകൂടാൻ ശ്രമിക്കാറില്ല.

34. പഠനകാര്യങ്ങളിൽ മാതാപിതാക്കളുടെ ഇടപെടൽ അസഹനീയമാണ്.

35. പാഠ്യസംബന്ധമായ സംശയങ്ങൾ തീർക്കുന്നതിനായി അധ്യാപകരേയോ കൂട്ടുകാരേയോ സമീപിക്കുന്നതിന് മടിക്കേണ്ടതില്ല.

36. പഠനകാര്യങ്ങളിൽ മാത്രം ശ്രദ്ധിക്കുന്നവർ അധ്യാപകരുടെ സ്നേഹവാത്സല്യങ്ങൾക്ക് പാത്രീഭവിക്കുന്നു.

37. അധ്യാപകരിൽനിന്നുള്ള അറിവ് ശരിയായ പഠനത്തിന് പരിമിതമാണ്.

38. അവധിദിവസങ്ങളിലും പഠിക്കണമെന്ന മാതാപിതാക്കളുടേയും അധ്യാപകരുടെയും നിർദ്ദേശം അസഹനീയമാണ്.

39. സ്കൂളിലെ അധ്യാപക-രക്ഷാകർതൃസമിതിയോഗങ്ങൾ വിദ്യാർത്ഥികളുടെ പഠനനിലവാരം ഉയർത്താൻ വേണ്ടിയുള്ളവയാണ്.

40. സ്കൂളിനെക്കുറിച്ച് ഓർക്കാൻപോലും ഇഷ്ടപ്പെടുന്നില്ല.

41. പഠനത്തിനായി മണിക്കൂറുകളോളം ഒരേ ഇരിപ്പ് ക്ലാസിൽ ഇരിക്കേണ്ടിവരുന്നത് മുഷിപ്പുളവാക്കുന്നു.

42. സ്കൂൾപഠനത്തിൽനിന്നും ജീവിതത്തിനാവശ്യമായ നൈപുണികൾ കിട്ടുന്നില്ല.

43. സ്കൂൾവിദ്യാഭ്യാസമല്ല വ്യക്തിത്വവികാസത്തിന് വഴിതെളിയിക്കുന്നത്.

44. വിദ്യാലയജീവിതം ഒരു വ്യക്തിക്ക് ലഭിക്കേണ്ട സ്വതന്ത്രജീവിതം നഷ്ടപ്പെടുത്തുന്നു.

45. സ്കൂളും പരിസരവും ഭംഗിയായി സൂക്ഷിക്കുന്നതും പഠനപ്രവർത്തനത്തിന്റെ ഭാഗമാണ്.

46. പഠനപരമായ കാര്യങ്ങളിൽ സ്കൂളിന് ഉന്നതസ്ഥാനം നേടിക്കൊടുക്കാൻ നാം യത്നിക്കേണ്ടതാണ്.

47. സ്കൂൾവിദ്യാഭ്യാസം ഉന്നത ആദർശങ്ങൾ വ്യക്തികളിൽ വളർത്തിയെടുക്കുന്നു.

48. ഓരോ ദിവസവും സ്കൂൾ വിടുമ്പോൾ ഇന്നത്തെ പഠനം തീർന്നല്ലോ എന്ന് സന്തോഷിക്കാറുണ്ട്.

49. അധ്യാപകർ തരുന്ന ഹോംവർക്കുകൾ ചെയ്യുക എന്നത് ഭാരമായി തോന്നാറുണ്ട്.

50. പഠനകാര്യത്തിൽ അലസതകാണിക്കുന്ന വിദ്യാർത്ഥികളെ ശിക്ഷിക്കേണ്ടതാണ്.

51. സ്കൂളിൽ ഇടക്കിടെ സമരം ഉണ്ടാകുന്നത് സന്തോഷമുള്ള കാര്യമാണ്.

52. അധ്യാപകർ നിർദ്ദേശിക്കുന്ന ഏതൊരു പ്രവൃത്തിയും സന്തോഷപൂർവ്വം ഏറ്റെടുക്കേണ്ടതാണ്.

53. സ്കൂളിൽ ഞാൻ എന്നും താമസിച്ചെത്തുന്ന വിദ്യാർത്ഥിയാണ്.

54. ക്ലാസ്സിൽ അച്ചടക്കം പാലിക്കുന്നത് പഠനത്തിന് ആവശ്യമാണ്.

55. പഠനം എപ്പോഴും ആവശ്യമാണ് എന്നതുകൊണ്ട് അധ്യാപനം മഹത്തായ തൊഴിലാണ്.

APPENDIX XXIV

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

SCALE OF ATTITUDE TOWARDS ACADEMIC WORK
(DRAFT)

Dr. V. Sumangala
Reader in Education

Mumthas.N.S.
Research Scholar

Instructions

This is a test to measure the attitude of students towards academic work. For this, 55 statements are given. Each statement is in such a way that, the responses can be 'Strongly Agree'(SA), 'Agree' (A), 'Uncertain' (U), 'Disagree' (D) or 'Strongly Disagree' (SD). After reading each statement, please mark your response (SA, A, U, D or SD) by putting an 'X' mark in the circle which denotes your response, against the ordinal number of the respective statement in the response sheet.

If you feel that the answer marked is wrong, envelope that answer by a rectangle (▭) and then mark your next choice of answer by putting 'X' mark.

1. Opportunities to participate in discussions on academic subjects should not be wasted.
2. I never allow extra-curricular activities to hinder my learning.
3. Other activities are interesting than learning.
4. Learning is an activity which is for examination purpose.
5. To me, learning without interruption is impossible.
6. A good student keeps a fixed time every day for learning.
7. It is important for me to learn any academic subject clearly and thoroughly.
8. The success in examination depends largely on luck than on learning.
9. A student who concentrates only on learning related activities looses his valuable life experiences.

10. We experience mental happiness and contentment when we learn new things.

11. Clearing the doubts of fellow students is also a type of learning.

12. To take leadership in learning related activities is interesting.

13. A student who concentrates on learning and related activities only can excel everywhere.

14. In schools, it is better to learn one or two subjects of our interest than of learning six subjects at the same time

15. Learning is mainly for getting a job.

16. Creative and imaginative activities be given more importance than learning for mere acquisition of knowledge.

17. I am not interested in any activity, including learning which does not give immediate results.

18. Learning is a boring activity.

19. Besides teaching lessons, teachers should give guidance on how to learn also.

20. As physical and cultural contests have great importance now a days, co-curricular activities should be given more weightage than curricular activities.

21. Discussions, debates and question sessions are the best times for day dreaming.

22. To read academic articles in periodicals is more interesting than reading stories and novels.

23. I am not interested in getting professions like teaching and research for which reading is essential.

24. To eliminate boredom in school learning books of short stories and novels should be there in school libraries.

25. 'Maximum use of school library' should be given the foremost place in co-curricular activities.

26. Reading should be a hobby to students.

27. Pupils should attend with care educational programmes broadcasted in radio, T.V. and news papers.

28. Even short breaks of time should be utilised for learning and related activities.

29. Our free time should be used for learning and related activities.

30. Unexpected holidays makes me happy.

31. Students should take part in quiz, discussions, and debates and not in sports or games.

32. Learning should be student's main activitiy and enjoyment.

33. I am not interested in making friendship with those who are indulged in learning related activities only.

34. Interference of parents in learning is intolerable.

35. There is no need to hesitate to approach teachers and friends to clear doubts..

36. Only those students who take active interest in learning become teacher' favourites.

37. The knowledge that we acquire from teachers is insufficient.

38. The insistence of teachers and parents to study even on holidays is intolerable.

39. The Parent Teacher Association in schools aim at improving the standard of schools.

40. I hate schooling.

41. Sitting in classroom for hours together leads to boredom.

42. School activities do not develop life skills.

43. Education in schools do not lead to personality development.

44. School education hinders the freedom that a student should enjoy.

45. Keeping school premises neat and clean is also a part of educational activity.

46. We should strive to raise the position of our school in academic activities.

47. School education develops noble values in individuals.

48. Each day I feel happy when the school ends.

49. Homeworks given by teachers is a tedious work.

50. Students who neglect learning activities should be punished.

51. The frequent strikes at school make me happy.

52. We should willingly take up any work given by teachers.

53. I am often a late comer in school.

54. Discipline in class is necessary for learning.

55. Teaching is a noble profession as learning is throughout needed.

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION
SCALE OF ATTITUDE TOWARDS ACADEMIC WORK

Dr. V.Sumangala **Mumthas,N.S.**
Reader in Education **Research Scholar**

നിർദ്ദേശങ്ങൾ: സ്ക്കൂൾ പഠനത്തോടും അനുബന്ധപ്രവൃത്തികളോടും വിദ്യാർത്ഥിക്കുള്ള മനോഭാവമറിയുന്നതിനുള്ള പരീക്ഷയാണിത്. ഇതിനായി 40 പ്രസ്താവനകൾ ഇതോടൊപ്പം നൽകുന്നു. ഓരോ പ്രസ്താവനയും 'പൂർണ്ണമായും യോജിക്കുന്നു'(SA), 'യോജിക്കുന്നു'(A), 'അഭിപ്രായമില്ല'(U), 'വിയോജിക്കുന്നു'(D), 'പൂർണ്ണമായും വിയോജിക്കുന്നു'(SD) എന്നിങ്ങനെ 5 തരത്തിൽ പ്രതികരിക്കത്തക്ക രീതിയിലാണ്. ഓരോ പ്രസ്താവനയും വായിച്ചതിനുശേഷം നിങ്ങളുടെ പ്രതികരണം(SA, A, U, D or SD) , ഇതോടൊപ്പം നൽകിയിട്ടുള്ള ഉത്തരക്കടലാസിൽ അതാത് ക്രമനമ്പരിനു നേരെ നിങ്ങളുടെ പ്രതികരണത്തെ സൂചിപ്പിക്കുന്ന വൃത്തത്തിൽ "X" അടയാളമിട്ട് രേഖപ്പെടുത്തുക.

രേഖപ്പെടുത്തിയത് തെറ്റായ വൃത്തത്തിലാണെന്ന് തോന്നിയാൽ ആ വൃത്തത്തെ "□"ചിഹ്നം കൊണ്ട് വലയം ചെയ്തശേഷം ശരിയായ വൃത്തത്തിൽ വീണ്ടും "X"അടയാളമിടുക.

1. പാഠ്യസംബന്ധിയായ വിഷയങ്ങളുടെ ചർച്ചകളിൽ പങ്കെടുക്കാൻ കിട്ടുന്ന ഒരവസരവും പാഴാക്കാൻ പാടില്ലാത്തതാണ്.
2. പഠിക്കുന്നതിനേക്കാൾ മറ്റ് പഠ്യേതരപ്രവൃത്തികളാണ് രസകരം
3. പഠനം പരീക്ഷയ്ക്ക് വേണ്ടി മാത്രം ചെയ്യേണ്ട ഒരു പ്രവൃത്തിയാണ്.
4. മറ്റ് കാര്യങ്ങളിലേയ്ക്ക് ശ്രദ്ധ വ്യതിചലിക്കാതെ പഠിക്കുക അസാധ്യമാണ്.
5. ഒരു നല്ല വിദ്യാർത്ഥി പഠനകാര്യങ്ങൾക്കായി ദിവസവും പ്രത്യേകസമയം നീക്കിവെക്കുന്നു.
6. പാഠ്യസംബന്ധമായ ഏതു കാര്യങ്ങളും സംശയലേശമെന്യേ പഠിക്കണമെന്ന് എനിക്ക് നിർബന്ധമാണ്.
7. പഠന പ്രവർത്തനങ്ങളിൽ മാത്രം ശ്രദ്ധിക്കുന്ന വിദ്യാർത്ഥി പാഠ്യേതരമായ തന്റെ വിലപ്പെട്ട ജീവിതാനുഭവങ്ങൾ നഷ്ടപ്പെടുത്തുകയാണ്.
8. പുതിയ കാര്യങ്ങൾ പഠിക്കുമ്പോഴാണ് മാനസിക സംതൃപ്തിയും സന്തോഷവും അനുഭവപ്പെടുക.
9. സഹപാഠികൾക്കുണ്ടാകുന്ന പഠനസംബന്ധമായ സംശയങ്ങൾ തീർത്തു കൊടുക്കലും പഠനതുല്യമാണ്.
10. പഠനം ജോലിക്ക് വേണ്ടി മാത്രമാണ്.
11. ഉടൻ ഫലം കിട്ടാത്ത ഒരു പ്രവൃത്തിയിലും (പഠനം ഉൾപ്പെടെ) എനിക്ക് താല്പര്യമില്ല.
12. പഠനം മുഷിപ്പനായ ഒരു പ്രവൃത്തിയാണ്.
13. പാഠങ്ങൾ എടുക്കുന്നതിന് പുറമെ ശരിയായ പഠനത്തിന് അധ്യാപകർ മാർഗ്ഗനിർദ്ദേശം നൽകേണ്ടതാണ്.

14. കലാകായിക മത്സരങ്ങൾക്ക് ഇന്ന് ഏറെ പ്രാധാന്യമുള്ളതുകൊണ്ട് പാഠ്യപ്രവർത്തനങ്ങളേക്കാൾ പാഠ്യേതര പ്രവൃത്തികൾക്കാണ് സ്കൂളിൽ മുൻതൂക്കം കൊടുക്കേണ്ടത്.
15. ക്ലാസ്സ് റൂം ചർച്ചകൾ, സംവാദങ്ങൾ, ചോദ്യോത്തരവേളകൾ തുടങ്ങിയവ ദിവാസ്വപ്നങ്ങൾക്ക് പറ്റിയ സമയങ്ങളാണ്.
16. ആനുകാലിക പ്രസിദ്ധീകരണങ്ങളിൽ വരുന്ന കഥകൾ, നോവലുകൾ എന്നിവയേക്കാൾ വിജ്ഞാനപ്രദങ്ങളായ ലേഖനങ്ങൾ വായിക്കുകയാണ് രസകരം.
17. വായനയാവണം വിദ്യാർത്ഥികളുടെ വിശ്രമസമയ വിനോദം.
18. റേഡിയോ, ടെലിവിഷൻ (TV), പത്രം തുടങ്ങിയ മാധ്യമങ്ങളിൽ വരുന്ന വിജ്ഞാനപ്രദങ്ങളായ കാര്യങ്ങളിലാവണം ശ്രദ്ധവേണ്ടത്.
19. സ്പോർട്സ്, ഗെയിംസ് ഇവകളിൽ പങ്കെടുക്കുന്നതിനേക്കാൾ ക്വിസ്, സംവാദം, ചർച്ച തുടങ്ങിയ മത്സരങ്ങളിലാണ് വിദ്യാർത്ഥികൾ പങ്കെടുക്കേണ്ടത്.
20. പഠനമാകണം ഒരു വിദ്യാർത്ഥിയുടെ പ്രധാന പ്രവൃത്തിയും വിനോദവും.
21. പഠന കാര്യങ്ങളെക്കുറിച്ച് മാത്രം സംസാരിക്കുന്നവരോട് കൂട്ടുകൂടാൻ ശ്രമിക്കാറില്ല.
22. പഠനകാര്യങ്ങളിൽ മാതാപിതാക്കളുടെ ഇടപെടൽ അസഹനീയമാണ്.
23. പാഠ്യസംബന്ധമായ സംശയങ്ങൾ തീർക്കുന്നതിനായി അധ്യാപകരേയോ കൂട്ടുകാരേയോ സമീപിക്കുന്നതിന് മടിക്കേണ്ടതില്ല.
24. പഠനകാര്യങ്ങളിൽ മാത്രം ശ്രദ്ധിക്കുന്നവർ അധ്യാപകരുടെ സ്നേഹവാത്സല്യങ്ങൾക്ക് പാത്രീഭവിക്കുന്നു.
25. അവധി ദിവസങ്ങളിലും പഠിക്കണമെന്ന മാതാപിതാക്കളുടേയും അധ്യാപകരുടേയും നിർദ്ദേശം അസഹനീയമാണ്.
26. സ്ക്കൂളിനെക്കുറിച്ച് ഓർക്കാൻ പോലും ഇഷ്ടപ്പെടുന്നില്ല.
27. പഠനത്തിനായി മണിക്കൂറുകളോളം ഒരേ ഇരിപ്പ് ക്ലാസ്സിൽ ഇരിക്കേണ്ടിവരുന്നത് മുഷിപ്പുളവാക്കുന്നു.
28. സ്ക്കൂൾ പഠനത്തിൽനിന്നും ജീവിതത്തിനാവശ്യമായ നൈപുണികൾ കിട്ടുന്നില്ല.
29. സ്ക്കൂൾവിദ്യാഭ്യാസമല്ല വ്യക്തിവികാസത്തിന് വഴിതെളിക്കുന്നത്.
30. വിദ്യാലയജീവിതം ഒരു വ്യക്തിക്ക് ലഭിക്കേണ്ട സ്വതന്ത്ര ജീവിതം നഷ്ടപ്പെടുത്തുന്നു.
31. സ്കൂളും പരിസരവും ഭംഗിയായി സൂക്ഷിക്കുന്നതും പഠനപ്രവർത്തനത്തിന്റെ ഭാഗമാണ്.
32. പഠനപരമായ കാര്യങ്ങളിൽ സ്കൂളിന് ഉന്നതസ്ഥാനം നേടിക്കൊടുക്കുവാൻ നാം യത്നിക്കേണ്ടതാണ്.
33. സ്കൂൾവിദ്യാഭ്യാസം ഉന്നത ആദർശങ്ങൾ വ്യക്തികളിൽ വളർത്തിയെടുക്കുന്നു.
34. ഓരോ ദിവസവും സ്കൂൾ വിടുമ്പോൾ ഇന്നത്തെ പഠനം തീർന്നല്ലോ എന്ന് സന്തോഷിക്കാറുണ്ട്.
35. അധ്യാപകർ തരുന്ന ഹോം വർക്കുകൾ ചെയ്യുക എന്നത് ഭാരമായി തോന്നാറുണ്ട്.
36. സ്കൂളിൽ ഇടക്കിടെ സമരം ഉണ്ടാകുന്നത് സന്തോഷമുള്ള കാര്യമാണ്.
37. അധ്യാപകർ നിർദ്ദേശിക്കുന്ന ഏതൊരു പ്രവൃത്തിയും സന്തോഷപൂർവ്വം ഏറ്റെടുക്കേണ്ടതാണ്.
38. സ്കൂളിൽ ഞാൻ എന്നും താമസിച്ചെത്തുന്ന വിദ്യാർത്ഥിയാണ്.
39. ക്ലാസ്സിൽ അച്ചടക്കം പാലിക്കുന്നത് പഠനത്തിന് ആവശ്യമാണ്.
40. പഠനം എപ്പോഴും ആവശ്യമാണ് എന്നതുകൊണ്ട് അധ്യാപനം മഹത്തായ തൊഴിലാണ്.

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION

SCALE OF ATTITUDE TOWARDS ACADEMIC WORK

Dr. V. Sumangala
Reader in Education

Mumthas.N.S.
Research Scholar

Instructions

This is a test to measure the attitude of students towards academic work. For this, 40 statements are given. Each statement is in such a way that, the responses can be 'Strongly Agree'(SA), 'Agree' (A), 'Uncertain' (U), 'Disagree' (D) or 'Strongly Disagree' (SD). After reading each statement, please mark your response (SA, A, U, D or SD) by putting an 'X' mark in the circle which denotes your response, against the ordinal number of the respective statement in the response sheet.

If you feel that the answer marked is wrong, envelope that answer by a rectangle (☐) and then mark your next choice of answer by putting 'X' mark.

1. Opportunities to participate in discussions on academic subjects should not be wasted.
2. Other activities are interesting than learning.
3. Learning is an activity which is only for examination purpose.
4. To me, learning without interruption is impossible.
5. A good student keeps a fixed time every day for learning.
6. It is important for me to learn any academic subject clearly and thoroughly.
7. A student who concentrates only on learning related activities looses his valuable life experiences.
8. We experience mental happiness and contentment when we learn new things.
9. Clearing the doubts of fellow students is also a type of learning.
10. Learning is mainly for getting a job.

11. I am not interested in any activity, including learning which does not give immediate results.

12. Learning is a boring activity.

13. Besides teaching lessons, teachers should give guidance on how to learn also.

14. As physical and cultural contests have great importance now a days, co-curricular activities should be given more weightage than curricular activities.

15. Discussions, debates and question sessions are the best times for day dreaming.

16. To read academic articles in periodicals is more interesting than reading stories and novels.

17. Reading should be a hobby to students.

18. Pupils should attend with care educational programmes broadcasted in radio, T.V. and news papers.

19. Students should take part in quiz, discussions, and debates and not in sports or games.

20. Learning should be student's main activitiy and enjoyment.

21. I am not interested in making friendship with those who are indulged in learning related activities only.

22. Interference of parents in learning is intolerable.

23. There is no need to hesitate to approach teachers and friends to clear doubts.

24. Only those students who take active interest in learning become teacher's favourites.

25. The insistence of teachers and parents to study even on holidays is intolerable.

26. I hate schooling.

27. Sitting in classroom for hours together leads to boredom.

28. School activities do not develop life skills.

APPENDIX XXVI (a)

SCALE OF ATTITUDE TOWARDS ACADEMIC WORK

SCORE SHEET

വിദ്യാർത്ഥിയുടെ പേര്...ക്ലാസ്സ് നമ്പർ..................

ക്ലാസ്സ് ഡിവിഷൻ...ആൺകുട്ടി/പെൺകുട്ടി

	SA	A	U	D	SD		SA	A	U	D	SD
1.	○	○	○	○	○	21.	○	○	○	○	○
2.	○	○	○	○	○	22.	○	○	○	○	○
3.	○	○	○	○	○	23.	○	○	○	○	○
4.	○	○	○	○	○	24.	○	○	○	○	○
5.	○	○	○	○	○	25.	○	○	○	○	○
6.	○	○	○	○	○	26.	○	○	○	○	○
7.	○	○	○	○	○	27.	○	○	○	○	○
8.	○	○	○	○	○	28.	○	○	○	○	○
9.	○	○	○	○	○	29.	○	○	○	○	○
10.	○	○	○	○	○	30.	○	○	○	○	○
11.	○	○	○	○	○	31.	○	○	○	○	○
12.	○	○	○	○	○	32.	○	○	○	○	○
13.	○	○	○	○	○	33.	○	○	○	○	○
14.	○	○	○	○	○	34.	○	○	○	○	○
15.	○	○	○	○	○	35.	○	○	○	○	○
16.	○	○	○	○	○	36.	○	○	○	○	○
17.	○	○	○	○	○	37.	○	○	○	○	○
18.	○	○	○	○	○	38.	○	○	○	○	○
19.	○	○	○	○	○	39.	○	○	○	○	○
20.	○	○	○	○	○	40.	○	○	○	○	○

APPENDIX XXVII

UNIVERSITY OF CALICUT

DEPARTMENT OF EDUCATION

SCALE OF MATHEMATICS ANXIETY

Dr. V. Sumangala
Reader in Education
University of Calicut

Mrs. Malini, P.M.
Research Scholar
Dept. of Education

The problems felt by you while learning mathematics are given here in the form of statements. Read each statement and mark your response in either of the forms 'Strongly Agree' (SA), 'Agree' (A), 'Undecided' (U), 'Disagree' (D), or 'Strongly Disagree' (SD). For this, you are given a separate answer sheet with five circles labelled as SA, A, U, D, SD against each statement number.

If your response to a statement is 'Strongly Agree', put an X mark on the circle below SA; if the response is 'Agree', 'Undecided', 'Disagree', or 'Strongly Disagree', put X mark on circles below A, U, D or SD respectively.

Eg: Mathematics is tough to me than other subjects.

SA	A	U	D	SD
O	O	O	X	O

In this example, the X mark is on D. This means that the student who answered disagrees to the statement.

Read each statement and mark your responses as instructed above.

1. While doing mathematical problems, if I feel that the teacher is caring me then it will be difficult for me to proceed with.

2. When the mathematics teacher starts asking questions, I will feel worry because of anxiety.

P130

3. I feel upset if I do not follow reading mathematics lessons.

4. Often I cannot do a problem in time because of the feeling that I have gone wrong somewhere.

5. I make mistakes even when answering to questions which are thorough to me.

6. While drawing mathematical figures the thought that the measures taken by me may not be correct usually disturbs me.

7. I am ready to do mathematics problems in the blackboard even if I feel that I may go wrong.

8. In mathematics classes I like to sit in the back row so as to avoid the teacher.

9. I am unable to do mathematics examination well even if I study well.

10. I do not feel difficult on my attempts to keep better in mathematics.

11. Evenafter many revised studies I am anxious at examinations whether I could do the exam well.

12. Even if I have severe doubts I do not try to solve it for I fear that I may be viewed as a poor student.

13. The thought that I may go wrong preyents me from doing mathematics problems independently.

14. I am satisfied if the teacher does all the problems on the blackboard so that I can copy down.

15. Even petty mathematical calculations done at shopping times becomes difficult for me when done in the classroom.

16. I copy from the books of my neighbour student because of the fear that the teacher may scold me if I go wrong.

17. I find it difficult to answer questions in mathematics classes even when the answer is known to me.

18. I keep myself aloof from opportunities involving transactions of given and take because of the fear that I may go wrong in calculations.

19. On the way of mathematics exam I usually have physical ailments like fever, stomach upset etc.

20. I do not participate in quiz programmes because of the fear that I may not be able to answer correctly.

21. While solving each new problem the fear whether I will be able to do it as in the earlier classes usually upsets me.

22. The anxiety I have before the commencement of mathematics exam do not bother me when the exam starts.

23. I always score lower marks in mathematics exam because of anxiety.

24. Because of my ambition to score full marks in the exam nothing hinders me in the way.

25. I cannot write even to the expected level in mathematics exam if I am not prepared against anxiety.

26. I am anxious that it will be difficult for me to pass competitive exams in future if I have no sound knowledge in mathematics.

27. I do not get upset even if I have to do several times to get correct answer for mathematics problems.

28. The anxiety of exams won't affect my studies in mathematics.

29. I forget the formulae at the time of exams due to anxiety even if I study well.

176

A132

APPENDIX XXVII(a)

SCALE OF MATHEMATICS ANXIETY

DEPARTMENT OF EDUCATION

UNIVERSITY OF CALICUT 1993

SCORE SHEET

	SA	A	U	D	SD		SA	A	U	D	SD
1	O	O	O	O.	O	16	O	O	O	O	O
2	O	O	O	O	O	17	O	O	O	O	O
3	O	O	O	O	O	18	O	O	O	O	O
4	O	O	O	O	O	19	O	O	O	O	O
5	O	O	O	O	O	20	O	O	O	O	O
6	O	O	O	O	O	21	O	O	O	O	O
7	O	O	O	O	O	22	O	O	O	O	O
8	O	O	O	O	O	23	O	O	O	O	O
9	O	O	O	O	O	24	O	O	O	O	O
10	O	O	O	O	O	25	O	O	O	O	O
11	O	O	O	O	O	26	O	O	O	O	O
12	O	O	O	O	O	27	O	O	O	O	O
13	O	O	O	O	O	28	O	O	O	O	O
14	O	O	O	O	O	29	O	O	O	O	O
15	O	O	O	O	O						

APPENDIX XXVIII

UNIVERSITY OF CALICUT
DEPARTMENT OF EDUCATION 1996

SCALE OF ACHIEVEMENT MOTIVATION IN MATHEMATICS

Dr. V. Sumangala
Reader in Education
University of Calicut

Vijayakumari. K
Research Scholar
Department of Education

Instruction:

This is to measure secondary school pupils striving to attain expected goals by lerning Mathematics. This has 42 statements and each statement can have 3 ways of responses viz., Always (A), Sometimes (B) and Never (C). Mark your responses (A,B or C) with a cross mark 'X' in the circle against each item number under the column heading A,B and C in the separate sheet given. All statements are to be responded.

1. I like to do mathematical problems which others cannot do.
2. I will learn difficult portions in Mathematics, even if it is time consuming.
3. I insist on learning mathematical lessons taught in the class on that day itself.
4. I do copy home work in mathematics from others.
5. I spend more time to learn Mathematics.
6. Everyday I put off my mathematics learning for the next day.
7. I workout problems in Mathematics text book which are not done in the class.
8. I am adament in completing the work assigned by my mathematics teacher within specified time.
9. It is obligatory that I shall get good marks in Mathematics examinations.
10. All my friends are good at Mathematics.
11. When I fail to understand what I learn in Mathematics I think that, I need not learn any Mathematics at all.
12. I am satisfied by my excellence in Mathematics.

13. I feel satisfaction when I am successful in completing difficult mathematical tasks.

14. I proudly show my mathematical ability in front of my peers.

15. I get depressed when others comment on my poor standard in Mathematics.

16. I have only inadequate opportunity for better mathematics learning.

17. I desire to be accepted in my mathematics class.

18. When I am successful in working out one problem, I tend to do the next immediately.

19. I respect those who perform well in Mathematics.

20. I want, I should be the No.1 in Mathematics learning.

21. Others should consider me as a model in Mathematics learning.

22. Eventhough I am the top scorer in the class, I study Mathematics very carefully.

23. Leadership in all mathematical activities will be on me.

24. I am sure that I will succeed in life through mathematics learning.

25. I like to sit in backbench in the mathematics class without being noticed by anyone.

26. I wish to have higher studies in Mathematics as much as possible.

27. I work hard to defeat bright students in Mathematics competitions.

28. I like to compete with students who are good at Mathematics.

29. I don't take part in competitions related to Mathematics because of the fear of under performance when compared to others.

30. I take part and win prizes in mathematical competitions.

31. I volunteer myself first when Mathematics teacher asks to do the problem in the blackboard.

32. I like to know more about Mathematics related matters which are not in the syllabus.

33. I get motivated in learning Mathematics by the small bits of appreciation.

34. I utilize the opportunities maximum to enrich my mathematical knowledge.

35. I work hard to maintain my first place in Mathematics in the class.

36. Eventhough I study a small portion in Mathematics, I insist to make it thoroughly.

37. My achievement in Mathematics is the result of my hardwork.

38. I doubt whether my learning style is enough to achieve high grades in Mathematics.

39. I wish my friends clarify their doubts in Mathematics by asking me.

40. I want to be the only person who can answer all the questions of my Mathematics teacher.

41. I desire the teacher to ask me to help those who are poor in Mathematics

42. I want to be the leader in all the mathematical activities.

A136

UNIVERSITY OF CALICUT

SCALE OF ACHIEVEMENT MOTIVATION

APPENDIX XXVIII(A)

RESPONSE SHEET

വിദ്യാർത്ഥിയുടെ പേര് .... ക്ലാസ് .... ക്ലാസ് നമ്പർ ....

സ്കൂളിന്റെ പേര് .... ആൺകുട്ടിയോ/പെൺകുട്ടിയോ വയസ്സ് ....

Sl. No.	A	B	C	Sl. No.	A	B	C	Sl. No.	A	B	C
1	0	0	0	15	0	0	0	29	0	0	0
2	0	0	0	16	0	0	0	30	0	0	0
3	0	0	0	17	0	0	0	31	0	0	0
4	0	0	0	18	0	0	0	32	0	0	0
5	0	0	0	19	0	0	0	33	0	0	0
6	0	0	0	20	0	0	0	34	0	0	0
7	0	0	0	21	0	0	0	35	0	0	0
8	0	0	0	22	0	0	0	36	0	0	0
9	0	0	0	23	0	0	0	37	0	0	0
10	0	0	0	24	0	0	0	38	0	0	0
11	0	0	0	25	0	0	0	39	0	0	0
12	0	0	0	26	0	0	0	40	0	0	0
13	0	0	0	27	0	0	0	41	0	0	0
14	0	0	0	28	0	0	0	42	0	0	0

181

Appendix XXIX

School-wise Distribution of Final Sample

Sl. No.	Name of the School	Type of School	Locale of the School	Type of Management	Number of Students		
					Boys	Girls	Total
1.	St. Joseph's Higher Secondary School, Thiruvananthapuram	Boys	Urban	Private	45	--	45
2.	L.M.S. High School, Vattappara	Co-ed.	Rural	Private	--	38	38
3.	C.P. Higher Secondary School, Kuttikkadu	Co-ed.	Rural	Private	16	26	42
4.	Govt. High School, Yeroor	Co-ed.	Rural	Government	22	21	43
5.	G.H.S.S. Kodakara	Girls	Rural	Government	--	38	38
6.	G.H.S. Puthukad	Co-ed.	Rural	Government	31	--	31
7.	A.R. Nagar High School	Co-ed.	Rural	Private	22	21	43
8.	M.S.M.H.S.S. Kallingalparamba	Co-ed.	Rural	Private	25	26	51
9.	Farook Higher Secondary School, Farook College	Co-ed.	Rural	Private	42	--	42
10.	Government Ganapath V.H.S.S., Feroke	Co-ed.	Rural	Government	23	26	49
11.	K.K.V.M.P.H.S., Panoor	Co-ed.	Rural	Private	18	18	36
12.	G.H.S., Payyannur	Co-ed.	Urban	Government	--	42	42
Total					244	256	500