SECOND SEMESTER (CBCSS—UG) DEGREE EXAMINATION APRIL 2021

Chemistry

CHE 2C 02—PHYSICAL CHEMISTRY

Time : Two Hours   Maximum : 60 Marks

Section A (Short Answers)

Answer at least **eight** *questions.*

Each question carries 3 marks.

All questions can be attended.

Overall Ceiling 24.

1. Give the statement of first law of thermodynamics and its mathematical formulation.

2. Define term unit cell and space lattice.

3. A crystal plane makes intercepts of $(1/2a, 1/2b, c)$. What are miller indices of plane ?

4. Define average velocity and most probable velocity.

5. Write down van der Waals equation for n moles of real gas and explain the terms.

6. Define term vapour pressure of a liquid. How does it depend on temperature ?

7. What are the factors that influence viscosity of a liquid ?

8. State and explain Boyle Vant Hoff law.

9. What are strong electrolytes ? Give two examples.

10. The cell constant of a cell is 0.5 cm^{-1}. The resistance of an electrolyte solution taken in cell is 50 ohms. Calculate conductivity of solution.

11. What is meant by standard electrode potential ?

12. What are buffer solutions ? Give two examples.

$(8 \times 3 = 24 \text{ marks})$

Turn over

Section B (Paragraph)

Answer at least **five** *questions.*
Each question carries 5 marks.
All questions can be attended.
Overall Ceiling 25.

13. Define enthalpy and free energy. How is enthalpy change in process related to free energy change ? Under what condition would a process for which $\Delta H = +$ and $\Delta S = -$ ve take place spontaneously ?

14. Diethyl ether boils at 35°C. Its heat of vaporization at its boiling point is 27.2 KJ mol^{-1}. Calculate entropy of vaporization ?

15. At what temperature would hydrogen gas molecules have same average speed as Helium atoms at 300 K.

16. State and explain second law of thermodynamics. Explain criterion for spontaneous process in terms of entropy change.

17. Describe how osmotic pressure of solution can be measured experimentally.

18. What do you understand by surface tension of liquids and what is the unit ? Explain term interfacial surface energy. Explain surface tension on basis of intermolecular attraction.

19. What are fuel cells ? Explain the electrode and cell reaction in a $H_2 - O_2$ fuel cell. List advantage of fuel cell.

(5 × 5 = 25 marks)

Section C (Essay)

Answer any **one** *question.*
The question carries 11 marks.

20. Give reasons for deviation of real gases from ideal behavior.

21. (a) Derive Ostwald's dilution law and mention its limitations.

    (b) Explain why an aqueous solution of potassium acetate is basic while that of ammonium nitrate is acidic.

(1 × 11 = 11 marks)

SECOND SEMESTER (CBCSS—UG) DEGREE EXAMINATION
APRIL 2021

Chemistry

CHE 2B 02—THEORETICAL AND INORGANIC CHEMISTRY—II

Time : Two Hours   Maximum : 60 Marks

Section A (Short Answers)

Answer at least **eight** *questions.*
Each question carries 3 marks.
All questions can be attended.
Overall Ceiling 24.

1. What is Photoelectric effect ?

2. Explain de Broglie's concept of matter waves with evidences.

3. Give expression for radius of Bohr orbit, velocity and energy of an electron in a hydrogen atom explain terms involved.

4. Explain term linear operator.

5. What is meant by well-behaved wave function ?

6. Draw angular distribution plots of p orbitals.

7. What is bonding molecular orbital ?

8. What is the % of s character in sp, sp^2 and sp^3 hybrid orbitals ?

9. What is the appropriate trial function for hydrogen molecule in V. B theory?

10. What is meant by normalization of wave function?

11. What is the type of hybridization and geometry in (1) NH_4^+ ; (2) $SiCl_4$.

12. Why is hyrid orbitals better oriented than a pure orbital ?

(8 × 3 = 24 marks)

Turn over

Section B (Paragraph)

Answer at least **five** *questions.*
Each question carries 5 marks.
All questions can be attended.
Overall Ceiling 25.

13. The threshold frequency of a metal is 4.412×10^{-14} S^{-1}. Calculate the K.E of photoelectron ejected when light of wavelength 4000 Å falls on surface of metal, $h = 6.626 \times 10^{-34}$Js.

14. Describe atomic spectrum of hydrogen atom.

15. Calculate the ground state energy of an electron confined in 1D box of length 0.2 m and calculate energy in $n = 4$ level, $m_e = 9.1 \times 10^{-31}$ kg, $h = 6.626 \times 10^{-34}$Js.

16. Draw radial probability distribution curves of 2s and 2p orbitals.

17. Illustrate and explain LCAO applied for heteronuclear diatomic molecules ?

18. Explain Born-Oppenheimer approximation.

19. What is the type of hybridization in the formation of BH_3 ? Discuss.

(5 × 5 = 25 marks)

Section C (Essay)

Answer any **one** *question.*
The question carries 11 marks.

20. State and explain postulates of quantum mechanics.

21. (a) Bonding of O_2 is better explained in molecular orbital theory than in valence band theory. Explain.

    (b) Explain the criteria for formation of molecular orbitals from atomic orbitals.

(1 × 11 = 11 marks)

SECOND SEMESTER (CUCBCSS–UG) DEGREE EXAMINATION, APRIL 2021

Chemistry

CHE 2C 02—PHYSICAL CHEMISTRY

Time : Three Hours Maximum : 64 Marks

Section A (One word)

Answer **all** *questions.*
Each question carries 1 *mark.*

1. Thermodynamic system, which can exchange neither energy nor matter with the surroundings is called ——————— system.

2. According to third law of thermodynamics, the entropy of a perfect crystal is zero at ———————.

3. The deviation of a gas from ideal behaviour is maximum at high pressure and ———————————.

4. The edge lengths and interfacial angles of the unit cell of a crystal are given as $a = b = c$ and $\alpha = \beta = \gamma \neq 90°$. The crystal system is ———————.

5. The maximum number of Bravais lattices is ———————.

6. The vapour pressure of a liquid becomes equal to one atmosphere at its normal ———————.

7. Properties of solutions which depend on the number of particles dissolved and not on their nature are called ———————.

8. The conductance of a column of electrolyte of unit volume is called ———————.

9. For an aqueous solution of $Al_2(SO_4)_3$, the equivalent conductance λeq and molar conductance λm are related as ———————.

10. The relation between the hydronium ion concentration $\left[H_3O^+ \right]$, dissociation constant of the acid Ka and concentration of the acid 'C' is given a $\left[H_3O^+ \right]$ = ———————.

(10 × 1 = 10 marks)

Section B (Short Answer)

Answer any **seven** *questions.*
Each question carries 2 *marks.*

11. State the second law of thermodynamics in terms of entropy.

12. A gas contained in cylinder expands from a volume of 10 L to 20 L against a constant external pressure of one atmosphere. For this the gas absorbs 800 J heat from the surroundings. Calculate the change in internal energy of the gas, during the process.

Turn over

13. Amorphous solids are isotropic while crystalline solids are anisotrophic. Explain.

14. Write the van der Waal's equation for 'n' moles of a gas and explain the terms.

15. Find the Miller indices of a plane whose intercepts are 2a, 3b and 3c.

16. Mention any two applications of Henry's law.

17. What is the reason for surface tension of a liquid ?

18. What is the nature of NH_4Cl in water ? Give reason.

19. Write any two limitations of a Standard Hydrogen Electrode.

20. Calculate the osmotic pressure of an aqueous solution containing 6 gram glucose in one litre solution, at 300 K.

(7 × 2 = 14 marks)

Section C (Paragraph)

Answer any four questions.
Each question carries 5 marks.

21. The heat of combustion of $CH_4(g)$ is – 855 kJ mol^{-1} at 300 K, under constant volume condition. Calculate the heat of combustion of $CH_4(g)$ at constant pressure.

22. What is meant by the term 'entropy' ? How will you explain the spontaneity of a process in terms of entropy ?

23. With the help of a diagram, explain the effect of temperature in the distribution of velocities among different molecules in a gas.

24. Write briefly on the classification and applications of liquid crystals.

25. Compare the effect of dilution on the molar conductance of a strong electrolyte with that of a weak electrolyte.

26. Discuss the conductometric titration curves of :

    (i) Strong acid – strong base titration.
    (ii) Strong acid – weak base titration.

(4 × 5 = 20 marks)

Section D (Essay)

Answer any two questions.
Each question carries 10 marks.

27. (i) What is meant by Gibb's free energy ? How is it physically significant ?   (4 marks)

    (ii) Explain the effect of temperature in the spontaneity of a process in terms of ΔG, ΔS and ΔH.

(4 marks)

    (iii) The enthalpy change associated with the fusion of 18 gram ice at 273 K is 6000 J. Calculate the molar entropy of fusion of ice, at 0°C.

(2 marks)

28. Give a brief account of the different types of imperfections in solids.

29. (i) From the laws of osmotic pressure derive the general solution equation.

(4 marks)

(ii) Explain reverse osmosis. (3 marks)

(iii) What are reference electrodes ? Give example. (3 marks)

30. (i) What are buffer solutions ? How are they classified ? (4 marks)

(ii) In a buffer solution of CH_3COOH and CH_3COONa, the concentrations of the acid and salt are in the ratio 1 : 10. If the pKa value of CH_3COOH is 4.74, calculate the pH of the buffer.

(3 marks)

(iii) The equivalent conductance at infinite dilution of NaCl, HCl and CH_3COONa are 126.5, 426 and 91 $Ohm^{-1}cm^2eq^{-1}$ respectively. Calculate the equivalent conductance at infinite dilution of CH_3COOH.

(3 marks)

[2 × 10 = 20 marks]

SECOND SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION, APRIL 2021

Chemistry

CHE 2B 02—THEORETICAL AND INORGANIC CHEMISTRY-II

Time : Three Hours
Maximum : 80 Marks

Section A (One Word)

Answer **all** *questions.*
Each question carries 1 mark.

1. Give the electronic configuration of O^{2-} ion.

2. Write an example of a Laplacian operator

3. The smallest atom in the periodic table is ——————.

4. Arrange F, Cl, Br, I in the increasing order of their electron gain enthalpy.

5. The number of valence electrons in BF_3 is ——————.

6. Draw the $dx^2_{-z}{}^2$ orbital.

7. Which among the following has zero dipole moment : CO_2, H_2O, HF ?

8. Give the hybridization of C_2H_2.

9. Give an example of a molecule with intramolecular hydrogen bonding.

10. How many nodes are there for 4p orbital ?

(10 × 1 = 10 marks)

Section B (Short Answer)

Answer any **ten** *questions.*
Each question carries 2 marks.

11. What are eigen functions and eigen values ?

12. State Pauli's exclusion principle.

13. What are Hamiltonian operators ? Give an example.

14. Define ionization energy. Arrange Li, Na, K, Rb in the increasing order of their ionization energy

15. Which is bigger : F^- or O^{2-} ? Justify your answer.

Turn over

16. What is lattice energy ? Give its significance.

17. Mention the factors that affect the formation of ionic compounds.

18. Explain the shape of SO_4^{2-} based on hybridization.

19. Account for the polarity of covalent bond with a suitable example.

20. Draw the resonance structures of CO_3^{2-}.

21. Among B_2 or C_2, which is paramagnetic ? Justify your answer.

22. What are van der Waals' forces ?

(10 × 2 = 20 marks)

Section C (Paragraph)

Answer any **five** *questions.*
Each question carries 6 marks.

23. Explain the characteristics of well-behaved functions.

24. Draw and explain the radial distribution curves of 2s, 2p and 3s orbitals.

25. Give an account of Mullikan scale of electronegativity.

26. State and explain modern periodic law. How many elements are there in the first four periods of periodic table ?

27. State Fajan's rule. Mention its applications.

28. Represent Born-Haber cycle of the formation of NaCl. Give its significance.

29. Explain metallic properties based on free electron theory.

30. Write notes on ion-dipole, dipole-dipole and ion-induced dipole interactions.

(5 × 6 = 30 marks)

Section D (Essay)

Answer any **two** *questions.*
Each question carries 10 marks.

31. Apply time independent Schrodinger wave equation to a particle in three-dimensional box.

32. a) Give an account of the concept of quantum numbers and their significance.

   b) State Slater's rules. Explain its applications.

33. a) Explain the geometry of C_2H_2, NH_4^+ and SF_6 based on hybridization.

   b) What are the limitations of Valence Bond Theory ?

34. Draw the MO level diagram of O_2 and CO. Find out the bond order. Predict their magnetic behavior.

(2 × 10 = 20 marks)