PHYSICAL CHEMISTRY

8. SOLID STATE-I

1. Write the difference between amorphous and crystalline solid (153)
2. Define unit cell. Write any two characteristics. (156)
3. How many types of cubic unit cell exists? (158)
4. What are Miller indices? (161) *(diagamPH.E)
5. Why crystalline solids have regular geometry. (H.E)
6. What is long range order?
7. What are compound oxides? Give example
8. What are the seven classes of unit cell? (158)
9. What is crystallography?
10. What is long range order?
11. Define double refraction.
12. Write a note on simple cubic (s.c) unit cells. body centred cubic (b.c.c) unit cells.
   And face centred cubic (f.c.c) unit cells. (What is the difference between bcc &fcc.) (Q.E)
13. Give the distinguishing features of crystalline solids and amorphous solids. (153)
14. Draw a neat diagram for sodium chloride structure and explain. (159) (or)
   Mention the number of sodium & Chloride ions in each unit cell of NaCl. (Q.E)
15. Draw a neat diagram for cesium chloride structure and explain. (160) (or)
   Mention the number of Cesium & Chloride ions in each unit cell of CsCl. (PH.E)(IR)
16. Explain anisotropic and isotropic? (153) (IR)(DM)********

PROBLEMS

17. How many atoms are there per unit cell in (i) simple cubic arrangement of atoms, (ii) body centred cubic arrangement of atoms, and (iii) face-centred cubic arrangement of atoms?
18. How do the spacings of the three planes (100), (101) and (111) of sc lattice vary? (168)
19. How do the spacings of the three planes (001), (011) and (111) of bcc lattice vary?
20. How do the spacings of the three planes (010), (110) and (111) of fcc lattice vary?
21. Draw the sketch for the following planes. (100), (010), (001), (110), (101), (011), (111).
22. Calculate the Miller indices of crystal plane, which cut through the crystal axes at 1. (2a,3b,c) 2. (a,b,c) 3. (6a,3b,3c) 4. (4a,2b,3c) 5. (2a,-3b,-3c) 6. (2a,4b,3c) 7. (2a,2b,c) *(164)(Q.E)
23. How do the spacing of the three planes (100), (110), (111) of the cubic lattice vary. (165)

9. GASEOUS STATE

1. Define Boyle’s law and Charle’s law. (171)
2. State Dalton’s law of partial pressure. (175) (Q.E)
3. Define Graham’s law of diffusion. (172)
4. What are the units of Vanderwaal’s constants a and b. (183) (PH.E)
5. Write the significance of Vanderwaal’s constants. (184) (H.E)
6. Write the limitations of Vanderwaal’s equation. (185)
7. What is critical temperature (T_C)? and critical pressure (P_C) and critical volume (V_C)? (186)
8. **Define Joule Thomson s effect. (192)** *(PH.E),(Q.E)***************

9. **What is meant by inversion temperature? (193)**

10. **What are the conditions for liquefaction of gases? (193)** Give the correction factors for the volume and pressure deviation for a Vanderwaal's gas.

11. Ideal gas escapes into an evacuated container, there is no change in the kinetic energy of the gas. Why?

12. What is the change in temperature when a compressed real gas is allowed to expand adiabatically through a porous plug.

13. What are measurable properties of gases?

14. What is the molar volume of nitrogen at 500 K and 600 atm according to ideal gas law?

15. Give the values of R-gas constant in calories and Joules.

16. **What is effusion? (178)**

17. If a gas diffuses twice as fast as oxygen, find the molecular mass of the gas *

18. **Classify the following gases NH₃, N₂, H₂, CO₂ as Permanent temporary gases (DM)**

19. **Describe Linde s process of liquefaction of gases. (194)**


21. Derive critical constant from Vanderwalls constant *(188)*

22. Explain the causes for deviation for real gases from ideal behaviour.

23. Deduce the relationship between critical constants and Vanderwall's constants.

24. What is meant by adiabatic demagnetization? Explain its use in liquefaction of gases.

25. **Andrews Isotherm of Carbondioxide. (186)**

26. **Explain Thomson s experiment of carbondioxide. (187)**

**PROBLEMS**

26. The critical constants for water are 374 °C, 218 atm and 0.0566 l mol⁻¹. Calculate a and b of water.

27. Vander Wall s constants in litre atmosphere per mole for carbon dioxide are a = 3.6 and b = 4.28 x 10⁻². Calculate the critical temperature and critical volume of the gas R = 0.0820 l atm K⁻¹ mol⁻¹.

28. Calculate the partial pressure N₂ and H₂ in a mixture of two moles of N₂ and two moles of H₂ STP. If a gas diffuses at the rate of one half as fast as O₂, find the molecular mass of the gas.

29. 50 ml of gas A effuse through a pin–hole in 146 seconds. The same volumes of CO₂ under identical conditions effuse in 115 seconds. Calculate the molecular mass of A.

30. One mole of carbon-dio ide as fou d to o up a olu e of . litre at °C a d at a pressure of 16.4 atm. calculate the pressure of the gas that would have been expected to behave ideally and nonideally.

31. Vanderwaal s constants for hydrogen chloride gas are a = 3.67 atm lit⁻² and b = 40.8 ml mol⁻¹. Find the critical temperature and critical pressure of the gas.

32. The critical temperature of hydrogen gas is 33.2°C and its critical pressure is 12.4 atm. Find out the values of a and b for the gas.

**11. COLLIGATIVE PROPERTIES**

1. What is colligative property? Mention them *(31)*

2. **Define relative lowering of vapour pressure (33)**

3. **Define Raoult s law (32)**
4. What do you understand by molal elevation of boiling point? (42)
5. Define osmosis and osmotic pressure (45)
6. What is Boyle s –Vont Hoff law (46) Cherle s – Vont Hoff law (46)
7. What are isotonic solution? (46)
8. hypertonic and hyphotonic solutions
9. What are the characteristics of osmamic pressure? (46)
10. What are the advantages of Berkley Hartley method? (47) (IR)
11. Define VantHoff factor (48)
12. Addition of non-volatile solute always increases the boiling point of the solution. Why?
13. Volatile hydrocarbons are not used in the brakes of automobile as lubricant, but non- volatile hydrocarbon are used as lubricants. Why?
14. Prove that the depression in freezing point is a colligative property.
15. Explain how the degree of dissociation of an electrolyte may be determined from the measurement of a colligative property.
16. What is depression of freezing point of the solution?
17. What is cryoscopic constant (or) molal freezing point depression constant?
18. What is molal boiling point elevation constant (or) ebuilloscopic constant?
19. Write a note on abnormal colligative properties
20. Saline solution used to treat dehydration has 0.9 % Nacl solution explain the above statement with suitable example. (PH.E)
21. Ice + camphor .................Ice + salt i) which side ice is melt faster?ii) write reason (H.E)
22. Explain the determination of relative lowering of vapour pressure by Ostwald walker method (34)
23. Explain the Beckmann thermometer method (39) (PH.E)
24. Describe the determination of depression in freezing point by Beckmann method (39)
25. Explain the determination of elevation of boiling point by Cottrell method (44)
26. Explain the laws of osmotic pressure and its determination by Berkley Hartley method (H.E)

**PROBLEMS**

1. What is the Vant Hoff factor for a solution of 1 M KCl solution? What is 85% dissociated?
2. Calculate the vapour pressure of the solution. The mole fraction of the solute is 0.25. The vapour pressure of the pure solvent is 0.8 atm. ******
3. Calculate the vapour pressure of the solution. The mole fraction of the solute is 0.5. The vapour pressure of the pure solvent is 0.6 atm. ******

**(DM)(PH.E)**
(Practice book example and exercise problem)

12. THERMODYNAMICS-I

1. What are homogeneous and heterogeneous system? (56)
2. What are intensive and extensive properties? (56) (IR)
3. Define adiabatic process (58)
4. Write the differences between endothermic and exothermic process(60) (IR)(H.E)***
5. Define zeroth law of thermodynamics (61) (DM)
6. Define first law of thermodynamics (64)
7. Define enthalpy (65)
8. Define enthalpy of combustion. (68)
9. Name the equipment using which heat of combustion of compounds are determined (68)
10. What are the types of macroscopic and microscopic properties?
11. Define Isothermal, Isobaric & Isochoric process.
12. Define cyclic process.
13. What is spontaneous & non – spontaneous system?
14. Define enthalpy of neutralization (70) (H.E)
15. What is state function? Give examples (61) path function? Give examples (61)
16. State the term (a) system (b) surrounding (c) boundary
17. What is degree of dissociation? List out its condition. (85)
18. Distinguish between reversible and irreversible process (59)
19. Describe a bomb calorimeter and explain how heat of formation of an organic compound is determined (68)
20. Explain the different types of systems with examples.
21. Derive the relationship between enthalpy and internal energy

**PROBLEMS**

1. Calculate the enthalpy of combustion of acetic acid (l) when burnt in excess of O₂ in a bomb calorimeter. Given that \( \Delta H^0_{f}, \text{H}_2\text{O}(l) = -285.84 \text{ kJ mol}^{-1} \) and \( \Delta_f H^0, \text{CO}_2(g) = -393.52 \text{ kJ mol}^{-1}; \Delta_f H^0 \text{CH}_3\text{COOH (l) = -463 KJmol}^{-1}. \)
   
   \[
   \text{CH}_3\text{COOH (l) + 2O}_2(g) \rightarrow 2\text{CO}_2(g) + 2\text{H}_2\text{O (l)}
   \]

2. Heat of neutralisation of a weak acid HA by NaOH is \( -12.13 \text{kJ mol}^{-1} \). Calculate the enthalpy of ionization of HA.

3. \( \Delta H \) for the reaction at 298K \( \text{CO(g) + ½O}_2(g) \rightarrow \text{CO}_2(g) \) is 282.85 kJmol\(^{-1}\). Calculate \( \Delta U \) of the reaction.

4. From the following data at constant volume for combustion of benzene, calculate the heat of this reaction at constant pressure condition.

5. Calculate the enthalpy of combustion of ethylene at 300K at constant pressure if its enthalpy of combustion at constant volume is \( -1406 \text{ kJmol}^{-1}. \)

**PROBLEMS**

1. At 25°C \( K_c \) for the reaction \( 3\text{C}_2\text{H}_4(g) \rightarrow \text{C}_6\text{H}_6 (g) \) is 4.0. If the equilibrium concentration of \( \text{C}_2\text{H}_2 \) is 0.5 mol.lit\(^{-1}\). What is the concentration of \( \text{C}_6\text{H}_6 \)?

2. 64g of HI are present in 2 litre vessel. What is the active mass of HI?

**13. CHEMICAL EQUILIBRIUM-I**

I. Answer the following shortly

1. What are reversible and irreversible reactions? (76)
2. Chemical equilibrium is dynamic in nature. Why? (78)
3. Define law of mass action (80) (IR)
4. What is equilibrium constant? (82)
5. Write the Kc expression for \( \text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3 \) (82)
6. Write the Kp expression for $\text{PCl}_5 \rightleftharpoons \text{PCl}_3 + \text{Cl}_2$. (88)

8. Write the Kc for (i) $\text{CH}_4 + \text{H}_2\text{O} \rightleftharpoons \text{CO}_2 + 3\text{H}_2$ (ii) $2\text{N}_2\text{O}_5 \rightleftharpoons 4\text{NO}_2 + \text{O}_2$

II. Explain elaborately on the following
1. Explain the characteristics of a chemical equilibrium. (78)
2. Derive an expression for the Kp, Kc for the equilibrium $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$ (85) (IR)
3. Derive an expression for the $K_p$, $K_c$ for the dissociation of $\text{PCl}_5$ (87)
4. What are the characteristics of equilibrium constant? (91)
5. Write note on heterogeneous equilibrium reaction (91)

14. CHEMICAL KINETICS-I

1. Define half life period. (DM)
2. Define rate of a reaction (96)
3. Name the factors that affect the rate of reaction (98)
4. What is a rate determining step. (102)
5. Define rate law. Write is unit (99)
6. Define order (100)
7. What are the differences between rate of reaction and rate constant of reaction? (101)
8. What is Second order reaction? Give an example. (104)
9. Give an example for Third order reaction. (104)
10. Write the unit of zero, first, second and third order reactions.
11. What is first order reaction? Give an example
12. What is zero order reaction? Give an example
13. Write the rate law of $\text{PA} + \text{qB} \ldots \ldots \ldots \ldots \ldots \text{Ic} + \text{mD}$ (IR)
14. Write the differences between order and molecularity (101) (IR)
15. Describe the factors on which the rate of reaction depends (98)

PROBLEMS
16. 1 ml of methyl acetate was added to 20 ml of 0.5N sulphuric acid. 2 ml of the reaction of mixture was withdrawn at various time intervals and titrated against a solution of standard alkali. The titre values are tabulated. Show that the reaction is first order and calculate the rate constant and half life period of the reaction.
17. In a first order reaction, the initial concentration of the reactant is 0.05mole/litre and the rate constant $1.5 \times 10^{-3}$ min$^{-1}$. Calculate the order of the reaction.
18. If a reaction with $t_{1/2} = 69.3$ second, has a rate constant value of $10^{-2}$ per second. Calculate the order of the reaction.
19. The half-life period of a first order reaction is 1 hr. What is the time taken for 87.5% completion of the reaction? (DM)
20. 87.5% of the substance is disintegrated in 45 minutes (first order reaction) what is its half-life?
21. If the half-life of first order reaction is 2 min, how long will take to reach 25% of initial concentration?
22. The half-life for radioactive decay of $^{14}$C is 5730 years. An archeological contained wood had only 80% of the $^{14}$C found in the living tree. Estimate the age of the sample
VOLUME II.  
10. CHEMICAL BONDING  

1. What are the different types of chemical bonding? (5)  
2. What is octet rule? Give an example (2)  
3. What is meant by electrovalent bond? (3) and covalent bonding? (4)  
4. What is meant by hybridization? (25) (Q.E)  
5. What is coordinate or dative bond? (27)  
6. Write the difference between homonuclear and heteronuclear molecule (1)  
7. What is ionic/ electrovalent bond? (3)  
8. State Fajan's rule. (14)  
ii) Define Polarization. (14)  
iii) What is resonance? (25)  
9. How sigma and pi bond are formed? and how it is formed oxygen molecule. (H.E)  
10. Write are the important features of VSEPR and VB theory. (17)  
11. What are the factor influencing on lattice energy?  
12. Give the structure and geometry of NH₃, SF₆ and CH₄ based on VSEPR theory.  
13. AlCl₃ in the increasing order of covalent character. AlCl₃ exist as dimer give reason  
14. Find the σ and π bonds in the following CH₃-CH₃, CH₂=CH₂, CH = CH and O₂ (PH.E)  
15. Among Na⁺, Ca²⁺, Mg²⁺, Al³⁺ which has high polarizing power?  
16. Write the differences between electrovalent and covalent bonds (Q.E)  
17. Give reason : CCl₄ is insoluble in H₂O while NaCl is soluble  
18. sp³-hybridisation is involved in CH₄, H₂O and NH₃. Why are the bond angles different in three cases?  
19. Explain the co-ordinate bond formation between BF₃ & NH₃.  
20. Explain the bond formation in AlBr₃ and CaO.  
21. Give the electron dot representation for PH₃ and ethane (Q.E)  
22. Write the Lewis dot structures for the following. S, S²⁻, P, P³⁻, Na, Na⁺, Al and Al³⁺.  
23. Discuss the partial covalent character in ionic compounds using Fajan's rule (14)  
24. What are the factors affecting Polarization of ionic bond by Fajans rule. (Q.E)  
25. Discuss the shapes of the following molecules based on VSEPR theory NH₃, H₂O, SO₂, O₃, CO₂ & N₂O. Arrange NaCl, MgCl₂ and BeCl₂  
26. Draw the electron dot structure of F₂, CO₂ and N₂  
27. Draw the Lewis dot structure of Cl₂, O₂, PH₃, F₂, CO₂ & N₂.  
28. What is homo nuclear diatomic molecule? Give two examples. and hetero nuclear diatomic molecule? Give two examples. homo nuclear polyatomic molecule? Give two examples. hetero nuclear polyatomic molecule? Give two examples. (H.E)  
29. Define Hess’s Law. (Q.E)  
30. Give any three properties of electrovalent, ionic compounds, covalent compounds.  
31. Arrange the decreasing covalent character of LiF, LiCl, LiBr, LiI. (one Mark)  
32. Write a note on partial ionic character of HCl  

34. Draw the molecular geometry of BeCl₂, BF₃, CH₄, HgCl₂, NH₄⁺, PCl₅, SF₆.
35. Write the descending order of repulsion interaction between lone pair and bond pair.
36. Give the Kekule’s structure of benzene and Dewar structure of benzene.
37. **Calculate the lattice energy of NaCl using Born-Haber cycle.**
38. Explain the polarity of covalent bonds in H₂O and HCl.
39. Discuss the shapes of following molecules: NH₃, H₂O, CH₄, PCl₅, and SO₂.
40. Explain the formation and difference between a sigma bond and pi-bond. Which has more bond strength?
41. Explain the Valence Bond (VB) theory.
42. **Discuss about the Valence Bond Electron Pair Repulsion (VSEPR) theory.**
43. Explain with reason the reduction of tetrahedral bond angle (109.28°) in ammonia and water molecule. ii) Why are bond angle of ammonia is less than tetrahedral angle (Q.E) ,(I)
44. **Calculate the lattice enthalpy of CaCl₂ given that the enthalpy of (i) Sublimation of Ca is 121 kJ mol⁻¹, (ii) Dissociation of Cl₂ to 2Cl is 242.08 kJ mol⁻¹, (iii) Ionisation of Ca to Ca²⁺ is 2422 kJ mol⁻¹, (iv) Electron gain for Cl to Cl⁻ is –355 kJ mol⁻¹, ΔHᵣ(0) overall is –795 kJ mol⁻¹ (D.M)**

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