

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) * (diagram)(P.H.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.(P.H.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 Charles'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) (P.H.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 500K and 600atm 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(H.E)**
18. **Classify the following gases NH₃, N₂, H₂, CO₂, as Permanent temporary gases (DM)**
19. **Describe Linde s process of liquefaction of gases. (194)**
20. **Describe Claude s process of liquefaction of gases. (195) *(DM)(PH.E)(Q.E)*******
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 Vanderwaal'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 lit 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 lit 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-dioxide is found to occupy a volume of . litre at °C and 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) Charles – Vont Hoff law (46)
7. **What are isotonic solution? (46)**
8. **hypertonic and hypotonic solutions**
9. What are the characteristics of osmotic 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) ebullioscopic 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 + camphorIce + 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 walkermethod (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 0.6atm.**
- *****(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 $\Delta H^{\circ}f$, H₂O(l) = -285.84 kJ mol⁻¹ and $\Delta_f H^{\circ}$, CO₂(g) = -393.52 kJ mol⁻¹; $\Delta_f H^{\circ}$ CH₃COOH (l) = -463 kJmol⁻¹.
$$\text{CH}_3\text{COOH} (l) + 2\text{O}_2(g) \longrightarrow 2\text{CO}_2(g) + 2\text{H}_2\text{O} (l)$$
2. Heat of neutralisation of a weak acid HA by NaOH is - 12.13kJ mol⁻¹. Calculate the enthalpy of ionization of HA.
3. ΔH for the reaction at 298K $\text{CO}_{(g)} + \frac{1}{2}\text{O}_{2(g)} \longrightarrow \text{CO}_{2(g)}$ is 282.85 kJmol⁻¹. Calculate ΔU 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 kJmol⁻¹.

PROBLEMS

1. At 25°C K_c for the reaction $3\text{C}_2\text{H}_2 \rightleftharpoons \text{C}_6\text{H}_6 (g)$ is 4.0. If the equilibrium concentration of C₂H₂ is 0.5 mol.lit⁻¹. What is the concentration of C₆H₆?
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 K_c expression for N₂ + 3H₂ ⇌ 2NH₃ (82)

6. Write the K_p expression for $\text{PCl}_5 \rightleftharpoons \text{PCl}_3 + \text{Cl}_2$. (88)
8. Write the K_c 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 K_p , K_c 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 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 its 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 $\text{PA} + \text{qB} \rightleftharpoons \text{lc} + \text{mD}$ (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 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 0.05 mole/litre and the rate constant $1.5 \times 10^{-3} \text{ min}^{-1}$.
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 NH_3 , SF_6 and CH_4 based on VSEPR theory.
13. **AlCl_3 in the increasing order of covalent character. AlCl_3 exist as dimer give reason**
14. **Find the σ and π bonds in the following $\text{CH}_3\text{-CH}_3$, $\text{CH}_2=\text{CH}_2$, $\text{CH}=\text{CH}$ and O_2 (PH.E)**
15. Among Na^+ , Ca^{+2} , Mg^{+2} , Al^{+3} which has high polarizing power ?
16. **Write the differences between electrovalent and covalent bonds (Q.E)**
17. **Give reason : CCl_4 is insoluble in H_2O while NaCl is soluble**
18. sp^3 hybridisation is involved in CH_4 , H_2O and NH_3 . Why are the bond angles different in three cases?
19. Explain the co-ordinate bond formation between BF_3 & NH_3 .
20. Explain the bond formation in AlBr_3 and CaO .
21. **Give the electron dot representation for PH_3 and ethane (Q.E)**
22. Write the Lewis dot structures for the following. S, S^{2-} , P, P^{3-} , Na, Na^+ , Al and Al^{3+} .
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 NH_3 , H_2O , SO_2 , S
26. Explain resonance structure with suitable example. (25) Give the resonance structure of O_3 , CO_3^{2-} , CO_2 & N_2O . Arrange NaCl , MgCl_2 and BeCl_2
27. Draw the electron dot structure of F_2 , CO_2 and N_2
28. Draw the Lewis dot structure of Cl_2 , O_2 , PH_3 , F_2 , CO_2 & N_2 .
29. **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)**
30. Define Hess's Law. (Q.E)
31. Give any three properties of electrovalent ,ionic compounds. covalent compounds.
32. Arrange the decreasing covalent character of LiF , LiCl , LiBr , LiI . (one Mark)
33. Write a note on partial ionic character of HCl

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34. Draw the molecular geometry of BeCl_2 , BF_3 , CH_4 , HgCl_2 , NH_4^+ , PCl_5 , SF_6 .
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 H_2O and HCl .
39. Discuss the shapes of following molecules: NH_3 , H_2O , CH_4 , PCl_5 and SO_2 .
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 PROBLEMS**
- 44. Calculate the lattice enthalpy of CaCl_2 given that the enthalpy of (i) Sublimation of C 121 kJ mol^{-1} , (ii) Dissociation of Cl_2 to 2Cl is 242.08 kJ mol^{-1} , (iii) Ionisation of Ca to Ca^{2+} 2422 kJ mol^{-1} , (iv) Electron gain for Cl to Cl^- is -355 kJ mol^{-1} , $\Delta H_f^{(0)}$ overall is -795 kJ mol^{-1} (D.M)****

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