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Unique Paper Code : 32171102

Name of Paper : Chemistry C-II Physical Chemistry I

States of Matter and Ionic Equilibrium

Name of the Course : B.Sc. (H) Chemistry

Semester : I

Duration : 3 hours

Maximum Marks : 75

Instructions for candidates

1. Do any out of the six questions given.

2. Answer all the parts of a question together.

3. Label clearly the number of question.

1. a) At moderate pressure a real gas occupies less volume than an ideal gas. True or False? Give reason.

b) The boiling point of a liquid is 350K and its heat of vaporization is 85 kJ mol^{-1} . Calculate the temperature at which the liquid will boil if the pressure is $2.6 \times 10^3 \text{ Nm}^{-2}$.

c) A substance of atomic weight 63 crystallizes in an fcc lattice of unit cell edge length 350pm. Predict the first four lines of the X ray diffraction pattern using X rays of wavelength 154pm. Index the lines.

d) A solution of CH_3COOH and CH_3COONa acts as a buffer but a solution of HCl and NaCl does not. Explain.

(3.75, 5, 5, 5)

2. a) Why are bubbles formed more easily in soap solution than in water?

b) At what pressure does the mean free path of helium gas at 25°C becomes equal to the diameter of the atom itself. The volume of a helium atom is $2.784 \times 10^{-30} \text{ m}^3$.

c) Calculate the solubility of AgCN in a buffer of pH 3, given solubility product of AgCN is 1.2×10^{-16} and ionisation constant for HCN is 4.8×10^{-10} .

d) List the symmetry elements present in an ammonia molecule? Illustrate diagrammatically.

(3.75, 5, 5, 5)

3. a) Explain why phenolphthalein cannot be used as an indicator in titration of strong acid and weak base.
- b) A substance having tetra atomic molecules has a molar heat capacity $C_{v,m}$ of $79 \text{ JK}^{-1} \text{ mol}^{-1}$ at 500 K .
- Predict its geometry
 - How many modes of vibrational motion does it have?
 - What will be its molar heat capacity $C_{v,m}$ at room temperature?

c) If 50 mL of $0.2 \text{ M CH}_3\text{COOH}$ (ionization constant = 1.8×10^{-5}) is being titrated with 0.1 M

NaOH . What is the pH of the solution when:

- 0 mL of NaOH is added
- 10 mL of NaOH has been added.
- 50 mL of NaOH has been added.

d) Calculate the Miller indices of the faces having the following intercepts

- $2a, 3b, 4c$
- $-2a, b, 3c$
- $1/2a, 2b, \infty c$
- $3/2a, 2b, c$
- $5/2a, 5/2b, c$

(3.75, 5, 5, 5)

4. a) Viscosity of liquids decreases as temperature is increased but that of gases

increases. Explain

b) State whether the following statement is correct giving reason. If the statement is incorrect

correct it giving reason.

If a little HCl is added to water the concentration of H^+ ions changes causing the ionic product of water to change.

c) The radius of Fe atom is $1.24 \text{ \AA}$. It occurs both in fcc and in bcc forms. Calculate density of each.

d) Calculate the mass of solid CH_3COONa that must be dissolved in 250 cm^3 of $0.09 \text{ M CH}_3\text{COOH}$ (K_a is 1.8×10^{-5}) in order to give a solution of pH 4.7

(3.75, 5, 5, 5)

5. a) Explain why the position of H atoms in a crystal of sugar cannot be deduced from its X ray diffraction pattern.

b) Calculate the value of σ , λ , Z_1 and Z_{11} for N_2 molecules at $25^\circ C$ and 10^{-3} torr given $b = 39.1 \text{ cm}^3 \text{ mol}^{-1}$.

c) The solubility of Ag_2CrO_4 is 0.001 g/L . Calculate its solubility product. What will be its solubility in a solution containing 10 g/L of K_2CrO_4 ?

d) Write the virial equation for a real gas. What are the advantages of using this equation as compared to the van der Waals equation?

(3.75, 5, 5, 5)

6. a) Why are x rays always used for studying crystal structures? Can any other rays be used instead of x rays? Why?

b) The compressibility factor for 1 mole of van der Waal's gas at $0^\circ C$ and 100 atm is found to be 0.5. Assuming that the volume of gas molecules is negligible, calculate the van der Waals constant a .

c) On passing H_2S , CoS precipitates in basic solution but CuS precipitates in acidic medium. Explain

d) Calculate the degree of hydrolysis of ammonium acetate in a solution of concentration 0.05 M . Also calculate the hydrolysis constant for the salt and pH of this solution. Given ionisation constant of acetic acid is 1.8×10^{-5} .

(3.75, 5, 5, 5)

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