2017

CHEMISTRY

(Major)

Paper : 6·2

(Physical Chemistry)

Full Marks : 60

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Answer the following in brief : 1×7=7

(a) Calculate the Miller indices of crystal plane which cut through the crystal axes at $(2a, -3b, -3c)$.

(b) Find the highest order that can be observed in Bragg's reflection from a solid by X-ray.

(c) Name the crystal system with characteristics $a \neq b \neq c$, $\alpha = \gamma = 90°$, $\beta \neq 90°$.

(d) State what you mean by critical micelle concentration.

(e) Define polydispersity index of a polymer.

(f) Define thermodynamic probability.

(g) State what you mean by isotactic polymer.

2. (a) The density of Li metal is 0·53 g cm^{-3} and the separation of the (100) planes of the metal is 350 pm. Determine whether the lattice is f.c.c. or b.c.c. (M(Li) = 6·941 g mol^{-1}) 2

(b) What is critical temperature in connection with superconductivity? What are high temperature super-conductors? 2

Or

Calculate the packing efficiency of a simple cubic metal.

(c) Define partition function. What does the partition function refer to at absolute zero temperature? 2

(d) "A colloidal solution is not precipitated on the addition of an electrolyte in presence of gelatin." Explain. 2

Or

Explain how the formation of micelle affects the electrical conductivity and the osmotic pressure of the solution.

3. Define average deviation and standard deviation. In an experiment, the set of masses of an element obtained were 29·8 mg, 30·2 mg, 28·6 mg and 29·7 mg. Calculate the standard deviation of the individual values and the standard deviation of the mean. Express the results as absolute and relative values. 5

Or

Write briefly about the various types of errors in measurement. What do you understand by uncertainty in the measurement of physical quantities? Distinguish error from uncertainty. 2+2+1=5

4. Answer *either (a)* and *(b) or (c)* and *(d)* :

(a) Consider six distinguishable particles distributed in three energy levels (0, ε and 2ε) in the following manner :

Energy	0	ε	2ε
Macrostate I	3	3	0
Macrostate II	2	2	2

Calculate the difference in entropy between the two macrostates. 3

(b) Calculate the translational partition function of H_2 molecule confined to a 1000 cm^3 vessel at 25 °C. 2

(c) Calculate the characteristic vibrational temperature of N_2 molecule, if $\bar{\nu}_0 = 2357{\cdot}6\ cm^{-1}$ for N_2 molecule. 3

(d) Consider 9 distinguishable particles divided equally among 3 non-degenerate energy levels. Find thermodynamic probability for this distribution. 2

5. Answer *either (a) or (b)* :

(a) Define number average and mass average molar mass of polymers. For a sample of polymer, which one has a larger value and why?

A solution contains 1 : 2 ratio of number of particles of two substances with molar masses 10·0 kg mol^{-1} and 20·0 kg mol^{-1} respectively. Calculate the values of number average and mass average molar masses. 3+2=5

(b) Discuss about the light scattering method for determination of the molar mass of polymer. 5

6. Answer *either* [*(a), (b)* and *(c)*] *or* [*(d), (e)* and *(f)*] :

(a) What are Schottky and Frenkel defects? Write what types of compounds exhibit these defects. Discuss the effect of these defects on the density of solids. 2+1+1=4

(b) CsCl has a b.c.c. arrangement and its unit cell edge length is 400 pm. Calculate the interionic distance in CsCl. 3

(c) When NaCl crystal is exposed to Na vapours, the crystal acquires yellow colour. Explain this observation. 3

(d) Discuss the molecular interpretation of paramagnetism. 4

(e) X-ray of wavelength 0·134 nm gives a first-order diffraction from the surface of a crystal when the value of θ is 10·5°. Calculate the distance between the planes in the crystal parallel to the surface. 3

(f) Explain the origin of low-temperature superconduction in terms of Cooper pair. 3

7. Answer *either (a)* and *(b) or (c)* and *(d)* :

(a) For a diatomic molecule vibrating as a simple harmonic oscillator, obtain an expression for vibrational partition function. 5

(b) Deduce the relationship

$$S = k \ln W$$ 5

(c) From the statistical thermodynamical consideration, deduce an expression for the equilibrium constant of an ideal gas reaction equilibrium. 5

(d) Deduce an expression for the most probable distribution of N numbers of distinguishable particles among various energy levels. 5

8. Answer *either* [*(a), (b)* and *(c)*] *or* [*(d)* and *(e)*] :

(a) Explain the cleansing action of soaps and detergents. Which of these two is more effective in hard water and why? 3+1=4

(b) Discuss how the stability of lyophobic colloids explained with the help of DLVO theory. 4

(Continued)

(c) For As_2S_3 sol., the flocculation values of NaCl solution and KCl solution are almost the same, though $CaCl_2$ solution has much less flocculation value. Explain this observation. 2

(d) Discuss the kinetics of addition polymerization. 5

(e) Define relative viscosity, specific viscosity and intrinsic viscosity. The intrinsic viscosity of a polymer in water is found to be $217\ cm^3\ g^{-1}$. If the relative viscosity of the solution is 1·5, calculate the approximate concentration of the solution. 3+2=5

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