Total number of printed pages–5

3 (Sem–6) CHM M 2

2021

CHEMISTRY

(Major)

Paper : 6·2

(Physical Chemistry)

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

GROUP–A

1. Give brief answers : 1×5=5

   (a) An electron trapped in an anion vacancy within the crystal is called ..... . *(Fill in the gap)*

   (b) Find the Miller indices of the crystal plane that cuts through the axes at $(2a, -3b, -3c)$.

Contd.

(c) Gold number of gum arabic is 0.15. How much gum arabic will be required to protect 100 mL of red gold sol from coagulation by 10 mL of 10% $NaCl$ solution ?

(d) What is the number of significant figure in the number 0.0008 ?

(e) Arrange the following in increasing order of their power of coagulating $Fe(OH)_3$ sol.

$$PO_4^{3-}, Cl^-, SO_4^{2-}$$

2. Answer the following : 2×5=10

(a) The unit cell of aluminium is a cube with edge length 405 *pm*. If the density of aluminium is 2.70 $g/c.c.$, predict the structure of the crystal.

(b) Define weight average and number average molecular weight of macromolecules. Why do we need to express the molecular weights of polymers as an average ?

(c) What do you mean by partition function ? What is its significance ?

(d) The result of an analysis is 36.97 g, compared with the accepted value of 37.06 g. What is the relative error in parts per thousand ?

(e) Why is ferric chloride preferred over potassium chloride in case of a cut leading to bleeding ?

3. Answer the following : ***(any three)***

(a) Why do crystals diffract X-rays ? Derive Braggs' equation. If the interplaner distance for a crystal is 4.04 $\mathring{A}$, calculate the glancing angle θ for second order reflection by this crystal. (Given, the wavelength of X-ray employed = 1.54 $\mathring{A}$) 1+2+2=5

(b) Derive an expression for the rotational partition function. What do you mean by characteristic rotational temperature and what is its significance ? 3+2=5

(c) Discuss the osmotic pressure method for determination of molar mass of polymers. Why does this method give number average molar mass only ? 2+3=5

(d) What do you mean by non-stoichiometric defects ? Give *one* example. Explain metal excess and metal deficiency defects with examples. 1+2+2=5

GROUP–B

4. Answer ***any three*** questions from the following :

(a) Discuss the three-dimensional close packing of crystals. What is packing efficiency ? Diagrammatically show how tetrahedral and octahedral voids are generated in crystals. Derive the relation between radius of the void (r) and radius of the atom (R) for both octahedral and tetrahedral voids. 2+1+2+5=10

(b) Distribute three energy quanta among three particles and calculate the probability of each distribution. Derive Boltzmann distribution law and give its physical significance. 2+2+5+1=10

(c) Discuss the powder method of X-ray diffraction technique for determination of crystal structure. A powder diffraction photograph of the element polonium gave lines at the following values of 2θ (in degrees) when 71.0 pm *Mo* X-rays were used :

12.1, 17.1, 21.0, 24.3, 27.2, 29.9, 34.7, 36.9, 38.9, 40.9, 42.8.

Identify the unit cell and determine its dimensions. 5+5=10

(d) For a diatomic molecule vibrating as a simple harmonic oscillator obtain an expression for vibrational partition function. What is characteristic vibrational temperature? The fundamental vibrational frequency of F_2 is $2.676 \times 10^{13} Hz$. Calculate the vibrational partition function of F_2 at $25^{\circ}C$. 4+1+5=10

(e) Define lyophilic and lyophobic colloids and give examples of each. Write the main differences of properties of these two types of colloids. What are micelles? Give the mechanism of formation of micelles. Discuss the cleansing action of soap. 10