

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

M.A./M.Sc. SECOND SEMESTER EXAMINATION, MAY 2016

FIRST YEAR [BATCH 2015-17]

APPLIED CHEMISTRY

Date : 20/5/2016

Time : 11 am – 1 pm

Paper : VIII

Full Marks : 50

[Answer a separate Answer Book for each group]

Group - A

Answer any five questions :

[5×5]

1. Differentiate between seven crystal system and Bravais lattice. Draw $(\bar{1}20)$ plane in a cubic crystal. Distinguish single crystalline and poly crystalline material. [2+1.5+1.5]
2. Define packing fraction. Calculate the radius of a FCC Iridium atom having density 22.4 gm/cc and atomic weight 192.2 gm/mol. Find out the packing fraction of a HCP unit cell. [1+2+2]
3. State briefly the 2nd Pauling rule of polyhedron. using this rule calculate the co-ordination no of oxygen in MgO. ($r_{Mg^{2+}} = 0.67 \text{ a.u}$ and $r_{O^{2-}} = 1.4 \text{ a.u.}$) Briefly describe Hume Rothery rule for the degree of solid solubility. [1+2+2]
4. a) Explain Frenkel and Schottky defects. [2]
b) Find the equilibrium concentration of vacancies in aluminium at 300K and 900K. [3]
[Given : Enthalpy of Formation of vacancies (ΔH_f) in Aluminium crystal is 68 KJ mol^{-1}]
5. Write down the expression and solution of Fick's law for non-steady state diffusion. At 950°C a 0.8% carbon steel is getting decarburized for the duration of 4hr. in an atmosphere equivalent to 0%C at the surface of the steel. Determine the minimum depth upto which post machining is to be done if the carbon content at the surface should not be below 0.6%. [1+4]
[Given : D_0 at 950°C = $0.7 \times 10^{-4} \text{ m}^2/\text{s}$, Q at 950°C = 157 KJ/mole, $\text{erf}(0.8) = 0.7421$, $\text{erf}(0.85) = 0.7707$]
6. a) Find out the condition as well as the basic driving force for continuous diffusion process. [1]
b) Name the two atomic mechanism of diffusion. [1]
c) A plate of iron is exposed to a carburizing (carbon-rich) atmosphere on one side and a decarburizing (carbon-deficient) atmosphere on the other side at 700°C. If a condition of steady state is achieved, calculate the diffusion flux of carbon through the plate if the concentrations of carbon at positions of 5 and 10 mm beneath the carburizing surface are 1.2 and 0.8 kg/m³ respectively. Assume a diffusion co-efficient of $3 \times 10^{-11} \text{ m}^2/\text{s}$ at this temperature. [3]
7. What is the position of Tetrahedral and octahedral voids in a FCC crystal? Calculate the r/R ratio in a tetrahedral and octahedral void where r = cationic radius, R = anionic radius. [2+3]
8. What is the stacking sequence of FCC and HCP crystal? What is stacking fault? Describe the formation process of F centre in an ionic crystal. [1+1+3]

Group - B

Answer any five questions :

[5×5]

9. Why diffusion annealing is called homogenizing annealing? Why tempering is important? [2.5+2.5]
10. To get complete martensite structure by hardening treatment, which heat treatment process is implemented? What is austempering? [2.5+2.5]
11. What is TTT diagram? Explain the effect of alloying elements of TTT diagram? [3+2]

12. Enumerate the degree of freedom of a three component system with four number of phases? Derive the degree of freedom of the triple point in a single component system? [2·5+2·5]
13. What is Cold Working? What are the disadvantages of Hot Working? [2·5+2·5]
14. Write short notes on Recovery and Recrystallization process? [2·5+2·5]
15. a) Note down two differences between addition polymerization and condensation polymerization. [2]
 b) Calculate the amount of benzoyl peroxide initiator required to produce 1kg of polyethylene with an average molecular weight of 200,000g/mol. What is the degree of polymerization? Assume that 20% of the initiator is actually effective and that all termination occurs by the combination mechanism. [3]
16. A continuous and aligned glass fibre-reinforced composite consists of 40 vol% of glass fibres having a modulus of elasticity of 69 Gpa and 60vol% of a polyester resin that, when hardened, displays a modulus of 3·4 Gpa.
 a) Compute the modulus of elasticity of this composite in the longitudinal direction. [2]
 b) If the cross-sectional area is 250 mm² and a stress of 50 Mpa is applied in the longitudinal direction, compute the magnitude of the load carried by each of the fibre and matrix phases. [3]

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