

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

M.A./M.SC. FIRST SEMESTER EXAMINATION, JANUARY 2013

FIRST YEAR

APPLIED CHEMISTRY

Date : 16/01/2013

Time : 11.00am – 1.00 pm

Paper :IV

Full Marks : 50

[Use Separate Answer Books for each group]

Group – A

1. Answer **any five** of the following MCQs : [5×1]
- a) The minimum number of double bonds required in the monomer for cross linking is :
i) 0 ii) 1 iii) 2 iv) 3
 - b) Lattice parameter of Si = $5.43\text{\AA}$, and the mass of Si atom is $28.08 \times 1.66 \times 10^{-27}$ Kg. The density of silicon in Kg/m^3 is :
i) 2330 ii) 1115 iii) 3445 iv) 1673
 - c) The number of unit cells in 1m^3 of Fcc Nickel ($r_{\text{Ni}} = 1.245 \text{\AA}$) is :
i) 2.3×10^{28} ii) 4.2×10^{28} iii) 6.5×10^{28} iv) 18.4×10^{28}
 - d) Diffusion coefficient is dependent on :
i) Temperature ii) Diffusing species iii) Both of these iv) None
 - e) Diffusion is quantitatively estimated by :
i) Fick's Law ii) Hooke's Law iii) Newton's Law iv) Kepler's Law
 - f) The $\vec{t}$ vector is parallel to $\vec{b}$ vector in a dislocation of the type :
i) Screw ii) Edge iii) Mixed iv) None
 - g) Typical dimensions of a unit cell in a crystal is of the order of :
i) m ii) mm iii) μm iv) nm
2. Answer **any five** of the following : [5×5]
- a) Speculate on the equilibrium concentration of vacancies in aluminium and nickel crystals near absolute zero temperature.
 - b) Explain self-diffusion, and diffusion in multiple phases (e.g. l-s, l-g etc).
 - c) i) Calculate the c/a ratio for an ideal HCP crystal.
ii) Calculate the density and packing efficiency of the NaCl crystal. [2×5×2]
 - d) Write a note on various types of unit cells with their characteristics dimensions and volumes.
 - e) i) Determine the ASTM grain size number of a metal specimen if 55 grains per square inch are measured at a magnifications of 100x.
ii) For the same specimen, how many grains per square inch will there be at a magnification of 85x? [2+3]
 - f) Write a short note on crystal imperfections.
 - g) From a powder camera of diameter 114.6 nm using an X-Ray beam of wavelength $1.54\text{\AA}$, the following s-values in mm are obtained for a material :
86, 100, 148, 180, 188, 232 and 272
Determine the structure and lattice parameter of the material. (Assume standard values and rules, if required).

Group –B

(Answer **any four** of the following)

3. a) Classify different types of materials with example. [2]
b) Illustrate the various kinds of structure. [3]

4. a) Define melting point and cohesive energy. [1]
 b) Derive the expression of melting point of nanoparticle. [4]
5. a) What is the influence of grain size (d) on the yield strength of materials? [1]
 b) A cylindrical copper rod if it is cold worked such that the diameter is reduced from 15.2 mm to 12.2 mm. Compute the amount of cold work that has been done. [2]
 c) After cold working what are the restoration processes that can revert back the precold properties of a material? [2]
6. a) What is composite? What are the advantages of using the composites? [1]
 b) A continuous and aligned fibre-reinforced composite is to be produced consisting of 30 vol% aramid fibres and 70 vol% of a polycarbonate matrix; mechanical characteristics of these two materials are as follows :

	Modulus of elasticity (GPa)	Tensile strength (GPa)
Aramid fibre	131	3600
Polycarbonate	2.4	65

 Calculate : i) the longitudinal tensile strength
 ii) the longitudinal modulus of elasticity [4]
7. a) Define phase, system and component. [2]
 b) For a 40 wt% Sn-60 wt% Pb alloy at 150°C,
 i) What phase(s) is (are) present and calculate their relative amounts.
 ii) What is (are) the composition(s) of the phase(s)? [3]
8. a) What are the phases present in Fe–C phase diagram? [1]
 b) What is Pearlite? [1]
 c) For a 99.65 wt% Fe–0.35 wt% C alloy at a temperature just below the eutectoid, determine the fractions of total ferrite and cementite phases. [3]

