

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. THIRD SEMESTER EXAMINATION, DECEMBER 2017

SECOND YEAR [BATCH 2016-19]

INDUSTRIAL CHEMISTRY [Honours]

Date : 12/12/2017

Time : 11 am – 3 pm

Paper : III

Full Marks : 75

[Use a separate Answer Book for each Group]

Group – A

(Answer any five questions)

[5×5]

1. a) What is Composite Material? [2]
b) A continuous and aligned Carbon fiber reinforced composite is made up of 20 vol% carbon fiber having a modulus of elasticity of 300GPa dispersed in a polymer matrix which on hardening has a modulus of elasticity of 4GPa. What will be the modulus of elasticity of the composite in longitudinal and transverse direction of the carbon fiber? [3]
2. a) Define and correlate between lattice, basis and crystal structure. [3]
b) Differentiate between seven crystal system and Bravais Lattice. [2]
3. Find out the packing fraction of a BCC and HCP system. [2+3]
4. a) Draw $[1\bar{1}0]$ and $[211]$ direction within a cubic unit cell. [2]
b) Sketch within a cubic unit cell the following planes : (012), (110) and $(0\bar{1}1)$. [3]
5. Calculate the r/R ratio in a tetrahedral and octahedral void where r = void radius, R = anionic radius. [5]
6. a) Write down the mathematical expression for percentage of crystallinity of a material? [2]
b) For a semicrystalline polymeric materials, free of voids, impurities, we define the following
 ρ = average density of a semi-crystalline polymer; ρ_c = density of crystalline phase; ρ_a = density of amorphous phase.
Derive the relation between the average density and the densities of crystalline and amorphous phase with the mass fraction of the crystalline phase (X). [3]
7. Draw different unit cells for seven crystal system. [5]
8. a) Distinguish single crystalline and poly crystalline material. [2]
b) Copper has an atomic radius of 0.128 nm, and FCC crystal structure and an atomic weight of 63.5 g/mol. Calculate its theoretical density. [3]

Group – B

(Answer any ten questions)

[10×5]

9. State the basic function of ingredients used in formulation of Triaxial Porcelain. Briefly describe with a flow sheet the process of manufacture of sanitary wares. [5]
10. Distinguish between Raw glaze and fritted glaze. How fritted glaze is prepared? Explain How a glaze is applied on Biscuit ware and then fired in Kiln to produce the finished ware. [5]
11. Draw and explain the Al_2O_3 -MgO phase diagram and mention the spinel $MgAl_2O_4$ formation region. Mention advantages of ULCC over LCC. [5]

12. Write the polymorphic transformation of SiO_2 and ZrO_2 . Explain in brief the process of sintering and what is the driving force responsible for it? [5]
13. Calculate the volume percent change during transformation of Zirconia from a tetragonal to a monoclinic structure.
The Lattice constants for the monoclinic unit cells are : $a = 0.5756 \text{ nm}$, $b = 0.5391 \text{ nm}$, and $c = 0.5104 \text{ nm}$ respectively. The angle β for the monoclinic unit cell is 98.1° . The Lattice constants for the tetragonal unit cell are $a = 0.5094 \text{ nm}$, and $c = 0.5304 \text{ nm}$. [5]
14. What are meant by “PCE” and “RUL” in a refractory manufacturing factory? Distinguish between Silica Refractory and High Alumina Refractory in respect of raw materials and end use. [5]
15. Write short notes on : Flint glass, Optical glass, Safety glass and Bioglass [5]
16. Determine the ratio of O : Si ions when 12 weight % of B_2O_3 is added to SiO_2 . Mol. mass of $\text{SiO}_2 = 60$ and $\text{B}_2\text{O}_3 = 69.6$. [5]
17. A soda-lime-Silica glass is made as under :
Glass Sand (SiO_2) = 6000 Kg, Lime Stone (CaCO_3) = 8000 Kg, Soda Ash (Na_2CO_3) = 12000 Kg
Calculate the oxide % composition of the finished glass. viz, $\text{Na}_2\text{O} : \text{SiO}_2 : \text{CaO}$. [5]
[$\text{SiO}_2 = 60$, $\text{CaO} = 56$, $\text{Na}_2\text{O} = 62$]
18. What is ordinary Portland Cement(OPC)? What are the raw materials used? What is a Rotary Kiln? What is the temperature of formation of clinker? Briefly mention in a flow sheet the dry process of manufacture of OPC. [5]
19. Discuss the chemistry of Hydration of a cement in brief. to form a set cement viz, Calcium Silicate Hydrate CSH gel. What is high Alumina Cement? [5]
20. What is blended cement? Describe the composition of PSC (Portland Slag Cement) and PPC (Portland Pozzolona Cement). State advantage of uses of blended cement over OPC. [5]
21. Write what do you know by the following terms in characterizing properties of cement.
a) Fineness (Blaine) in Cm^2/gm .
b) initial and final setting time
c) Normal Consistency (NC)
d) Compressive strength — 1, 3, 7 and 28 days the term OPC S3 grade implies 28 days compressive strength of a cement state the unit of “S3”. [5]

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