M.Sc. 3rd Semester Examination, 2011

CHEMISTRY

PAPER—CEM-304

Full Marks : 40

Time : 2 hours

The figures in the right-hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

Illustrate the answers wherever necessary

(*Organic Special/Physical Special*)

Answer any **four** questions

1. (*a*) Explain the terms 'monomer', 'mer' and 'degree of polymerisation' with suitable examples.

(b) Classify polymers according to the following bases of classification :

(i) Application

(ii) Tacticity.

(c) Show graphically how specific volume changes with temperature for amorphous and crystalline polymers and hence explain the nature of the graphs. $(1 + 1 + 1) + (2 + 2) + 3$

2. (a) Draw a typical molecular weight distribution curve for a polymer sample and show the positions of the different average molecular weights on the distribution curve.

(b) A polymer sample consists of the following fractions :

Fraction	No. of molecules	Mol. weight
1	80	25000
2	15	70000
3	5	150000

Calculate the polydispersity index of the polymer sample.

    (c) Considering stoichiometric equivalence of $-COOH$ and $-OH$ groups calculate the average functionality of a polyesterification reaction involving phthalic acid and glycerol.

    (d) Write down the structure of the repeat unit of natural rubber. $3 + 4 + 2 + 1$

3. (a) Distinguish between addition polymerisation and condensation polymerisation.

    (b) Discuss the free radical polymerisation mechanism of a vinyl monomer $CH_2 = \underset{\underset{X}{|}}{CH}$ with a free radical initiator I.

    (c) Define kinetic chain length and write down its relation with number average degree of polymerisation. $4 + 4 + 2$

4. (a) Derive the copolymer composition equation for chain copolymerisation of two monomers M_1 and M_2.

    (b) Explain the significance of monomer reactivity ratios r_1 and r_2 in determining the structures of copolymers. $7 + 3$

5. (a) Derive an expression showing the quantitative effect of stoichiometric imbalance on maximum attainable molecular weight in the condensation polymerisation of two bifunctional monomers of the A — A and B — B types.

   (b) For the free radical polymerisation of a vinyl monomer involving chain transfer reactions in addition to normal bimolecular termination reactions establish The Mayo equation. 5 + 5

6. Make a comparative study of the bulk, solution, suspension and emulsion polymerisation processes. 10

7. (a) Discuss how the number average molecular weight $\overline{M}_n$ of a polymer sample can be determined by measuring the osmotic pressure of its dilute solution.

   (b) Indicate how the extent of polymer crystallinity is affected by chemical structure. 6 + 4

8. Write short notes on any *four* of the following : $2\frac{1}{2} \times 4$

   (i) Glass transition temperature, Tg

   (ii) Kinetics of acid catalysed esterification reaction

(*Continued*)

(*iii*) Azeotropic copolymerisation

(*iv*) Living polymer

(*v*) Inhibition and retardation.

(*vi*) Carothers equation.

(*Environmental*)

(*Inorganic Special*)

Answer any **four** questions

1. (*a*) CFC plays an effective role in removing O_3 in the stratosphere. Explain.

(*b*) Comment on possible substitutes of CFC.

(*c*) What are the important chemical species in each region of the atmosphere ?

(*d*) Trace the origin of organic particulate matter in the atmosphere. $3 + 2 + 2 + 3$

2. (*a*) Discuss the role of carbon monoxide as air pollutant on the basis of its control techniques.

(*b*) What is the main source of CO pollution ?

(*Turn Over*)

(c) Explain acid-base and ion-exchange reactions in soil.

(d) Name the two secondary pollutants. $3 + 2 + 4 + 1$

3. (a) Explain the biochemical effects of lead with particular reference to its sources, species and pathways in the environment and impact on humans.

(b) Lead poisoning can be cured by treatment with chelating agents. Explain.

(c) Explain the mechanism of smog formation reactions. Distinguish between oxidising and reducing smogs. $4 + 2 + 4$

4. (a) Explain biological methylation and illustrate propagation of mercury in food chain.

(b) Write the structure of DDT.

(c) Show schematically the working principle of catalytic converter. $(3 + 3) + 1 + 3$

5. (a) Give some examples of microbially-mediated redox reaction in natural water.

(*Continued*)

(b) Explain in brief, the overall hydrological cycle.

(c) Describe dissolved oxygen and biochemical oxygen demand. $4 + 4 + (1 + 1)$

6. (a) Explain the roles of natural ligands in natural water.

(b) How does the earth manage its radiation balance so as to maintain an average temperature of 15 °C ?

(c) Give an account of oxygen cycle in the environment. $2 + 4 + 4$

7. (a) Define the solid waste.

(b) Discuss the classification of solid waste.

(c) Write the advantages and disadvantages of the sanitary landfill.

(d) What are the controlling factors for effective incineration ? $1 + 3 + 3 + 3$

8. (a) Define BOD.

(b) Discuss the oxygen seg curve.

(c) Write the problems associated with the discharge of the following in the waste water :

   (i) Synthetic organic compounds like pesticides, detergents etc.

   (ii) Plant nutrients.

   (iii) Thermal discharge.   1 + 3 + 6

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