

M.Sc 3rd Semester Examination 2010

CHEMISTRY

PAPER—2104

Full Marks : 40

Time : 2 hours

The figures in the right-hand margin indicate marks

(Organic Special / Physical Special)

Answer any **four** questions

1. (a) In what respects do polymer molecules differ from simple molecules ?

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

(i) Thermal response

(ii) Origin.

(c) What do you mean by glass transition temperature of a polymer ? 4 + (2 + 2) + 2

2. (a) Write down the structures of the repeat unit of the following polymers :
- (i) Polymethyl methacrylate
- (ii) Polyethylene terephthalate.
- (b) Write down the expressions for number average molecular weight (\bar{M}_n) and weight average molecular weight (\bar{M}_w) and hence define polydispersity index.
- (c) Establish the rate expression for the free radical polymerisation of a vinyl monomer assuming normal bimolecular termination and no chain transfer reaction. $(1 + 1) + (1 + 1 + 1) + 5$
3. (a) Derive Carothers' equation relating extent of reaction (p) with average functionality (f) and number average degree of polymerisation (\bar{X}_n) for a condensation polymerisation process.
- (b) Calculate the number average degree of polymerisation of an equimolar mixture of adipic acid and hexamethylene diamine for extents of reaction 0.50, 0.80 and 0.90.
- (c) Calculate the extent of reaction at which gelation occurs for the polymerisation of phthalic anhydride and glycerol in the molar ratio 3 : 1.95.

4 + 3 + 3

4. (a) For free radical Copolymerisation of two monomers M_1 and M_2 derive the copolymer composition equation.
- (b) What will be the values of the product of two monomer reactivity ratios r_1 and r_2 for the following copolymerisation processes—
- (i) ideal copolymerisation
 - (ii) Alternate copolymerisation. 8 + (1 + 1)
5. (a) Define the terms kinetic chain length (ν) and number average degree of polymerisation, \bar{X}_n .
- (b) Write down the relationship between \bar{X}_n and ν for the following cases :
- (i) Termination taking place exclusively by coupling.
 - (ii) Termination taking place exclusively by disproportionation.
 - (iii) Fraction of propagating chains undergoing termination by coupling being 'a' and the average number of initiator fragments present per polymer molecule being b.

(c) Explain the role of solvent in controlling the molecular weight of polymer in free radical polymerisation process. (1 + 1) + (1 + 1 + 3) + 3

6. (a) A polymer sample consists of the following fractions :

Fraction	No. of molecules	Mol. weight
1	70	20,000
2	20	30,000
3	15	50,000
4	5	1,00,000

Calculate \bar{M}_n and \bar{M}_w of the polymer sample from the above data.

(b) Discuss the procedure for the determination of viscosity average molecular weight (\bar{M}_v) of a polymer sample. 4 + 6

7. Write short notes on any *two* of the following : 5 × 2

(i) Anionic polymerisation

(ii) Inhibition and retardation

(iii) Mayo equation

(iv) Tacticity

(v) Kinetics of self catalysed polyesterification reaction.

8. (a) Schematically show stress-strain behaviour of the following :

plastics, elastomers, rigid plastics.

(b) For a monomer of general structure $\text{CH}_2 = \text{CHX}$, complete the following table. Put '+' if the monomer can be polymerized by the method mentioned at the top of the column, and '-' if polymerization by the method is not feasible. Briefly justify your answer.

X	Free radical	Anionic	Cationic
- Ph			
- OCH ₃			
- COOCH ₃			
- CN			

- (c) Complete the table with respect to the MW obtained by the following techniques of measurement

Technique	Absolute or Relative	M_w or M_n or M_v or M_z
Viscosity		
Light scattering		
Osmotic pressure		
End group of NMR		

2 + 4 + 4

[Inorganic Special]

(Environmental Science)

Answer any four questions

- (a) Define dust, smoke, fume, mist, fog and aerosol. 3

(b) Discuss air pollution effects in short. 4

(c) Write the industrial sources of SO_2 , CO , H_2S , HF , NO_x and particulate matter. 3

2. Write the control mechanism of nitrogen oxides from industrial sources. 10
3. (a) Define the following terms : 1 + 1
- (i) Receptor of a pollutant
 - (ii) Pathways of a pollutant
- (b) What are freous ? 2
- (c) How Ozone is formed and removed from atmosphere ? 3
- (d) What are micro and macro nutrients in soil for plants ? 3
4. (a) What is albedo ? What is the average surface temperature of earth ? 1 + 1
- (b) How inorganic particulates are formed in atmosphere ? 3
- (c) What are green house gases ? Discuss their contribution to global warming. 2 + 3
5. (a) Mention the possible buffer actions which help to maintain the pH of ocean water constant. 3

- (b) Write the role of micro organism in natural processes that occur in water. 4
- (c) Write short notes on phosphorus and sulphur in aquatic environment. 3
6. (a) Discuss the structure of atmosphere in brief with temperature profile. 3
- (b) Illustrate how PAN is formed in a smog-producing chain reaction. 3
- (c) What is El Nino phenomenon? 4
7. (a) Enumerate the biochemical effects of Arsenic with particular reference to its sources, species and pathways in the environment and impact on humans. 4
- (b) Characterise the toxic effects of CO in the body. Is this effect reversible or irreversible? 4 + 2
8. (a) Discuss the role of NO_x as primary air-pollutant on the basis of concentration profile and control techniques. 3 + 3
- (b) Write a short note on acid rain. 4