2009

M.Sc. Part–II Examination

CHEMISTRY

PAPER—VIII

Full Marks : 75

Time : 3 Hours

The figures in the right-hand margin indicate full marks.

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

Illustrate the answers wherever necessary.

(Polymer Chemistry)

Answer any *five* questions
taking at least *two* from each group.

Group—A

1. (a) Classify polymers on the basis of application and physical properties.   3

   (b) Derive glass transition temperature, Tg of polymers. Why is it also called second order transition temperature ?   3

   (c) Calculate the average functionality and the extent of reaction at which gelation occurs for the condensation polymerisation of a mixture of phthalic anhydride and glycerol in the molar ratio 1·50 : 0·98 .   3

   (d) Draw a molecular weight distribution curve for a sample of polystyrene composed of a series of fractions of different-sized molecules as follows :

Fraction	Weight fraction	Molecular weight	
(i)	0.15	20,000	
(ii)	0.10	30,000	
(iii)	0.10	50,000	
(iv)	0.40	80,000	
(v)	0.10	1,00,000	
(vi)	0.10	1,20,000	
(vii)	0.05	1,50,000	3

(e) Name the monomers and write down the structures of repeat units of the following polymers :   3
   (i) Nylon 6 ;
   (ii) Polymethyl methacrylate ;
   (iii) Butyl rubber.

2. (a) Establish the copolymer composition equation for binary copolymerisation of vinyl monomers by free radical mechanism.   8

   (b) Explain the significance of monomer reactivity ratios in binary copolymerisation.   3

   (c) Write a short note on ideal copolymerisation.   4

3. (a) Derive a rate expression for the acid catalysed polyesterification reaction.   5

   (b) For free radical vinyl polymerisation establish the Mayo equation relating no. average degree of polymerisation, $\bar{X}_n$ with rate of polymerisation, R_p, different rate constants and chain transfer constants.

       6

   (c) Write a short note on inhibition and retardation.

       4

      (Continued)

(a) Give example of the following (any *five*) :   5×1

    (i) A polymer with self-extinguishing property ;

    (ii) A polymer 100% degradable in environment ;

    (iii) A natural fibre forming polymer ;

    (iv) A transparent polymer ;

    (v) A highly crystalline polymer ;

    (vi) A highly brittle polymer.

(b) State whether the following statements are true or false :   5×1

    (i) Fibres have lowest molecular weight range among fibre, plastic and rubber.

    (ii) 'Tg' of a polymer is that particualr temperature at which segmental mobility starts.

    (iii) Concept of absolute molecular weight is more important than the average molecular weight in case of polymeric materials.

    (iv) Monomers with average functionality '2' does not practically ensure formation of absolutely linear polymer.

    (v) Addition polymerisation gives higher molecular weight polymers than condensation polymerisation.

(c) Derive overall rate expression for a free radical initiated polymerisation assuming no transfer reaction.   5

4. (a) Explain the terms no. average molecular weight weight average molecular weight and polydispersity index of polymers.   3

   (b) Describe the method for the determiantion of viscosity average molecular weight, $\overline{M}_V$, of a polymer.   7

(c) What do you mean by tacticity of polymers? Explain the variation in physical properties of polymers with tacticity.   2+3

5. (i) Explain 'Auto acceleration effect' with the help of kinetic parameters.   5

   (ii) State the reason behind deviation from the normal kineic feature at the initial stages of a poly-condensation reaction.   3

   (iii) Ionic polymerization always shows unimolecular termination while free-radical polymerisation shows bimolecular termination — Why?   4

   (iv) State at least three advantages of emulsion polymerization technique over bulk polymerization technique.   3

Group—B

6. (a) Write down the average composition of natural rubber latex. How is latex preserved?   2+1

   (b) Describe the process for the manufacture of pale crepe from natural rubber latex.   6

   (c) Explain the roles of vulcanising agents and accelerators in the compounding of rubber.   3+3

7. (a) Describe the suspension polymerisation process for the manufacture of polyvinyl chloride.   6

   (b) What do you mean by phenolic resins? Describe the manufacturing process of resol mentioning thereby the reactions involved. How resol is converted to resite?   1+4+2

   (c) What do you mean by environmental stress cracking?   2

8. (i) Write full form of the following abbreviations :
LDPE, HDPE, LLDPE, UHMPE, VLDPE, MDPE.   6

  (ii) Compare the synthetic routes of LDPE and HDPE.   6

  (iii) Mention important features of PP and PVC.   3

9. (i) Polypropylene and polyethylene both are crystalline plasics whereas their copolymer is a rubber. —Explain.   4

  (ii) Differentiate between EPR and EDPM.   4

  (iii) State different 'dienes' alongwith their chemical structures commercially used for EPDM synthesis.   3

  (iv) State how following properties change on increasing acrylonitrile content in NBR :
Solvent swelling resistance, Tensile modulus, Low temperature flexibility, Glass transition temperature.   4

10. Justify the following statements (any *five*) :   5×3

  (i) Rubber is a 'different state' rather than a 'different material' from plastics / fibres.

  (ii) Generally, rubbers have Tg much below room temperature.

  (iii) A rubber does not behave like a rubber unless it is crosslinked.

  (iv) Rubbers show considerable deformation under small stress.

  (v) Different compounding ingredients are added to rubber for lifting their physico-chemical properties.

  (vi) Thermoplastic elastomers combine the properties of both plastics (rigid) and rubbers.

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C/09/M.Sc.-Part-II/Chem./8   *(Turn Over)*

(Inorganic Chemistry)

Answer any *five* questions
taking at least *two* from each group.

Group—A

1. (a) Define dust, smoke, fumes and fogs.

   (b) Discuss the selection criteria of air pollution control equipment.

   (c) Discuss the effects of air pollution in short.

   6+4+5

2. (a) Write the difference between pollutant and contaminant. Give an account of the effects of microorganisms on the chemistry of water.

   (b) What is EI Nino phenomenon ?

   (c) Write short note on oxygen cycle. (2+5)+5+3

3. (a) Discuss the biochemical effects (toxicology) of As and Pb.

   (b) Define the following terms :

   (i) Receptor of a pollutant.

   (ii) Source and sink of a pollutant.

   (iii) Speciation. (6×2)(3×1)

4. (a) Describe the operating principle of a Cyclone separator.

   (b) Discuss the collection system in Cyclone.

   (c) Write the principle of Venturi scrubber. 5+5+5

(Continued)

5. (a) Write notes on :

    (i) Green house effect—Global Warming.

    (ii) Chemistry of ozone in atmosphere.

  (b) Define the terms DO, and C.O.D. What is the normal level of DO in pure water ?   (6+5)+(3+1)

Group—B

6. (a) Why the drainage water from a coal mine is acidic in nature ?

  (b) Why is the pH of sea water is constant at 8.1 ± 0.2 ?

  (c) Illustrate the water cycle.

  (d) Discuss the factors affect the ground water pollution ?

  (e) Write the problems associated with large oil spillage from oil tanker accident in sea.   3+3+3+3+3

7. (a) Define BOD.

  (b) Discuss oxygen sag curve.

  (c) Write the industrial sources and its effects of the chromium, cadmium and mercury present in the waste water.

  (d) Write the problem associated with the presence of synthetic organic compound in waste water streams.

    2+4+6+3

8. (a) What are the purpose of the following processes used in waste water treatment :

(i) pretreatment,

(ii) Sedimentation,

(iii) Flotation.

(b) Draw the flow diagram of a conventional sewage treatment process.

(c) Describe the activated sludge process.   6+4+5

9. (a) Describe sanitary landfil method.

(b) (i) How inorganic particulate matter can be formed chemically ?

(ii) What are the origin of organic particulate matter in the atmosphere ?

(iii) What are the effects of particulate on climate ?
3+(4+4+4)

10. (a) How would you broadly divide the major regions of the atmosphere ? State the respective altitudes and temperature ranges. What are the important chemical species in each region ?

(b) Explain the role of humic substances in aquatic environment. Suggest the structure of humic acid and what are the degradation products.

(3+4+3)+(2+2+1)

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