

**INDIAN RUBBER INSTITUTE  
DIRI EXAMINATION – 2011**

Paper – I

Date : 29<sup>th</sup> June, 2011

Duration : 3 Hours

Time : 10.00 – 13.00 hrs.

Full Marks : 100

Polymer Science

Answers should be illustrated with sketches wherever helpful  
Total **FIVE** questions are to be answered. From “**Group-A**” answer **FOUR** questions out of which **Question No. 1** is compulsory and From “**Group-B**” answer **ONE** question only.

**GROUP – A**

I. Multiple choice questions: Select the correct answer from the given alternatives:

- (i) EPDM is a  
(a) Homopolymer                      (b) Copolymer  
(c) Terpolymer                        (d) Fibre
  
- (ii) Light scattering is used to determine  
(a) Viscosity average molecular weight      (b) Weight average molecular weight  
(c) Number average molecular weight        (d) Z-average molecular weight
  
- (iii) Number of branches is minimum in  
(a) LDPE                                (b) LLDPE  
(c) HDPE                                (d) VLDPE
  
- (iv) Example of self-reinforcing rubber is  
(a) NR                      (b) BR                      (c) SBR                      (d) EPDM
  
- (v) Ring opening polymerization is related to  
(a) Isoprene                              (b) Caprolactam  
(c) Butadiene                              (d) Styrene
  
- (vi) Dicumyl peroxide is an example of  
(a) Plasticizer                              (b) Crosslinking agent  
(c) Initiator                                (d) Peptizer
  
- (vii) Example of a good weather resistant polymer is  
a) NR                      (b) BR                      (c) SBR                      (d) EPDM
  
- (viii) T<sub>g</sub> of a copolymer can be determined using  
(a) Bragg Equation                        (b) Fox Equation  
(c) Hildebrand Equation                      (d) Carothers' Equation

- (ix) SBS is a  
 (a) Linear polymer (b) Alternating copolymer  
 (c) Random copolymer (d) Block copolymer
- (x) Which one is a natural polymer  
 (a) Silk (b) Rayon  
 (c) Polyester (d) Nylon
- (xi) Nylon is a  
 (a) Polyester (b) Polyamide  
 (c) Polyolefin (d) None of the above
- (xii) Functionality of Glycerol is  
 (a) One (b) Two  
 (c) Three (d) Four
- (xiii) Resorcinol- formaldehyde resin is an example of  
 (a) Natural polymer (b) Semi-synthetic polymer  
 (c) Thermoplastic polymer (d) Thermosetting polymer
- (xiv) Aluminum chloride is used as a catalyst for  
 (a) Free radical polymerization (b) Cationic polymerization  
 (c) Anionic polymerization (d) Stereospecific polymerization
- (xv) Cationic polymerization is generally used for making  
 (a) SBR (b) PCP  
 (c) Nitrile rubber (d) Butyl rubber
- (xvi) Glass transition temperature of NR is  
 (a)  $30^{\circ}\text{C}$  (b)  $0^{\circ}\text{C}$   
 (c)  $-30^{\circ}\text{C}$  (d)  $-74^{\circ}\text{C}$
- (xvii) The rubber modulus is  
 (a) Same as Young's modulus (b) Stress at specified elongation  
 (c) Ratio of stress by strain (d) None of the above.
- (xviii) The total area under stress strain curve is called  
 (a) Impact strength (b) Toughness  
 (c) Resilience (d) Hysteresis
- (xix) Chain flexibility of polymers depends on  
 (a) Segmental Motion (b) Molecular motion  
 (c) Brownian motion (d) None of the above
- (xx) Processing properties of polymer will be better if  
 (a) Molecular weight distribution is higher (b) Molecular weight distribution is narrower  
 (c) Higher molecular weight (d) Glass transition temperature is higher.

(1 x 20) = 20

- 2.
- Define the terms: (i) monomer (ii) functionality and (iii) polymerization
  - Explain the basic difference with examples between addition and condensation polymers.
  - How do you classify polymer based on thermal response? Give examples.
  - Explain with examples the difference between linear polymer, branched polymer and crosslinked polymer.
  - Explain the term 'polydispersity'. What is its significance?
- (3+4+3+5+5) = 20
3. Distinguish between the following (with suitable examples):
- Homopolymer and Copolymer
  - Thermoplastics and Thermosets
  - Random and Alternating Copolymers
  - Block and Graft Copolymers
  - Isotactic and Syndiotactic Polymer
  - Gelation and Gel effect
  - Elasticity and Viscoelasticity
  - Inhibition and Retardation
- (8 x 2.5) = 20
4. Name the polymers used in each case with the structure of the corresponding monomer and polymer.
- A rubber which exhibits very good low temperature flexibility.
  - A rubber which exhibits excellent weather resistant property.
  - A heat and oil resistant rubber.
  - A rubber used in tyre tread compound.
  - A rubber used for making adhesive.
- (1+3) x 5 = 20
- 5.
- Write down a typical recipe for hot SBR by emulsion polymerization method and discuss the role of different ingredients used.
  - Why this particular technique is often used for making rubbers?
  - Explain why this polymerization is stopped much before 100% conversion.
- (12 + 4 + 4) = 20
6. Write short notes on **any four** of the following
- Solubility parameter
  - Stereoregular polymerization
  - Glass transition temperature and its significance
  - Cationic polymerization
  - Factors affecting crystallization of polymer
  - Ring opening polymerization
- (4 x 5) = 20

**GROUP - B**

- 7.
- (i) Illustrate the following with example: Viscosity; Elasticity; Plasticity & Viscoelasticity.
  - (ii) How rubber can be distinguished from plastics, fibre and metal in terms of mechanical behavior.
  - (iii) Illustrate the factors affecting the flow behavior for the material having viscous flow.  
(2 x 4) + 6 + 6 = 20
8. Explain the following terms as applied to rubbers
- (a) Hysteresis loss
  - (b) Creep and Relaxation
  - (c) Shape factor
  - (d) Die swell
  - (e) Fatigue behaviour

(5 x 4) = 20

