INDIAN RUBBER INSTITUTE
PGD-IRI EXAMINATION – 2017

Paper - I

Date : 19.08.2017   Time : 10.00-13.00 hrs.

Duration : 3 Hours   Full Marks : 100

POLYMER SCIENCE

Answers should be illustrated with sketches wherever helpful

Question number 1 is compulsory. Answer **FOUR** from the remaining questions taking **TWO** from each group

GROUP – A

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

(i) Shellac is a

a) Natural resin   b) Synthetic resin   c) Regenerated resin   d) Rubber

(ii) When the T_g of the polymer is well below room temperature, it is a

a) Plastic   b) Rubber   c) Fibre   d) Dendrimer

(iii) Polyethylene terephthalate is a

a) Polyamide   b) Polyimide   c) Polyether   d) Polyester

(iv) EVA is a

a) Homopolymer   b) Copolymer   c) Terpolymer   d) non polymeric material

(v) The weight average molecular weight is determined by

a) Spectroscopy   b) Osmometry   c) Viscometry   d) Light scattering

(vi) For a Hookean region stress is directly proportional to

a) Viscosity   b) Strain rate   c) Strain   d) Modulus

(vii) Aramids are high performance

a) Polyesters   b) Polyethers   c) Polyimides   d) Polyamides

(viii) NBR is a

a) Random copolymer   b) Alternate copolymer

c) Block copolymer   d) none of the above

(ix) Polypropylene is known as

a) Glassy polymer   b) Amorphous polymer   c) Crystalline polymer   d) Ionomer

(x) Glass transition temperature of polystyrene is

a) $-100\,^{\circ}C$ b) $-70\,^{\circ}C$ c) $+100\,^{\circ}C$ d) $+150\,^{\circ}C$ *[TURN OVER]*

(xi) Glass transition temperature of a polymer is determined by
a) Infrared spectrophotometer   b) Differential scanning calorimeter
c) Mass spectrometer   d) Scanning electron microscopy

(xii) Polymer produced from anionic polymerization is called
a) Dead polymer   b) Living polymer   c) Ladder polymer   d) none of these

(xiii) Atactic polymers are
a) Crystalline   b) Semi-crystalline   c) Amorphous   d) None of these

(xiv) Copolymer of styrene and butadiene, which is used in tire is
a) SBS   b) SBR   c) SEBS   d) XSBR

(xv) IIR is commercially prepared by
a) Radical polymerization   b) Ziegler – Natta polymerization
c) Cationic polymerization   d) Anionic polymerization

(xvi) Crystallinity of a polymer is quantitatively determined by
a) XRD   b) TGA   c) DETA   d) DMA

(xvii) If PE has a molecular weight (M_n) of 2,80,000 what is its degree of polymerization?
a) 100   b) 1000   c) 10000   d) None of the these

(xviii) Name of a plasticizer for PVC is
a) DRC   b) DCP   c) DPG   d) DBP

(xix) Gutta Percha is
a) Cis 1,4 polyisoprene   b) Trans 1,4 polyisoprene
c) Vulcanised polyisoprene   d) Ebonite

(xx) A rubber having good biocompatibility is
a) NR   b) SBR   c) NBR   d) PDMS

$(1 \times 20) = 20$

2.(a) Write down the different steps of free radical polymerization by taking styrene as monomer and by using AIBN as initiator.

(b) How can you prepare Nylon 6 and Nylon 66?

(c) Explain the term 'back biting mechanism'.

(d) What is Ziegler – Natta Catalyst?

$(8+6+4+2) = 20$

3.(a) Write down the catalyst or initiator generally used to polymerize the following monomers and write down the structures of the resultant polymer and copolymer.

i) Acrylonitrile and Butadiene

ii) Isobutylene and Is

iii) Phenol and Formaldehyde

iv) Ethylene, propylene and 1,4 hexadiene.

v) Terephthalic acid and Ethylene glycol.

$5 \times 2 = 10$

(b) Give the name of the method of preparation of the following polymers mentioning the corresponding monomers used.

i) SBR   ii) PU   iii) S-B-S   iv) BR   v) FKM

$5 \times 2 = 10$

4.(a) Explain the difference between suspension and emulsion polymerization.

(b) Explain the difference between cationic and anionic polymerization.

(c) Explain the difference between an initiator and an inhibitor.

$(10+6+4) = 20$

GROUP – B

5. Discuss the differences between

(a) Newtonian fluid and Non-Newtonian fluid.

(b) Maxwell model and Voigt model.

(c) Stress relaxation and Creep.

(d) Pseudoplastic and dilatant material.

(e) Elasticity and viscosity.

$(5 \times 4) = 20$

6.(a) Give a comparative account of the stress – strain plots for:

(i) A ductile plastic.

(ii) A typical rigid / brittle plastic.

(iii) A typical fibre.

(iv) A rubber having strain induced crystallization.

(b) What is 'hysteresis'? Explain its importance.

(c) Explain the term 'shape factor'. What is its importance?

(d) Define the term 'transmissibility'.

$(8+5+5+2) = 20$

7. Name the synthetic rubbers used in each case with the structure of the corresponding monomer and polymer is each case.

(a) A rubber which exhibits very good low temperature flexibility.

(b) A rubber which exhibits excellent weather resistant property.

(c) A heat and oil resistant rubber.

(d) A rubber used is Tyre tread compound.

(e) A rubber used for making adhesive.

$(1+3) \times 5 = 20$

8. Write short notes on **Any Four** of the following

(a) Z-average molecular weight

(b) Polydispersity index

(c) Dilatometer

(d) Strain induced crystallization

(e) Solubility parameter

(f) Spherulite

$(4 \times 5) = 20$