F : POLYMER SCIENCE AND ENGINEEIRING

Q. 1 – Q. 9 carry one mark each.

Q.1 The biodegradable polymer among the following polymers is

(A) poly(lactic acid)
(B) poly(butylene terephthalate)
(C) polystyrene
(D) polypropylene

Q.2 Notched impact strength of a plastic decreases with

(A) increase in notch tip radius
(B) increase in notch depth
(C) increase in temperature
(D) decrease in notch depth

Q.3 The compound used as a reactive diluent in unsaturated polyester resins is

(A) benzene
(B) cresol
(C) styrene
(D) adipic acid

Q.4 The diameter of a die of an extruder producing extrudate of diameter 2.4 mm with a die-swell ratio of 2 is _____mm.

Q.5 The degree of polymerization of Nylon 6 (ignore end-groups) with molar mass of 1,00,000 g mol^{-1} is _____.

Q.6 The polymer synthesized by ring opening polymerization is

(A) poly(acrylic acid)
(B) Nylon 6
(C) poly(ethylene terephthalate)
(D) Nylon 66

Q.7 Which among the following are used as initiators for free radical polymerization?

P. K_2SO_4 Q. $K_2S_2O_8$ R. AIBN S. *t*-Butyl hydroperoxide + Fe^{2+}

(A) P, Q & R only
(B) Q, R & S only
(C) P, R & S only
(D) P, Q, R & S

Q.8 Weight average molecular weight can be determined by

(A) Osmometry
(B) Ebulliometry
(C) End group analysis
(D) Light scattering

Q.9 Butyl rubber is a copolymer of

(A) Isobutylene and butadiene
(B) Butadiene and 1-butene
(C) Isobutylene and isoprene
(D) Isoprene and 1-butene

Q. 10 – Q. 22 carry two marks each.

Q.10 Match the characterization technique with the polymer property it is used to determine

Technique	Property
P. X-ray diffraction	1. Melting temperature
Q. Differential scanning calorimetry	2. Crystallinity & crystal size
R. Thermogravimetric analysis	3. Glass transition temperature
S. Dynamic mechanical analysis	4. Ash content

(A) P-3; Q-1; R-4; S-2
(B) P-3; Q-4; R-2; S-1
(C) P-2; Q-4; R-1; S-3
(D) P-2; Q-1; R-4; S-3

Q.11 Match the following plastic additives with their function

Additive	Function
P. Di-isooctyl phthalate	1. Antioxidant
Q. 4-Methyl-2,6-*t*-butylphenol	2. Plasticizer
R. Dicumyl peroxide	3. Antistatic agent
S. Quaternary ammonium compound	4. Cross-linking agent

(A) P-2; Q-4; R-1; S-3
(B) P-4; Q-1; R-3; S-2
(C) P-2; Q-1; R-4; S-3
(D) P-3; Q-1; R-4; S-2

Q.12 The correct statement with respect to electrical property of polymeric materials is

(A) For non-polar materials, dielectric constant is independent of frequency & temperature
(B) For polar materials, dielectric constant depends on frequency but not on temperature
(C) For non polar materials, power losses are high and depend on temperature & frequency
(D) For polar materials, power losses are low and independent of frequency

Q.13 The order of melting point for the given polymers is

(A) Nylon 66 > PTFE > Nylon 6 > PP
(B) Nylon 66 > Nylon 6 > PTFE > PP
(C) PTFE > Nylon 66 > Nylon 6 > PP
(D) PTFE > Nylon 6 > Nylon 66 > PP

Q.14 Match the processing technique used to manufacture the appropriate product

Processing Technique	Product
P. Calendering	1. Pipes
Q. Extrusion	2. Disposable cups
R. Injection Molding	3. Sheets
S. Thermoforming	4. Nylon gears

(A) P-3; Q-2; R-1; S-4
(B) P-3; Q-1; R-2; S-4
(C) P-3; Q-1; R-4; S-2
(D) P-3; Q-2; R-4; S-1

Q.15 Match the thermosetting resins to the raw materials they are synthesized from

Resin	Raw material
P. Epoxy	1. Cresol + furfural
Q. Phenolic	2. Diethylene glycol + diallyl phthalate
R. Unsaturated polyester	3. Bisphenol A + epichlorohydrin
S. Allyl	4. Maleic acid + 1,2-propylene glycol

(A) P-4; Q-2; R-3; S-1
(B) P-3; Q-1; R-2; S-4
(C) P-3; Q-2; R-1; S-4
(D) P-3; Q-1; R-4; S-2

Q.16 The damping factor of a solid polymer under sinusoidal loading in single cantilever mode showing 80 percent recovery in modulus is _____.

Q.17 A styrene-butadiene random copolymer with equal weight fraction of polystyrene (T_g = 100 °C) and polybutadiene (T_g = −100 °C) shows a single glass transition peak. The T_g of the copolymer is _____ °C.

Q.18 In a unidirectional carbon fibre reinforced epoxy composite, the ratio of fibre-to-matrix moduli is 30 and the fibres take up 50% of the cross-section. The percentage of applied force taken up by the fibres is _____.

Q.19 The viscoelastic behavior of a plastic is represented by spring and dashpot elements having constants of 2 GN m^{-2} and 90 GN s m^{-2}, respectively. If a constant stress of 12 MN m^{-2} is applied, the strain predicted by Maxwell model after 50 s is _____ %.

Q.20 Match the elastomers given below to their suitable application

Elastomer	Application
P. EPDM	1. Golf balls
Q. Polyurethane	2. Fuel transfer hose
R. Nitrile rubber	3. Cable insulation
S. Polybutadiene	4. Footwear

(A) P-3; Q-4; R-2,; S-1
(B) P-4; Q-3; R-2; S-1
(C) P-3; Q-2; R-4; S-1
(D) P-1; Q-4; R-2; S-3

Q.21 Match the following reagents to their function in natural rubber latex technology

Reagent	Function
P. Ammonia	1. Prevent storage hardening
Q. Hydroxylamine	2. Delay plugging mechanism
R. Formic acid	3. Stabilizer
S. Ethephone	4. Coagulating agent

(A) P-3; Q-1; R-2; S-4
(B) P-3; Q-2; R-4; S-1
(C) P-3; Q-1; R-4; S-2
(D) P-3; Q-4; R-1; S-2

Q.22 1.0 g of a polybutadiene sample with carboxylic acid groups at both the ends requires 2.5 mL of 0.1 M KOH for complete neutralization. The molecular weight of the polymer in g mol^{-1} is _____.

END OF THE QUESTION PAPER