XE (F): Q. 1 – Q. 9 carry one mark each & Q. 10 – Q. 22 carry two marks each.

Q.1 Which one of the following polymers occurs naturally?

(A) Bakelite (B) Teflon (C) Cellulose (D) Perspex

Q.2 The order of average molecular weights of a polymer is

(A) $M_z > M_w > M_v > M_n$
(B) $M_w > M_z > M_n > M_v$
(C) $M_n > M_w > M_v > M_z$
(D) $M_z > M_v > M_n > M_w$

Q.3 Rubbers are a class of polymer known for

(A) High intermolecular forces
(B) High T_g polymers
(C) Crystalline polymers
(D) Low intermolecular forces

Q.4 Nylon 6 is manufactured from

(A) Sebacic acid and hexamethylene diamine
(B) Caprolactam
(C) Adipic acid and hexamethylene diamine
(D) Caprolactone

Q.5 Storage modulus and tan δ of a polymer are experimentally measured by

(A) Differential scanning calorimetry
(B) Thermogravimetric analysis
(C) Thermomechanical analysis
(D) Dynamic mechanical thermal analysis

Q.6 A plastic bucket is manufactured by

(A) Compression moulding
(B) Injection moulding
(C) Extrusion
(D) Blow moulding

Q.7 The monomers, A and B with reactivity ratios r_A and r_B, form alternate copolymers when,

(A) $r_A = r_B = 0$ (B) $r_A = r_B = 1$ (C) $r_A > 1,\ r_B > 1$ (D) $r_A < 1,\ r_B < 1$

Q.8 The degree of polymerization of a poly(methyl methacrylate) sample having number average molecular weight of 1,50,000 g/mol is_____.
(C = 12, H = 1, O = 16 g/mol).

Q.9 If the heat of fusion of 100 % crystalline polyethylene is 290 mJ/mg, a sample of polyethylene with heat of fusion of 141 mJ/mg will have_____ % crystallinity.

Q.10 Match the following:

P. Butyl rubber	1. Metallocene polymerization
Q. Cold SBR	2. Cationic polymerization
R. Poly(ethylene terephthalate)	3. Redox polymerization
S. Polypropylene	4. Condensation polymerization

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

Q.11 Match the following:

P. Polyaramid	1. Baby-feeding nipple
Q. Polytetrafluoroethylene	2. Optical glasses
R. Polycarbonate	3. Non-stick cookware
S. Poly(dimethyl siloxane)	4. Bullet-proof jacket

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

Q.12 Flexible PVC tubes are used for watering. If some organic solvents are passed through this tube, it becomes stiff. This is due to the fact that the organic solvents

(A) plasticize PVC and raise T_g.
(B) remove plasticizer and raise T_g.
(C) remove plasticizer and lower T_g.
(D) react with PVC and increase T_g

Q.13 Match the following:

P. Plastic egg container	1. Injection moulding
Q. Water tank	2. Extrusion
R. Chair	3. Rotational moulding
S. Cable	4. Thermoforming

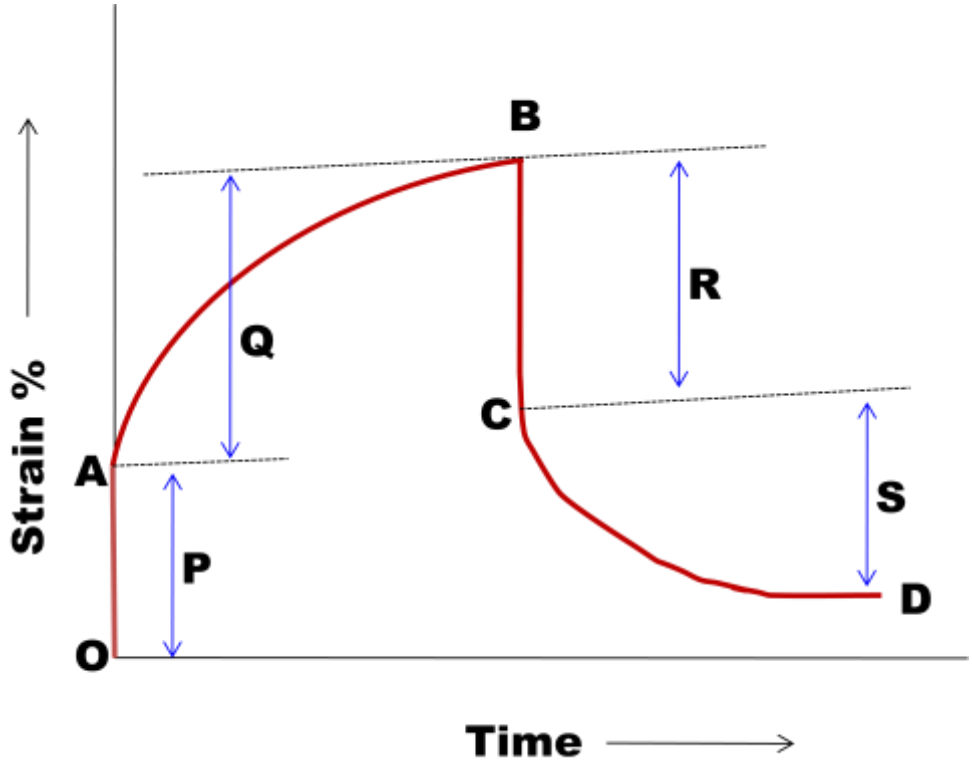
(A) P-3; Q-1; R-4; S-2
(B) P-4; Q-3; R-2; S-1
(C) P-2; Q-3; R-4; S-1
(D) P-4; Q-3; R-1; S-2

Q.14 Match the following:

P. Flame retardant	1. 4-Methyl-2,6-di-t-butyl phenol
Q. UV absorber	2. Azocarbonamide
R. Blowing agent	3. Phenyl salisylate
S. Antioxidant	4. Aluminium trihydrate

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

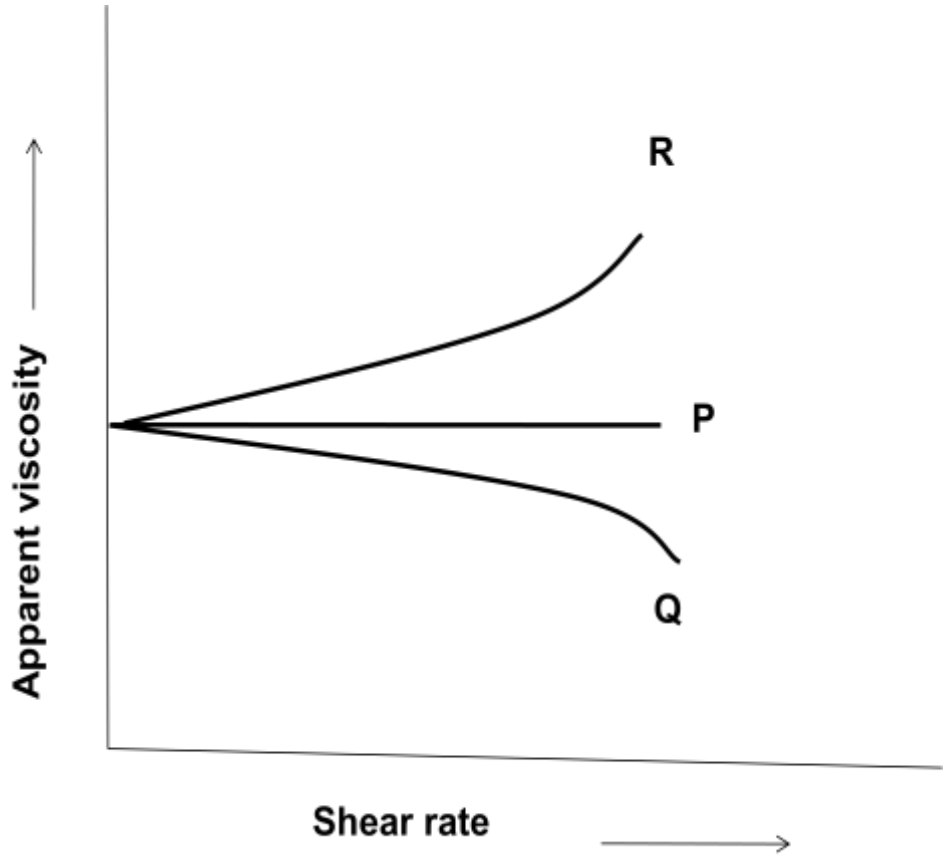
Q.15 A plot of strain (%) versus time of a polymer is given below. Based on this plot and the properties as mentioned below, find out the correct combination.



1 = Viscoelastic deformation; 2 = Elastic deformation
3 = Viscoelastic recovery; 4 = Elastic recovery

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

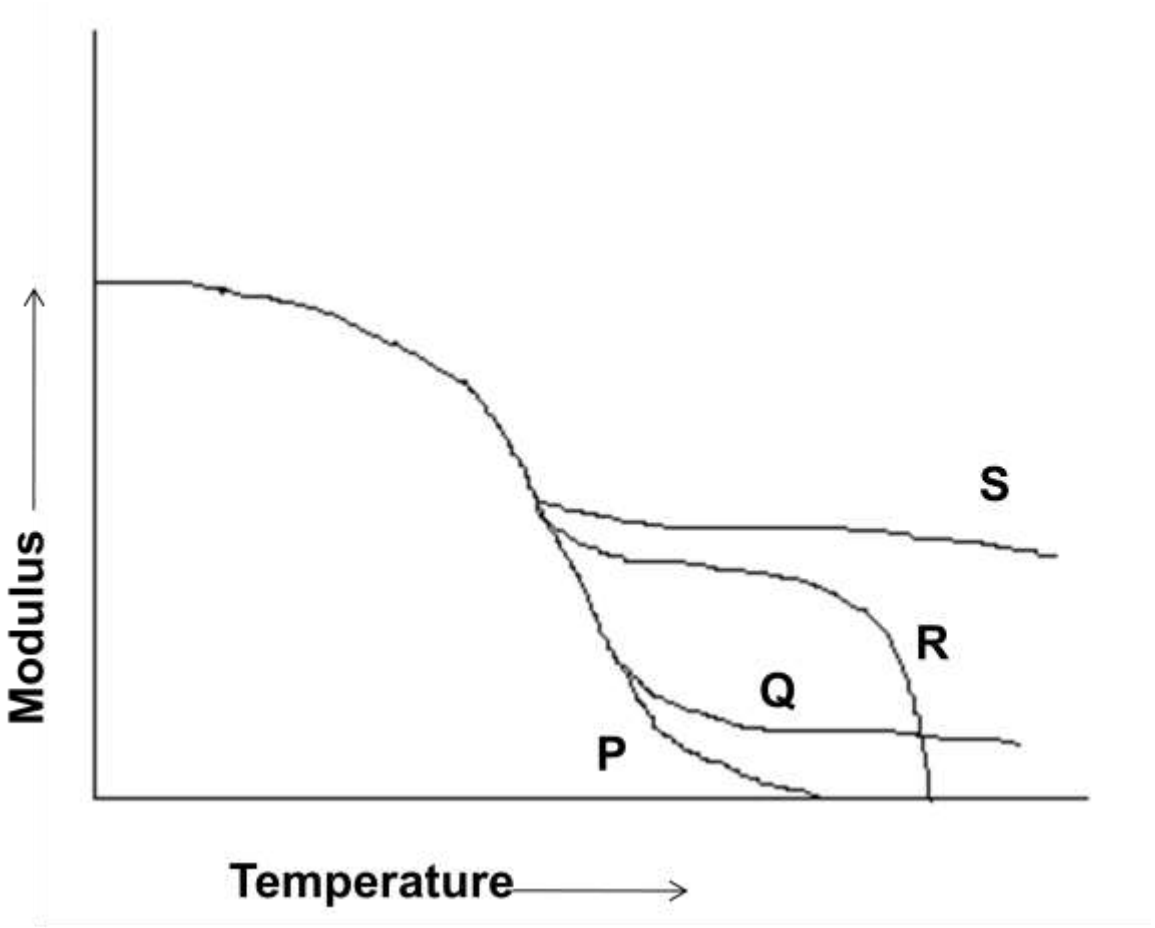
Q.16 The plot shows apparent viscosity versus shear rate of Newtonian, Dilatent and Pseudoplastic fluids. Based on this plot and the fluid behaviour as mentioned below, find out the correct combination.



1 = Dilatent fluid; 2 = Newtonian fluid, 3 = Pseudoplastic fluid

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

Q.17 Plot of the modulus versus temperature of different types of polymers is given below. Based on this plot and the nature of the polymers as mentioned below, find out the correct combination.



1 = An amorphous polymer of high molecular weight having entanglements
2 = An amorphous polymer of moderate molecular weight
3 = Highly crosslinked polymer
4 = Semi-crystalline polymer

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

Q.18 The T_g of homopolymers of A and B are +100 ^oC and -70 ^oC respectively. The T_g of a random copolymer of A and B having 40 wt% A and 60 wt% B is _____ ^oC.

Q.19 The number average molecular weight of a polymer prepared from $HO(CH_2)_{14}COOH$ is 24,000 g/mol. The conversion of the monomer required to reach the above molecular weight is_____%. (C = 12, H = 1, O = 16 g/mol).

Q.20 Glass fibers in nylon provide reinforcement. The modulus of elasticity for each component of the composite is; E_{glass} = 10.5 x 10^6 psi; E_{nylon} = 0.4 x 10^6 psi. If the nylon contains 30 vol % E-glass, the fraction of the applied force is carried by the glass fiber is_____. (Assume that both glass fiber and nylon have equal strain).

Q.21 The solubility parameter of a polymer having cohesive energy density (E_{coh}) 43870 J/mol and molar volume (V) 136 cm^3/mol is _____ $(J/cm^3)^{1/2}$.

Q.22 The heat of polymerization of styrene is 20 Kcal/mol. Heat of 5 x10^5 Kcal will be released on polymerization of _____ Kg of styrene (C = 12 and H = 1 g/mol).

END OF THE QUESTION PAPER

Q.No.	Type	Section	Key/Range	Marks
1	MCQ	GA	A	1
2	MCQ	GA	C	1
3	MCQ	GA	B	1
4	MCQ	GA	B	1
5	MCQ	GA	B	1
6	MCQ	GA	A	2
7	MCQ	GA	D	2
8	MCQ	GA	D	2
9	MCQ	GA	B	2
10	MCQ	GA	C	2
1	MCQ	XE-A	D	1
2	MCQ	XE-A	A	1
3	NAT	XE-A	0.01 to 0.01	1
4	NAT	XE-A	5 to 5	1
5	NAT	XE-A	0.29 to 0.32	1
6	NAT	XE-A	250 to 250	1
7	NAT	XE-A	108 to 108	1
8	MCQ	XE-A	B	2
9	MCQ	XE-A	C	2
10	NAT	XE-A	3 to 3	2
11	NAT	XE-A	0.04 to 0.04	2
1	MCQ	XE-B	B	1
2	MCQ	XE-B	A	1

Q.No.	Type	Section	Key/Range	Marks
3	MCQ	XE-B	D	1
4	MCQ	XE-B	A	1
5	MCQ	XE-B	C	1
6	MCQ	XE-B	B	1
7	MCQ	XE-B	A	1
8	NAT	XE-B	4 to 4	1
9	NAT	XE-B	39 to 42	1
10	MCQ	XE-B	B	2
11	MCQ	XE-B	C	2
12	MCQ	XE-B	C	2
13	MCQ	XE-B	A	2
14	NAT	XE-B	900 to 990	2
15	NAT	XE-B	40 to 42	2
16	NAT	XE-B	2.9 to 3.1	2
17	NAT	XE-B	107 to 127	2
18	NAT	XE-B	440000 to 442000	2
19	NAT	XE-B	0.001 to 0.002	2
20	NAT	XE-B	30 to 45	2
21	NAT	XE-B	4800 to 4800	2
22	NAT	XE-B	1200 to 1350	2
1	MCQ	XE-C	C	1
2	MCQ	XE-C	A	1
3	MCQ	XE-C	B	1

Q.No.	Type	Section	Key/Range	Marks
4	MCQ	XE-C	C	1
5	MCQ	XE-C	A	1
6	MCQ	XE-C	D	1
7	MCQ	XE-C	C	1
8	NAT	XE-C	2 to 2	1
9	NAT	XE-C	6 to 6	1
10	MCQ	XE-C	B	2
11	MCQ	XE-C	A	2
12	MCQ	XE-C	B	2
13	NAT	XE-C	430 to 500	2
14	NAT	XE-C	124 to 124	2
15	NAT	XE-C	2.60 to 2.70	2
16	NAT	XE-C	59.00 to 60.00	2
17	NAT	XE-C	1.85 to 2.00	2
18	NAT	XE-C	132 to 132	2
19	NAT	XE-C	5.01 to 5.17	2
20	NAT	XE-C	5 to 5	2
21	NAT	XE-C	15.5 to 18.5	2
22	NAT	XE-C	1420 to 1480	2
1	MCQ	XE-D	D	1
2	MCQ	XE-D	A	1
3	MCQ	XE-D	D	1
4	MCQ	XE-D	B	1

Q.No.	Type	Section	Key/Range	Marks
5	MCQ	XE-D	B	1
6	NAT	XE-D	52.50 to 53.50	1
7	NAT	XE-D	27.00 to 28.00	1
8	NAT	XE-D	80 to 80	1
9	NAT	XE-D	220.00 to 222.00	1
10	MCQ	XE-D	B	2
11	MCQ	XE-D	B	2
12	MCQ	XE-D	D	2
13	MCQ	XE-D	C	2
14	MCQ	XE-D	C	2
15	MCQ	XE-D	A	2
16	MCQ	XE-D	D	2
17	NAT	XE-D	195.00 to 197.00	2
18	NAT	XE-D	0.01 to 0.02	2
19	NAT	XE-D	14.5 to 15.5	2
20	NAT	XE-D	26.00 to 27.00	2
21	NAT	XE-D	3.10 to 3.20	2
22	NAT	XE-D	13.5 to 14.5	2
1	MCQ	XE-E	B	1
2	MCQ	XE-E	A	1
3	MCQ	XE-E	C	1
4	MCQ	XE-E	A	1
5	MCQ	XE-E	C	1

Q.No.	Type	Section	Key/Range	Marks
6	MCQ	XE-E	D	1
7	NAT	XE-E	160.0 to 161.0	1
8	NAT	XE-E	14.5 to 15.0	1
9	NAT	XE-E	0.30 to 0.32	1
10	MCQ	XE-E	C	2
11	MCQ	XE-E	C	2
12	MCQ	XE-E	D	2
13	MCQ	XE-E	B	2
14	MCQ	XE-E	A	2
15	MCQ	XE-E	D	2
16	NAT	XE-E	332.5 to 336.5	2
17	NAT	XE-E	3.01 to 3.07	2
18	NAT	XE-E	838.0 to 844.0	2
19	NAT	XE-E	961.0 to 962.0	2
20	NAT	XE-E	5.7 to 6.1	2
21	NAT	XE-E	12950.0 to 13000.0	2
22	NAT	XE-E	513.0 to 517.0	2
1	MCQ	XE-F	C	1
2	MCQ	XE-F	A	1
3	MCQ	XE-F	D	1
4	MCQ	XE-F	B	1
5	MCQ	XE-F	D	1
6	MCQ	XE-F	B	1

Q.No.	Type	Section	Key/Range	Marks
7	MCQ	XE-F	A	1
8	NAT	XE-F	1500.00 to 1500.00	1
9	NAT	XE-F	48.52 to 48.72	1
10	MCQ	XE-F	D	2
11	MCQ	XE-F	A	2
12	MCQ	XE-F	B	2
13	MCQ	XE-F	D	2
14	MCQ	XE-F	B	2
15	MCQ	XE-F	D	2
16	MCQ	XE-F	C	2
17	MCQ	XE-F	C	2
18	NAT	XE-F	-25.00 to -24.50	2
19	NAT	XE-F	98.80 to 99.10	2
20	NAT	XE-F	0.90 to 0.93	2
21	NAT	XE-F	17.91 to 18.00	2
22	NAT	XE-F	2600 to 2600	2
1	MCQ	XE-G	B	1
2	MCQ	XE-G	A	1
3	MCQ	XE-G	C	1
4	MCQ	XE-G	D	1
5	MCQ	XE-G	D	1
6	NAT	XE-G	1.55 to 1.65	1
7	NAT	XE-G	103.0 to 103.2	1

Q.No.	Type	Section	Key/Range	Marks
8	NAT	XE-G	54 to 56	1
9	NAT	XE-G	0 to 0	1
10	MCQ	XE-G	B	2
11	MCQ	XE-G	C	2
12	MCQ	XE-G	C	2
13	MCQ	XE-G	A	2
14	MCQ	XE-G	D	2
15	MCQ	XE-G	A	2
16	MCQ	XE-G	C	2
17	MCQ	XE-G	B	2
18	NAT	XE-G	9.8 to 10.2	2
19	NAT	XE-G	1.1 to 1.8	2
20	NAT	XE-G	14.5 to 15.5	2
21	NAT	XE-G	6.0 to 6.4	2
22	NAT	XE-G	10 to 10	2
1	MCQ	XE-H	B	1
2	MCQ	XE-H	C	1
3	MCQ	XE-H	A	1
4	MCQ	XE-H	B	1
5	MCQ	XE-H	B	1
6	MCQ	XE-H	C	1
7	MCQ	XE-H	D	1
8	MCQ	XE-H	D	1

Q.No.	Type	Section	Key/Range	Marks
9	MCQ	XE-H	B	1
10	MCQ	XE-H	A	2
11	MCQ	XE-H	B	2
12	MCQ	XE-H	A	2
13	MCQ	XE-H	B	2
14	NAT	XE-H	1254 to 1256	2
15	NAT	XE-H	19.42 to 19.44	2
16	NAT	XE-H	734.8 to 735.0	2
17	NAT	XE-H	9.16 to 9.18	2
18	NAT	XE-H	12.8 to 13.2	2
19	NAT	XE-H	92.4 to 92.8	2
20	NAT	XE-H	1.3 to 1.4	2
21	NAT	XE-H	0.11 to 0.12	2
22	NAT	XE-H	9.99 to 10.01	2