

Name:	Student ID:	Group no:
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Part one : 24 Multiple-Choice Questions (MCQ) (24 x 1.25 = 30 points)

For each question, choose the correct answer and place the corresponding letter in the table below:

Q	1	2	3	4	5	6	7	8	9	10	11	12
Ans												
Q	13	14	15	16	17	18	19	20	21	22	23	24
Ans												

1- Polydimethylsiloxane is

- (a) copolymer
(b) homopolymer
(c) organic polymer
(d) None of the above

2-By Using the data of the table, the distribution of comonomers in poly(styrene-co-vinyl acetate) is

Monomer A	Monomer B	RA	RB
Styrene	Butadiene	1.0	1.0
Styrene	Vinyl acetate	0.55	0.35
butadiene	Methyl methacrylate	0.98	1.05
Acrylonitrile	Butadiene	0.02	0.05
Vinyl acetate	Methylacrylate	0.71	0.34
Vinyl chloride	Vinylidene chloride	2.30	3.56

- a) Block copolymer
b) Azeotrope system
c) Random copolymer
d) Alternating copolymer

3- Which of the following is hexamer?

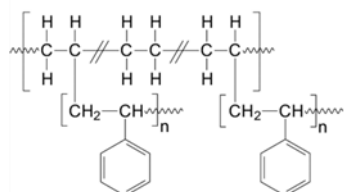
- (a) $-\text{[CH}_2\text{-CH-Cl]}_3-$
(b) $-\text{[Si(CH}_3\text{)}_2\text{O]}_4-$
(c) $-\text{[Si(CH}_3\text{)}_2\text{O]}_6-$
(d) $-\text{[O-CH}_2\text{-CH}_2\text{]}_5-$

4- Which of the following is a correct statement?

- (a) Polymer chains are linked by primary bonds
 - (b) Polymer is never used as a synonym for 'plastic' or rubber
 - (c) All plastic are polymers, but not all polymers are plastics or rubber
 - (d) Polymers are formed by repeated linking of the huge molecules called "monomers"
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5-The name of this polymer is

- a) Poly(ethylene-rand-styrene)
- b) Poly(ethylene-block-styrene)
- c) Poly(ethylene-graft-styrene)
- d) Poly(ethylene-alt-styrene)



6- The structure of poly(methyl methacrylate) is:

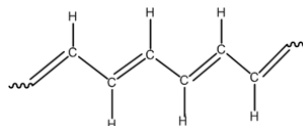
- (a) $\text{CH}_2\text{C}(\text{CH}_3)(\text{COOCH}_3)$
 - (b) $[-\text{CH}_2\text{C}(\text{CH}_3)(\text{COOCH}_3)-]_n-$
 - (c) $[-\text{CHC}(\text{CH}_3)(\text{COOCH}_3)-]_n-$
 - (d) $[-\text{CH}_2\text{C}(\text{CH}_3)(\text{COO})-]_n-$
-

7- Which polymers occur naturally

- A) Starch and nylon
 - B) Starch and cellulose
 - C) Proteins and nylon
 - D) Proteins and PVC
-

8-The microstructure of this molecule is:

- (a) Isotactic
 - (b) Syndiotactic
 - (c) Microstructure cis
 - (d) Microstructure trans
-



9 - The maximum degree of crystallinity (~ 80 %) is found in polyethylene because polyethylene

- (a) has a bulky substituent.
- (b) is a linear polymer.
- (c) does not have substituents.
- (d) b and c.

10 - Amorphous polymers is/has

- (a) Low-moderate chemical resistance
- (b) low elongation
- (c) Less Soluble
- (d) opaque

11- Crystallinity can be measured by:

- (a) Density measurements
- (b) X-ray diffraction e.g. powder (XRD)
- (c) Differential scanning calorimeter (DSC)
- (d) All the above

12- Among the following initiators which of them is used in the free radical polymerization?

- (a) NaOH
- (b) HCl
- (c) Ph-CO-O-O-COPh
- (d) CH₃-CO-OCH₃

13- In coordination polymerization, initiators are complex formed from a catalyst + co-catalyst system such as

- (a) CoCl₂/AlCl₃
- (b) HNO₃/AlCl₄
- (c) NaCl/AlCl₃
- (d) Et-Na/AlCl₄

14- What is the correct sentence between the following sentences?

- (a) If the interchain attractive force in polymer is higher, then T_g is lower.
- (b) If the crystallinity of polymer is higher, then T_g is higher.
- (c) If the Mwt of polymers is higher, then T_g is lower.
- (d) If the plasticization is higher, then T_g is lower.

15- Glass transition temperature (T_g) is:

- (a) The temperature above which the material is transformed from a glassy state to a soft state.
 - (b) The temperature above which the material is transformed from a soft state to a glassy state.
 - (c) The temperature above which the material is transformed from a solid to a liquid state.
 - (d) The temperature above which the material is transformed from a solid to a gas state.
-

16- The DSC measures:

- (a) The Heat flow with temperature.
 - (b) The mass with temperature.
 - (c) The Heat capacity with temperature.
 - (d) The thermal expansion with temperature.
-

17- The solubility of polymers increases when:

- (a) The molecular weight of the polymer increases
 - (b) Crystallization of the polymer increases
 - (c) The molecular weight of the polymer decreases
 - (d) None of the above
-

18- The molar mass of the monomer used to obtain a polymer with an average molar mass of 1.0×10^5 g/mol and a polymerization degree of 456 is.....g/mol.

- (a) 129
- (b) 192
- (c) 219
- (d) 912

19- The retention volume (V_m) of a polymer P, determined by SEC technique, is 15.6 mL. The retention volume (V_m) of a standard polymer S with average molecular weight of 10^5 g/mol is 13.4 mL. What is the average molecular weight of a polymer P?

- (a) 58900 g/mol
 - (b) 95800 g/mol
 - (c) 98500 g/mol
 - (d) 85900 g/mol
-

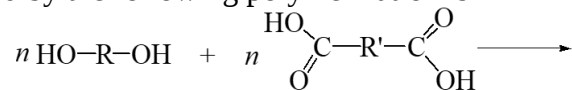
20- Increasing the molecular weight of the polymer

- (a) Increases its resistance to the chemicals
 - (b) increases its strength
 - (c) decreases its creep
 - (d) all the above
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21- If $M_w = M_n$ this mean

- (a) All molecules have different length
 - (b) Polymer is monodisperse
 - (c) Polymer is polydisperse
 - (d) $PDI > 1$
-

22- The polymer produced by the following polymerization is



- (a) linear and thermoplastic polymer
 - (b) cross linked and thermoplastic polymer
 - (c) linear and thermoset polymer
 - (d) cross linked and thermoset polymer
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23- Regarding precipitation and solution techniques, which statement is true?

- (a) In precipitation technique, the polymer obtained is dissolved in the solvent.
 - (b) In solution technique, the solvent is not needed.
 - (c) In precipitation technique, the polymer obtained is not dissolved by the solvent.
 - (d) In solution technique, the initiator is not needed.
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24 - Polyethylene is obtained from ethylene by reaction.

- (a) Addition
 - (b) Condensation
 - (c) Interaction between acid and base
 - (d) None of the above
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Part two : Answer all the following questions (10 points)

Q2 (3 points): For a polymer sample constituted of:

Ni	3×10^3	5×10^3	7×10^3
Mi / g mol ⁻¹	4×10^4	6×10^4	8×10^4

a) Determine the weight average molecular weight (M_w in **kg mol⁻¹**)

b) Determine the viscosity average molecular weight (M_v in **kg mol⁻¹**) ($\alpha = 1.35$)

Q3 (4 points): Explain the suspension technique for Polymers (With Advantages and disadvantages) (4 marks)

Q4: Write the polymerization steps for the following monomer in the presence of base (3 marks):

