U.G. 6th Semester Examination - 2021

CHEMISTRY

Course Code : BCEMDSHC6

Course Title : Polymer Chemistry

Full Marks : 30 Time : 2 Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Answer any **ten** questions: 1×10=10

a) Which of the following molecules will undergo ring opening polymerization (ROP)?

N-vinyl Caprolactam, ε-Caprolactone, Lactide, Styrene.

b) Write down the name of two monomers those can be polymerized by living radical as well as living ionic polymerization technique.

c) Draw the chemical structures of the polyvinyl alcohol and polyisobutylene.

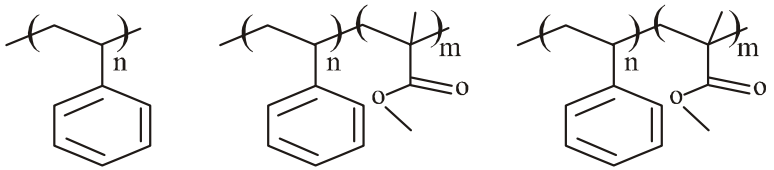
d) Which polymerization technique is used to make polyisobutylene?

e) Give two important applications of polyvinyl chloride.

f) Which of the following polymers are degradable and why?

Polyethylene, polyethylene terephthalate, polystyrene, polyamide.

g) How many glass transition temperature (T_g) would be obtained in each of the following polymer?



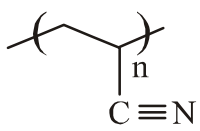
6 Random Copolymer DiBlock Copolymer

h) Mention any one initiator used in each of cationic and anionic polymerization.

i) Name one polymer which shows upper critical solution temperature (UCST) in water.

j) Name one gel permeation chromatography (GPC) detector which will help you to obtain weight average molecular weight (M_w) of polymer.

k) Give the IUPAC nomenclature of



l) What are chain transfer agent? Give an example.

m) What do you mean by ceiling temperature of a polymer?

n) Calculate the molecular weight of polypropylene whose degree of polymerization is 2500.

o) Name any two fluoropolymers and write down their structures.

2. Answer any **five** questions: 2×5=10

a) Draw the structures of atactic polystyrene and syndiotactic polystyrene. Which of the above isomer will exhibit melting temperature (T_m)? Justify your answer.

b) In polymerization of styrene, how do you know that the polymer is formed or not? If the polymer is formed how do you purify that polymer?

c) Living controlled polymerization of styrene (St) and isobutylene (IB) produced a random copolymer. Structural analysis of the copolymer by ^{1}HNMR spectroscopy gives 0.4 weight fraction of IB in the copolymer. Polystyrene has a T_g=100°C and polyisobutylene has a T_g=–70°C. Estimate the T_g of the random copolymer.
M_W of St=104.1 g/mol and IB=56.11 g/mol.

d) A linear step polymerization is 99% complete. Calculate $\bar{X}_n$, $\bar{X}_W$ and PDI.

e) What are virial coefficients?

f) If the value of initial concentration of hydroxyl and carboxyl monomer is 10 molL^{-1} and rate constant is 10^{-3} L mol^{-1}s^{-1} for a self-catalyzed polycondensation reaction, how long would it take to obtain $\bar{X}_n$ of 50?

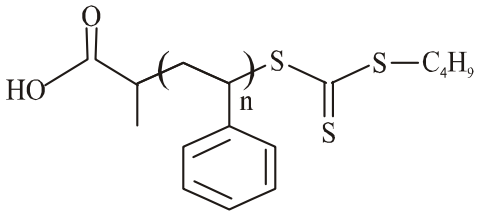
g) Why is bakelite a thermosetting plastic?

h) Why methyl methacrylate does not polymerize above 200°C?

3. Answer any **two** questions: 5×2=10

a) i) Polystyrene was synthesized with chain end functionality as shown below by controlled living radical polymerization method. How can you use chain-end

analysis methods such as UV-vis spectroscopy and ^{1}HNMR spectroscopy to determine the average degree of polymerization of polystyrene. 3



ii) Complete the following: 1

$$n\ H_2N(CH_2)_6NH_2 + nHO_2C(CH_2)_4CO_2H \rightarrow$$

$$H\left[NH-(CH_2)_6-NHCO-(CH_2)_4-CO\right]_nOH + ?..H_2O$$

iii) What is cage effect? 1

b) i) For the following reactivity ratio value (r_1 and r_2), what type of polymers would be expected?

$r_1=0$ and $r_2=0$; $r_1=r_2=1$. 2

ii) Explain the following fact: 3

Monomer	Radical	Cationic	Anionic
Styrene (St)	$r_1=0.52$	$r_1=10$	$r_1=0.1$
Methyl methacrylate (MMA)	$r_2=0.46$	$r_2=0.1$	$r_2=6.0$

c) Discuss the various factors which affect glass transition temperature of polymers. 5

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