

Q5. In the bulk polymerization of methyl methacrylate (MMA) with azo-bis-isobutyronitrile (AIBN) at 60°C the initial rates of initiation and propagation are  $R_i = 1.7 \times 10^{-6}$  mol/L sec and  $R_p = 8.8 \times 10^{-4}$  mol/L sec, respectively. Predict the initial molecular weight of the polymer formed in this polymerization, if the extent of disproportionation is 70% at 60°C. Neglect chain transfer reactions for calculations. (Given that molecular weight of MMA = 100 g/mol). (3 Marks)

ENTRY NO. / 2017-18 / 11 / 0 / 2 / 3 / 4 / Total Marks

- Please write your name and entry number at the space provided on top of the sheet
- There are total 12 questions, some have negative marking
- Provide your answers within the space provided
- No additional sheet will be provided
- Write your answers in legible and step-wise manner

**Q1** Polymerization of styrene was initiated using azo bis isobutyronitrile AIBN ( $C_8H_{12}N_2$ ) and 50% of the growing chains terminated by combination. Calculate the end group content (weight fraction) due to AIBN in the final polymer having molecular weight of 136000 g/mol. (2 Marks)

118

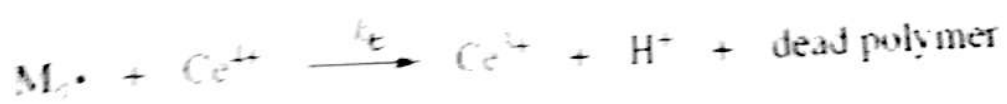
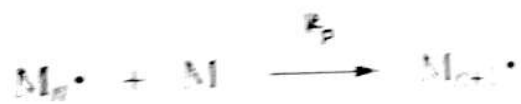
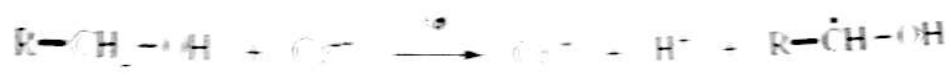
Q8. Mark following statements as TRUE or FALSE (-0.5 marks for every wrong answer, no answer no mark) (3 Marks)

- (a) Degree of polymerization depends on monomer conversion in chain growth polymerization False
- (b) In a theta solvent the polymer chains are present in unperturbed (unchanged) state true
- (c) All elastomers are thermosets False
- (d) Glass transition is the property of only the amorphous portion of a semi-crystalline polymer False
- (e) The extent of intra-molecular chain transfer is higher in LDPE as compared to HDPE True
- (f) Vinyl alcohol can not be polymerized due to its very low boiling point False

Q11. Draw all possible repeat unit structures of chloroprene (2-chloro-1,3-butadiene) when polymerized by a thermal free radical initiator (2 Marks)

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Q12. Derive equation for rate of polymerization ( $R_p$ ) for following system. Assume steady-state approximation. (2 Marks):



Q3 What will be the effect of chain transfer reactions on the polymerization rate and polymer molecular weight in following cases, where  $k_p$  is rate constant for propagation,  $k_t$  is rate constant for termination and  $k_{tr}$  is rate constant for chain transfer. Justify your answer with reasons. (2 Marks)

Case	Condition	Effect on $R_p$	Effect on $M_n$

Q2. A 2.5g sample of polyester containing acid groups at both ends of every chain required 20 ml of 0.01M KOH solution to reach the end point of titration. Calculate the  $M_n$  of the polyester. (2 Marks)

Answer: 1250

Q7. How much change in Polydispersity of a mixture containing 4 moles of polymer A (mol. wt. = 25,000 g/mol) and 6 moles of polymer B (mol. wt. = 45,000 g/mol) will occur when an impurity of 1 mole of molecule C (mol. wt. = 500 g/mol) is inadvertently added to the mixture (3 Marks)

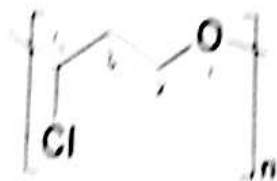
for initial

2.7 1500



Q6. For a radical chain polymerization of polystyrene, the polymer produced has on the average 1.6 initiator fragments per polymer molecule and number average degree of polymerization = 32,000. Calculate the relative extents of termination by coupling & disproportionation and kinetic chain length assuming that no chain transfer occurred. (2 Marks)

**Q4** Write the IUPAC name for following polymer chain (1 Mark)



Q10) Which of the following materials you expect to be transparent and why? (2 Mark)

~~Amorphous polystyrene~~

~~Crystalline polystyrene~~

~~Amorphous polystyrene~~

Polystyrene mixed with glass

Q. Half-life of a free radical initiator having initial concentration of  $[I]_0$  is 10 minutes at a given temperature. How much initiator is left after 40 minutes at that temperature? (Mark)

$$[I] = [I]_0 \left(\frac{1}{2}\right)^n$$