

CHEM 342 – Polymers and Petrochemicals
Homework – Chapter 1: Introduction to Polymers
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Question 1

A polymer sample contains four molecules: two with a molar mass of 20,000 g/mol, one of 40,000 g/mol and one of 60,000 g/mol.

- (a) Calculate the number-average molar mass (M_n).
- (b) Calculate the weight-average molar mass (M_w).
- (c) Calculate the polydispersity index (PDI) and comment on its meaning. What is the PDI of a monodisperse sample?
- (d) Name the technique used to determine M_n and M_w .

Question 2

Degree of polymerization (atomic masses: C = 12, H = 1, Cl = 35.5):

- (a) Define the degree of polymerization (DP) and give the equation used to calculate it.
- (b) Calculate the DP of a poly(vinyl chloride) sample, $[-CH_2-CHCl-]_n$, with $M = 125,000$ g/mol.
- (c) A polystyrene sample, $[-CH_2-CH(C_6H_5)-]_n$, has DP = 3,000. Calculate its molar mass.

Question 3

Monomer composition:

- (a) Define a homopolymer and a copolymer.
- (b) Using monomers A and B, draw a schematic chain sequence for each of the four types of copolymer (random, alternating, block, graft).
- (c) Give one example of an alternating copolymer and one example of a block copolymer.

Question 4

Based on molecular (intermolecular) forces, polymers are classified into four types. For each of elastomers, fibres, thermoplastics and thermosetting polymers, state:

- (a) the strength/type of the intermolecular forces or bonding between chains,
- (b) the characteristic property or behavior on heating,
- (c) one example.

Question 5

Isomerism in polymers:

- (a) Give an example of a pair of structurally isomeric polymers and draw their repeating units.
- (b) Compare cis- and trans-1,4-polybutadiene in terms of their physical properties.
- (c) Define isotactic, syndiotactic and atactic polypropylene. Why is isotactic PP highly crystalline ($T_m \approx 160$ °C) while atactic PP is amorphous and sticky?