

**Exercise 1.** Which feature distinguishes addition from condensation polymerization?

- a) Addition uses monomers with double bonds; condensation eliminates a small molecule.
  - b) Addition eliminates water; condensation keeps all atoms of the monomer
  - c) Addition forms only linear chains; condensation forms branched chains
  - d) Addition occurs only with aliphatic monomers; condensation only with aromatic monomers
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**Exercise 2.** Which of the following statements about crystalline polymers is true?

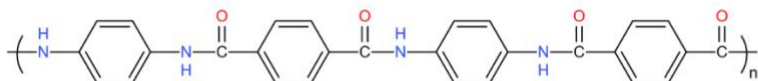
- a) Crystalline polymers have irregular chain packing and low density.
  - b) Crystalline polymers have ordered chain packing and higher density.
  - c) Crystalline polymers always have lower melting points than non-crystalline polymers.
  - d) Crystalline polymers cannot form strong intermolecular interactions.
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**Exercise 3.** Which of the following statements about biological polymers is true?

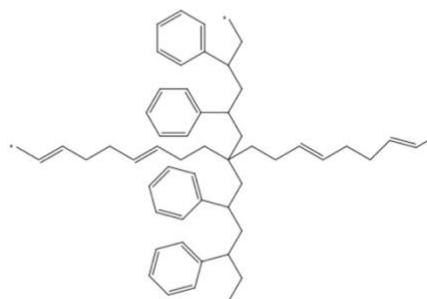
- a) Unlike synthetic polymers, their sequences are always determined by a rigid template
  - b) Unlike synthetic polymers, their assembly must occur under mild aqueous conditions.
  - c) Unlike synthetic polymers, they can create amide and ester linkages.
  - d) Unlike synthetic polymers, their three-dimensional structures are generally random.
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**Exercise 4.** Identify what type of copolymers based on assembly are shown below:

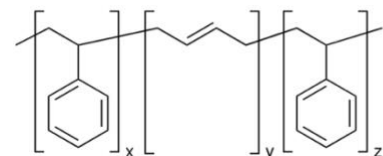
a) Kevlar



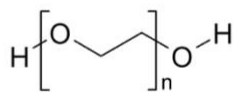
d) High impact polystyrene (HIPS)



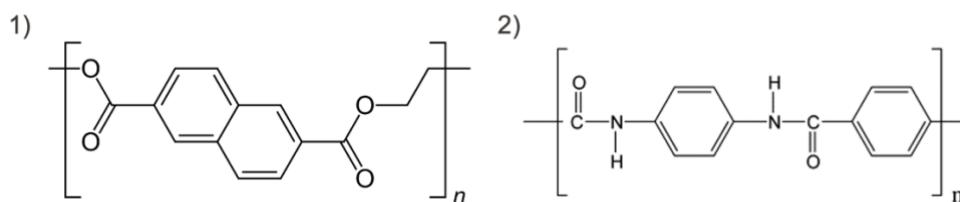
b) Styrene-butadiene-styrene (SBS)



c) Polyethylene glycol (PEG)



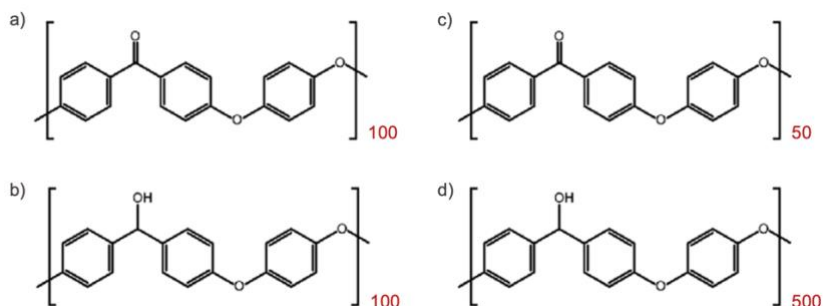
**Exercise 5.** Consider the following condensation polymers.



a) What subcategory of condensation polymers they belong to?

b) Label the two molecules comprising each repeating unit?

**Exercise 6.** Rank these polymers based on the expected melting point ( $T_m$ ) from highest to lowest:



**Exercise 7.** Sketch three repeating units of the addition polymer formed from:

- 2-Methylpropene
- 2-methyl-1,3-butadiene

**Exercise 8.** Draw the structural formula of the repeating unit of the polyamide formed by a condensation reaction between:

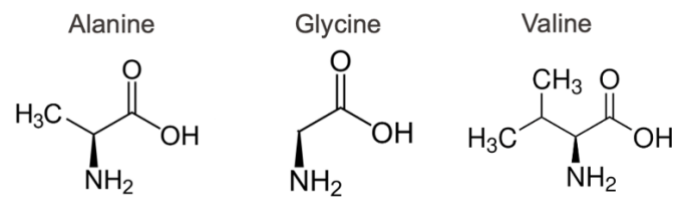
- Ethane-1,2-diamine and butane-1,4-dioic acid
- Hexane-1,6-diamine and benzene-1,4-dioic acid

**Exercise 9.** Draw the structural formula of the repeating unit of the polyester formed by a condensation reaction between:

- Butane-1,4-dioic acid and propane-1,3-diol
- Benzene-1,3-dioic acid and 2-methylpropane-1,3-diol

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**Exercise 10.** Draw a structure of a short peptide (=mini-protein) assembled by sequentially connecting Valine, Glycine and Alanine (in that order) using peptide bonds.

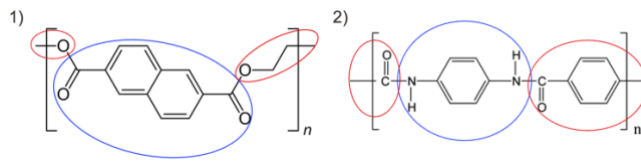


*Hint:* There is more than one way to connect them.

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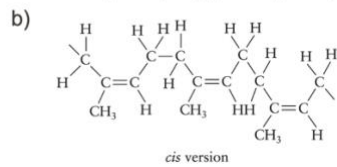
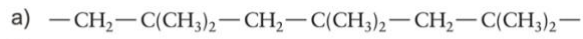
Quick Answers:

1. a)
2. b)
3. b)
4. a) alternating copolymer  
b) block copolymer  
c) simple polymer  
d) graft copolymer
5. a) Polymer 1 is a polyester, while polymer 2 is a polyamide.  
b)



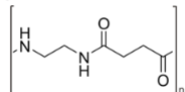
6.  $T_m(d) > T_m(b) > T_m(a) > T_m(c)$

7.

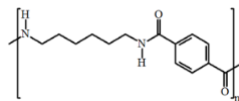


8.

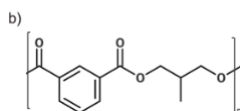
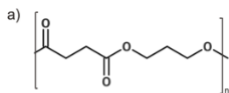
a) Nylon-2,4



b) Nylon-6T



9.



10.

