Chapter 2

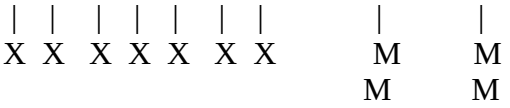
EXERCISES
(To answer some of these questions you may need to look at other parts in the book for structures and specific details.)

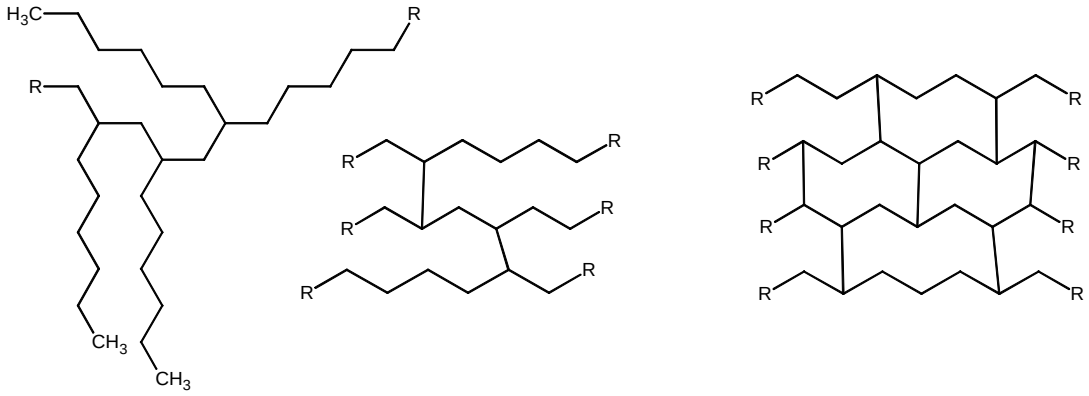
1. Make sketches or diagrams showing (a) a linear polymer, (b) a polymer with pendant groups, (c) a polymer with short branches, (d) a polymer with long branches, and crosslinked polymers with (e) low and (f) high crosslinked density.
2. Which has (a) the greater volume for the same weight of material and (b) the lower softening point: HDPEC or LDPE?
3. What is the approximate bond length of the carbon atoms in (a) a linear and (b) a crosslinked polymer.
4. What is the approximate contour length of a HDPE chain with an average degree of polymerization (chain length) of n = 2000 and of a PVC chain of the same number of repeating units?
5. Which of the following are monodisperse polymers with respect to chain length? (A) heva rubber, (b) corn starch, (c) cellulose from cotton, (d) an enzyme, (e) HDPE, (f) PVC, (g) a specific DNA, (h) nylon 66, (i) a specific RNA?
6. What is the average degree of polymerization of LDPE having an average molecular weight of 28,000?
7. What is the structure of the repeating unit in (a) polypropylene, (b) poly(vinyl chloride, (c) hevea rubber?
8. Which of the following is a branched chain polymer: (a) HDPE, (b) Isotactic PP, (c) LDPE, (d) amylose starch?
9. Which of the following is a thermoplastic: (a) ebonite, (b) Bakelite, (c) vulcanized rubber, (d) HDPE, (e) celluloid, (f) PVC, (g) LDPE?
10. Which has the higher crosslinked density, (a) ebonite or (b) soft vulcanized rubber?
11. Do HDPE and LDPE differ in (a) configuration or (b) conformation?
12. Which is a trans isomer: (a) gutta percha or (b) hevea rubber?
13. Which will have the higher softening point: (a) gutta percha or (b) hevea rubber?
14. Show (a) a heat-to-tail, and (b) a head-to-head configuration for PVC.
15. Show the structure of a typical portion of the chain of (a) s-PVC, (b) i-PVC.
16. Show Newman projections of the gauche forms of HDPE.
17. Name polymers whose intermolecular forces are principally (a) London forces, (b) dipole-dipole forces, (c) hydrogen bonding.
18. Which will be more flexible: (a) poly(ethylene terephthate), or (b) poly(butylene terephthalate)?
19. Which will hve the higher glass transition temperature: (a) poly(methylene methacrylate) or (b) poly(butyl methacrylate)?
20. Which will have the higher T_g : (a) i-PP or (b) a-PP?
21. Which will be more permeable to a gas at room temperature: (a) i-PP or (b) a-PP?
22. Under what kind of physical conditions are you more apt to form spherulites.
23. What is the full contour length of a molecule of HDPE with a DP of 1,500?
24. Which would be more flexible: (a) poly(methyl acrylate) or (b) poly(methyl methacrylate?
25. Which would you expect to form “better” helical structures (a) i-polypropylene or (b) a-

polypropylene?
26. Which would you expect to have a higher melting point (a) nylon-66, or (b) an aramide?
27. What type of hydrogen bonds are present in the internal structure of a globular protein?
28. Which would have the greater tendency to "cold flow" at room temperature: (a) poly(vinyl acetate) (T_g = 301 K) or (b) polystyrene (T_g = 375 K)?
29. Which would be least transparent: (a) combination of amorphous and crystalline PS, (b) entirely crystalline PS, or (c) entirely amorphous PS?
30. Which would be more apt to produce crystallites: (a) HDPE or (b) poly(butyl methacrylate)?
31. Which of the following would you expect to provide strong fibers (a) nylon-66, (b) a-polypropylene, (c) wool.
32. Which would tend to be more crystalline when stretched: (a) unvulcanized rubber or (b) ebonite?
33. Which would be more apt to exhibit side chain crystallization (a) poly(metnyl methacrylate) or (b) poly(dodecyl methacrylate)?

ANSWERS

1. (a) -MMMMMMMMMMMMM-, (b) -CCCCCCCCCCCCCC-, (c) -CCCCCCCCC-



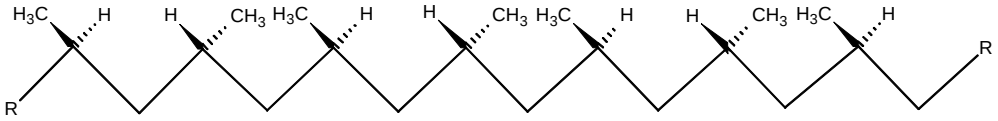


(d) (e) (f)

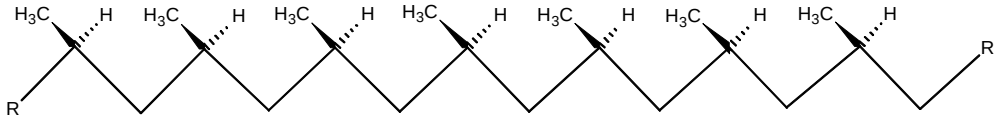
2. (a) LDPE, (b) LDPE.
3. (a) about 109.5; (b) about 109.5 ; zigzag chains characteristic of alkanes
4. Contour length are both about the same since the backbone for each is composed entirely of carbon atoms. Given a C-C bond length of 0.126 nm this means the effective length for each unit is 2 x 0.126 nm = 0.252 nm. Thus the contour length is 0.252 nm times 2000 units = 504 nm.
5. d,g,i.
6. 1,000

7. (a) $-CH_2-CH(CH_3)-$,
(b) $-CH_2-CHCl-$,
(c) $-CH_2-CH(CH_3)=CH-CH_2-$
8. c.
9. d,e,f,g.
10. a.
11. a.
12. a.
13. a.
14. (a) $-CH_2-CH(OH)-CH_2-CH(OH)-$,
(b) $-CH_2-CH(OH)-CH(OH)-CH_2-$

15.
(a) syndiotactic-polypropylene or simply sPP.



(b) isotactic-polypropylene or simply iPP.



16. See Figure 2.7; simply extend the end methyl groups making them methylene groups.
17. (a) HDPE, LDPE, hevea rubber, etc., (b) PVC, etc., (c) nylon-66, cellulose, silk, etc.
18. b.
19. a.
20. a.
21. b.
22. Low or no flow; slow cooling rate; linear polymers.
23. 378 nm
24. a.
25. (a) because of a more regular structure.
26. b.
27. Intramolecular hydrogen bonds.
28. a.
29. Being transparent depends of having a homogeneous structure so (a) is the least homogeneous and thus has varying refractive indexes causing it to appear hazy.
30. a
31. a and c.
32. a.

33. b.