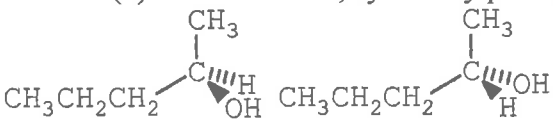
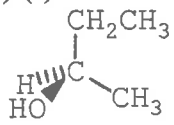
Answers to Puzzles of Chapter 3
Stereoisomers

3.1 (a) constitutional isomers (b) identical (c) conformations (d) stereoisomers
(e) conformations

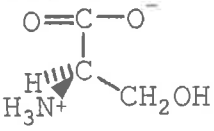
3.2 (a) achiral, symmetry plane (b) achiral, symmetry plane (c) chiral, asymmetric
(d) chiral, asymmetric (e) chiral, asymmetric (f) achiral, symmetry plane (g) chiral, asymmetric

3.3 (a) no chiral atom, symmetry plane, achiral (b) no chiral atom, symmetry plane, achiral
(c) 1 chiral atom, asymmetric, chiral: 
(d) no chiral atom, symmetry plane, achiral (e) no chiral atom, symmetry plane, achiral

3.4 (a) (-)-2-butanol

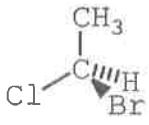
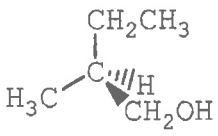
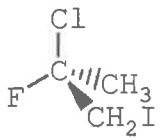
(b)  bp 100°C, d = 0.80 g/mL (20°C), $[\alpha]^5 = +13.5°$

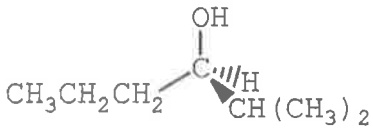
3.5 (a) yes, because it has 3 polar groups and only 3 carbons.

(b)  (c) both are equally soluble (d) (+), clockwise

3.6 (a) The 2 enantiomer alkyl chlorides react at the same rate with *achiral* alkoxide ion.
(b) The 2 enantiomer alkyl chlorides can react at different rates with *chiral* alkoxide ion.

3.7 (a) (*R*)-chlorofluoroiodomethane (b) (*S*)-chlorofluoroiodomethane
(c) (*R*)-3-deuterio-2-methylhexane (d) fluoroiodomethane (e) (*R*)-4-ethyl-4-methyloctane
(f) (*S*)-3-chloro-2-methyl-1-propanol (g) (*R*) (h) (*R*)

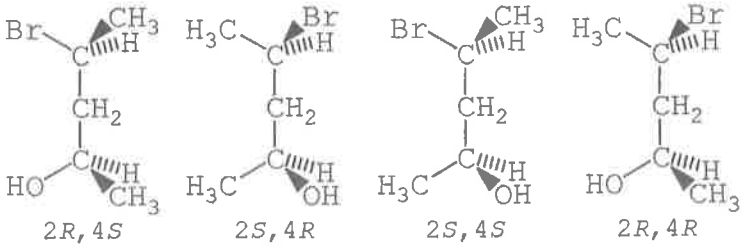
3.8 (a)  (b)  (c) 

(d) 

3.9 (a) *R* (b) *R* (c) *S* (d) *R*

3.10 *R*

3.11 (a) no, because the rings prevent inversion (b) 2: the nitrogen and the 3° carbon

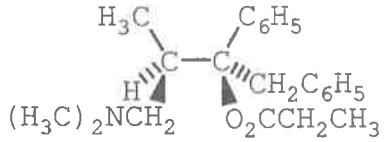
3.12 (a) 

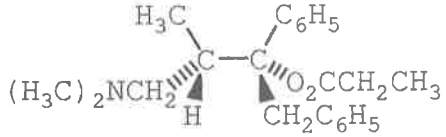
2*R*,4*S* 2*S*,4*R* 2*S*,4*S* 2*R*,4*R*

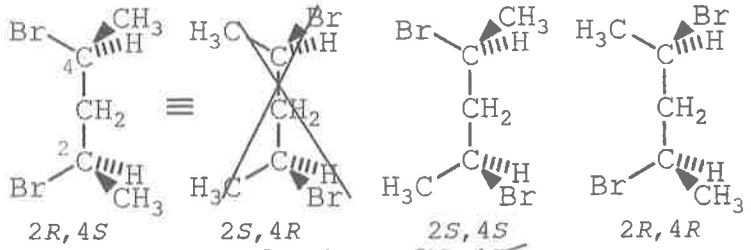
(b) 2*R*,4*S* <– enant. –> 2*S*,4*R*

diast. diast. diast.

2*S*,4*S* <– enant. –> 2*R*,4*R*

3.13 (a) 

(b) 

3.14 (a) 

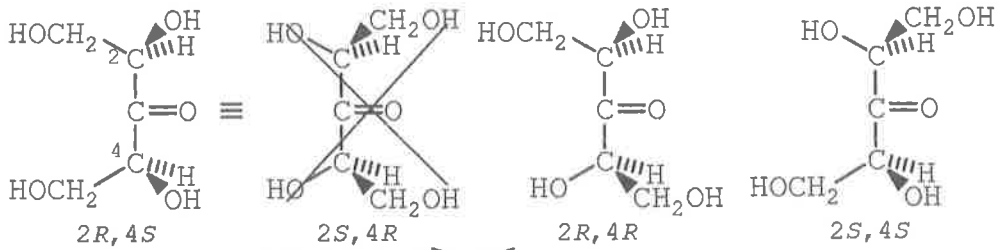
2*R*,4*S* 2*S*,4*R* 2*S*,4*S* 2*R*,4*R*

(b) 2*R*,4*S* ≡ ~~2*S*,4*R*~~

diast. diast.

2*S*,4*S* <– enant. –> 2*R*,4*R*

(c) 2*R*,4*S* (= 2*S*,4*R*) is achiral

3.15 (a) 

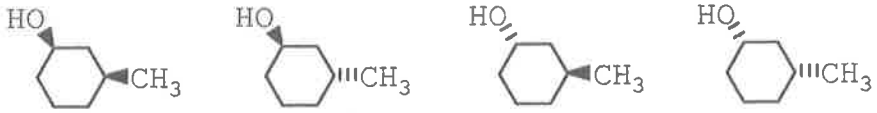
2*R*,4*S* 2*S*,4*R* 2*R*,4*R* 2*S*,4*S*

(b) 2*R*,4*S* ≡ ~~2*S*,4*R*~~

diast. diast.

2*S*,4*S* <– enant. –> 2*R*,4*R*

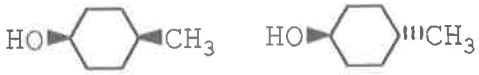
(c) 2*R*,4*S* (= 2*S*,4*R*) is achiral

3.16 (a) 

1*R*,3*S* cis 1*R*,3*R* trans 1*S*,3*S* trans 1*S*,3*R* cis

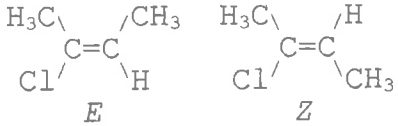
(b)

(c) no achiral stereoisomers

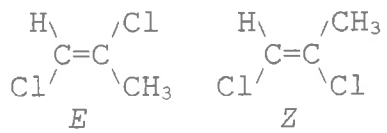
3.17 (a) 

(b) cis trans (c) both are achiral

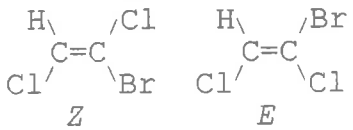
3.18 All pairs are diastereomers.

3.19 (a) no stereoisomers (b) 

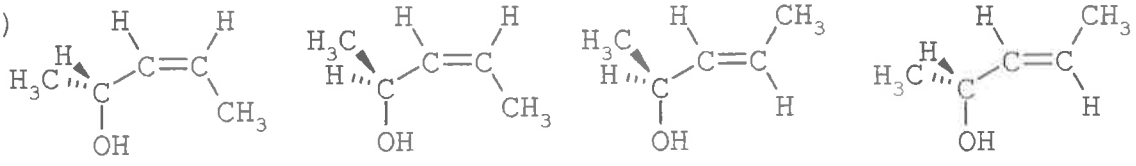
E *Z*

(c) 

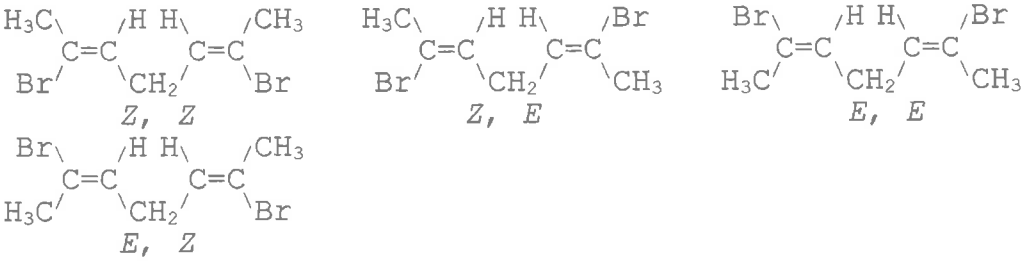
E *Z*

(d) 

Z *E*

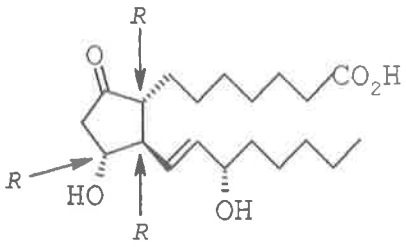
(e) 

Z *Z* *E* *E*

(f) 

Z, Z *Z, E* *E, E*

E, Z

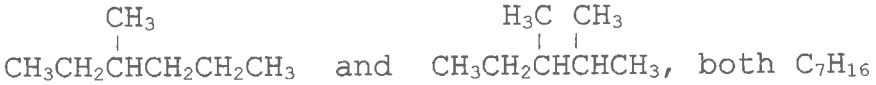
3.20 (a) *E* (b) 

3.21 It must have a chiral part that associates differently with the two enantiomers.

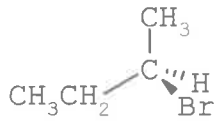
3.22 Identical heats of hydrogenation because they are enantiomers with equal energies, yielding identical products.

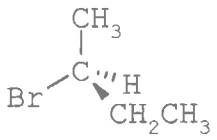
3.23 (a) yes, because a superoxide radical is achiral and reacts equally with two enantiomers.
(b) no, because the proteolytic enzymes are chiral and react differently with two enantiomers.
(c) Its potential is strong because it could destroy superoxide radicals without being degraded by proteolytic enzymes.

3.24 (a) enantiomers (b) identical (c) diastereomers (d) conformations
(e) constitutional isomers (f) enantiomers (g) identical (h) identical

3.25 (a) 

(b) 

3.26 (a) 

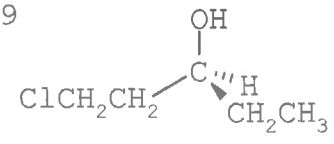
(b)  bp 90°C, d 1.254 g/mL (25°C), $[\alpha]^{22} = +23.1^{0}$

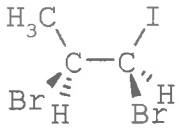
(c) $\alpha = +23.1° \ (.100)(.500) = +1.16°$

3.27 (a) identical extent of reaction, involving 2 enantiomers & an achiral reagent
(b) possibly different extents of reaction, involving 2 enantiomers & a chiral reagent
(c) identical extent of reaction, with the 2 reactions being mirror images

3.28 (a) (*S*)-1-chloroethanol (b) (*S*)-1-bromo-2-butanol
(c) (1*R*,2*S*)-1,2-dibromo-1,2-dichloroethane (d) *cis*-1,5-dimethylcyclooctane
(e) (1*R*,4*R*)-1,4-dimethylcyclooctane

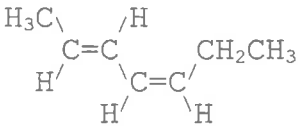
3.29

(a) 

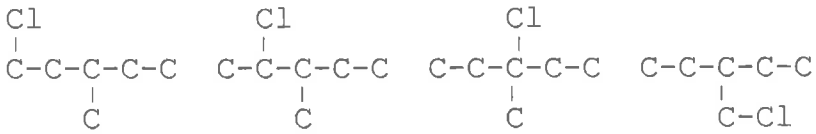
(b) 

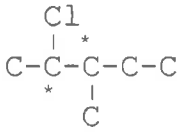
(c) 

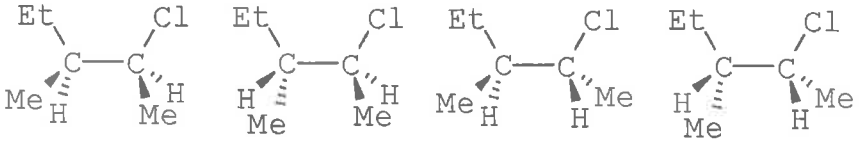
(d) 

(e) 

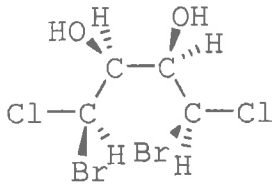
3.30 (a) *R* (b) *R* (c) no designation (d) *Z* (e) *S* (f) no designation, no chiral atom

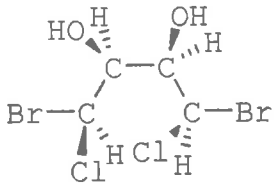
3.31 (a) 

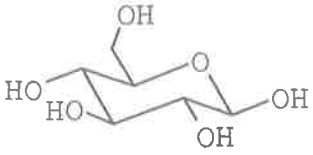
(b) 

(c) 

3.32 (a) 4 chiral atoms (b) $2^4 = 16$ stereoisomers, if none achiral

(c)  *1R,2S,3R,4S*

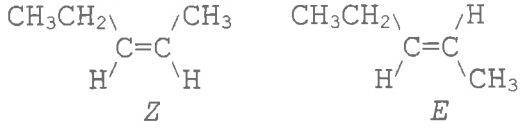
 *1S,2S,3R,4R*

3.33 (a) sp^3 O (b) 

(c) 5 chiral atoms => $2^5 = 32$ stereoisomers; none achiral
(d) Since β-D-glucose can have all of its ring substituents equatorial, none of its stereoisomers can be stabler, and its enantiomer is its only stereoisomer that is equally stable.

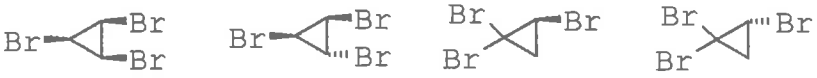
3.34 (a) $CH_3CH_2CH_2CH{=}CH_2$ $CH_3CH_2CH{=}CHCH_3$

$CH_3CHCH{=}CH_2$ $CH_3C{=}CHCH_3$ $CH_2{=}CCH_2CH_3$

(b) 

Z *E*

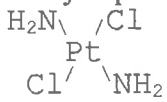
3.35 (a) 

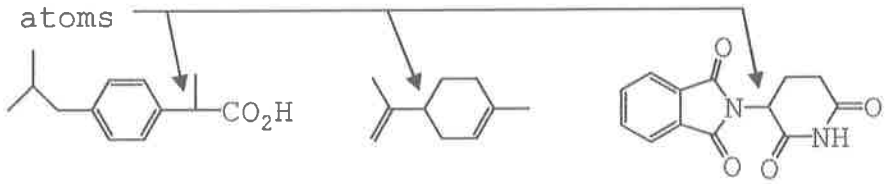
(b) 

(c) 3 distilled fractions (d) no optically-active fractions (1 racemic mixture)

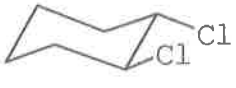
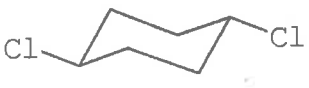
3.36 Different reaction rates since the two alkenes are diastereomers of different energy.

3.37 (a) The platinum does not have tetrahedral geometry because it has a stereoisomer.
(b) A reasonable (and also true) geometry is planar. So the stereoisomer would be:



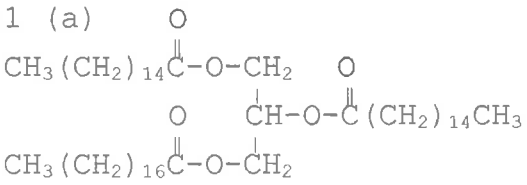
3.38 (a) chiral atoms 

(b) they are chiral sites

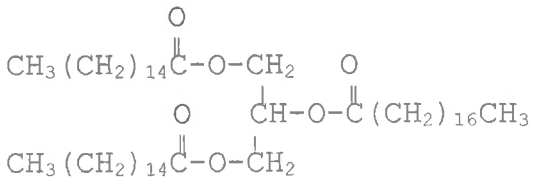
3.39 (a)  trans (b)  cis (c)  trans

3.40 (a) no chiral atoms (b) enantiomers (c) yes, chiral

3.41 (a)

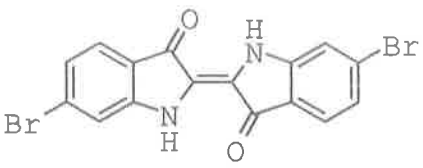


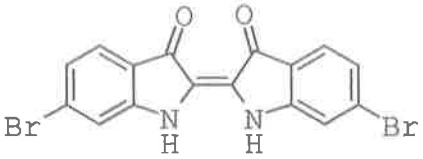
(b)



3.42 (a) no chiral atoms (b) no, achiral (c) no stereoisomers

3.43





3.44 (a) *sp* (b) perpendicular (c) 2 (d) 2 (e) 0

5/05