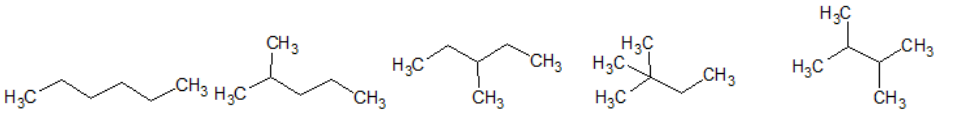
4.15: SOLUTIONS TO ADDITIONAL EXERCISES

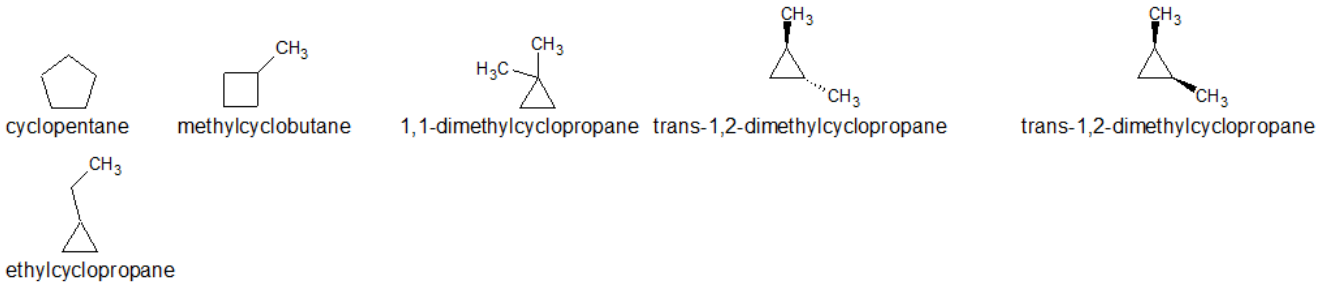
STRUCTURAL AND GEOMETRIC ISOMERISM

4-1 a)



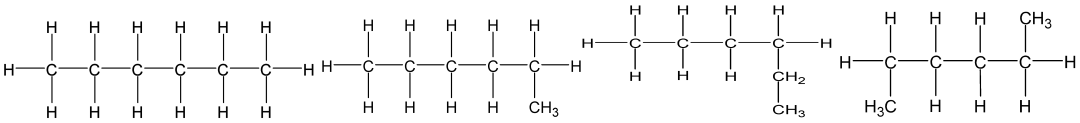
b) The isomer that releases the least energy is the most stable, so neohexane is more stable than hexane.

c)

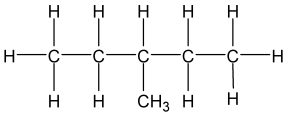


4-2

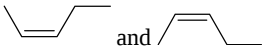
a) The following structures all represent hexane.



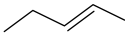
The following structure represents 3-methylpentane:



b) Both structures represent cis-2-pentene:


and

Both structures represent trans-2-pentene: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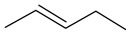
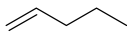
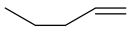
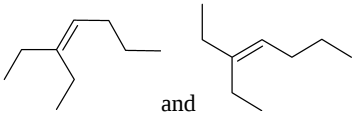


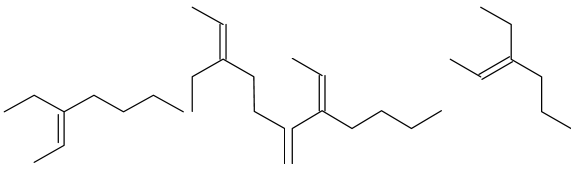
Both structures represent 1-pentene:


and


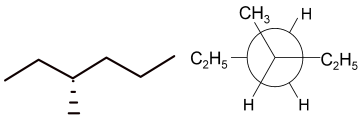
c) Both structures represent 3-ethyl-3-heptene:


and

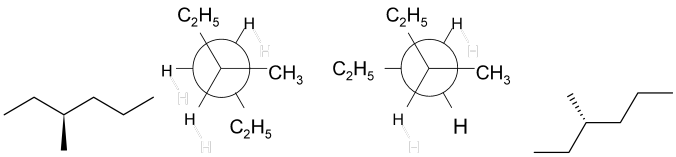
These three structures all represent 3-ethyl-2-heptene:



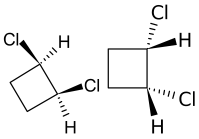
d) Both structures represent (3R)-3-methylhenxane:



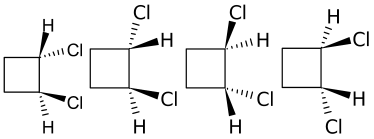
All four structures represent (3S)-3-methylhenxane:



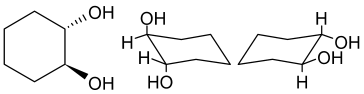
e) Both structures represent trans-1,2-dichlorocyclobutane:



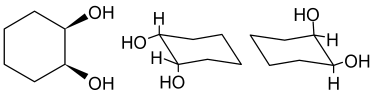
All four structures represent cis-1,2-dichlorocyclobutane:



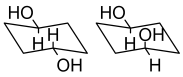
f) All three structures represent trans-1,2-cyclohexanediol:



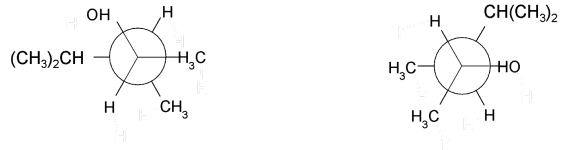
All three structures represent cis-1,2-cyclohexanediol:



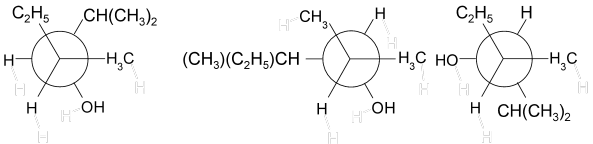
Both structures represent trans-1,4-cyclohexanediol Cis-1,4-cyclohexanediol:



g) Both structures represent 3,4-dimethylpentan-2-ol:

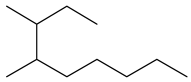


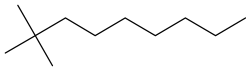
All three structures represent 2,4-dimethylhexan-3-ol:



4-3

(a) a dimethylnonane


3,4-dimethylnonane

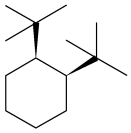

2,2-dimethylnonane

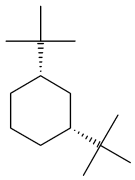
(b) a trans-dimethylcyclobutane


trans-1,2-dimethylcyclobutane

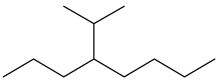

trans-1,3-dimethylcyclobutane

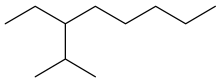
(c) a cis-di-tert-butylcyclohexane


cis-1,2-di-*tert*-butylcyclohexane

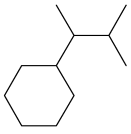

cis-1,3-di-*tert*-butylcyclohexane

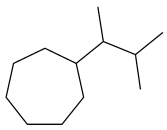
(d) an isopropyloctane


4-isopropyloctane

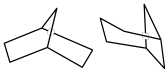

3-ethyl-2-methyloctane

(e) a (1,2-dimethylpropyl)cycloalkane

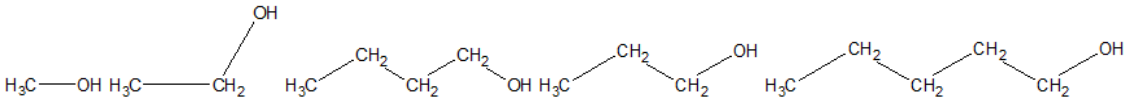

(1,2-dimethylpropyl)cyclohexane


(1,2-dimethylpropyl)cycloheptane

(f) a bicycloheptane


Bicyclo[2.2.1]heptane Bicyclo[3.1.1]heptane

4-4



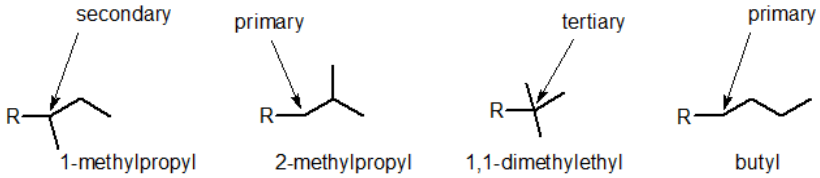
4-5

(a) Nonane has the higher boiling point because it has the higher molecular weight. Recall that higher molecular weight compounds have more surface area, and therefore they have stronger London dispersion forces. As a result, higher molecular weight compounds have the higher boiling temperatures.

(b) Pentane has the higher boiling point. Pentane has a straight chain while 2-methylbutane is branched. Compared to a straight-chain isomer, a branched hydrocarbon has a lower boiling temperature because of its smaller surface area.

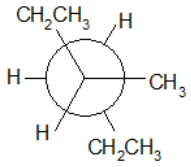
(c) Octane has the higher boiling point because 2,2,4-trimethylpentane is highly branched while octane is a straight-chain hydrocarbon.

4-6

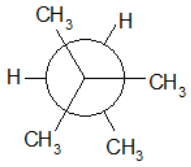


4-7

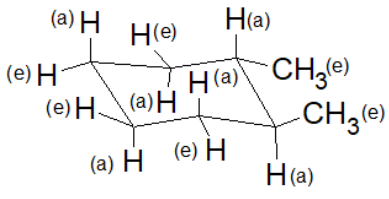
(a)



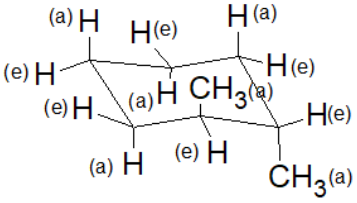
(b)



4-8



lower-energy conformation

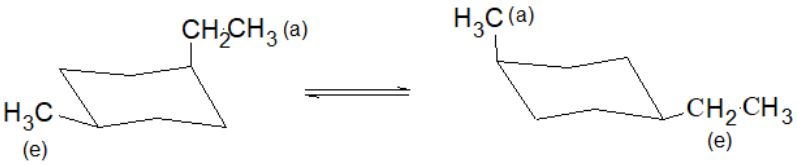


higher-energy conformation

(c) The first conformer has one gauche interaction between the $-CH_3$ groups, so the strain energy of this conformer is 0.9 kcal/mol. The second conformer has four 1,3-diaxial interaction between H and $-CH_3$ groups, so its strain energy is 4 x 0.9 = 3.6 kcal/mol. Therefore, the energy difference in these two conformations is 3.6 – 0.9 =2.7 kcal/mol.

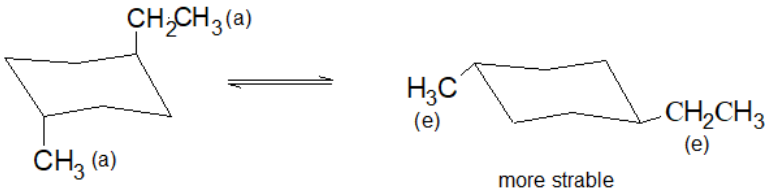
4-9

(a)



more strable

(b)

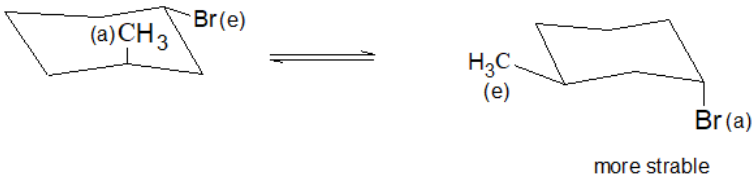


more strable

(c)

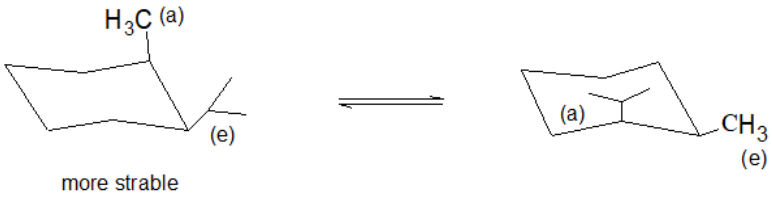
more strable

(d)



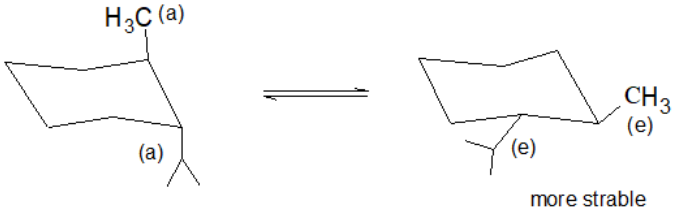
more strable

(e)



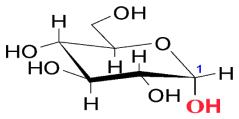
more strable

(f)

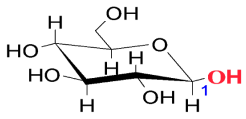


more strable

4-10



α-D-Glucopyranose

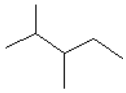


β-D-Glucopyranose

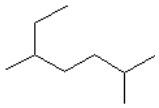
In α-D-glucopyranose, the hydroxyl group at C1 occupies an axial position. In β-D-glucopyranose, the hydroxyl group at C1 of occupies an equatorial position, which is the more stable structure. So the β forms predominates in equilibrium.

4.11

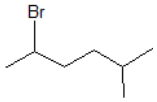
(a)



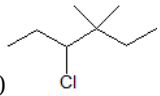
(b)



(c)



(d)



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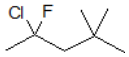
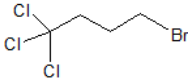
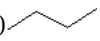


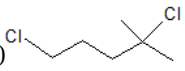
(f)



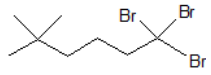
(g)



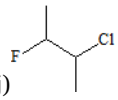
(h)



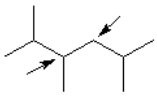
(i)



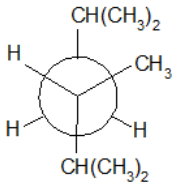
(j)



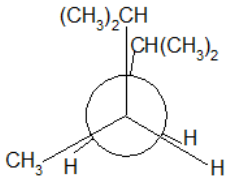
4.12



2,3,5-trimethylhexane

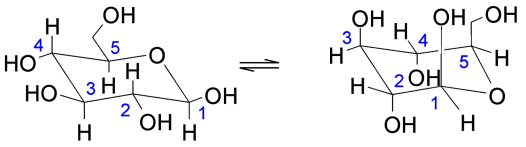


most stable



least stable

4.13



more stable
