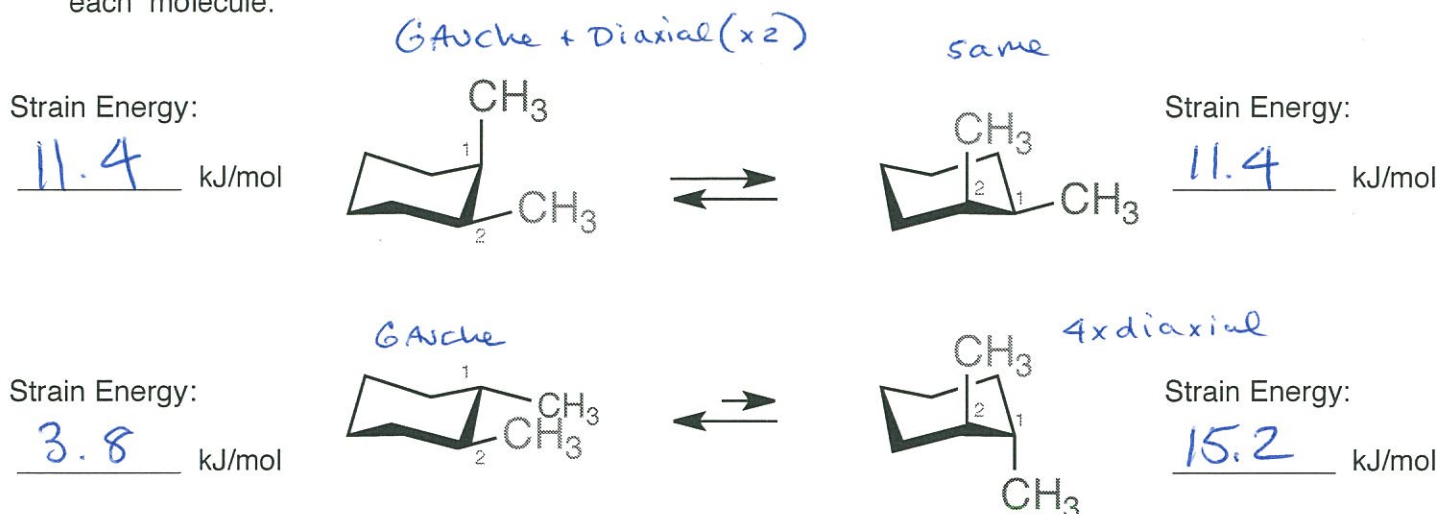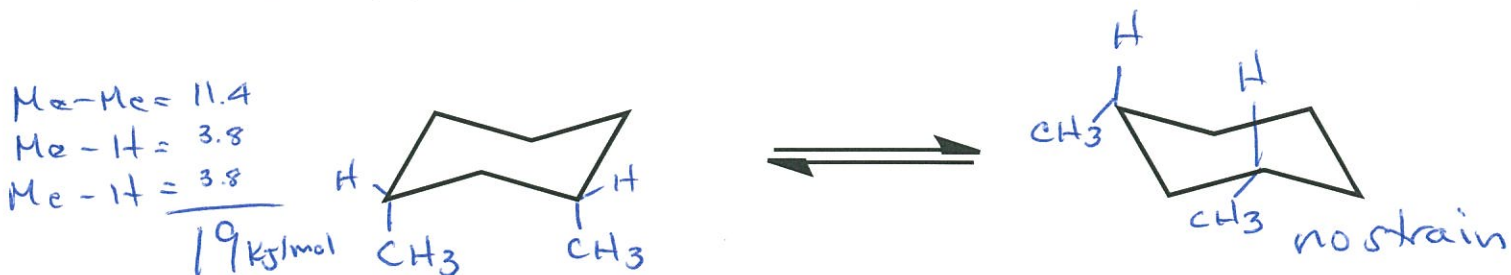# CHAPTER 4: CYCLOALKANES (cont.)

The first structure, shown below, is *cis*-1,2-dimethylcyclohexane and the structure beneath it is the *trans*-isomer. On the four structures, draw the hydrogens on carbons 1 and 2. Don't forget, these are tetrahedral carbons - do not draw 90° angles. Calculate the total strain energy for each molecule.

Gauche + Diaxial (x2)   same

Strain Energy:

11.4 kJ/mol

Strain Energy:

11.4 kJ/mol

Gauche   4x diaxial

Strain Energy:

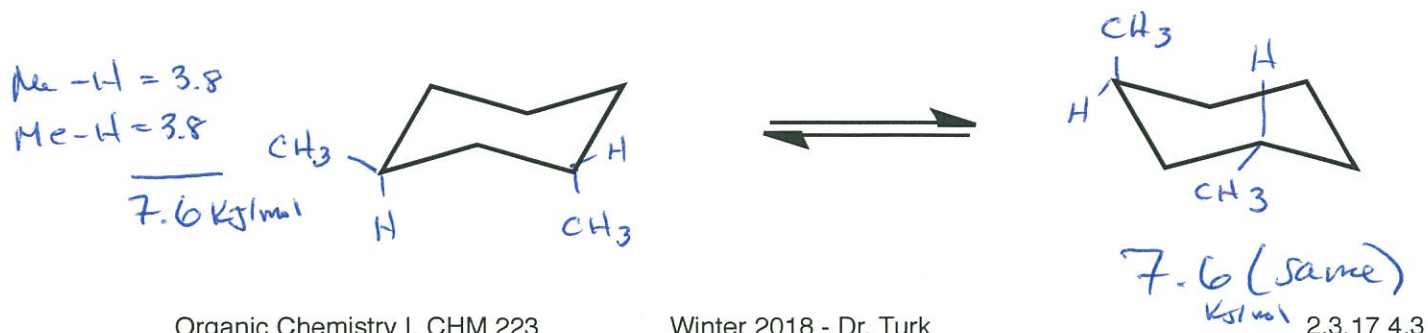**3.8** kJ/mol

Strain Energy:

15.2 kJ/mol

On the blank chairs drawn for you below (and on next page), draw the chair conformations for the *cis* and *trans* isomers of 1,3-dimethylcyclohexane and 1,4-dimethylcyclohexane. Then calculate the total strain energy for each conformation. When you draw a methyl (or any other) substituent, please also draw the hydrogen that is attached to that carbon. This helps me out when I'm trying to decide if you've drawn something axial or equatorial.
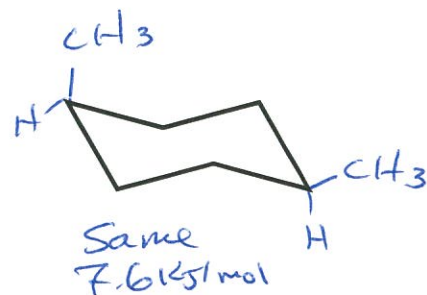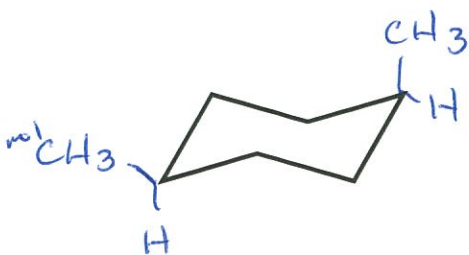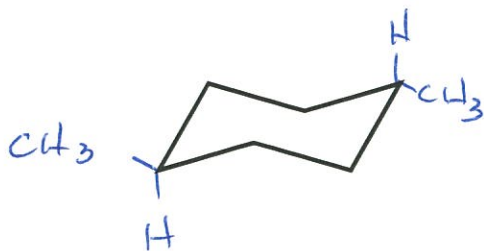
cis-1,3-dimethylcyclohexane

Me—Me = 11.4
Me — H = 3.8
Me — H = 3.8
_____
19 kJ/mol

no strain

trans-1,3-dimethylcyclohexane

Me —H = 3.8
Me—H = 3.8
_____
7.6 kJ/mol

7.6 (same)
kJ/mol

cis-1,4-dimethylcyclohexane

Me–H =3.8
Me–H =3.8
7.6 kJ/mol
80

CH_3
H
CH_3
H

⇌

CH_3
H
CH_3
H
Same
7.6 kJ/mol

trans-1,4-dimethylcyclohexane

H
CH_3
CH_3
H

no strain

⇌

CH_3
H
H
CH_3

4x Me–H diaxial
15.2 kJ/mol
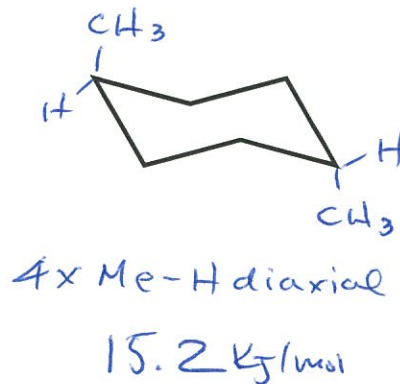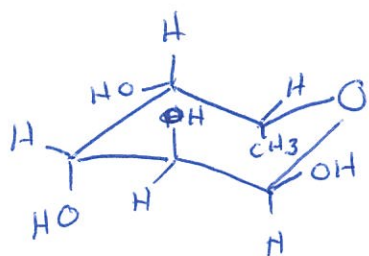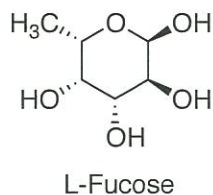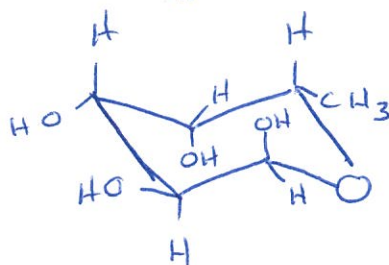
L-Fucose is a sugar component of the determinants of the A, B, O blood group typing. Draw the two chair conformations of L-Fucose and identify which is most stable:

H_3C,,, O OH
HO'' OH
ÖH

L-Fucose

MOST stable
conformation
⇓

H
HO
⊕H
H O
CH_3
OH
H
HO H
HO
H

3 x OH–OH Gauche
1 x OH–CH₃ Gauche
1 x OH–CH₃ diaxial
2 x OH–H diaxial
1 x CH₃–H diaxial

more strain

H   H
HO   H CH_3
OH
OH
HO   H   O
H

3 x OH–OH Gauche
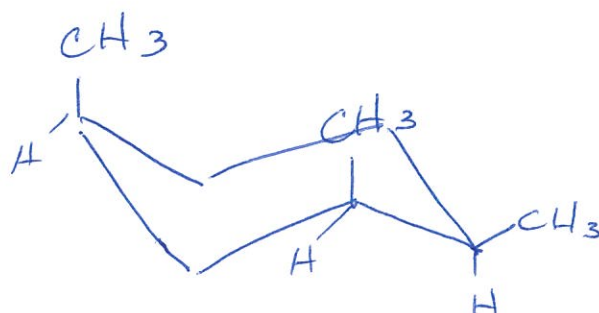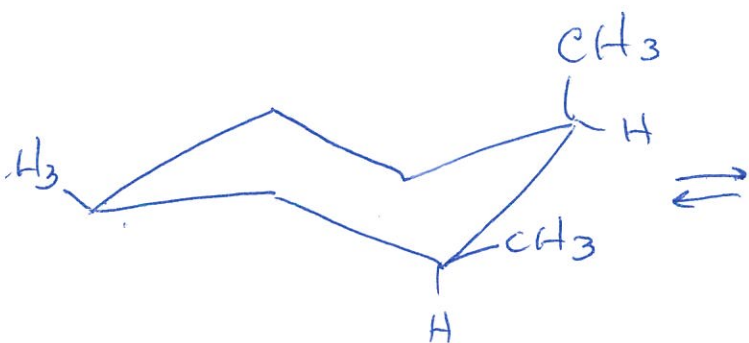1 x OH–CH₃ Gauche
3 x OH–H diaxial

less strain.

SAfe to
assume
CH_3 is
larger than OH.

Draw the most stable chair conformation of 1,2,4-trimethylcyclohexane and calculate the difference in energy between each of the two chair-flip conformers.

CH₃

CH₃

1,2,4-trimethylcyclohexane

CH₃
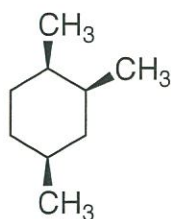
Interaction	Energy (kJ/mol)
Me-Me gauche	3.8
Me-H 1,3-diaxial	3.8
Me-Me 1,3-diaxial	11.4

CH_3

H

H_3

CH_3

H

$\rightleftharpoons$

CH_3

H

CH_3

H

CH_3

H

$1 \times CH_3 - CH_3$ GAuche

$2 \times CH_3 - H$ diaxial

$3.8 + (2 \times 3.8) = 11.4$

$1 \times CH_3 - CH_3$ GAuche

$1 \times CH_3 - CH_3$ diaxial

$2 \times CH_3 - H$ diaxial

$3.8 + 11.4 + (2 \times 3.8) = 22.8$

11.4 KJ/mol difference.