Chem 0310
Dennis P. Curran
March 2, 2009
Exam 2

Name:_____

Signature:_____

Answer all questions on this exam. If you need more space than that provided, use the back of any page.

1. _____ (20 points)

2. _____ (20 points)

3. _____ (20 points)

4. _____ (20 points)

5. _____ (20 points)

TOTAL _____

The test has **7** pages (including this cover page and the Table on page 7) and **5** questions

The exam ends at 10:55 am sharp.

Good Luck !!!

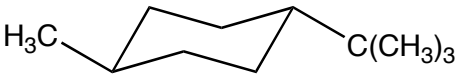
1) Names and Structures (5 x 4 = 20 points)
a, b, c) Provide clear three-dimensional structures for compounds with the following names.

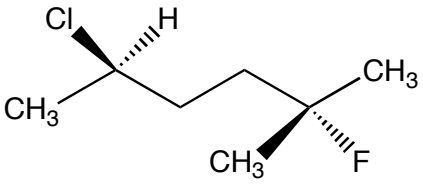
a) (3*S*)-1,3-dibromooctane

b) *cis*-1-ethyl-4-methylcycloheptane

c) (2*S*,3*S*)-2,3-dichloro-5-methylhexane

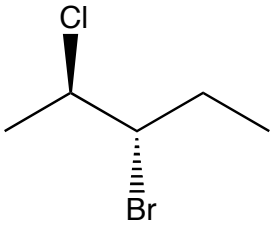
d,e) Provide IUPAC names for the following structures.
Be sure to include *R/S/meso/cis/trans* if needed.

d) 

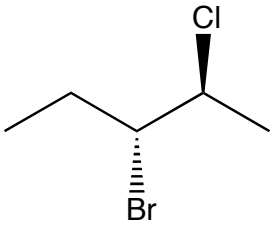
e) 

2) Structural comparisons (5 x 4 = 20 points)
Indicate whether the pairs of compounds in a-e are the same, constitutional isomers, diastereoisomers (diastereomers), or enantiomers.

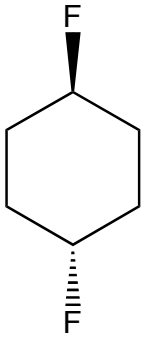
a)



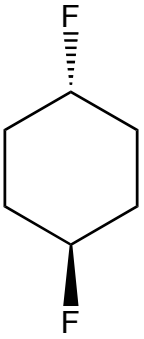
and



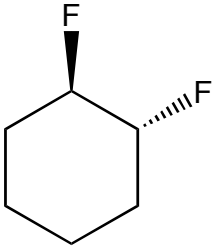
b)



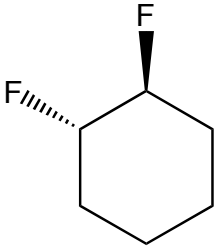
and



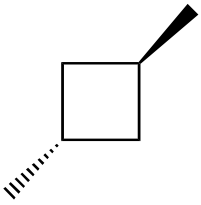
c)



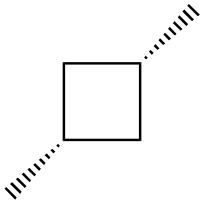
and



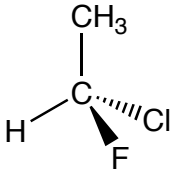
d)



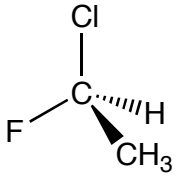
and



e)



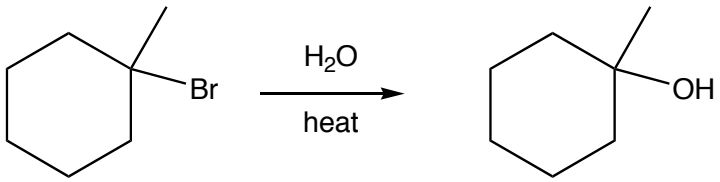
and



3) Short Answer Questions (4 x 5 = 20 points)

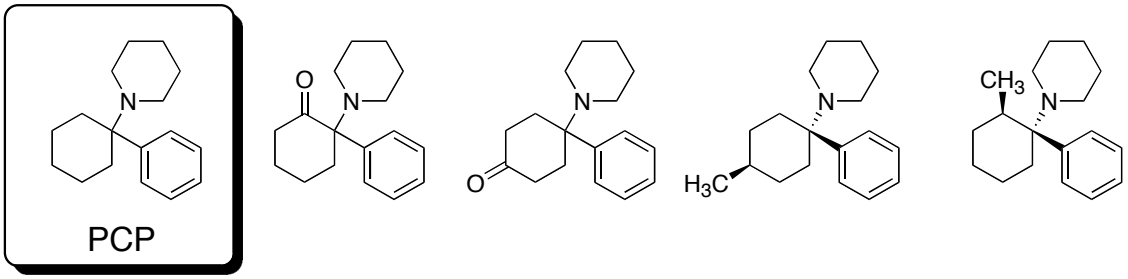
a) Define "enantiomeric excess (ee)".

b) Show a clear step-by-step mechanism for the following reaction. Use arrows to track electron flow.



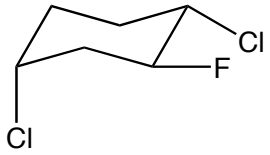
c) Provide a *specific example* of a meso-compound.

d) Shown below are structures of the street drug phencyclidine (called PCP or "angel dust") and four analogs. Indicate whether each molecule is ***chiral or achiral***.

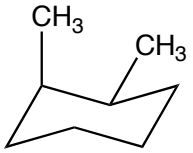


4) Conformations of Cyclohexanes (4 x 5 = 20 points)

a) For the indicated compounds **1** and **2**, indicate whether each non-hydrogen ring substituent is in an axial orientation or an equatorial orientation.

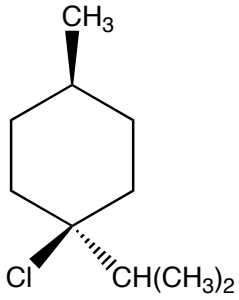


1



2

b) Draw both chair conformations of the following compound **3**.



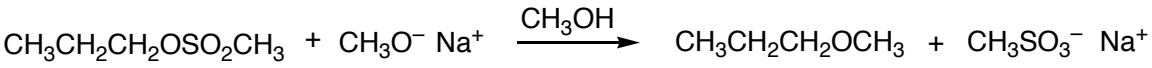
3

c) Use the table of ΔG^0 values at the end of the exam to calculate which of your conformations is favored and by how much.

d) PCP, question 3d, has three six-membered rings: a cyclohexane ring, a piperidine ring (with N) and a phenyl ring. Like cyclohexanes, piperidines exist in chair conformations with axial and equatorial substituents. The ΔG^0 values of cyclohexyl and piperidinyl rings are large compared to the ΔG^0 values of lone pairs and phenyl rings. With that information, ***draw a complete 3D representation of PCP that shows the shape and location of each of three rings.***

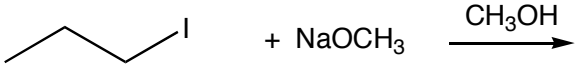
5) Substitution and Elimination Reactions (20 points)

a) For the reaction below, indicate the substitution product, the leaving group, the solvent, the nucleophile, and the electrophile (5 points).

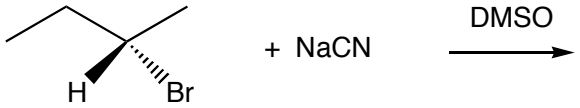


b) Show the major product that you expect from each of the following reactions. Be sure to clearly indicate stereochemistry if relevant. (5 x 3 = 15 points)

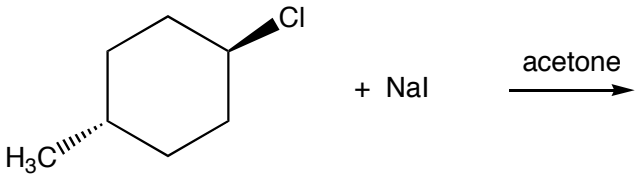
b1)



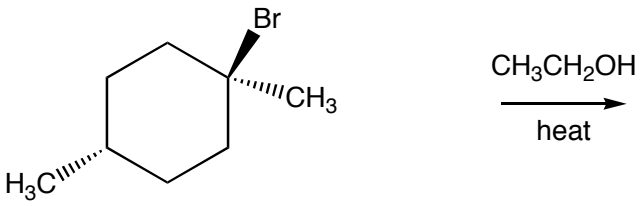
b2)



b3)



b4)



b5)

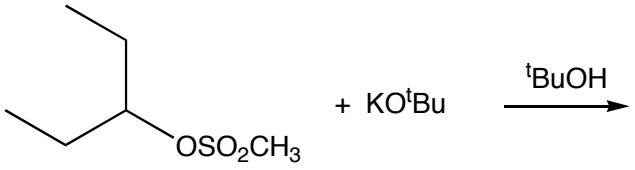


TABLE 4-3 Change in Free Energy on Flipping from the Cyclohexane Conformer with the Indicated Substituent Equatorial to the Conformer with the Substituent Axial

Substituent	ΔG° [kcal mol^{-1} (kJ mol^{-1})]	Substituent	ΔG° [kcal mol^{-1} (kJ mol^{-1})]
H	0 (0)	F	0.25 (1.05)
CH_3	1.70 (7.11)	Cl	0.52 (2.18)
CH_3CH_2	1.75 (7.32)	Br	0.55 (2.30)
$(CH_3)_2CH$	2.20 (9.20)	I	0.46 (1.92)
$(CH_3)_3C$	≈ 5 (21)	HO	0.94 (3.93)
HO—C(=O)	1.41 (5.90)	CH_3O	0.75 (3.14)
CH_3O—C(=O)	1.29 (5.40)	H_2N	1.4 (5.9)

Note: In all examples, the more stable conformer is the one in which the substituent is equatorial.