

LAST NAME:

FIRST NAME:

STUDENT ID:

CHEM 221 - ORGANIC CHEMISTRY I MIDTERM EXAMINATION

INSTRUCTIONS: *PLEASE READ THIS BOX WHILE WAITING TO START YOUR EXAM.*

- Check that your paper is complete: 4 pages (both sides).
- Note the (removable) reference data page: table of pK_a s, periodic table, electronegativities.
- Model kits and calculators are permitted. Cell phones & electronic dictionaries are not allowed.
- Read through the whole test quickly before starting.
- Please ask for clarification if you do not understand what a question is asking.
- You have 70 minutes to complete the test.

Mark breakdown:

Page 2. / 10

Page 3. / 11

Page 4. / 10

Page 5. / 10

TOTAL: / 40 (maximum ⁴¹/40)

PERCENT: %

EARNED toward
FINAL GRADE: / 15

1. (5 marks) TRUE or FALSE? Circle T or F to describe the following statements.

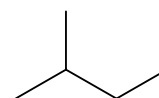
T / F Eclipsed bonds produce less torsional strain than staggered bonds.

T / F Branched alcohols are less soluble in water than straight-chain alcohols (*assuming same # of Cs*).

T / F Any molecule or atom described as a *Lewis acid* can also be described as an *electrophile*.

T / F Resonance delocalization occurs via the overlap of p-orbitals on adjacent atoms.

T / F The molecule shown here (at the right) contains three secondary carbons:



2. (1 mark) Which ONE of the following functional groups contains a π -bond?

- alkoxy
- amino
- carbonyl
- hydroxyl

3. (1 mark) The σ^* orbital for the C–Br bond in CH_3Br could be represented as:



4. (1 mark) Each of the features below tends to *decrease* the stability of a resonance contributor, except

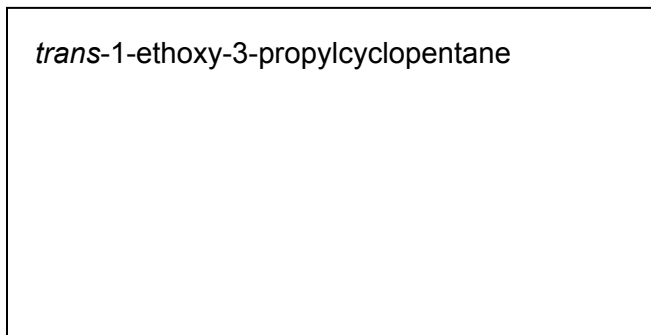
- an atom with an incomplete octet
- a negative charge on the most electronegative atom
- a negative charge not on the most electronegative atom
- charge separation

5. (2 marks) Which common base would be strong enough to deprotonate $(\text{CH}_3)_2\text{CHNH}_2$?

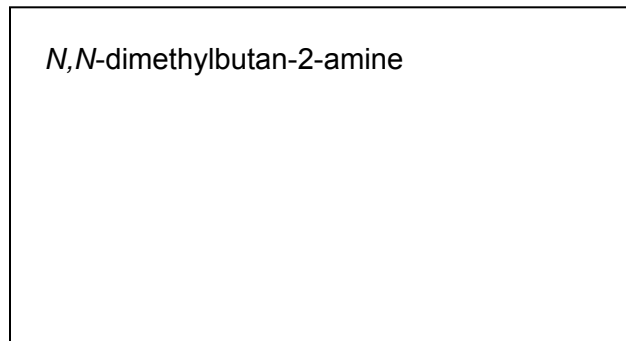
- sodium acetate: $\text{Na}^+ \text{CH}_3\text{COO}^-$
- potassium *tert*-butoxide: $\text{K}^+ (\text{CH}_3)_3\text{CO}^-$
- sodium hydride: $\text{Na}^+ \text{H}^-$
- n*-butyl lithium: $\text{Li}^+ \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2^-$

6. (3 Marks) Draw a line (skeletal) structure for the following compounds:

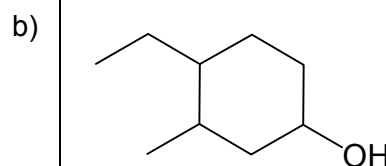
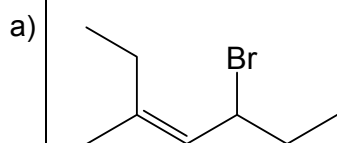
a) *trans*-1-ethoxy-3-propylcyclopentane



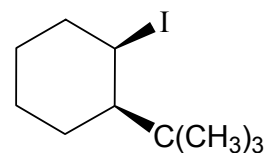
b) *N,N*-dimethylbutan-2-amine



7. (3 Marks) Provide a systematic IUPAC name (including E/Z, if applicable) for the following compounds:

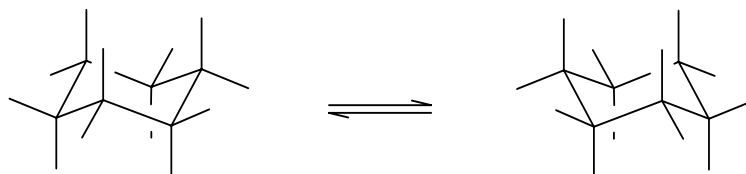


8. (5 marks) Shown below is an incomplete drawing of the ring-flipping equilibrium for *cis*-1-*tert*-butyl-2-iodocyclohexane (shown here at right).



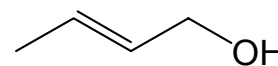
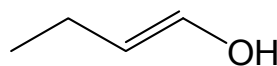
a) (2 marks) To the chairs below: add the Hs and substituents
& label the substituents as axial ("ax") or equatorial ("eq").

b) (1 mark) Name the important steric interactions in each conformer. Circle the substituents involved.



c) (2 marks) Imagine that a molecule of *cis*-1-*tert*-butyl-2-iodocyclohexane collides with a molecule of another compound "B" in a sample at room temperature. Which conformation of *cis*-1-*tert*-butyl-2-iodocyclohexane will molecule "B" most likely encounter? Why?

9. (4 marks) Two isomeric alcohols are shown here:



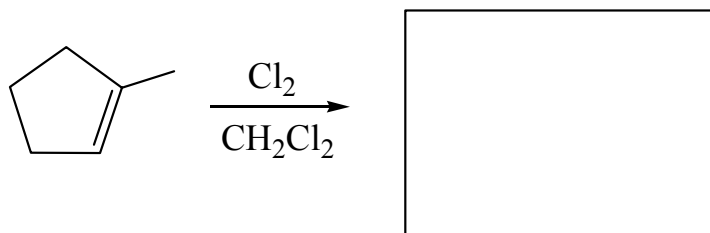
Which of the two compounds is more acidic?

Explain your choice, and include relevant structures to support your arguments.

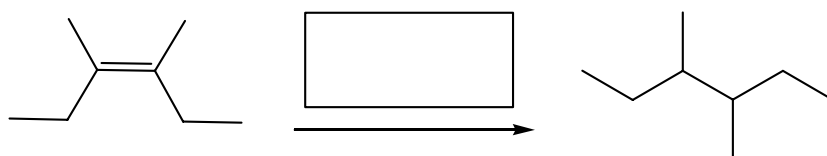
10. (6 marks) Fill in the boxes: draw the missing reactant or major product OR

list the missing conditions: reagent, catalyst, solvent (if critical for reaction)

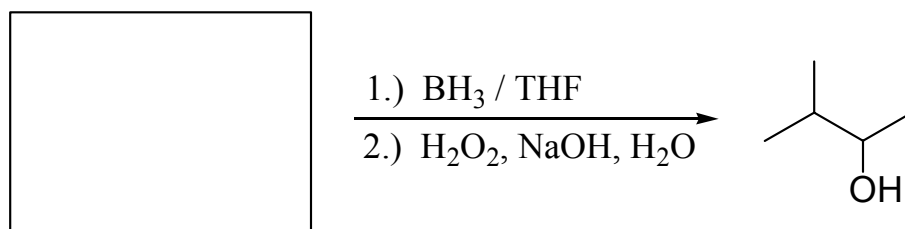
a)



b)



c)

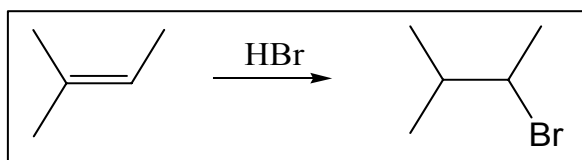


11. (10 marks) When planning the synthesis of one compound from another, it's just as important to know what *not* to do as to know what to do. For example, the target reaction shown below has a serious drawback to it. Your task here is to explain what is wrong with this approach.

Your explanation must include:

(6 marks) • full arrow-pushing mechanisms for: the target reaction *vs.* the pathway that will actually dominate

(4 marks) • written comments to explain (in detail) what causes this difference.



EXTRA SPACE FOR ROUGH WORK

POTENTIALLY USEFUL INFORMATION**TABLE OF pK_a VALUES**

Representative Compound	pK_a
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$	>51
CH_4	51
$\text{H}_2\text{C}=\text{CH}_2$	44
CH_3NH_2	40
NH_3	38
H_2	35
$\text{HC}\equiv\text{CH}$	25
$(\text{CH}_3)_3\text{COH}$	19
$\text{CH}_3\text{CH}_2\text{OH}$	17
CH_3OH	15.5
H_2O	15.7
RNH_3^+	9
H_2CO_3	6.4
$\begin{array}{c} \text{OH} \\ \\ \text{CH}_3\text{C} \\ \\ \text{O} \end{array}$	4.7
HF	3.2
H_3O^+	-1.7
$\text{CH}_3\text{CH}_2\text{OH}_2^+$	-2.4
H_2SO_4	-5.2
$\begin{array}{c} \text{OH} \\ \\ \text{CH}_3\text{C} \\ \\ \text{O}^+\text{H} \end{array}$	-6.5
HCl	-7
HI	-9