

Practice Exam #1
Chemistry 5.12
Organic Chemistry

- Midterm exam #1 will be held on Friday, February 21, from 12–1pm.
- Notes and calculators will not be allowed in the exam.
- You will be free to use molecular models during the exam.
- You will be given a periodic table.
- The exam will cover reading (Ch. 1, 2, 3.1–3.9) and lecture material through Tuesday, February 18.
- Dr. Tabacco will give a review session at 7pm on Tuesday, February 18
- Additional suggested problems from the book (some of these were already suggested during lecture): 1-23,25,27,34,36,37,39–43, 45–47, 2-27–31,33, 3-34,35,38,39,41a,b,42.
- For best results, take this test as if it were your exam. That way, you'll know which areas need extra work before you get to the real exam.

ANSWER KEY

1. Circle the correct answer.

a) What is the approximate H-C-H bond angle in methane?

109°

120°

180°

b) What is the IUPAC name for isobutane?

isopropylmethane

3-methylbutane

2-methylpropane

c) How much is a gauche butane interaction worth?

1.3 kcal/mol

0.9 kcal/mol

4.0 kcal/mol

d) What is the barrier to rotation of ethane?

1.0 kcal/mol

1.3 kcal/mol

3.0 kcal/mol

e) What is the pK_a of ethane?

4.5

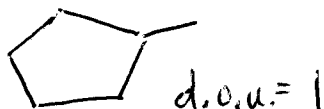
50

15.7

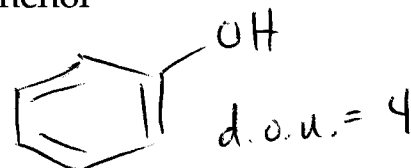
2. a) Provide line drawings for the following compounds.

b) How many degrees of unsaturation does each compound have?

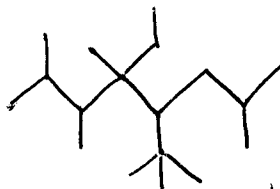
methylcyclopentane



phenol



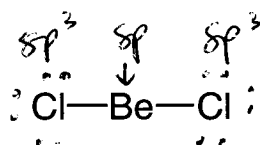
5-tert-butyl-4-ethyl-2,3,4,7-tetramethyloctane



Name

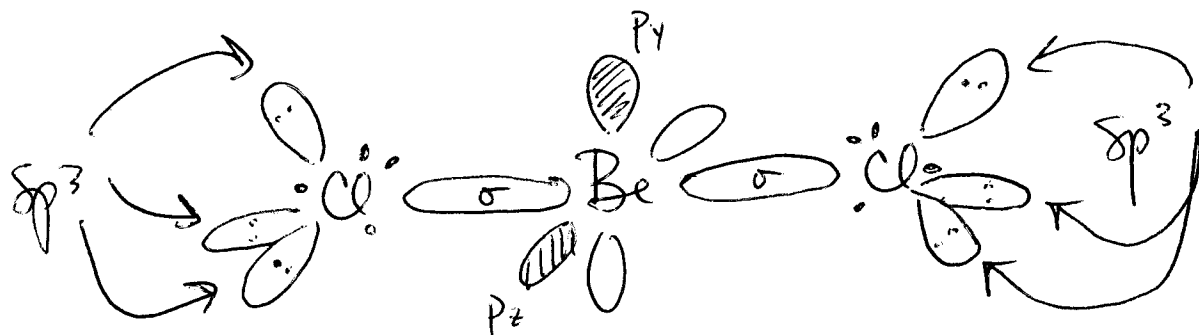
Key

3. Below is a line drawing of beryllium chloride (BeCl_2).
- Draw in all of the lone pairs.
 - Label the atoms with their appropriate hybridization.
 - What is the bond angle in BeCl_2 ?



180° (linear)

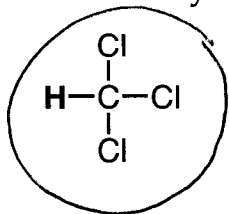
- Draw an orbital picture of BeCl_2 . Label all orbitals (bonding and non-bonding).



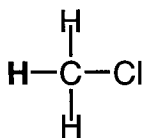
- Would you expect BeCl_2 to be nucleophilic or electrophilic? Explain briefly.
 Electrophilic. Be has four valence electrons and two empty orbitals. It can accept electrons.

Name Key

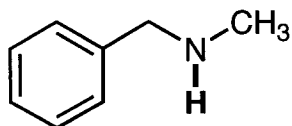
4. For each pair, circle the molecule with the lowest pK_a and provide a brief explanation for your choice.



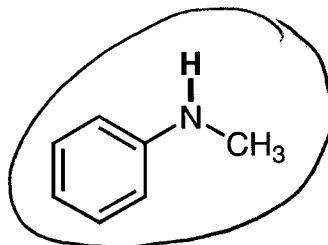
vs



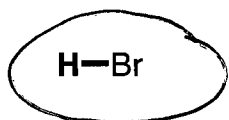
most acidic
inductive effects
(more EWGs → lower pK_a)



vs



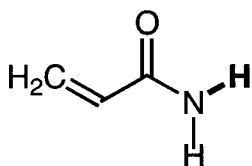
resonance



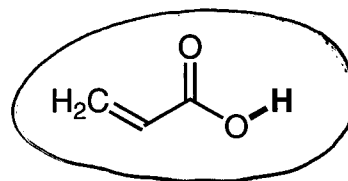
vs



atom size
(larger atom → lower pK_a)

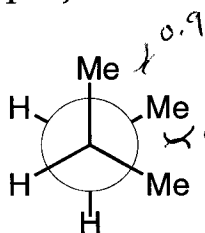


vs

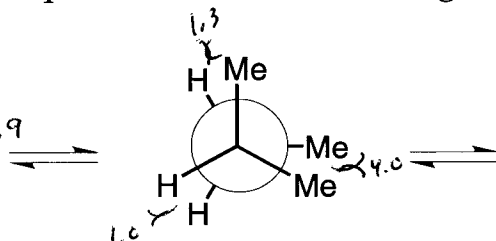


electronegativity
(O more EN than N)

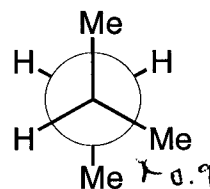
5. Provide a line drawing for the alkane represented by the following Newman projections and predict the relative energies of the conformers.



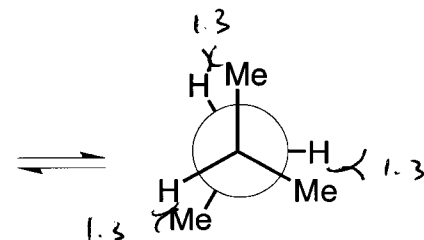
$$E_{\text{rel}} = 1.8$$



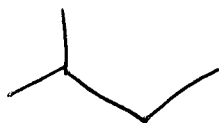
$$E_{\text{rel}} = 6.3$$



$$E_{\text{rel}} = 0.9$$



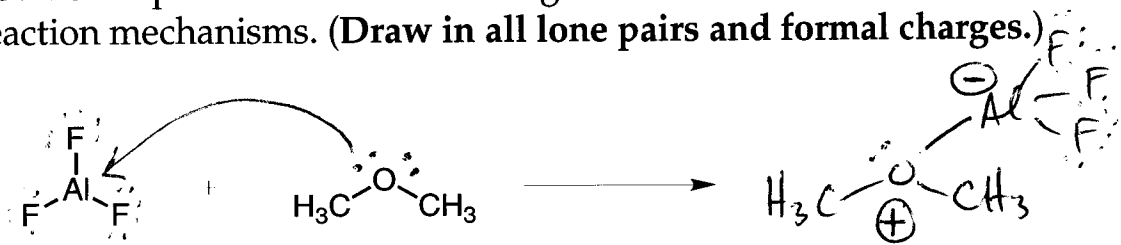
$$E_{\text{rel}} = 3.9$$



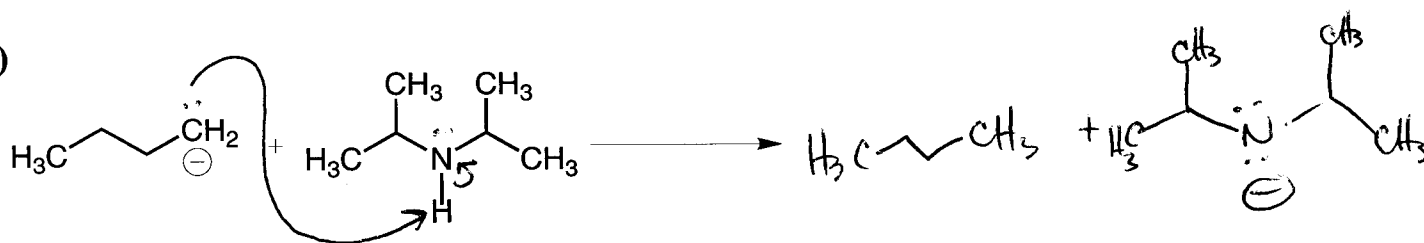
Name Key

6. Provide the products of the following reactions and use curved arrows to draw the reaction mechanisms. (Draw in all lone pairs and formal charges.)

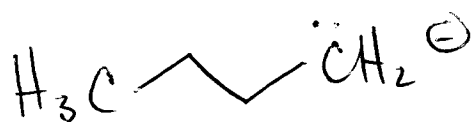
a)



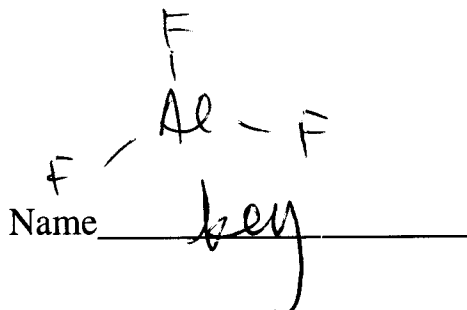
b)



c) In the above reactions, which of the four molecules is acting as a Bronsted base?

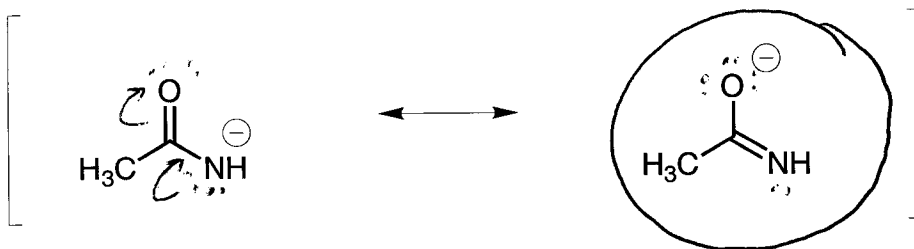


d) In the above reactions, which of the four molecules is acting as a Lewis acid?

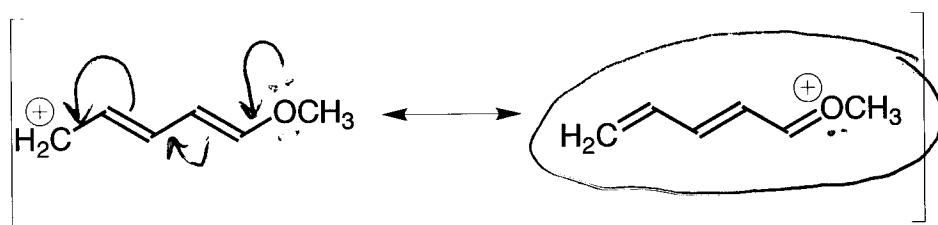


7. a) For each pair, circle the major (lowest energy) resonance structure and provide a brief explanation for your choice.

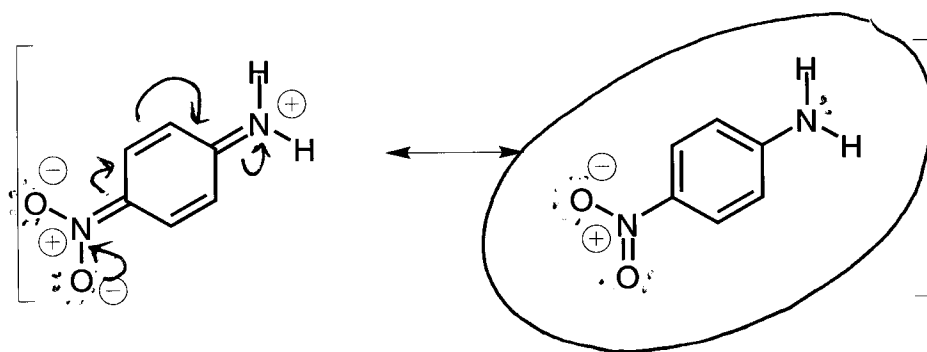
b) Draw curved arrows to convert the structures on the left to the structures on the right. Draw in any lone pairs that you move with curved arrows.



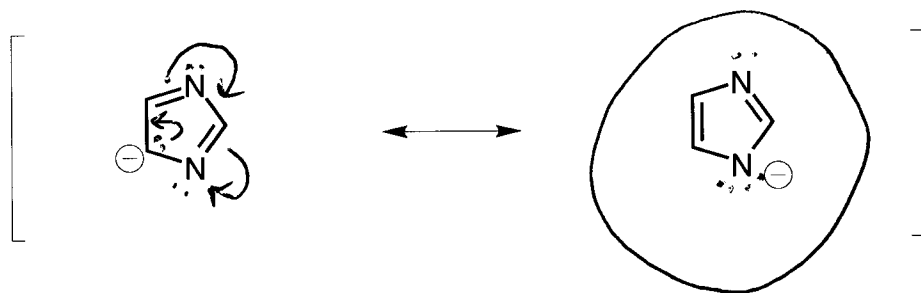
O more EN than N.



filled octets



less charge separation

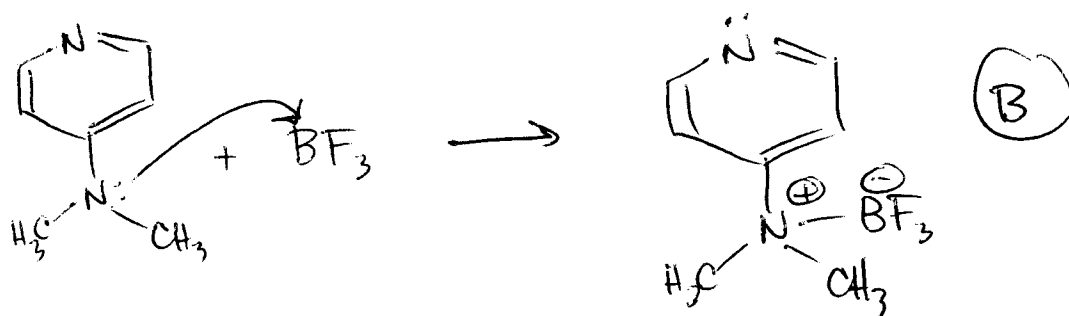
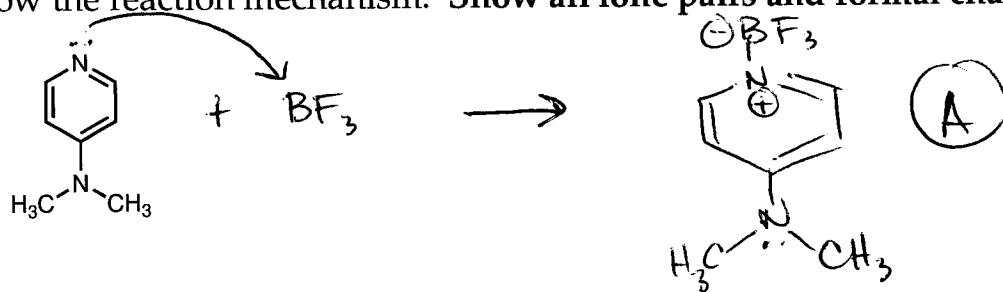


N more EN than C.

Name

Isay

8. a) Both of the nitrogen atoms in A are potentially Lewis basic. Draw the two possible products resulting from the reaction of A with BF_3 . Use curved arrows to show the reaction mechanism. Show all lone pairs and formal charges.



b) Which product from part a would you expect to be more stable? Draw resonance structures to illustrate your answer.

