

NAME: _____

Chem istry 231

TAKE-HOME EXAM 1

FALL 2001

Associate Professor: Dr. Gergens

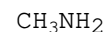
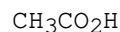
DUE 9/26

1. (12) Circle the most (highest); underline the least (lowest)

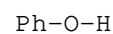
basic



acidic

preferred side of
equilibrium

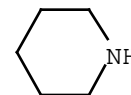
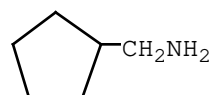
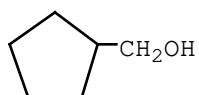
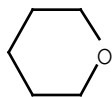
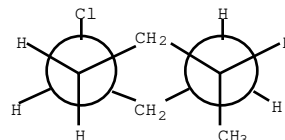
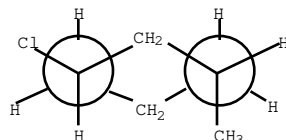
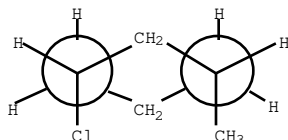
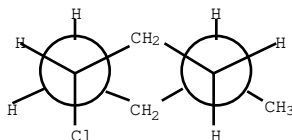
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+



highest boiling isomer

stable chair
structure for
 $\text{C}_7\text{H}_{13}\text{Cl}$ 

electronegative atom

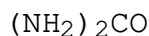
C

O

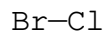
N

I

2. (2) In the following, circle ALL compounds that are covalent:



ammonium bromide

3. (2) Draw in the direction of the bond dipole moment and indicate which end of the bond is partial positive, δ^+ , and which is partial negative, δ^- :

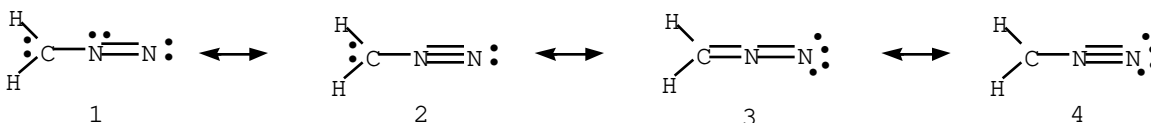
4. (2) Complete the following for carbon-14.

Number of neutrons:	Number of protons:	Number of electrons:
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5. (4) A typical covalent bond is worth between _____ and _____ kcal/mole in bond strength. Nonbonding interactions are considerably weaker. A hydrogen bond is _____ kcal/mole, a dipole-dipole interaction is _____ kcal/mole, and a dispersion force is _____ kcal/mole.

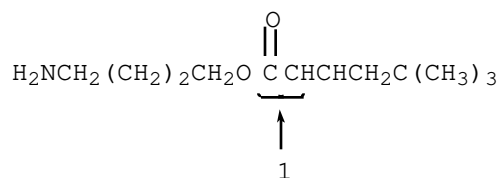
Structure and Bonding

6. (2) Mark with an "X" all formulas that are NOT valid resonance structures of diazomethane, CH_2NN .



7. (2) For each valid structure in question 6, indicate the formal charge on each atom.
8. (3) Between the valid structures of CH_2NN in question 6, which structure is the major contributor and why?
9. (3) Using atomic orbitals, draw a three-dimensional representation (using wedges and dashes lines) of the structure for the major contributor in question 6, showing how the sigma and pi bonds are formed and where the electrons are located.

10. (4) For the compound below.



Circle the best choice for the following:

0 1 2 3 4 5 6	a. Draw the line-angle structure.
0 1 2 3 4 5 6	b. How many non bonding electron pairs are in this molecule?
0 1 2 3 4 5 6	c. What is the degree of unsaturation in this molecule?
0 1 2 3 4 5 6	d. How many tertiary centers are in this molecule?
0 1 2 3 4 5 6	e. How many atoms in this molecule have sp^2 hybridization?
$\pi_{(\text{p}-\text{p})}$ $\sigma_{(\text{sp}^2-\text{sp}^2)}$ $\sigma_{(\text{sp}^2-\text{sp}^3)}$	f. The bonding molecular orbital between the carbonyl and the CH, identified as number 1.

11. (3) Valence Bond Theory

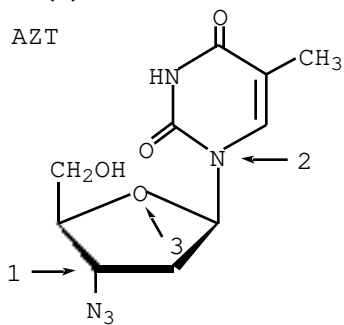
a. Based on the experimentally determined bond angle for water, the predicted H-S-H bond angle in H_2S would be 104.5° . The actual experimental bond angle in the H-S-H bond angle in H_2S has been experimentally determined to be 92° .

b. Draw the valence bond picture for the experimentally observed bond angle for H_2S .



12. (3)

AZT



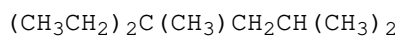
3'-azido-3'-deoxythymidine

a. Indicate the geometry and hybridization about atoms 1-4.

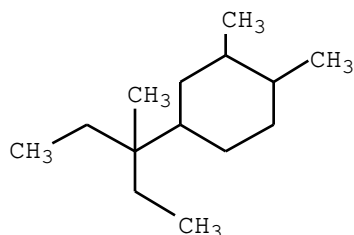
Geometry	Hybridization
1. _____	_____
2. _____	_____
3. _____	_____

13. (2) What are the predicted bond angles for the numbered atoms in AZT: 1. _____; 2. _____; 3. _____.

14. (8) Name or draw the following compounds:



1-cyclopropyl-2-(1-ethylbutyl)-5-methylcyclohexane

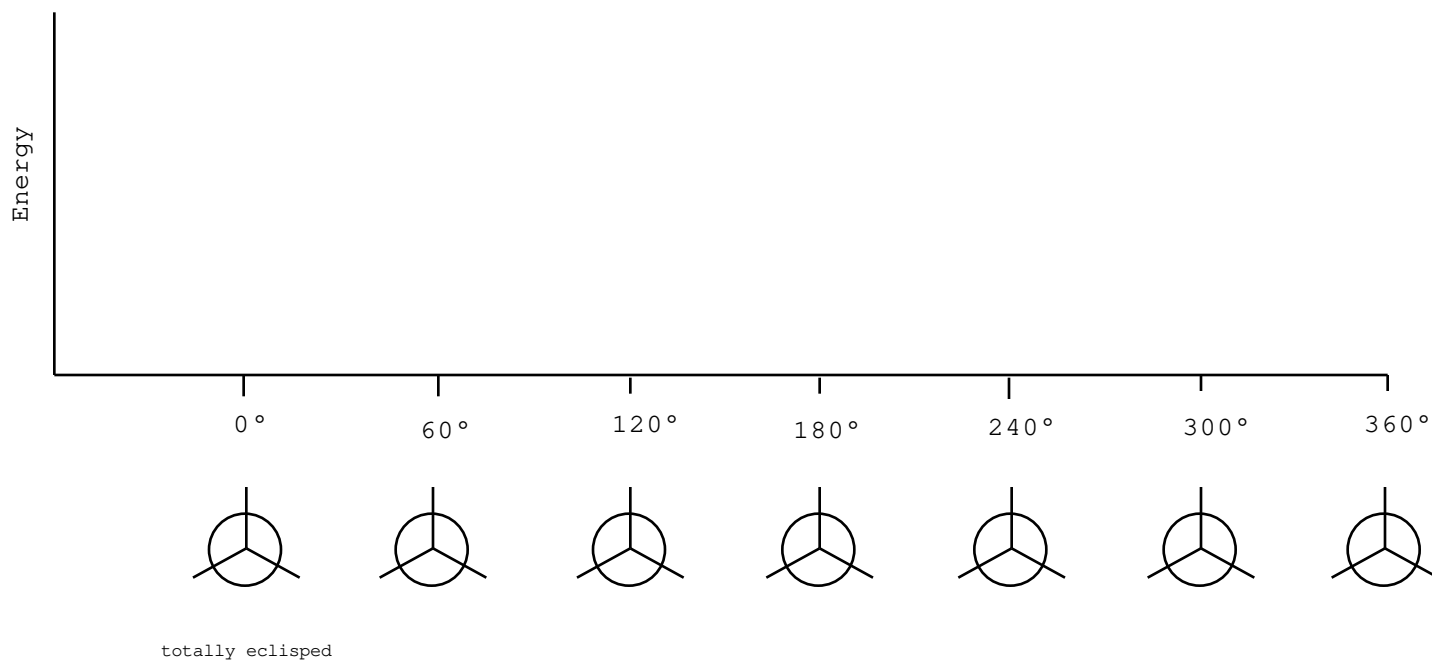


isobutylcyclopentane

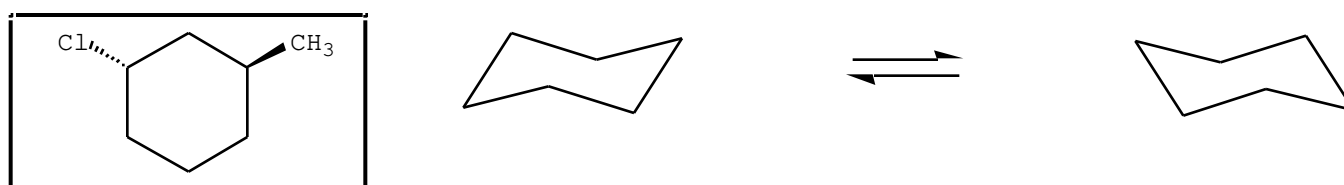
15. (6) Conformation Analysis

Draw the Newman projection for 2-methylbutane about the C_2-C_3 bond in the eclipsed, staggered, and skewed conformations and label all gauche interactions. Draw a graph of the torsional strain observed in 2-methylbutane as it rotates about the C_2-C_3 bond. Show the dihedral angle and calculated torsional strain for each conformation.

eclipsing methyl groups > eclipsing methyl hydrogen > eclipsing hydrogen-hydrogen
 torsional strain 3.0 kcal 1.3 kcal 1.0 kcal

16. (6) Chair Conformations

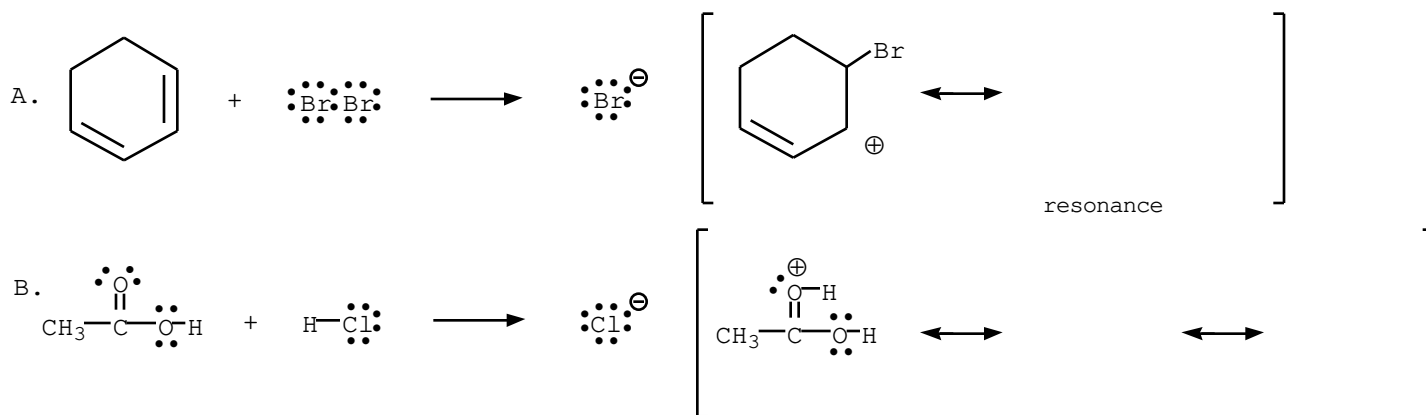
a. Draw the chair conformation for compound in the box at the left.



b. Circle the most stable conformer.

c. Determine the energy difference between two chair conformers and calculate the equilibrium concentration of each conformer at room temperature.

17. (2) Label the reactants in these acid-base reactions as Lewis acids (electrophiles) or Lewis bases (nucleophiles).

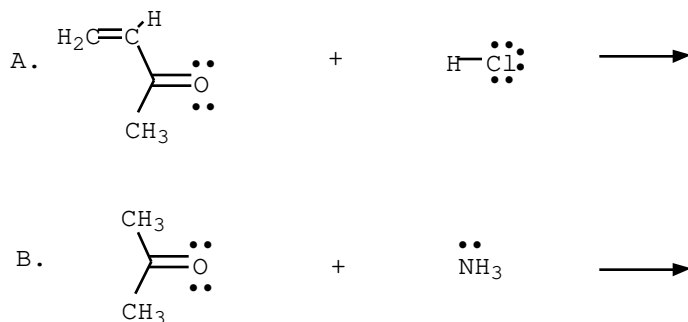


18. (2) Use curved arrows to show the movement of electrons in the Lewis acid-base reactions of question 17.

19. (2) Complete the resonance structures in question 17.

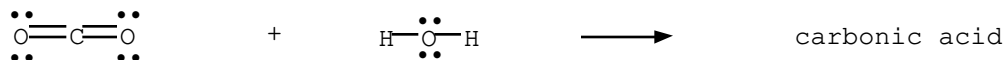
20. (4) Complete the reaction and classify the reaction type as either substitution, addition, acid-base, or elimination. If the final product has resonance forms, draw them.

Reaction Type:



21. (2) Use curved arrows to show the movement of electrons in the Lewis acid-base reactions of questions 18.

22. (4) Using your knowledge of Lewis acid-base chemistry, draw a possible mechanism for the formation of carbonic acid. Show all steps, resonance structures, formal charge, and arrow pushing in your mechanism. Proceed stepwise. You should have a minimum of three individual steps in the mechanism.



NAME: _____

Chemistry 231

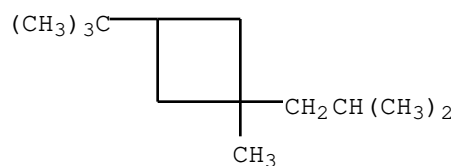
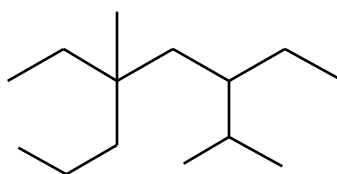
EXAM QUIZ 1

9/26

FALL 2001

Associate Professor: Dr. Gergens

1. (6) Name the following compounds:



2. (18) Multiple Choice - Place your answer in the box at the right.

a. A molecule of NH_2NH_2 has _____ hybridization about each nitrogen atom.

A. sp^3	B. sp^2	C. sp	D. p^3	
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b. A ion of sulfite, SO_3^{2-} , has _____ hybridization about the sulfur atom

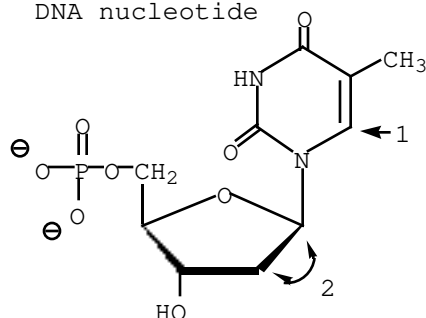
A. sp^3	B. sp^2	C. sp	D. p^3	
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c. Of the molecules listed, the one that would be linear is

A. BeF_2	B. SO_2	C. O_3	D. H_2S	
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d-g

DNA nucleotide



2'-deoxythymidine 5'-phosphate

d. Indicate the hybridization about atom 1

A. sp	B. sp^2	C. sp^3	D. dsp^3	E. s	
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e. Indicate the geometry about atom 1.

A. linear	B. bent	C. trigonal planar	D. pyramidal	E. tetrahedral	
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f. Indicate the bond angle about atom 1

A. 90°	B. 104.5°	C. 109.5°	D. $\sim 120^\circ$	E. 180°	
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g. The degree of unsaturation in this molecule is

A. 2	B. 3	C. 4	D. 5	E. 6	
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h. The predicted bonding molecular orbital between the carbon atoms indicate by the curved arrow attached to number 2;

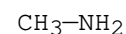
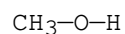
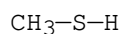
A. $\pi(\text{p}-\text{p})$	B. $\sigma(\text{sp}^2-\text{sp}^2)$	C. $\sigma(\text{sp}^2-\text{sp}^3)$	D. $\sigma(\text{sp}^3-\text{sp}^3)$	
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i. Draw in the direction of the bond dipole moment and indicate which end of the bond is partial positive, δ^+ , and which is partial negative, δ^- :

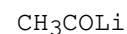
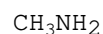
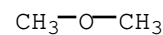
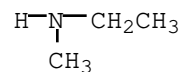
A. $\delta^+ \text{C}-\text{O} \delta^-$	B. $\delta^- \text{C}-\text{O} \delta^+$	C. $\delta^+ \text{C}-\text{O} \delta^-$	D. $\delta^- \text{C}-\text{O} \delta^+$	
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3. (20) Circle the most (highest); underline the least (lowest)

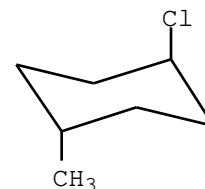
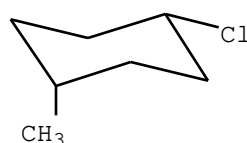
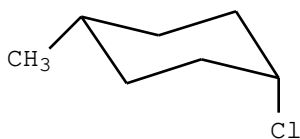
acidic



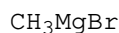
basic

highest boiling compound $\text{H-O-CH}_2\text{CH}_2\text{CH}_3$ 

stable conformer



preferred side of equilibrium



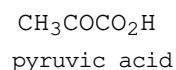
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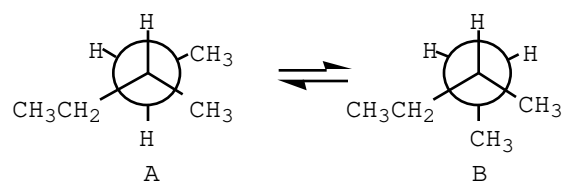
4. (4) For the compound below.



a. Draw the line-angle structure. b. Show all non bonding electron pairs.

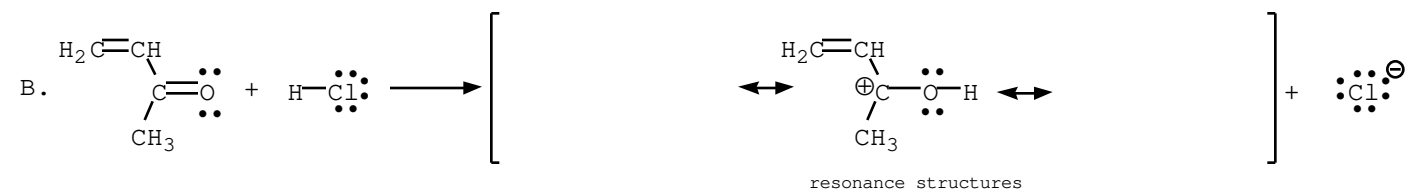
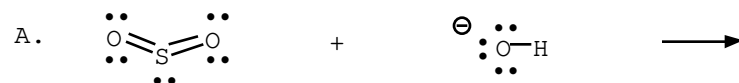
5. (6) a. Name the compound in the box below: _____

b. What is the difference in free-energy between the two forms?



c. Which side of equilibrium is preferred?

6. (6) For each reaction, indicate the Lewis acid and base. Complete the reaction and use curved arrows to show the movement of electron pairs (i.e., arrow pushing of electrons). Show all formal charges and resonance structures in the product.



d. What percentage of each conformer will be present at 25 °C?

NAME: _____

Chemistry 231

EXAM 1

9/23

FALL 1997

Assistant Professor: D.D. Gergens, Ph.D.

1. (18) Circle the most (highest); underline the least (lowest)

polar bond



electronegative atom

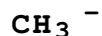
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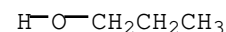
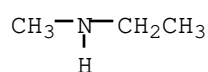
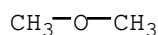
S

Be

basic



highest boiling isomer



preferred side of equilibrium



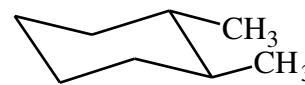
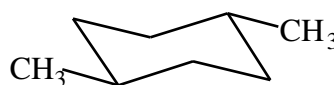
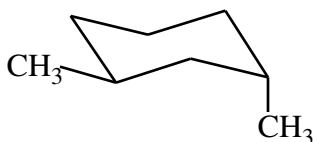
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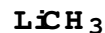
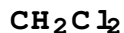
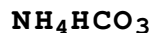
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stable conformer

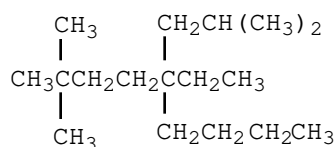


2. (4) In the following, circle ALL compounds that are ionic:



sodium acetate

3. (8) Name or draw the following compounds



trans-1-sec-butyl-2-isopropylcyclohexane