Printed Name:_____

CHEM 3311-100, Fall 2013
Professor Walba
First Hour Exam
September 24, 2013

scores:

1) 20

2) 20

3) 20

4) 20

5) 20

_____

100

CU Honor Code Pledge: On my honor, as a University of Colorado at Boulder Student, I have neither given nor received unauthorized assistance.

Signature: Key _____

Recitation TA Name: _____

Recitation day and time: _____

This is a closed-book exam. The use of notes, calculators, scratch paper, or cell phones will not be allowed during the exam. You may use models brought in a clear ziplock bag. Please put all you answers on the test. Use the backs of the pages for scratch.

PLEASE read the questions very carefully!

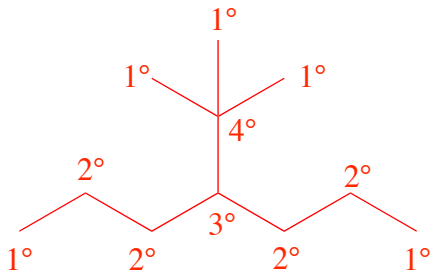
PLEASE legibly print your name on each page of the exam.

Partial Periodic Table

1A							8A
1 H	2A	3A	4A	5A	6A	7A	2 He
3 Li	4 Be	5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
						35 Br	
						53 I	

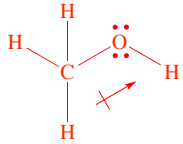
Printed Name:_____

1 (20 pts) a) Draw a valence bond "skeletal" structure (molecular graph showing only carbon vertices) of 4-*tert*-butylheptane. Please make the structure large enough to include the information requested in part b below.

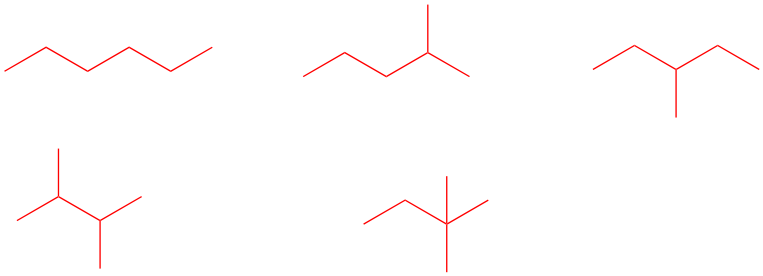


b) Carefully label every carbon atom in your structure of 4-*tert*-butylheptane above with its degree of substitution using the symbols 1°, 2°, 3°, or 4°.

c) Draw a valence bond structure of methanol (CH_3OH) [remember – all valence electrons must be shown in your structure). On your structure, carefully indicate the direction of the net dipole moment associated with methanol using the conventional shorthand (⟶).



d) Draw skeletal structures (molecular graphs showing only carbon vertices) for all possible isomers of hexane (C_6H_{14}). Be careful to draw each isomer only once – points will be taken off for both missing and redundant structures.



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2) (20 pts) For each of the following molecular formulas, draw a valid valence bond structure showing all atoms (including Hs), and lone pairs (hint: The correct structures have no formal charges).

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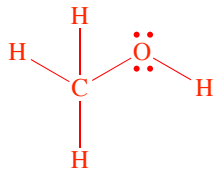
a) CH_3OH



Tetrahedral, sp^3

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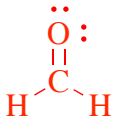
b) CH_2O



Trigonal, sp^2

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c) HCN

Linear, sp

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d) For each structure in a-c above, indicate the geometry (tetrahedral, trigonal planar, or linear) and hybridization (*sp^3, sp^2, or sp*) **on carbon**. Put your answers next near the structures.

e) For each of the following pairs of structures, circle the stronger Brønsted acid.

CH_4 **H_2O**	**HF** H_2O
H_2O NH_3	H_2O **H_2S**

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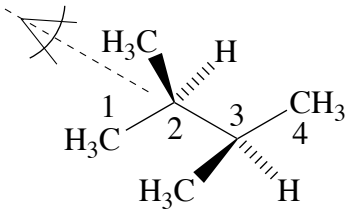
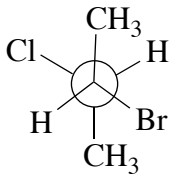
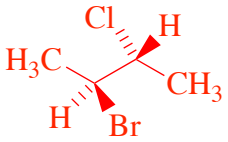
3) 20 pts) a) For 2,3-dimethylbutane (structure given below), carefully draw Newman projections of the three staggered conformations sighting down the C2 - C3 bond, as indicated. Put your projections in the boxes.



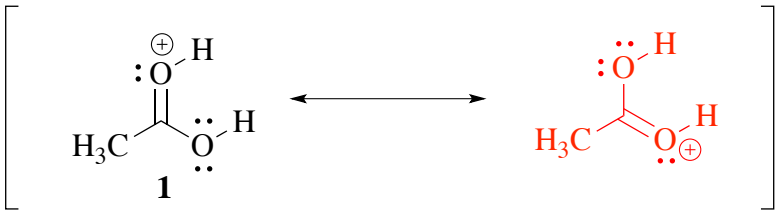
b) Circle the most stable conformation (or conformations if two are equal and most stable) of 2,3-dimethylbutane above.

c) Carefully re-draw the Newman projection of 2-bromo-3-chlorobutane given below as a wedges and dashes structure similar to that given for 2,3-dimethylbutane in part a) above.

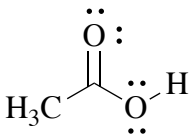




d) Acetic acid can be protonated to give the cation **1** below. The structure shown is not a good model for the structure of the actual cation. Complete the valence bond with resonance indicated to give a better picture of the real structure.



e) The structure of acetic acid is given below. Is the protonated acid **1** a stronger acid or weaker acid than acetic acid? Circle your answer below.



is a (stronger) or (weaker) acid than **1**

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4) (20 pts) a) Give the product expected from reaction of methanol with boron trifluoride. Make the structure of the product a valid valence bond structure showing all lone pairs and formal charges. The product has the formula CH_4BF_3O (this formula gives all the atoms in the structure, but is not meant to indicate the connectivity of the atoms).

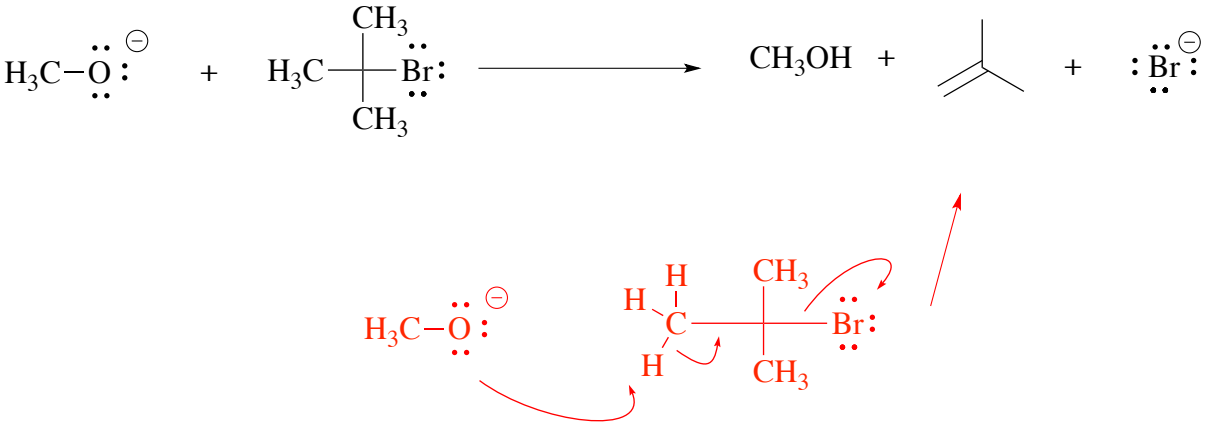
b) Place a check mark next to the generic name of the type of reaction shown in part a) above.

Lewis acid-base association ☑

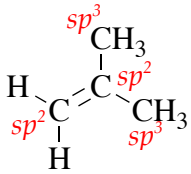
Lewis acid-base dissociation ☐

Electron pair displacement ☐

c) Propose an arrow-pushing mechanism for the following transformation.



d) For the alkene product of the above reaction, indicate the hybridization of **each carbon** by labeling them on the structure re-drawn below.



e) How many π bonds are present in the structure of the alkene product of the reaction in part c? (Please put your answer in the box)

1

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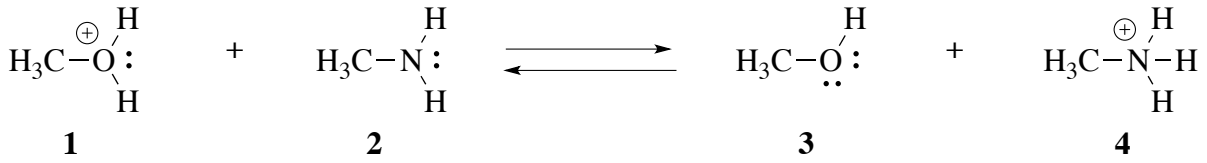
5) (20 pts) For the Brønsted acid-base equilibrium given below:



1 **2** **3** **4**

a) Using the compound numbers, indicate in the box which of these four molecules are the acids in this reaction.

1 & 4

b) Indicate by number which acid is the stronger acid in the box below.

1

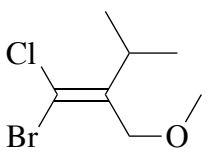
c) Give a **short** explanation of your answer in part b above.

The relative acidity of a pair of acids in a row of the periodic table is dominated by the relative stability of the ions. Nitrogen is less electronegative than oxygen. Therefore, a positive nitrogen is more stable than a positive oxygen, other things being equal. Due to this electronegativity effect, the methylammonium cation (**4**) is more stable, and therefore the weaker acid, and the methoxonium cation (**1**) is less stable, and the stronger acid.

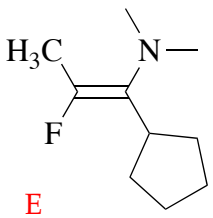
d) Is the equilibrium constant for the reaction above greater than 1, or less than 1? (put your answer in the box).

K_{equ} is > 1

e) For each of the following alkenes, label the stereochemical configuration as E or Z.



Z



E

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