

CHEM 3311

HARRINGTON

Exam 1 7:00 – 8:30 PM September 20, 2016 in MATH 100

Instructions. No notes, books, laptops, phones, or calculators.
Periodic Table and electronegativity chart are provided.

NAME: KEY

	Points Possible	Score
1	15	
2	11	
3	15	
4	16	
5	14	
6	15	
7	14	
Exam 1 Total Raw Score	100	
Curve		
Exam 1 Curved Score		
Exam 1 Letter Grade		

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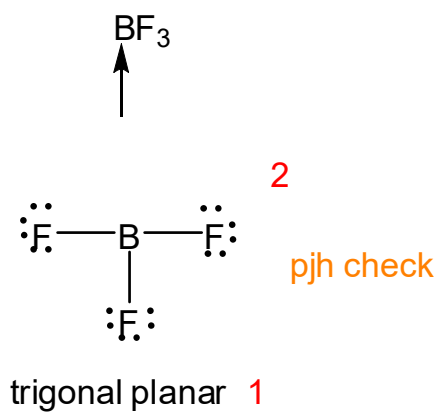
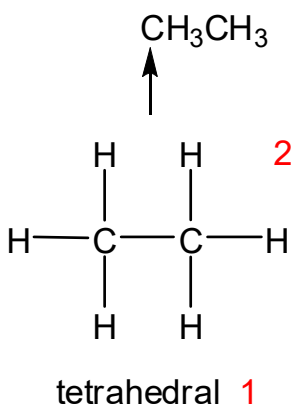
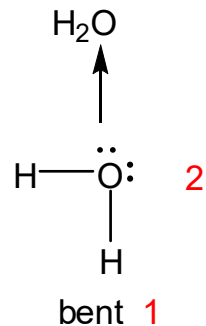
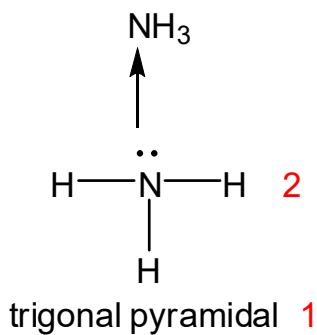
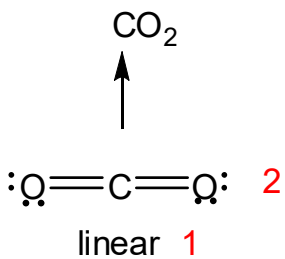
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1. (15 points) For each molecule, draw a Lewis Dot structure and then use VSEPR Theory to predict the approximate **MOLECULAR GEOMETRY** around the indicated atoms.

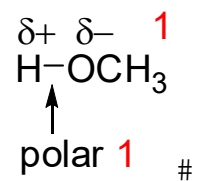
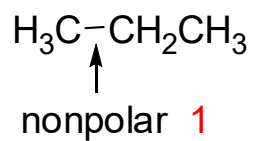
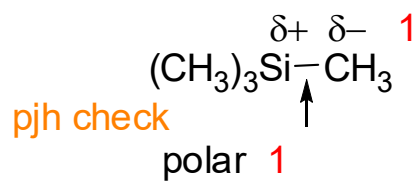
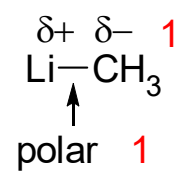
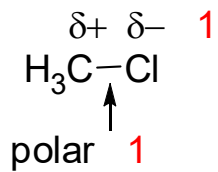
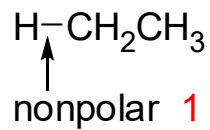


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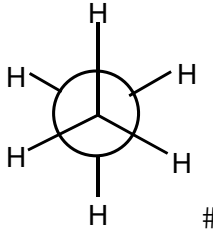
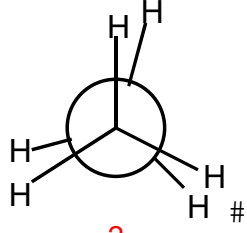
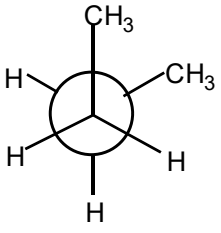
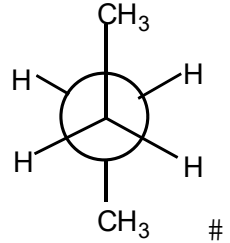
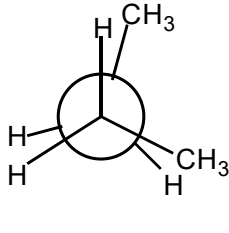
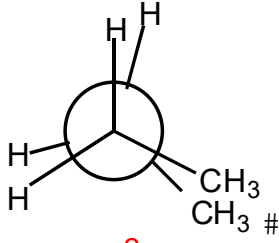
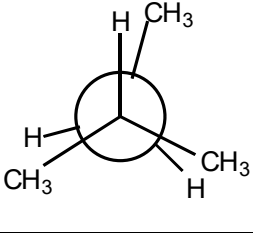
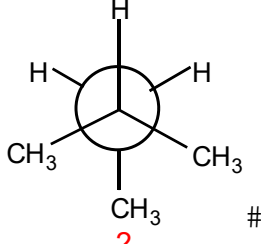
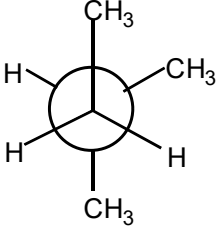
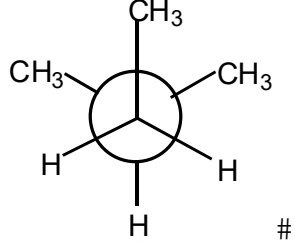
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2. (11 points) For each covalent bond shown below, indicate if the bond is **polar or nonpolar**. If the bond is polar, indicate the **direction of the polarization** using partial charges (δ^+ and δ^-).



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3. (15 points) Follow the directions given to convert each Newman projection into a second Newman projection. Draw the second projection. Is the second projection **HIGHER** in energy than the first, **LOWER** in energy than the first, or the **SAME** energy as the first?

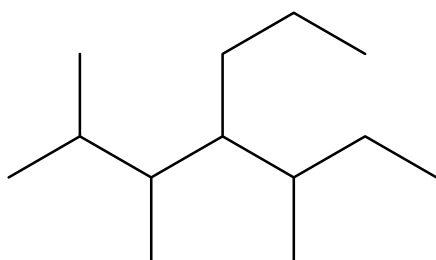
Projection #1	Directions	Projection #2	Higher Energy Lower Energy Same Energy?
	rotate back C 60° clockwise	 <p>2 drawing: pjh check</p>	Higher 1
	rotate back C 120° clockwise	 <p>2</p>	Lower 1
	rotate back C 120° clockwise	 <p>2</p>	Higher 1
	rotate back C 180° clockwise	 <p>2</p>	Lower 1
	rotate back C 120° counterclockwise	 <p>2</p>	Higher 1

4. (16 points) Name each of the following compounds using IUPAC substitutive nomenclature.

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a.

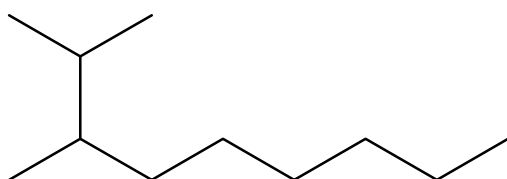


all numbers correct 1

2,3,5-trimethyl-4-propylheptane

1 1 1

b.

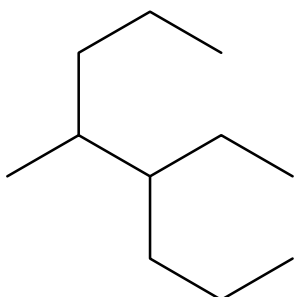


all numbers correct 1

2,3-dimethylnonane

1 2

c.



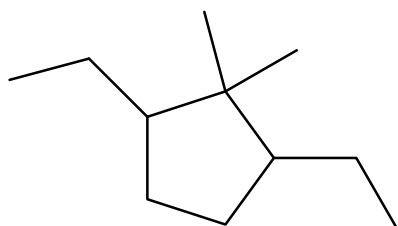
pjh check

all numbers correct 1

4-ethyl-5-methyloctane

1 1 1

d.



all numbers correct 1

2,5-diethyl-1,1-dimethylcyclopentane

1 1 1

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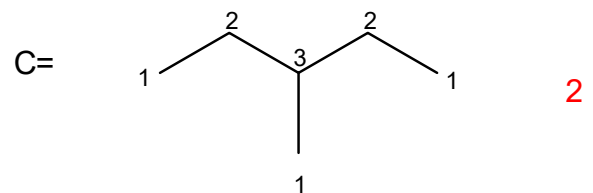
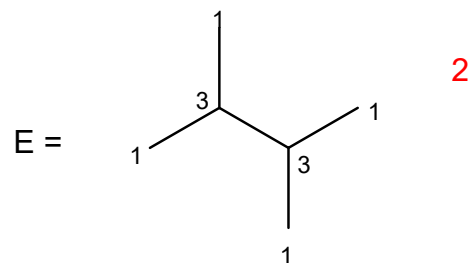
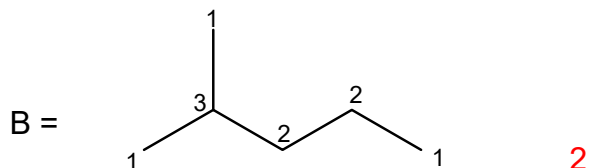
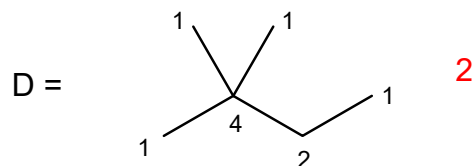
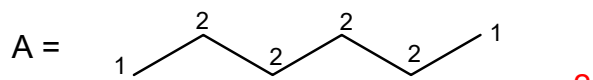
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5. (14 points) Draw structures for all the constitutional isomers of C_6H_{14} .

Classify all the C's in one of your structures.

pjh check

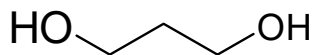


Label correct structures ABCDE as shown above.
Ignore incorrect structures.

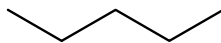
Classification 4

If the student classifies all C's in all structures, grade only the first structure.
If the student does not classify all C's in the structure, -1 for each missed C.

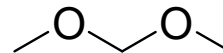
6. (15 points) The five compounds below have a molecular weight in the range of 72 to 76 g/mol but their boiling points range from +9 to +211°C! List all relevant intermolecular attractive forces for each compound. Use these forces to explain your match of each compound to a boiling point.



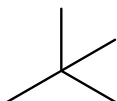
A



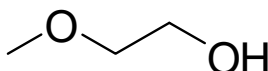
B



C



D



E

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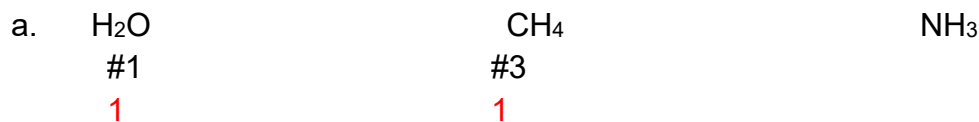
Compound	Boiling Point (°C)	Intermolecular Attractive Forces
A 1	211	2 hydrogen bonds (HB) 2
E 1	124	1 hydrogen bond (HB) 2
C 1	42	dipole-dipole attraction (DD) 2
B 1	36	Instantaneous dipole-induced dipole (IldI) IldI only higher surface area than D 2
D 1	9	Instantaneous dipole-induced dipole (IldI) IldI only branching reduces surface area 2

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Must include A has 2 HB and E has only 1 to get 4 for A and E explanations.

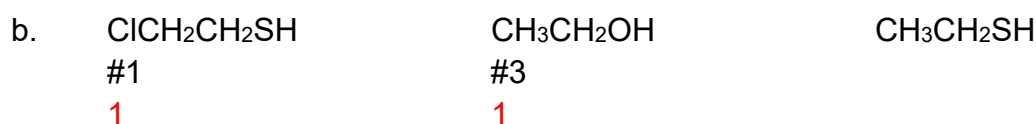
Must include B has greater surface area than D to get 4 for B and D explanations.

7. (14 points) For each set of three compounds, label the most acidic #1 and the least acidic #3. Provide a brief explanation for each answer in the space provided.



Element Effect: electronegativity 2

The 3 anions have charge on O C N, all elements from the 2nd row of the periodic table. Use electronegativity to evaluate relative stability. $\text{O} > \text{N} > \text{C}$ so H_2O is the strongest acid and CH_4 is the weakest acid.

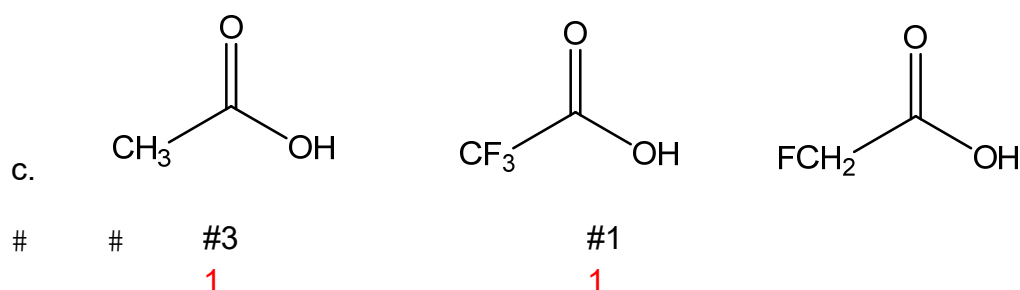


Element Effect: size 2 AND Inductive Effect 2

The anions from $\text{CH}_3\text{CH}_2\text{OH}$ and $\text{CH}_3\text{CH}_2\text{SH}$ have charge on O and S, both elements from column 6A of the periodic table. Use size to evaluate relative stability.

S is larger than O so $\text{CH}_3\text{CH}_2\text{SH}$ is stronger acid than $\text{CH}_3\text{CH}_2\text{OH}$.

The anions from $\text{CH}_3\text{CH}_2\text{SH}$ and $\text{ClCH}_2\text{CH}_2\text{SH}$ both have charge on S. The Cl of $\text{ClCH}_2\text{CH}_2\text{SH}$ induces a δ^+ on the attached C. The δ^+ stabilizes the nearby S- so $\text{ClCH}_2\text{CH}_2\text{SH}$ is a stronger acid than $\text{CH}_3\text{CH}_2\text{SH}$.



Inductive Effect 2

The 3 anions all have charge on O.

The F of FCH_2 induces a δ^+ on the attached C. The δ^+ stabilizes the nearby O-. FCH_2COOH is stronger acid than CH_3COOH .

The 3 F's of CF_3 induce a larger δ^+ on the attached C. The δ^{+++} stabilizes the nearby O- more than δ^+ . CF_3COOH is stronger acid than FCH_2COOH .