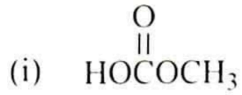
Hw1: Intro & Chem Principle Review

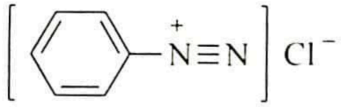
1. Draw a Lewis structure for each of the following compounds:

(a) C_2H_6 **(b)** C_2H_4 **(c)** C_2H_2 **(d)** C_3H_8 **(e)** C_3H_6 **(f)** CH_3OH

2. According to the octet rule, draw dots to identify all the lone pair of electrons in the compounds below:

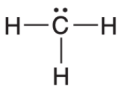
(i) 

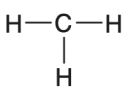
(ii) 

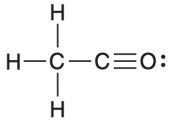
(iii) 

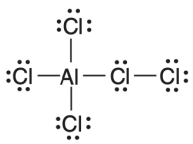
3. Borane (BH_3) is very unstable and quite reactive. Draw a Lewis structure of borane and explain the source of the instability.

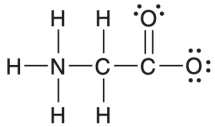
4. Identify any formal charges in the structures below:

(e) 

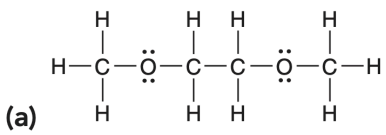
(f) 

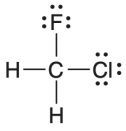
(g) 

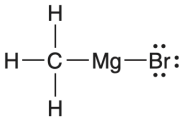
(h) 

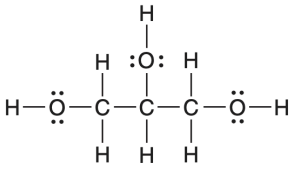
(i) 

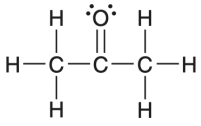
5. For each of the following compounds, identify any polar covalent bonds by drawing δ+ and δ− symbols in the appropriate locations:

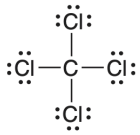

(a)


(b)

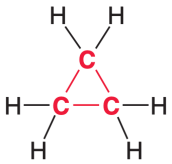

(c)


(d)


(e)


(f)

6. Cyclopropane is a compound in which the carbon atoms form a three-membered ring:

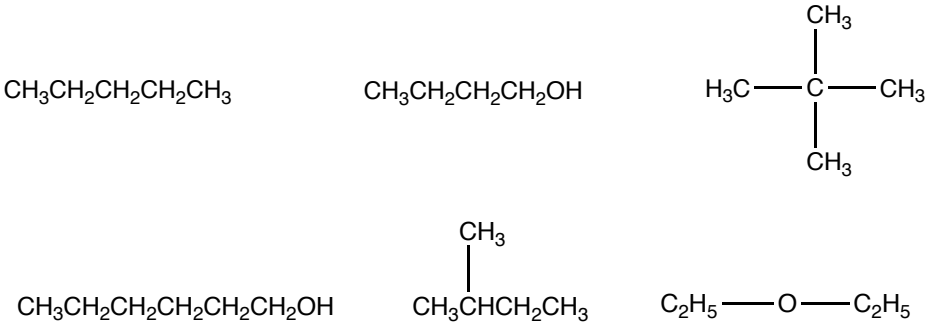


Each of the carbon atoms in cyclopropane is sp^3 hybridized. Cyclopropane is more reactive than other cyclic compounds (four-membered rings, five-membered rings, etc.).

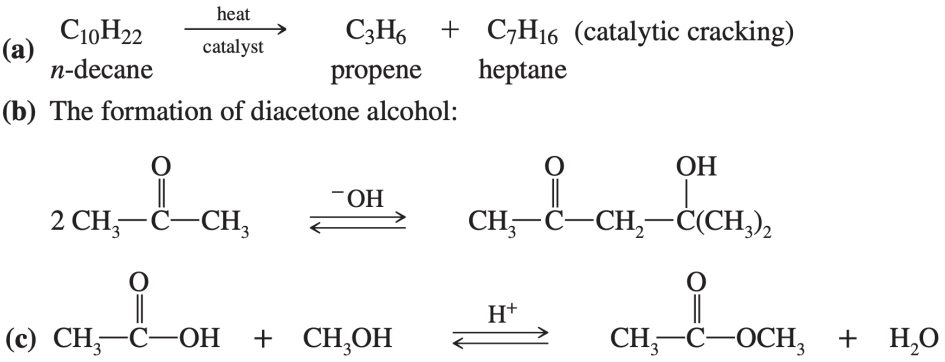
a) Analyze the bond angles in cyclopropane.

b) Explain why cyclopropane is so reactive. (Tips: use the bond angle you predicted in (a) and the bond angle of sp^3 hybridization to solve this problem)

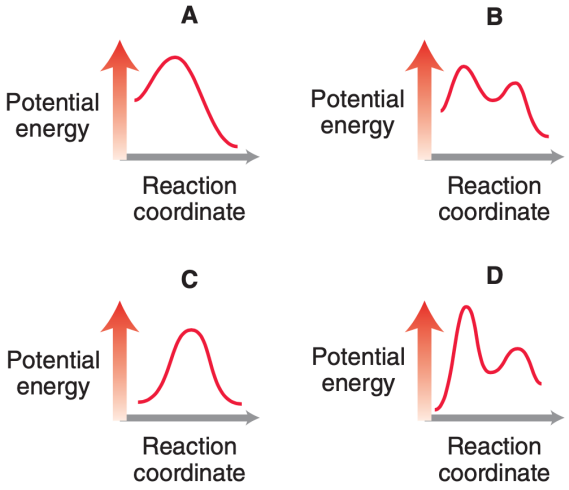
7. Order the boiling points of the following compounds from low to high:



8. For each reaction, estimate whether $\Delta S°$ for the reaction is positive, negative, or impossible to predict.



9. Consider the following four energy diagrams:



a) Which diagrams correspond with a two-step mechanism?

b) Which diagrams correspond with a one-step mechanism?

c) Compare energy diagrams A and C. Which has a relatively larger E_a?

d) Compare diagrams A and C. Which has a negative ΔG?

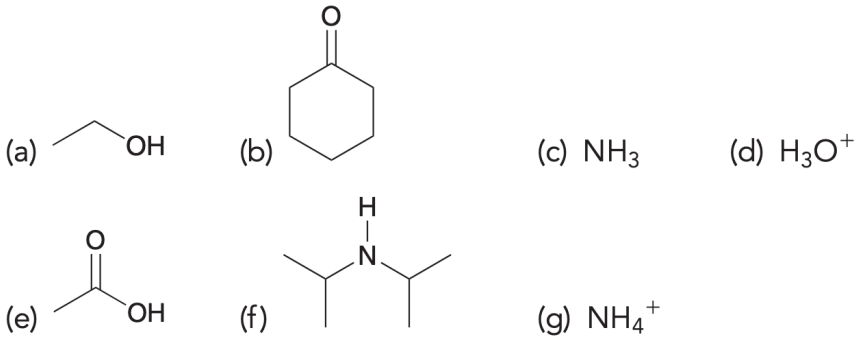
e) Compare diagrams A and D. Which has a positive ΔG?

f) Compare all four energy diagrams. Which one exhibits the largest E_a?

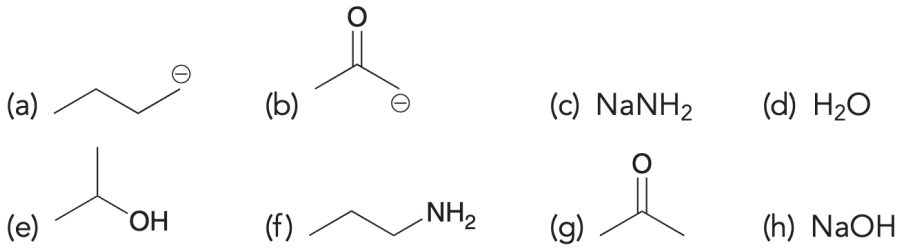
g) Which processes will have a value of K_{eq} that is greater than 1?

h) Which process will have a value of K_{eq} that is roughly equal to 1?

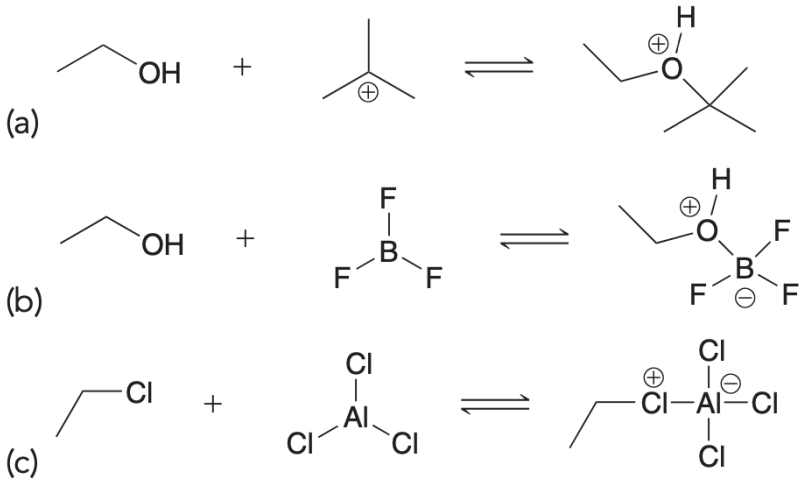
10. Draw the conjugate base for each of the following acids:



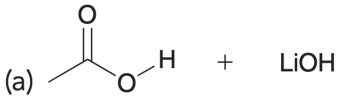
11. Draw the conjugate acid for each of the following bases:



12. In each reaction, identify the Lewis acid and the Lewis base:



13. (optional) In each case below, identify the acid and the base. Then draw the curved arrows showing a proton transfer reaction.



14. (optional) Isonitriles (**A**) are an important class of compounds because of the versatile reactivity of the functional group, enabling the preparation of numerous new compounds and natural products. Isonitriles can be converted to isonitrile dihalides (**B**), which represents a useful procedure for temporarily hiding the reactivity of an isonitrile.

a) Identify the hybridization state for each highlighted atom in **A**.

b) One of the carbon atoms in **A** exhibits a lone pair. In what type of atomic orbital does this lone pair reside?

c) Predict the C – N – C bond angle in compound **A**.

d) Identify the hybridization state for each highlighted atom in **B**.

e) The nitrogen atom in **B** exhibits a lone pair. In what type of atomic orbital does this lone pair reside?

f) Predict the C – N – C bond angle in compound **B**.