Name _____ Test 4
PHYS 0109 Fall 2003

1. (8 pts.) Draw Lewis structures for the following elements and ions.

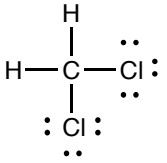
a. O 

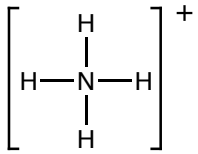
b. Cl^- 

c. P 

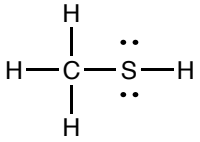
d. Si 

2. (16 pts.) Draw Lewis structures for the following molecules and ions (it is not necessary to calculate formal charges).

a. CH_2Cl_2 

b. NH_4^+ 

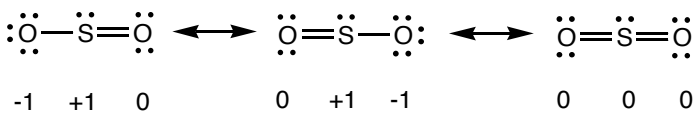
c. CO 

c. CH_3SH 

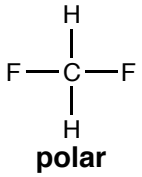
3. A Lewis structure for SO_2 is drawn below.

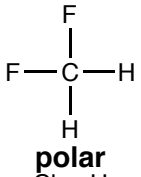
a. (4 pts.) Determine the formal charges for all of the elements. Label the neutral elements with a 0.

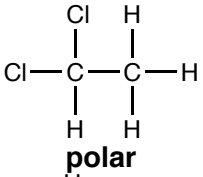
b. (4 pts.) Draw the two other resonance forms for SO_2.

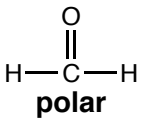


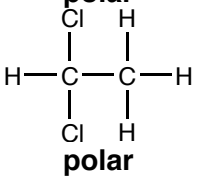
4. (9 pts.) Determine which of the following molecules is(are) polar. Kekulé structures (Lewis structures missing the lone pairs) are provided.

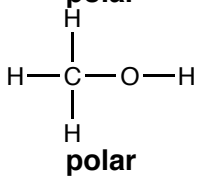
a. 
polar

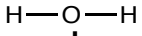
b. 
polar

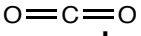
c. 
polar

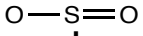
d. 
polar

e. 
polar

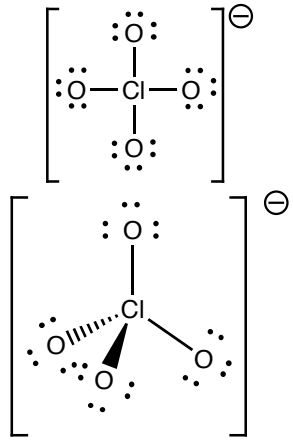
f. 
polar

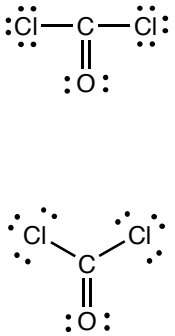
g. 
polar

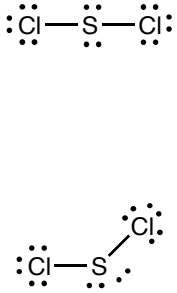
h. 
non-polar

i. 
polar

5. (9 pts.) Draw wedge and dashed bond shapes for the following molecules. Alternatively, you may name the shape and provide approximate bond angles.

a. 
tetrahedral geometry
ideal bond angles 109.5°

b. 
trigonal planar geometry
ideal bond angles 120°

c. 
based on tetrahedral geometry
ideal bond angle 109.5°

6. (10 pts.) A 35.0-g sample of water that was initially at 95.0 °C released 1,334 J of energy. Considering that the heat capacity of water is 4.184 $J \cdot g^{-1} \cdot K^{-1}$, determine the final temperature of the water.

$$-1334\ J = (35.0\ g)(4.184\ J \cdot g^{-1} \cdot K^{-1})(T_f - 95.0\ °C)$$

$$-1334/(35.0 \times 4.184) = T_f - 95.0$$

$$-9.1095 = T_f - 95.0$$

$$T_f = 85.89084.9\ °C$$

$$\mathbf{T_f = 85.9\ °C}$$

7. (10 pts.) If $\Delta H_{combustion}$ = -2598.8 kJ • mol^{-1} for C_2H_2. Determine the mass, in grams, of C_2H_2 required to produce 1,755 kJ of heat.

$$-1755 \text{ kJ} \times \frac{1 \text{ mol } C_2H_2}{-2598.8 \text{ kJ}} \times \frac{26.038 \text{ g } C_2H_2}{1 \text{ mol } C_2H_2} = 17.5838 \qquad 17.58 \text{ g } C_2H_2$$

8. (10 pts.) Considering that $\Delta H_f°$ for $AlCl_3(s)$ is –704 kJ, $\Delta H_f°$ for $H_2O(l)$ is –286 kJ, $\Delta H_f°$ for $H_2O(g)$ is –242 kJ, $\Delta H_f°$ for HCl(g) is –92 kJ, and $\Delta H_f°$ for $Al(OH)_3(s)$ is –1276 kJ, determine $\Delta H°_{reaction}$ for the following reaction.

$$AlCl_3(s) + 3\ H_2O(l) \longrightarrow Al(OH)_3(s) + 3\ HCl(g)$$

$$\Delta H_{reaction} = \sum \Delta H°_{f,products} - \sum \Delta H°_{f,reactants}$$

$$\Delta H_{reaction} = [(3(-92) + (-1276)] - [3(-286) + (-704)]$$

$$\Delta H_{reaction} = 10 \text{ kJ}$$

9. A sample of metal released 367 J of energy, and all of the energy was transferred to a sample of water

   a. (5 pts.) Determine q_{metal}. –367 J

   b. (5 pts.) Determine q_{water}. 367 J

10. (5 pts.) An exothermic reaction is a reaction that absorbs or releases energy?

    releases

    (5 pts.) The sign of q for an exothermic reaction is positive or negative?

    negative