CHEM 105 – Dr. Lammi Names: ______________________

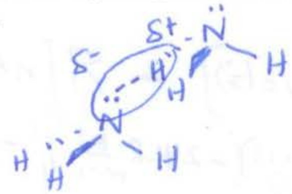
Group Assignment ("Quiz 6") – Oct. 23, 2019

1. (12 pts) The following questions relate to intermolecular forces (IMF).

   a. Which of the following pure substances contain **dipole-dipole** forces? Please circle all that apply.

   H – F   O = C = O BF_3 (trigonal planar geom.)

   b. Please **diagram** the **hydrogen-bonding** interactions that take place in a sample of ammonia, NH_3.



   c. Does hydrogen bonding occur in PH_3 (which has the same structure)? If not, why not?

   No. Hydrogen bonding requires the presence of N-H, O-H, or F-H bonds, none of which are present in PH_3.

   d. Based on your answer in (c), which do you expect to have the **higher boiling point**, NH_3 or PH_3? Explain briefly.

   NH_3. Since NH_3 has hydrogen bonds and stronger dipole-dipole forces, its IMF are stronger, and higher temps. are required for boiling.

2. (6 pts) The questions below relate to the following thermochemical equation:

$$Cu\,(s) + Cl_2\,(g) \rightarrow CuCl_2\,(s) \qquad \Delta H^\circ_{rxn} = -220.1\text{ kJ}$$

   a. Is the reaction **endothermic** or **exothermic**? Is heat **absorbed** or **released**?

   (because ΔH° is negative)

   b. According to the reaction above, how much heat (in kJ) would be absorbed or released in the formation of 4 moles of $CuCl_2$?

   $\frac{-220.1\text{ kJ}}{1\text{ mol }CuCl_2} * 4\text{ mol }CuCl_2 = -880.4\text{ kJ}$

   c. What is the value of ΔH°_{rxn} for the following reaction? [Note that you need **not** answer (b) in order to answer this question.]

$$CuCl_2\,(s) \rightarrow Cu\,(s) + Cl_2\,(g) \qquad \Delta H^\circ_{rxn} = ??$$

   $\Delta H^\circ = +220.1\text{ kJ}$
   Changed rxn direction and changed sign of ΔH°.

3. (7 pts) Use the standard enthalpies of formation provided below to determine ΔH°_{rxn} for the following reaction:

$$2\ H_2S\ (g) + 3\ O_2\ (g) \rightarrow 2\ SO_2\ (g) + 2\ H_2O\ (g) \qquad \Delta H^\circ_{rxn} = ???$$

Substance	ΔH°_f (kJ/mol)
$H_2S\ (g)$	-20.17
$SO_2\ (g)$	-296.8
$H_2O\ (g)$	-241.8
$O_2\ (g)$	0

$$\Delta H^\circ_{rxn} = \sum [n\Delta H_f^\circ (\text{products})] - \sum [n\Delta H_f^\circ (\text{reactants})]$$

$$\Delta H^\circ_{rxn} = \left[(2\ \text{mol}\ SO_2)\left(-296.8\ \tfrac{kJ}{mol}\right) + (2\ \text{mol}\ H_2O)\left(-241.8\ \tfrac{kJ}{mol}\right)\right] - \left[(2\ \text{mol}\ H_2S)\left(-20.17\ \tfrac{kJ}{mol}\right) + (3\ \text{mol}\ O_2)\left(0\ \tfrac{kJ}{mol}\right)\right]$$

$$\Delta H^\circ_{rxn} = -1077.2\ kJ - (-40.34\ kJ) = -1037\ kJ$$

(LOTS of extra room here!!)