Worksheet on Entropy

1. Define entropy in your own words, and list the variables or conditions that you must consider when comparing the entropy of two substances, or when trying to determine the relative change in entropy.

Entropy is the degree of chaos or disorder in a system. When comparing the relative entropy you must consider the temperature, the physical state, and the molecular complexity.

2. Does entropy increase or decrease with increase in temperature? Explain.

Entropy increases with increasing temperature. An increase in temperature corresponds to an increase in the average kinetic energy of the molecules. This means they are moving around more and have more disorder.

3. Work on this part with your partner, one of you first going over Part A, explaining your answers to the other person, and then that person going over Part B.

A. Without reference to any data tables, which member of the following pairs has the greater predicted amount of entropy.	B. Without reference to any data tables, which member of the following pairs has the **lesser** predicted amount of entropy.
CO_2 (g) or CO_2 (s)	H_2O (l) or H_2O (s)
PbS (s) or PbF_2(s)	$FeCl_2$ (s) or $FeCl_3$(s)
H_2(g) in a 1 L vessel or H_2(g) in a 2 L vessel	Fe(s) at 25˚C or Fe(s) at 100˚C

4. For each of the following reactions, indicate whether you would expect the entropy of the system to increase or decrease, and explain why. If you cannot tell just by inspecting the equation, explain why.

(a) $CH_3OH(l) \rightarrow CH_3OH(g)$ Increase, gases have more freedom of motion

(b) $N_2O_4(g) \rightarrow 2NO_2(g)$ Increase, there are more moles of gas produced in this rxn

(c) $CO(g) + H_2O(g) \rightarrow CO_2(g) + H_2(g)$ Can't tell. The molecular complexity of CO goes up, but the molecular complexity of H_2O goes down. There are the same # of moles of gas on each side of the equation.

(d) $2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$ Increase, you are forming a gas.

(e) $2NH_3(g) + H_2SO_4(aq) \rightarrow (NH_4)_2SO_4(aq)$ Decrease, you are losing gas and you have a decrease in the number of molecules.

5. Predict which of the following reactions has a **positive** entropy change.

I. $2\ N_2(g) + O_2(g) \rightarrow 2\ N_2O(g)$
II. $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$ making a gas!
III. $Zn(s) + 2\ HCl(aq) \rightarrow ZnCl_2(aq) + H2(g)$ making a gas!

6. Predict which of the following reactions has a **negative** entropy change.

I. $2\ HgO(s) \rightarrow 2\ Hg(l) + O_2(g)$
II. $Ba2+(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$ making a solid from liquid
III. $2H_2O_2(l) \rightarrow 2\ H_2O(l) + O_2(g)$

7. Predict which of the following reactions has a **negative** entropy change.

I. $2\ SO_2(g) + O_2(g) \rightarrow 2\ SO_3(g)$ losing a mole of gas
II. $MgO(s) + CO_2(g) \rightarrow MgCO_3(s)$ losing gas!
III. $PCl_5(s) \rightarrow PCl_3(l) + Cl_2(g)$