Equilibrium Take-home Quiz (**Due Nov 16th by 8:00 AM**)

1. For each of the following, determine the sign of ΔH and state if the reaction is endothermic or exothermic. If you don't know what the word means, look it up.
   a. Condensation
   b. Sublimation

   g → l ΔH < 0 exothermic
   g → s ΔH < 0 exothermic

2. Order these compounds by increasing ΔH_{fus}.

   NH_3, NCl_3, PCl_3

   non-polar (LDF only) polar (dipole)
   $NCl_3 < PCl_3 < NH_3$
   H-bonds

3. Predict which of the following will have a higher S°.
   a. H_2O (l) vs. H_2O (g)
   b. H_2S (l) vs. H_2O (l)

   g > l
   H_2S is lower than H_2O

4. Consider a system at rest. Which of the following will have a greater impact on the total internal energy of the system? (ii)
   i. The volume of the system changes by 0.5 L with a constant external pressure of 4 atm OR
   ii. The volume of the system changes by 1 L with a constant external pressure of 2.5 atm

   W = -4(0.5) = -2
   W = -2.5(1) = -2.5

5. Use the following data for ethyl alcohol (CH_3CH_2OH) to determine the enthalpy change when 360 g of ethanol is heated from 50 °C to 92 °C. see below 333,793 J

T_b (°C)	T_m (°C)	ΔH_{fusion} (kJ/mol)	$\Delta H_{vaporization}$ (kJ/mol)	C (solid) J / (mol°C)	C (liquid) J / (mol°C)	C (gas) J / (mol°C)
78.3	-117	5.02	38.57	111.5	112.4	87.55

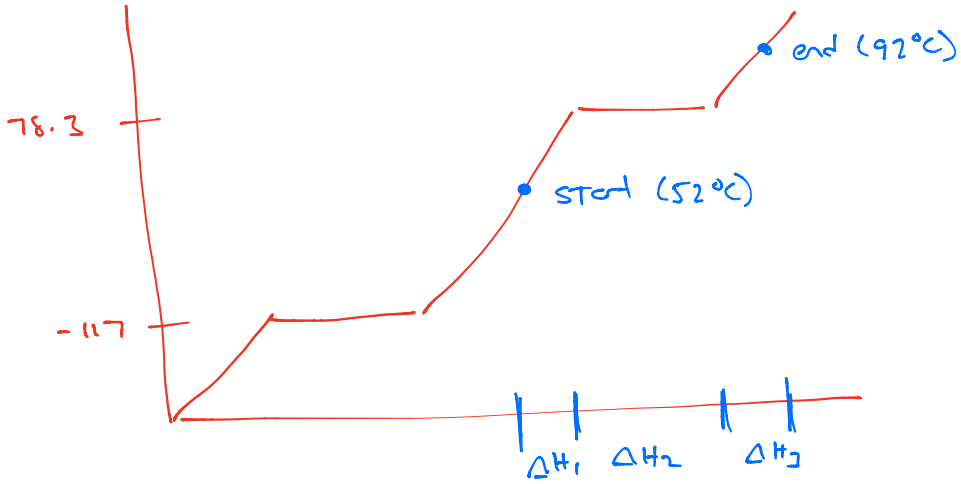
6. Consider the following reaction at equilibrium. For each of the following, determine if the equilibrium will shift toward products or reactants or if there will be no change.

   $Zn(s) + CO_2(g) \rightleftharpoons ZnO(s) + CO(g)$ $\Delta H^0_{rxn} = -100\ kJ\ mol^{-1}$ $K_p = 600$

   a. The volume is decreased in a flask that was at equilibrium. No change (gases on both sides one eqn)
   b. The temperature is increased in a flask that was at equilibrium. reactants
   c. Zn (s) is added to the reaction chamber. No change
   d. Carbon dioxide is added to the chamber. products

7. For each change listed in Problem 6, determine if $\Delta G_{rxn} > 0$, $\Delta G_{rxn} < 0$, or $\Delta G_{rxn} = 0$.

   a) ΔG = 0
   b) ΔG > 0
   c) ΔG = 0
   d) ΔG < 0



$\Delta H_1 = 112.4 \frac{J}{mol\,^\circ C} (78.3 - 52) = 2956.12 \frac{J}{mol}$

$\Delta H_2 = 38.57 \frac{kJ}{mol} \left| \frac{10^3 J}{1 kJ} \right. = 38,570 \frac{J}{mol}$

$\Delta H_3 = 87.55 \frac{J}{mol\,^\circ C} (92 - 78.3) = 1199.44 \frac{J}{mol}$

$\Delta H_{total} = 2956.12 \frac{J}{mol} + 38570 \frac{J}{mol} + 1199.44 \frac{J}{mol} = 42725.56 \frac{J}{mol}$

$360 g \left| \frac{mol}{46.08 g} \right. = 7.8125 mol \times 42,725.56 \frac{J}{mol} = 333,793 J$