Team: _____ **Gibbs free energy Assessment**

1. Under what conditions will a reaction with a decreasing entropy be thermodynamically favorable?
   If the reaction releases heat/ exothermic/ ΔH is negative.

2. Under what conditions will an endothermic reaction be thermodynamically favorable?
   If the reaction increases entropy/disorder/more microstates/more states of freedom/ ΔS is positive.

3. An exothermic reaction is thermodynamically **unfavorable** under what conditions of temperature **and** entropy change?
   If entropy is decreasing and the temperature is high.

4. Complete the table below.

	Reaction	Enthalpy (+/-)	Entropy (+/-)	Favorable at what values of temperature? (high, low, all, none)
a	$PCl_3(g) + Cl_2(g) \leftrightarrow PCl_5(g) + 92.5$ kJ/mol	-	-	Low
b	$2NH_3(g) \leftrightarrow N_2(g) + 3H_2(g)$ $\Delta H = +92$kJ/mol	+	+	High
c	$4PH_3(g) \leftrightarrow P_4(s) + 6H_2(g)$ $\Delta H = -37$kJ/mol	-	+	All
d	181.6 kJ/mol $+ 2HgO(s) \leftrightarrow 2Hg(l) + O_2(g)$	+	+	High

5. The equilibrium constant of a reaction is K=1.
   a. Large values of K show the forward reaction is favorable. What does a reaction with an equilibrium constant equal to 1 imply about the relationship between the concentration of reactants and products?
      The reactants are forming the products at an equal rate/ the reaction is at equilibrium, the concentrations are constant.

   b. Calculate the value of the Gibbs free energy change of this reaction at standard state.
      $\Delta G = -RT\ln K = -8.314(298)\ln(1) = 0$

   c. Find the temperature at which this reaction with $\Delta H = -11.7$ kJ/mol and $\Delta S = -105$ J/molK would become thermodynamically favorable.
      $\Delta G = \Delta H - T\Delta S = 0$
      $\Delta H = T\Delta S$
      $-11.7 = x(-.105)$
      $x = 111$K