Thermodynamics.

1. For each reaction, select the correct answer for ΔH, ΔS, and ΔG.

H_2O_2 (l) ⇌ H_2O_2 (s)	$\Delta S > 0$ $\Delta S < 0$	C (s) + 4 H (g) ⇌ CH_4 (g)	$\Delta S > 0$ $\Delta S < 0$
	$\Delta H > 0$ $\Delta H < 0$		$\Delta H > 0$ $\Delta H < 0$
	$\Delta G > 0$ $\Delta G < 0$		$\Delta G > 0$ $\Delta G < 0$
	Temperature Dependent		Temperature Dependent

2. For each of the following reactions in problem 1, identify which graph most accurately reflects the relationship between ΔG and T.

3. For melting reaction, $\Delta G = 0$ at the melting temperature (Tm).
   a. Write out an equilibrium showing the melting of Li (s).

   b. Why can't we write an equilibrium constant for this reaction?

   c. Which of the graphs in problem 2 is most likely to represent the DG vs. T relationship for this melting reaction?

   d. At the melting temperature, is it more favorable to make solids or liquids? Why?

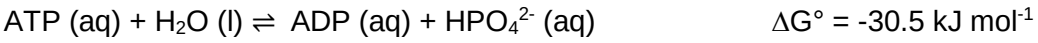
   e. With this in mind, rearrange $\Delta G = \Delta H - T\Delta S$ to show the relationship between ΔH and ΔS at the melting temperature (Tm).

   f. Use the equation that you developed in 3e to calculate the entropy of melting for lithium and sodium. The melting temperature and melting enthalpy are given below.

Metal	Tm (K)	ΔH_{fus} (kJ mol^{-1})
Li	454	2.99
Na	371	2.60

   g. Do the signs of ΔH and ΔS make sense based on your understanding of the reaction?

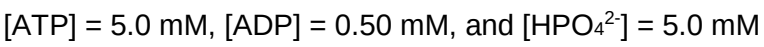
4. ATP hydrolysis is a very important reaction in biological systems. Consider the information given below. **This reaction is balanced.**



   a. Does this reaction consume or produce energy? How do you know?

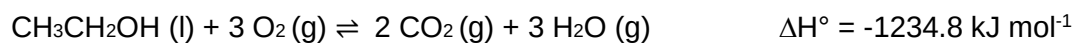
   b. Calculate the equilibrium constant for this reaction.

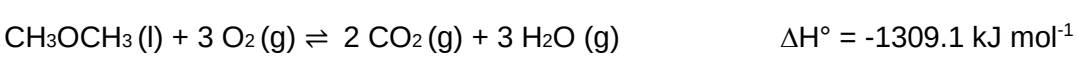
   c. Under the conditions below, will the reaction shift to make reactants or products? What do you predict the sign of ΔG to be?



   d. For the conditions above, calculate ΔG at 37°C.

5. Calculate $\Delta H°$ for $CH_3CH_2OH\ (l) \rightleftharpoons CH_3OCH_3\ (l)$ noting that:





6. From the data below, calculate **ΔG° and K** for the following reaction at 25°C.

Ag^+ (aq) + Cl^- (aq) ⇌ $AgCl(s)$

	Ag^+ (ag)	**Cl^- (aq)**	**AgCl(s)**
ΔG_f^0 (kJ mol^{-1})	77.1	-131.2	-109.8
S° (J $mol^{-1}K^{-1}$)	72.7	56.5	96.3

7. What do you think the sign of ΔH and ΔS will be for the reaction in problem 6? Explain your choice.

8. For the reaction in problem 6, determine ΔS° and ΔH°.

9. Using the information you determined in problems 6 and 7, determine **K, ΔG°, ΔH°, and ΔS°** for the following reactions:

$$3\ Ag^+ (aq) + 3\ Cl^- (aq) \rightleftharpoons 3\ AgCl(s)$$

$$AgCl(s) \rightleftharpoons Ag^+ (aq) + Cl^- (aq)$$

10. From what you learned in problem 6, explain why our solubility rules predict that AgCl is not soluble.

11. Using the values from problems 6 and 8, determine the temperature that would be needed to make dissolving AgCl (s) favorable. Hint: you'll need to calculate K at 25 °C and use ΔH from problem 8. Also, you should figure out what K value is needed when the reaction changes to being nonspontaneous.