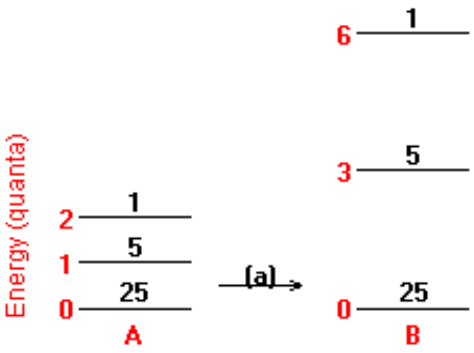
**These questions are from a previous exam. They serve only to give you an idea of the sort of questions you might expect on Exam 2 in Chemistry 126. Please note, however, that each year different sorts of problems are introduced, and I make no guarantee that any problems of any particular sort will be included on this year's exam.**

(15) 1. For the diagram shown on the right, calculate *U*, *W*, and *S* for each state (A and B) and both *q* and *w* for change (a) provided 1 quantum unit = 0.02 aJ. Suggest a "real-world" scenario that this diagram might be a model for.




(10) 2. Estimate $\Delta U$ for the following reaction based on mean bond energies.

$$CF_2Cl_2 + 2\,O_2 \longrightarrow CO_2 + OF_2 + OCl_2 \qquad \Delta U = ?$$

(20) 3. Consider the following data from an experiment involving a calorimeter similar to the one you used in lab. Assume the heat capacity of the solution is 4.30 J/g-K (including the solute) and the heat capacity of the calorimeter is 8.0 J/K (including all materials but not the solution itself).

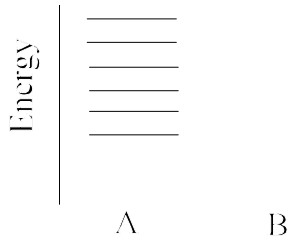
| | |
|---|---|
| reactants: | 4.583 g of $Na_2SO_4$ (s) (142.050 g/mol) and 250.0 mL of $H_2O$ |
| initial temp: | 24.0 ºC |
| final temp: | 27.2 ºC |

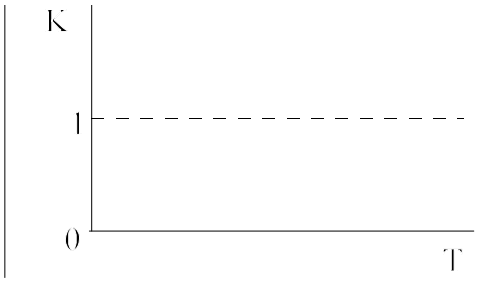
Based on this information, give your best estimate of $\Delta U$ **to the proper number of significant digits** for the reaction **as written**:

$$1/2\ Na_2SO_4 \longrightarrow Na^+ + 1/2\ SO_4^{2-} \qquad \Delta U = ?\ kJ$$

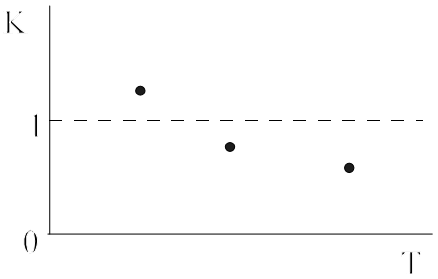
Briefly discuss the primary sources of error in your analysis, including the source of information upon which you base your number of significant digits in your final answer.

(15) 4. Complete the two diagrams on the right, showing what would be expected for a system where the **bonding is stronger in B, and the standard molar entropy is larger for A**. Suggest a real-world situation that this model might represent.




(10) 5. What can be deduced about the system (in terms of bonding and disorder of reactants vs. products) for which the data shown in the graph on the right were obtained?




(10) 6. Explain why adding heat always increases the temperature, internal energy, and the entropy of a substance, provided no chemical reactions occur and the volume remains constant. (Specifically, show how *T*, *U*, and ln *W* must all increase based on the system being a Boltzmann distribution.)

(15) 7. Calculate $\Delta S^o$ at 298 Kelvin for the chemical reaction corresponding to the following chemical equation. Would you expect products or reactants to be favored at high temperature? Why or why not?

$$2\ HCl\ (g) \longrightarrow H_2\,(g) + Cl_2\,(g) \qquad \Delta S^o = ?\ J/K$$

(10) 8. Explain in your own words how it could be that when you dissolve solid urea in water the temperature drops. The structure of urea (except for lone pairs) is shown on the right. Would you expect the same to be true for the dissolving of solid calcium chloride?