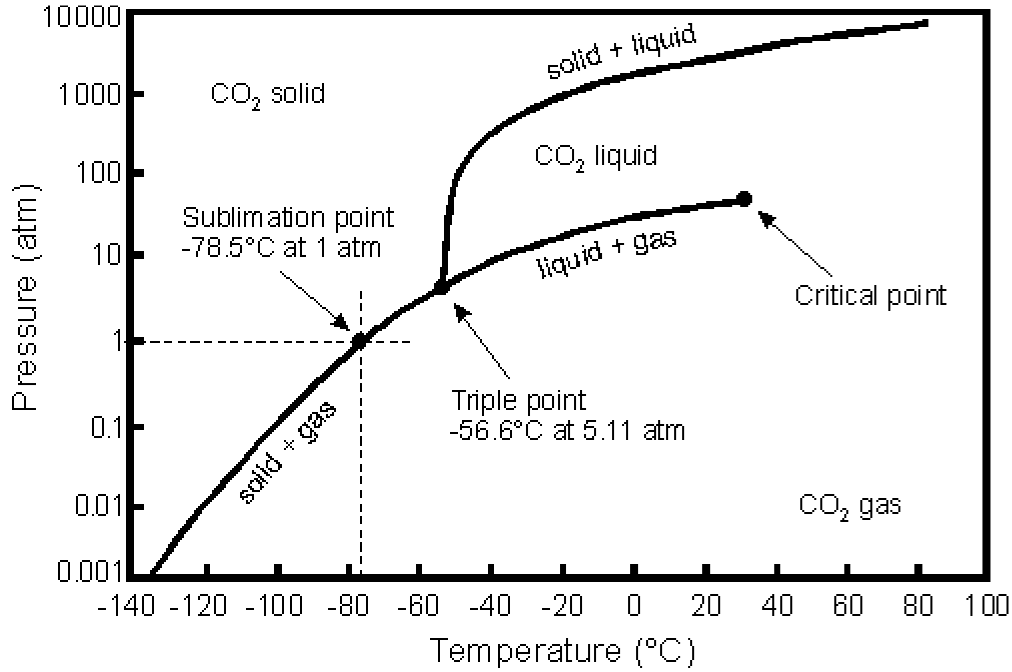
Instructions

Solve the following problems entirely on your own. Attempt every problem but note incorrect solutions are acceptable and will not cause you to lose points. Share your attempts with your group by posting your solved problems on the group DB. Review everyone's attempts. Choose a group leader for Unit 4. Leader's job is to collect and turn in the groups work. Discuss the problems with your group. Develop a group solution to the problem set. Leader turns in the group solution. The group solution is graded for correctness. See the syllabus for points possible and deadline.

1. Fill in the missing values in the table below. Note for NA the values were not available. No need to try to calculate any cells that have an NA.

Substance (UNITS)	$\Delta H_{vaporization}$ (kcal/mole)	T_b(K)	$\Delta S_{vaporization}$ (cal/Kmole)	ΔH_{fusion} (kcal/mole)	$T_{melting}$ (K)	ΔS_{fusion} (cal/Kmole)
Ethanol	9.2	351.5		1.2	158.5	
Hexane	7.6	342		3.12	178	
Laureic acid	NA	571	NA	8.8	317	
Oleic Acid	NA	NA	NA		286.5	33
Ammonia	23.35	239.7		5.65	195.4	
Carbon dioxide	6.06	194.6 ($T_{sublimation}$)			217	9.19

2. Below is a phase diagram for CO_2. From this diagram estimate the slope of the P/T line between the solid and the liquid phases. Using the thermodynamic data for CO_2 given in the table for problem #1, calculate the change in volume that occurs upon melting. Note the Tm given here is the triple point T since there is no T at which the liquid exists at 1atm.



Pressure-Temperature phase diagram for CO_2.

Figure from: http://mhchem.org/221/COTW/carbon_dioxide/CO2_phase_diagram.gif

3. Calculate the ΔS for the transfer of one mole of octane to water using the change in multiplicities assumed for the first shell of water molecules surrounding the octane molecules.

4. Protein folding and unfolding transitions can be treated as phase transitions. Lysozyme unfolds at 75.5°C and has an enthalpy change upon unfolding of 509 kJ/mole. Determine the entropy of unfolding 1 mole of Lysozyme.

5. Soybean seed coat peroxidase (SBP) is a small protein of 326 amino acids. The ΔH for unfolding of SBP is 778.9 kJ/mole at 359K. The ΔC_p for SBP is 15.5 kJ/(mol K). Calculate the ΔH for unfolding of SBP at 39ºC.

6. The binding of a hydrophobic ligand to a protein also shows a pronounced hydrophobic effect. The thermodynamic data for the binding of octenoyl-CoA to the Medium chain acyl-CoA dehydrogenase(MCAD) is given below. Calculate ΔC_p, ΔS at T=308K and ΔG at T=308K for this binding reaction. (Assuming ΔS at T=284K is 4.3 E-2 kcal/mole.)

Temp (K)	ΔH (kcal/mole)
284	-9.5
288	-10.9
294	-13.3
298	-17.2
303	-19.6
308	-21.5

What do the signs for ΔH, ΔS and ΔG tell you about the driving forces for the binding of the ligand to MCAD?

7. Predict, based on the Hofmeister series, which of the following salts would increase the solubility of a hydrocarbon (note, NOT a protein) and which would decrease it: $Al_2(SO_4)_3$, K_3citrate, $Mg_3(\text{citrate})_2$, CsI. Explain your reasoning.