Homework #4 **Chemistry 452** **Due: Two weeks**

A. PROBLEMS

[1] The normal boiling diagram for partially miscible liquids A and B is shown below.

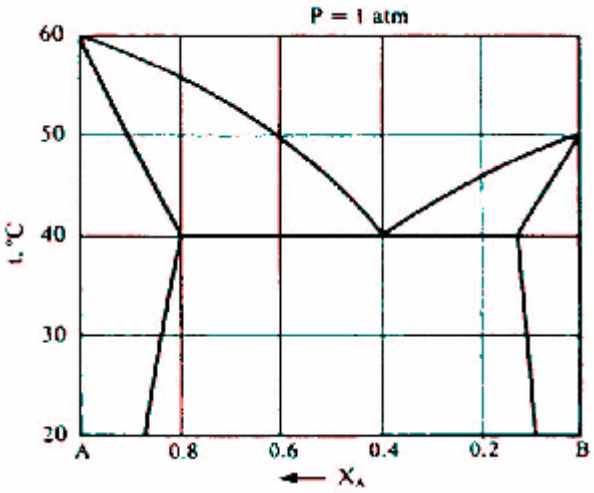
a. Label each phase region as to the phase(s) present.

b. A mixture of overall mole fraction $X_A = 0.6$ is boiled in an open container. What is the boiling temperature, and what is the vapour composition?

c. If the same mixture of $X_A = 0.6$ is brought to 45°C at 1 atm pressure in a closed container. The total amount of the mixture present is found to be one mole. Now, show what phase or phases are present. If there is more than one phase present, determine the amounts (in mole) and compositions of each one.

d. Suppose we cool the mixture of $X_A = 0.6$ from 55°C to 25°C. Sketch the cooling curve and explain what we are expected to see at different points of this curve.

e. Now, suppose we have a mixture of $X_A = 0.4$ and we repeat the same cooling experiment from 55°C to 25° C. Sketch the correponding cooling curve and explain what we are expected to see at different points of this curve.



[2] A typical cooling curve identifies temperatures that associate with "halts" and "breaks". A halt corresponds to a line of three-phase equilibrium while a break corresponds to a boundary between one-phase and a two-phase region. Given the following break and halt temperatures for the cooling curves of melts of metals A and B. Construct a phase diagram consistent with these curves. Label the phase regions and give the probable formula of any compound(s).

Mole % A	First break (°C)	First halt (°C)	Second halt (°C)
100		1000	
90	950	800	
80	900	800	
70	900	800	
60	1000	800	
50		1100	
40	1000	700	
30	750	700	500
20	550	500	
10	575	500	
0		600	

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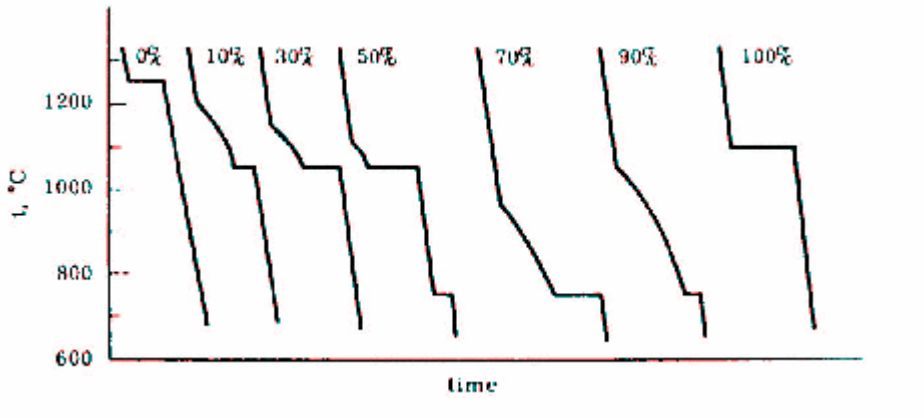
[3] The following cooling curves are obtained for the system CaF_2–$CaCl_2$ (compositions are given in mole % of $CaCl_2$ in the melt). Construct the most reasonable semiquantitative freezing-point phase diagram, label all phase regions, and give the probable formulae of any compounds that are formed.



[4] Na and K melt at 98°C and 65°C, respectively. They form one solid compound NaK, which decomposes at 10°C to give a solid and a melt containing 60% K. There is a eutectic at -5°C.

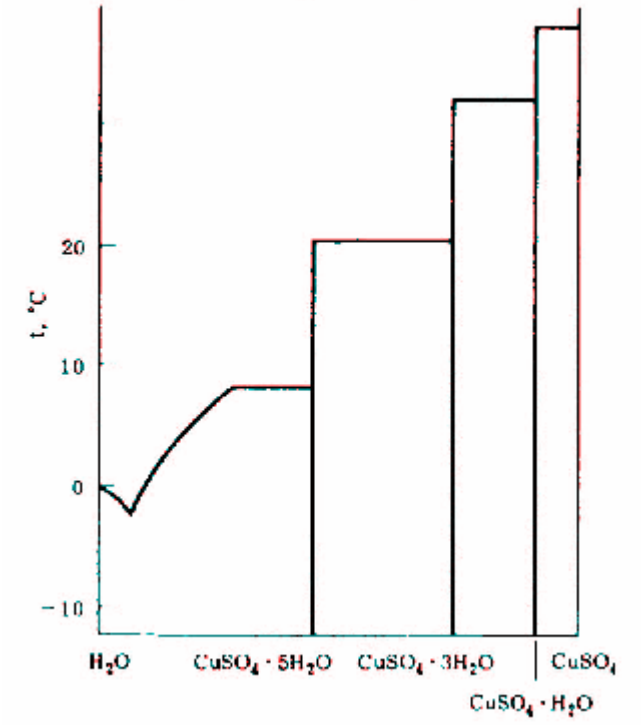
a. Sketch the simplest phase diagram consistent with the above data, and label the phase regions.

b. Draw cooling curves for melts containing 40% K, 55% K and 90% K. Label different parts of the cooling curves and indicate the phases appearing and disappearing at each break or halt.

[5] Given the following incomplete phase diagram for the system H_2O–$CuSO_4$.

a. Complete the diagram by filling in additional lines needed to define the various phase areas. Label each area as to the phase(s) present. Hint: In addition to all the obvious "solvated" $CuSO_4$ "solid" compounds, we have both "ice" and "water vapour" phases and a "solution" phase.

b. Describe the sequence of phase changes if a dilute solution of copper sulfate is dehydrated at 5°C, ending up with anhydrous copper sulfate.



☺ END OF HOMEWORK ☺