Principles of Physical Chemistry CHEM-C123 exam 19.10.2022 (start at 14:00)

The exam where the exercises are counted. You will have 3.0 h exam time (and 0.5 h to return the exam)

This home exam starts at 14:00 and ends 17:30 (or at 18:30 if you have a special permit). Your answers have to be returned to MyCourses (there are two folders with different deadlines). The answers need to be in English.

The filename (or files) need to have your name in it. Your name and student number should be in the file too. Most common file types, like .doc .pdf are OK. The answers can be hand written and scanned but pay attention of the clarity of the output file. Try to send a single file.

You can use any material you find but do not copy it directly to the answers. The points will be reduced if I find direct copy form e.g. Wikipedia or the textbook. Note that the books appendix tables are needed in the exam. If you use other data quote the source.

1) Iron Fe(s) oxides quite easily to Fe_2O_3(s). Which is more exothermic at room temperature – the oxidation with gas phase water H_2O(g) or with O_2(g). You can assume that the hydrogen from water will form H_2 gas. What are the reaction enthalpies at 700 K. Explain what you are calculations and apply them to these reactions.

2) Explain how the constant pressure calorimeter works. What you measure with it? What is the reaction enthalpy if you dissolve 1.423 g Na_2SO_4(s) to 80 g of water and the calorimeter heats 0.036 K. The calorimeters heat capacity is 342.5 J/K and water molar heat capacity is 75.3 J/(K mol). Compare this to the table value of the reaction.

3) The phase changes can be investigated using either P-T or P-V diagram (Figures 1(a) and (b)) Explain how these two plot are connected by going in details the phase changes at constant pressure. It is easier to describe the changes by increasing the temperature. Choose a pressure where the solid-liquid and liquid-gas transitions occur. Explain what happen to volume when the temperature change. Note that letters a,b,c and lines in these figures are not connected. Line a in not the same process in figures a) and b). Do not use water as an example.

4) What is the reaction Gibbs energy in standard conditions and how you can compute it for a general reaction. How the reaction Gibbs energy is related to equilibrium coefficient. How you can estimate the Gibbs energy at other temperatures than room temperature.

5) What are the partial pressures of mixture of two ideal liquids with respect of the concentration (at room temperature) if the partial pressures of pure liquids are P_1 and P_2. The figure 2 shows the pressures of CS_2-acetone mixture. Is this system ideal? What is the Henry's law and what it would tell of the system in Figure 2?

6) Use a simple reaction aA + bB <-> cC + dD as an example and explain what are the rate constants and reaction rate. What are the reactions orders and how you know them? How the equilibrium constant and rate constants are related in this case?

Below is a table of some reaction (A+B -> P). What are the reaction orders and the rate constant?

[A] (M)	[B] (M)	initial rate (M/s)
$2.3*10^{-4}$	$3.1*10^{-5}$	$5.25*10^{-4}$
$4.6*10^{-4}$	$6.2*10^{-5}$	$4.20*10^{-3}$
$9.2*10^{-4}$	$6.2*10^{-5}$	$1.68*10^{-2}$

Figure 1 (a) and (b)

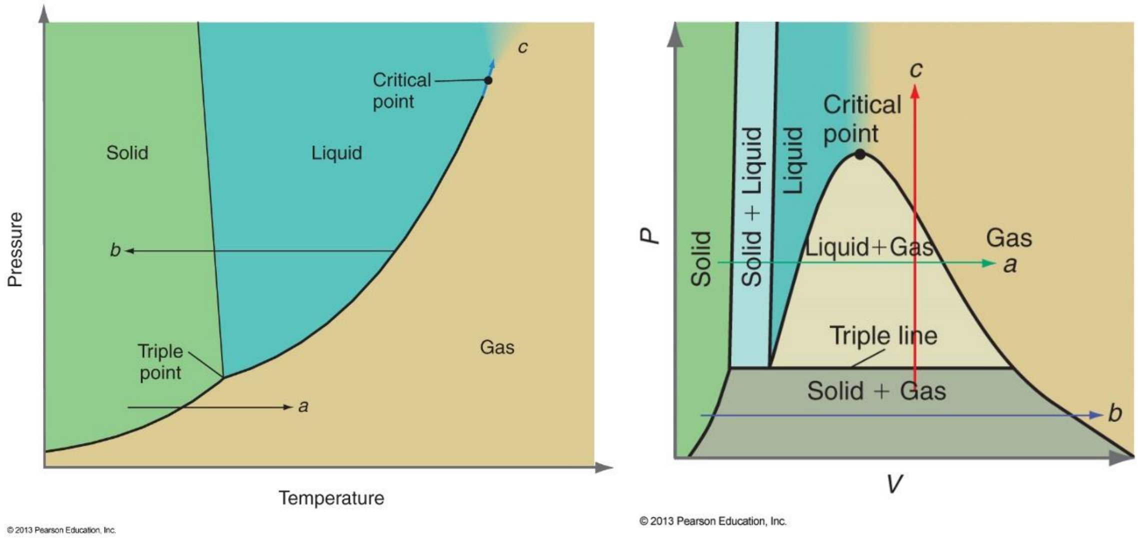

Figure 2