Chemistry 225 Semester 04-2016
Homework for Submission #3

Answer the following questions and submit them for marking as instructed. Only answers showing full working can attract full marks. Express your answers to the correct number of significant figures. Submissions showing evidence of copying will attract zero marks.
NB. It would be worthwhile to complete this homework before the midterm exam. Students may ask for advice after any class.

1) Write equilibrium expressions in the form "K =" in each of the following cases:
   a) $5Fe^{2+}(aq) + MnO_4^-(aq) + 8H^+(aq) \rightleftharpoons 4H_2O(l) + Mn^{2+}(aq) + 5Fe^{3+}(aq)$
   b) $Fe_3O_4(s) + 4H_2(g) \rightleftharpoons 4H_2O(g) + 3Fe(s)$
   c) $2Fe(s) + Cr_2O_7^{2-}(aq) + 14H^+(aq) \rightleftharpoons 2Fe^{3+}(aq) + 2Cr^{3+}(aq) + 7H_2O(l)$
   d) $C_2H_5OH(l) \rightleftharpoons C_2H_5OH(g)$

2) Hydrogen iodide and iodine are introduced into a sealed vessel at a temperature at which iodine, hydrogen and hydrogen iodide are gases, and reaction is allowed to take place until an equilibrium mixture of hydrogen iodide, iodine and hydrogen is reached at this same temperature. Sketch:
   a) a graph of concentration against time showing the concentrations of hydrogen, iodine and hydrogen iodide.
   b) a second graph showing both the rate of destruction of hydrogen iodide (one curve) and the rate of its production (a second curve) as a function of time. Use the same pair of axes for both these curves.

3) a) An equilibrium *mixture* contains 0.0200 mol of bromine, 0.0125 mol of hydrogen and 0.0005 mol of hydrogen bromide at a fixed temperature. Determine the equilibrium constants (K_c) for the reactions represented by
      i) $2HBr(g) \rightleftharpoons H_2(g) + Br_2(g)$
      ii) $\frac{1}{2}H_2(g) + \frac{1}{2}Br_2(g) \rightleftharpoons HBr(g)$
      and determine the mathematical relationship between these constants.
      Hint: let the volume of the container be V dm^3.

   b) In another experiment conducted *at this same temperature*, some HBr was admitted into an evacuated 2000 cm^3 vessel and when equilibrium was attained some had decomposed yielding 6·32 mol of bromine as one product. What was the concentration of each species present at equilibrium?

4) A 0.831 g sample of SO_3 is placed in a 1.00 L container and heated to 1100 K. The SO_3 ***dissociates*** to SO_2 and O_2 according to the following equation:

$$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$$

At equilibrium the total pressure in the container is 1.300 atm. Find the value of K_p for this equilibrium at 1100 K. (Hint: develop your ICE table in terms of partial pressures and recall the relationship between total pressure and partial pressures for a mixture.)