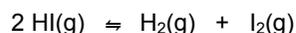# Kc CALCULATIONS

1) 2.0 moles of PCl_5 vapour are heated to 500 K in a vessel of volume 20 dm^3. The equilibrium mixture contains 1.2 moles of chlorine. Calculate K_c for the equilibrium at 500K.

$$PCl_5(g) \leftrightharpoons PCl_3(g) + Cl_2(g)$$

2) The following equilibrium is established at 444°C when 1.0 mol of HI is contained. It is found that the HI has undergone 22% dissociation. Calculate K_c.
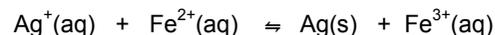
$$2 HI(g) \leftrightharpoons H_2(g) + I_2(g)$$

3) Calculate K_c for the following equilibrium at a particular temperature, given the results of an analysis of the equilibrium mixture which show that the concentration of SO_2 = 0.23, O_2 = 1.37, and SO_3 = 0.92 mol dm^{-3}.

$$2 SO_2(g) + O_2(g) \leftrightharpoons 2 SO_3(g)$$
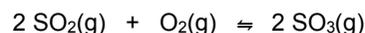
4) Calculate K_c for the equilibrium below if [A] = 0.02 mol dm^{-3}, $[B_2]$ = 0.1 mol dm^{-3} and [AB] = 0.4 mol dm^{-3}.

$$2 A + B_2 \leftrightharpoons 2 AB$$
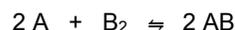
5) An aqueous solution is made by dissolving 1.0 moles of $AgNO_3$ and 1.0 moles of $FeSO_4$ in water and making up to 1.00 dm^3. When equilibrium is established, there was found to be 0.44 moles of Ag^+. Calculate K_c.

$$Ag^+(aq) + Fe^{2+}(aq) \leftrightharpoons Ag(s) + Fe^{3+}(aq)$$

6) Some PCl_5 was heated in a sealed container at 250°C, resulting in the following equilibrium. Analysis of the equilibrium mixture showed that it contained 0.0042 moles of PCl_5, 0.040 moles of PCl_3 and 0.040 moles of Cl_2. The total volume was 2.0 dm^3. Calculate the concentration of each species at equilibrium and then K_c.

$$PCl_5(g) \leftrightharpoons Cl_2(g) + PCl_3(g)$$
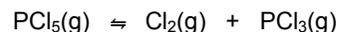
7) 200.0 g of ethyl ethanoate and 7.0 g of water were refluxed together. At equilibrium, the mixture contained 0.25 mol of ethanoic acid. Calculate K_c for the hydrolysis of ethyl ethanoate.

$$CH_3COOCH_2CH_3(l) + H_2O(l) \leftrightharpoons CH_3COOH(l) + CH_3CH_2OH(l)$$
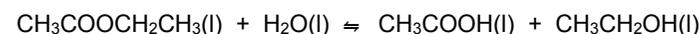
8) In the following equilibrium, K_c = 54.1 at a particular temperature. The equilibrium mixture was found to contain H_2 at a concentration of 0.48 x 10^{-3} mol dm^{-3}, and HI at a concentration of 3.53 x 10^{-3} mol dm^{-3}. The

$$H_2(g) + I_2(g) \leftrightharpoons 2 HI(g) \qquad \Delta H > 0$$
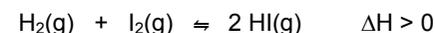
a) What is the equilibrium concentration of I_2?
b) What effect would doubling the concentration of hydrogen have on the equilibrium position and K_c?
c) What effect would increasing the temperature have on the equilibrium position and K_c?

9) When 1.0 moles of steam and 1.0 moles of carbon monoxide were allowed to reach equilibrium, 33.3 % of the equilibrium volume is hydrogen. Calculate K_c at this temperature (you will need to think **very** carefully about equilibrium quantities).

$$H_2O(g) + CO(g) \leftrightharpoons H_2(g) + CO_2(g)$$
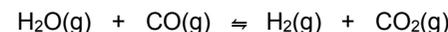
10) K_c for the equilibrium below is 0.0036 at 2680 K. If 1 mole of N_2 and 1 mole of O_2 are allowed to reach equilibrium at 2680 K, what mass of NO will be present in the mixture (you will need to solve a quadratic equation to answer this)?

$$N_2(g) + O_2(g) \leftrightharpoons 2 NO(g)$$
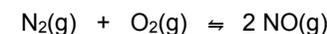
11) K_c for the equilibrium below is 10 at 450 K. If 1 mole of the ester is mixed with 5 moles of water and the mixture allowed to reach equilibrium, how many moles of each species will be present at equilibrium (you will need to solve a quadratic equation to answer this)?

$$HCOOCH_3(g) + H_2O(g) \leftrightharpoons HCOOH(g) + CH_3OH(g)$$