Univercity center Mila
Institute of natural and lif sciences
First year EUS

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module :chemistry 2

Series 3

Exercise 1 :

In an analysis of the following reaction at 100°C

$$Br_2(g) + Cl_2(g) \rightleftharpoons 2BrCl(g)$$

the equilibrium concentrations are [Br2] = 2.3 x 10–3 *M*, [Cl2] = 1.2 x 10–2 *M*, [BrCl] = 1.4 x 10–2 *M*. Write the equilibrium expression and calculate Kc for this reaction.

Exercise 2 :

1. The equilibrium concentrations for the reaction between carbon monoxide and molecular chlorine to form $COCl_2$ (*g*) at 74°C are [CO] = 0.012 *M*, [Cl_2] = 0.054 *M*, and [$COCl_2$] = 0.14 *M*. Calculate the equilibrium constants *Kc* and *Kp*.

$$CO\ (g) + Cl_2\ (g) \rightleftharpoons COCl_2\ (g)$$

2. Given the following data:

(1) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ K_{c1} = 4.3 x 10-25

(2) $2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$ K_{c2} = 6.4 x 109

Determine the values of the equilibrium constants for the following reactions:

(a) $4NO(g) \rightleftharpoons N_2(g) + 2NO_2(g)$

(b) $4NO_2(g) \rightleftharpoons 2N_2(g) + 4O_2(g)$

(c) $2NO(g) + 2NO_2(g) \rightleftharpoons 3O_2(g) + 2N_2(g)$

Exercise3 :

1. At 448°C, KP = 51 for $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

Predict the direction the reaction will proceed, if at 448°C the pressures of HI, H_2, and I_2 are 1.3, 2.1, and 1.7 atm.

2. A closed system initially containing 10^{-3} M H_2 and 2 x 10^{-3} M I_2

At 448°C is allowed to reach equilibrium. Analysis of the equilibrium mixture shows that the concentration of HI is 1.87 x 10^{-3} M. Calculate Kc at 448°C for the reaction:

$$H_2\ (g) + I_2\ (g) \rightleftharpoons 2\ HI\ (g)$$

3. At 1280°C the equilibrium constant (*Kc*) for the reaction

Is 1.1 x 10-3. If the initial concentrations are [Br2] = 0.063 *M* and [Br] = 0.012 *M*, calculate the concentrations of these species at equilibrium.

Exercise 4 :

1. Kc = 0.297 for $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

At equilibrium, [N_2] = 2.05 *M*, [H_2] = 1.56 *M*, [NH_3] = 1.52 *M*. Now we add $N_2(g)$ so that [N_2] = 3.00 *M*. What happens?

2. $2H_2S(g) + O_2(g) \rightleftharpoons 2S(s) + 2H_2O(g)$

If we remove elemental sulfur, $S(s)$, what happens?

3. Hydrogen is produced by the endothermic reaction

$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$

Assuming the reaction is initially at equilibrium, indicate the direction of the shift (left, right, or none) if :

§ $H_2O(g)$ is removed

§ The temperature is increased

§ Nickel (Ni) catalyst is added

§ The volume of the container is tripled