SCH4U1
ET06

Name:
Date:

Equilibrium Constant - Worksheet 1

1. Write the equilibrium expression for the following reactions:

   a. $wW + xX \rightleftharpoons uU + vV$

   $$K = \frac{[U]^u[V]^v}{[W]^w[X]^x}$$

   b. $H_2O_{(g)} + CO_{(g)} \rightleftharpoons H_{2\,(g)} + CO_{2\,(g)}$

   $$K = \frac{[H_2]\,[CO_2]}{[H_2O]\,[CO]}$$

   c. $COCl_{2(g)} \rightleftharpoons CO_{(g)} + Cl_{2\,(g)}$

   $$K = \frac{[Cl_2]\,[CO\,]}{[COCl_2]}$$

   d. $H_{2(g)} + Cl_{2\,(g)} \rightleftharpoons 2\,HCl_{(g)} + energy$

   $$K = \frac{[HCl]^2}{[H_2]\,[Cl_2]}$$

   e. $CO_{(g)} + NO_{2\,(g)} \rightleftharpoons NO_{(g)} + CO_{2\,(g)}$

   $$K = \frac{[NO]\,[CO_2]}{[NO_2]\,[CO]}$$

   f. $Zn_{(s)} + 2\,Ag^+_{(aq)} \rightleftharpoons Zn^{2+}_{(aq)} + 2\,Ag_{(s)}$

   $$K = \frac{[Zn^{2+}]}{[Ag^+]^2}$$

   *Note: solids are not included

   g. $C_2H_{6\,(g)} \rightleftharpoons H_{2\,(g)} + C_2H_{4\,(g)}$

   $$K = \frac{[H_2]\,[C_2H_4]}{[C_2H_6]}$$

2. Consider the following equilibrium reaction:

   $$H_{2(g)} + Br_{2\,(g)} \rightleftharpoons 2\,HBr_{\,(g)} + energy$$

   The K_{eq} for this reaction at 25℃ is 1.02. At equilibrium the concentration of HBr is 0.50mol/L. Assuming H_2 and Br_2 are present in equal amounts, calculate the concentration of H_2 at equilibrium.

   $[H_2]$ = 0.50 mol/L

3. Analysis of the following equilibrium reaction at 900°C provides the concentrations listed below:

$$H_2O_{(g)} + CO_{(g)} \rightleftharpoons H_{2\,(g)} + CO_{2\,(g)}$$

Experiment	[H_2O]	[CO]	[H_2]	[CO_2]
1	0.352	0.352	0.148	0.648
2	0.266	0.266	0.234	0.234
3	0.686	0.186	0.314	0.314

Write the equilibrium expression for the reaction and calculate the value of the equilibrium constant for each experiment.

$$K = \frac{[H_2]\,[CO_2]}{[H_2O]\,[CO]}$$

Expt 1: K = 0.774
Expt 2: K = 0.774
Expt 3: K = 0.773

4. In the following reaction at 448°C, the equilibrium concentrations are HI = 0.0040M, H_2 = 0.0075M, I_2 = 0.000043M. Calculate the equilibrium constant given the reaction below:

$$2\,HI_{(g)} \rightleftharpoons H_{2\,(g)} + I_{2\,(g)}$$

K = 0.020

5. If the temperature of an exothermic reaction at equilibrium is lowered, is the value of K_{eq} increased or decreased?

K will increase if the temperature at equilibrium is lowered.