Homework - Worksheet

PRODUCT-FAVOURED

$$H_{2(g)} + I_{2(s)} \overset{84.6\%}{\rightleftharpoons} 2HI_{(g)}$$

	$H_{2(g)}$	$I_{2(s)}$	$2HI_{(g)}$
init.	3.37 mol	4.24 mol	—
eqm.			5.70 mol

$$\%\ rxn = \frac{exp.}{theor.} \times 100\%$$

Find max. product

If $H_{2(g)}$ is L.R.

$$3.37\ \text{mol } H_2 \times \frac{2\ \text{mol HI}}{1\ \text{mol } H_2} = 6.74\ \text{mol HI}$$

If I_2 is L.R.

$$4.24\ \text{mol } I_2 \times \frac{2\ \text{mol HI}}{1\ \text{mol } I_2} = 8.48\ \text{mol HI}$$

$\therefore H_2$ is L.R.

$$\%\ rxn = \frac{exp.}{theor.} \times 100\%$$

$$\%\ rxn = \frac{5.70\ \text{mol}}{6.74\ \text{mol}} \times 100\%$$

$\%\ rxn = 84.6\%$

Equilibrium Law

Equilibrium Constant (K) - analysis of the experiments reveals a mathematical relationship that provides a constant value for an chemical system over a range of concentrations.

This constant value is called the equilibrium constant (K) for the reaction system.

EQUILIBRIUM LAW

The Equilibrium Law is applied to calculate K:

For the reaction: aA + bB <==> cC + dD

$$K = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

A,B,C,D are chemical entities and a,b,c,d are their coefficients in the balanced equation.

The greater the value of the equilibrium constant, the more the system will favor the forward reaction.

The greater the value of K, the greater the percent reaction.
K > 1 is a product-favoured reaction
K < 1 is a reactant-favoured reaction

Sample Problem
Write the equilibrium law for the reaction of nitrogen monoxide gas with oxygen gas to form nitrogen dioxide gas.

(1) equation:

(2) balance: $2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)}$

(3) write equilibrium expression:

$$K = \frac{[NO_{2(g)}]^2}{[NO_{(g)}]^2[O_{2(g)}]}$$

Sample Problem

A mixture of H_2 and I_2 is allowed to react at 448°C. When the equilibrium is established the concentrations of the participates are found to be $[H_2]$ = 0.46 mol/L, $[I_2]$=0.39 mol/L, and [HI] = 3.0 mol/L. Calculate the value of K_{eq} at 448°C from the data.

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

eqm. 0.46 M 0.39 M 3.0 M

$$K = \frac{[HI_{(g)}]^2}{[H_{2(g)}][I_{2(s)}]}$$

$$K = \frac{[3.0]^2}{[0.46][0.39]}$$

$$\boxed{K = 50.}$$ Product-favoured

$$CH_3COOH_{(aq)} \overset{1\%}{\rightleftharpoons} H^+_{(aq)} + CH_3COO^-_{(aq)}$$

Worksheet