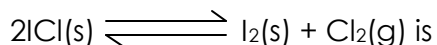




Exercise

1. The conventional equilibrium constant expression (K_c) for the system as described by the equation



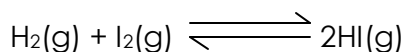
A. $[\text{Cl}_2]$

B. $[\text{Cl}_2]/[\text{ICl}]^2$

C. $\frac{[\text{I}_2][\text{Cl}_2]}{[\text{ICl}]^2}$

D. $\frac{[\text{I}_2][\text{Cl}_2]}{2[\text{ICl}]}$

2. At 295K at 3L flask contain 7mol HI, 4mol H_2 and 0.6mol I_2 in equilibrium. What is the value of K at 250K?



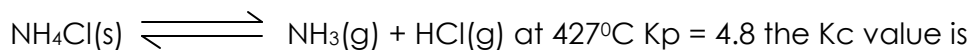
A. 10.2

B. 20.4

C. 30.4

D. 61.2

3. For the decomposition of ammonium chloride NH_4Cl



A. 0.08

B. 0.836

C. 1.6

D. 0.04

Application of equilibrium constant

- Very large numerical value of K_p and K_c signifies that the forward reaction goes to completion
 - i) Tell us the position of equilibrium
 - ii) Predicts the extent (degree) of reaction

N.B. The equilibrium constant also tells about the relative concentration of product and reactants

Case 1: When $K_c > 1$

Indicate the formation of product is favoured

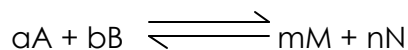
Case 2: When $K_c < 1$

The Indicate the formation of product is not favoured

Case 3: When $K_c = 1$

This show forward reaction is equal to the rate of backward reaction

Reaction Quotient (Q): it is a ratio of product to reactant.



$$Q_c = \frac{[\text{M}]^m [\text{N}]^n}{[\text{A}]^a [\text{B}]^b} = K_c$$

- At equilibrium $K_c = Q_c$ and $K_p = Q_p$. If $Q > K$ a net change occurs from right to left that is formation of reactant is favoured if $Q < K$ a net change occurs from left to right, that is formation of products is favoured.

Note: The larger the value of equilibrium constant, the greater is the extent of the reaction.

- The main use of Q is predicts the direction of the reaction at any stage also decides whether the reaction has attained equilibrium or not.

i.e. $Q < K$ more product is formed

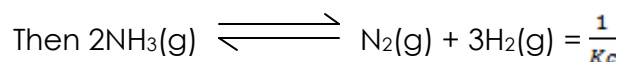
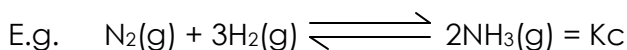
$Q > K$ more reactant is formed

$Q = K$ reaction attain equilibrium

Changing equilibrium conditions – Le Chateliers principle

Factors affecting the K_c

- Temperature** for exothermic reaction temperature is lowered then more products are formed
- The form of equation** i.e, it's extensive and when the reaction is reversed we can take reciprocal



N.B. The equilibrium constant does not depend on the initial concentration of the reactant

K_c and K_p are independent of pressure

- Le Chatelier's principle describe the change that will take place when any one of the reaction parameters are changed at equilibrium.

Parameters are (T, P, noble gas, volume . . . etc)

Optimum conditions

- The conditions that gives maximum yield of the products are known as optimum conditions
- These conditions are decided by the enthalpy of reaction and its stoichiometry applying Le Chatelier's principle.
- Industrial processes are designed to give maximum possible yield of the products

Phase equilibrium

- Equilibrium occurs in physical process under certain condition of temperature and pressure
- Three state of matter, namely Solid, Liquid and Gas



KE $\gg$ FA for gaseous substance

FA $\gg$ KE for solid substance

FA $\approx$ KE for liquid substance

N.B. the kinetic energy (KE) and force of attraction (FA) decided the physical matter of the substance.