**CHEMICAL EQUILIBRIUM**

Equilibrium is defined as the state of a system there is non-observable change in the properties of the system with respect to time. Equilibrium can either be dynamic or static. In a static equilibrium, the particles are in a stationary position e.g. a balanced see-saw

In dynamic equilibrium, the particles of the system are in constant motion. A saturated solution is a typical example of a dynamic equilibrium. The rate of dissolving is equal to the rate of precipitation in a saturated solution. In a dynamic equilibrium, physical and chemical changes usually occur.

In physical equilibrium, there is no change in the composition of the substance involved

In chemical equilibrium, there is a change of the composition of the substance involved.

For a reaction to be in equilibrium, the following must be satisfied

The reaction must be reversible

It must occur in a closed system

Factors affecting equilibrium must be kept constant

The (Gibb’s) free energy change must be zero.

A reversible reaction is one that proceeds in both directions. A reversible reaction is said to be in dynamic equilibrium if the rate of the forward reaction and the back reaction are occurring at the same rate thereby producing no net changes in the properties of the system.

LAWS OF MASS ACTION

This law states that

The rate of a chemical reaction is directly proportional to the active masses of the reactants at constant temperature and pressure

For the forward reaction,

Here, m and n are the molecularities of A and B respectively

For the backward reaction,

At dynamic equilibrium,

For partial pressure,

The relationship between

Equilibrium constant is used to express substances in gaseous state. You only consider the gaseous reactants or products and not solids

The product of the equilibrium constant for the forward and backward reaction is equal to 1

Calculate the equilibrium constant for the reverse reaction

Answer: 0.2

Find the expression for the equilibrium constant for the following equations and state the relationship between kp and kc

The only gaseous substance above is

LE CHATELIER’S PRINCIPLE

This states that if an external constraint (such as a change in temperature, pressure or concentration) is imposed on a chemical system in equilibrium, the equilibrium will shift so as to neutralize the constraint.

EFFECT OF TEMPERATURE ON EQUILIBRIUM

For an exothermic reaction: A decrease in temperature shifts the equilibrium position to the right while an increase in temperature shifts the equilibrium position to the left

For an endothermic reaction: An increase in temperature shifts the equilibrium position to the right while a decrease in temperature shifts the equilibrium position to the left

It should be noted that temperature is the only factor that will affect equilibrium constant. Generally, an increase in temperature increases the equilibrium constant while a decrease in temperature decreases the equilibrium constant.

EFFECT OF PRESSURE: Pressure affects only the gaseous reactions and there must be a change in the mole of the reactant and the product. Generally a decrease in volume corresponds to an increase in pressure which automatically changes the position of the equilibrium

EFFECT OF CONCENTRATION

When reactants are added or products are removed, equilibrium shifts to the right but when products are added or reactants removed, equilibrium shifts to the left.

EFFECT OF CATALYST ON EQUILIBRIUM POSITION

A catalyst has no effect on the position of equilibrium. The basic function of a catalyst in any reaction is to increase the rate by lowering the activation energy.

For a reaction in equilibrium, its specie is involved in the equilibrium constant expression are dissolve and gaseous species.