

PENANG SANGAM HIGH SCHOOL

P.O.BOX 44, RAKIRAKI

LESSON NOTES

WEEK 20

Year/Level: 13A/B

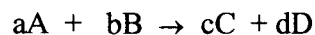
Subject: Chemistry

Strand 3	Reactions
Sub Strand 3.3	Aqueous Chemistry
Content Learning Outcome	By the end of this lesson students should be able: <ul style="list-style-type: none"> • Write equilibrium constant expressions (K_c) for systems at equilibrium • Use K_c expression to calculate the value of K_c value of a reaction

Equilibrium Constant

For any general chemical equation:

e.g.



The mass action expression or equilibrium expression is:

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

Q- Reaction quotient or mass action expression

[] – concentration

At dynamic equilibrium and constant temperature:

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

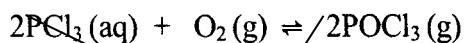
K_c – Equilibrium constant

$$K_c = \frac{[\text{Products}]}{[\text{Reactants}]}$$

[Reactants]

Example:

Write the equilibrium constant expression for the following reaction using molar concentrations.



$$K_c = \frac{[\text{POCl}_3]^2}{[\text{PCl}_3]^2 [\text{O}_2]}$$

Solution:

Note:

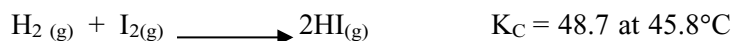
★ K_c for the reverse reaction at the same temperature is the reciprocal (opposite) of the K_c for the forward reaction.

★ Pure solids and pure liquids do not appear in equilibrium expressions.

Use a pencil and see carefully how I've labelled everything using arrow. Follow that

reverse reaction at the same

Example:

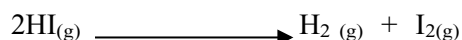


$$K_c = \frac{[\text{C}]^c[\text{D}]^d}{[\text{A}]^a[\text{B}]^b}$$

$$K_C = \frac{[\text{HI}]^2}{[\text{I}_2][\text{H}_2]} \quad 48.7 \text{ at } 45.8^\circ\text{C}$$

} forward reaction

For the reverse reaction:



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

$$K_C = \frac{[\text{I}_2][\text{H}_2]}{[\text{HI}]^2} = 1/48.7 \text{ AT } 45.8^\circ$$

} backward reaction

look at both Kc; see what happened??

$K_c \text{ reverse} = 1/K_c \text{ forward}$

★ K_c value is specific at specific temperature, i.e. if temperature changes, the K_c also changes.

Example:



For the forward reaction:

$$K_c = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$$

The forward reaction is exothermic, therefore an increase in temperature would favour the formation of N_2 and H_2 and a decrease in NH_3 which leads to a decrease in the K_c value.

Summary:

If ΔH is positive, reaction is endothermic, then:

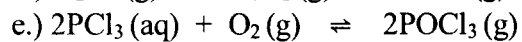
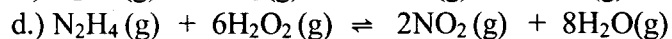
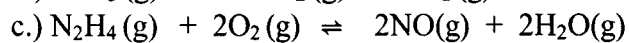
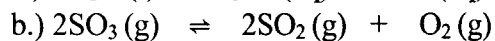
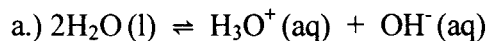
- * K_c increases as temperature increases.
- * K_c decreases as temperature decreases.

If ΔH is negative, reaction is exothermic, then:

- * K_c decreases as temperature increases.
- * K_c increases as temperature decreases.

Exercise

1. Write the **equilibrium constant expression** for the following reactions using molar concentrations?



2. Write an equation given the K_c :

$$K_c = \frac{[\text{P}_4][\text{Cl}_2]^6}{[\text{PCl}_3]^4}$$
