NGO & SONS
ACADEMIC COACHING

# CHEMISTRY

Parramatta Campus:
Level 3, 1-3 Fitzwilliam St
Fairfield Main Campus:
39 Barbara St

# MODULE 5

## STUDENT BOOKLET

- ❑ Equilibrium
- ❑ Gibb's Free Energy
- ❑ LCP
- ❑ Keq
- ❑ Acid Equilibria
- ❑ Ksp

YEAR 12

Name:

Teacher:

# 1. Equilibrium

In this section:



## 1.1. Equilibrium

In chemistry, chemical reactions are not always reactants turning into products. Some reactions are **reversible:**

$$\boldsymbol{reactants \rightleftharpoons products}$$

- This means, although reactants can turn into products, the products can turn back into reactants.
- We will explore more of reversible reactions in section 1.3.

When we have reversible reactions, a dynamic equilibrium can be achieved.
Before we explore dynamic equilibria, we will look at the term **equilibrium**.

Equilibrium is a scientific term used to describe ‘balance’.
An equilibrium can exist in two ways:

1. Static equilibrium

..........................................................................................................................................................

2. Dynamic equilibrium

..........................................................................................................................................................

Dynamic equilibrium will be the majority of the focus in year 12, however, we must be able to describe the differences between a static and dynamic equilibrium in chemistry.

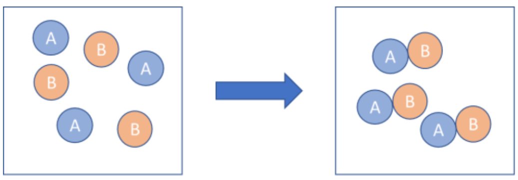
We first will look at some examples of static/dynamic equilibrium.

**Static Equilibrium:**

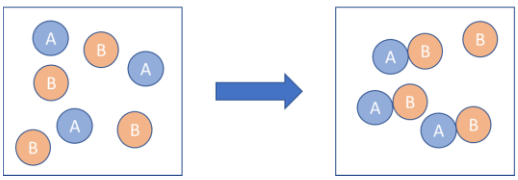
..........................................................................................................................................................

..........................................................................................................................................................

..........................................................................................................................................................



$A + B \rightarrow AB$



In the example above, both represent a static equilibrium as the concentration of reactants/products are not changing.

Notice in the second example, we have an excess amount of reactants.

- This excess reactant cannot turn into products, hence the reaction still has reached completion.
- Thus, similar to the first example, static equilibrium has been achieved.

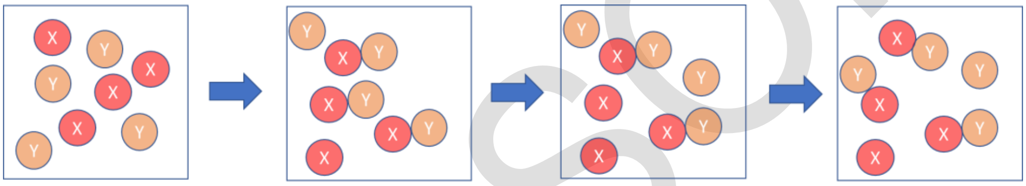
**Dynamic Equilibrium:**

..........................................................................................................................................................................

..........................................................................................................................................................................

i.e. reactants are turning into products the same rate products are breaking down to reactants. Hence there is no net change in concentration.

..........................................................................................................................................................................

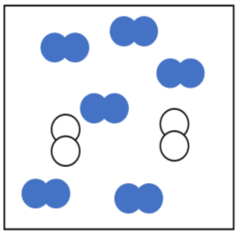


To identify dynamic equilibrium, there are both reactants and products when equilibrium has been reached.

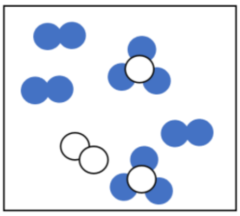
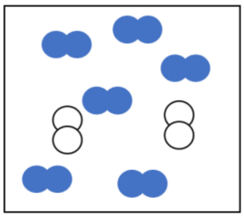
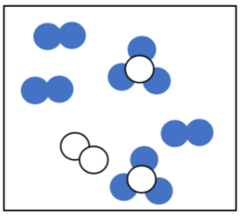
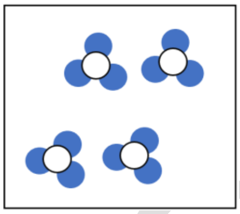
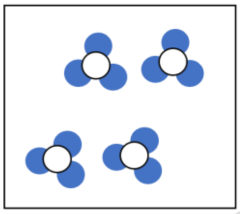
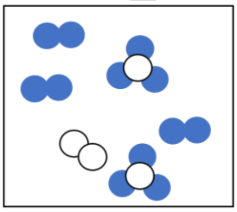
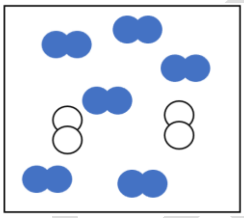
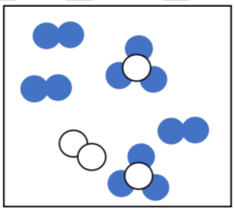
In the model above, we can see that X and Y reactant atoms have the ability to react with each other, however they remain at constant concentration once equilibrium has been reached. This is suggesting that the product XY is constantly breaking down.

**Example 1**

Each of the diagrams below represent an all gaseous system. The initial reactants are shown in the diagram below:



Which of the following diagrams below best model a dynamic equilibrium and static equilibrium for this system

| | Dynamic | Static |
|---|---|---|
| a) |  |  |
| b) |  |  |
| c) |  |  |
| d) |  |  |

**Example 2**

a) Outline a method to model static and dynamic equilibrium, explaining the chemical significance of the method. (3 marks)

*We can use dark/light counters to represent reactant particles*

- *Static equilibrium:*
    1. *Join one light and one dark counters to create product particles*
    2. *Continue joining until there are no more pairs that can be made*

.................................................................................................................................................................

.................................................................................................................................................................

- *Dynamic equilibrium:*
    1. *One person joins one light and one dark counter to create products*
    2. *A second person breaks up the product back into light and dark counters*
    3. *As person one matches the speed of person two, observe the concentration of reactant and products*
    4. *As one person moves faster than the other, observe the concentration of reactants and products fluctuate*

.................................................................................................................................................................

.................................................................................................................................................................

b) Evaluate the effectiveness of this model. (2 marks)