

# Concentration and limiting reactant

## Concentration of solutions

► **Solution :**

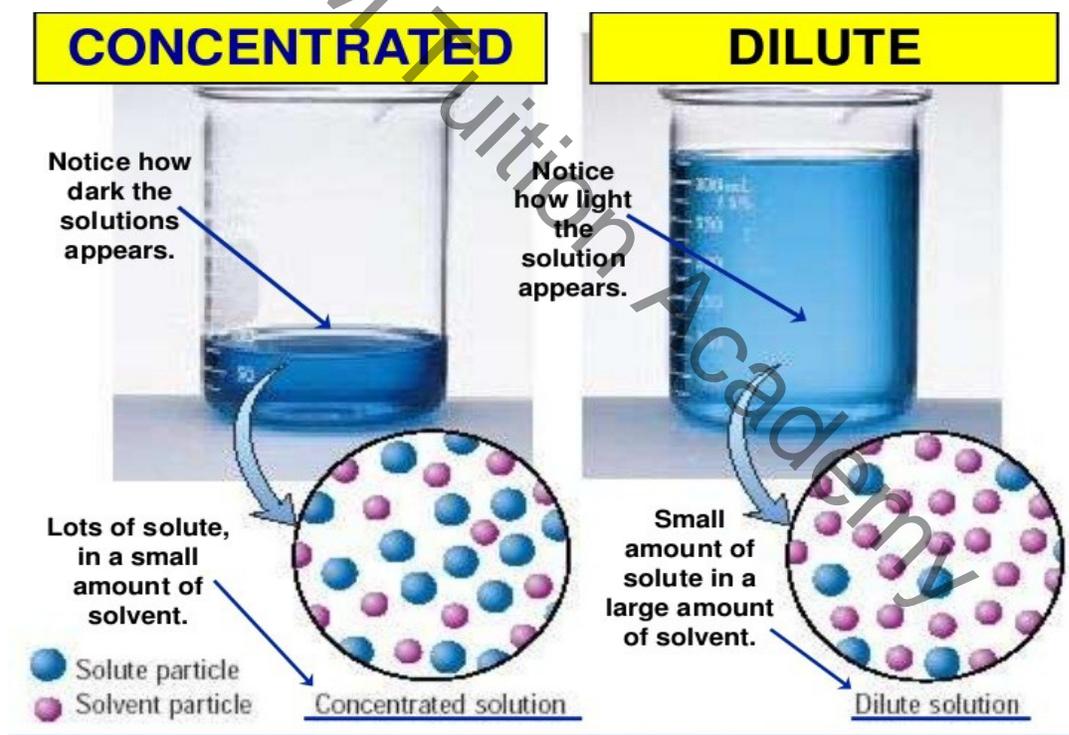
A solution forms when a solute dissolves in a solvent.

► **Type of solution :**

① **Concentrated Solution:** In this solution the amount of solute is high as compared to solvent.

② **Dilute Solution :** In this solution the amount of solution as compared to solvent.

► The **concentration of a solution** is a measure of how 'crowded' the solute particles are. The more concentrated the solution, the more particles it contains in a given volume.



### C3: Quantitative

#### Chemistry.

#### ASM Tuition Academy

### Calculating concentration

- The concentration of a solution can be calculated using:
- the mass of dissolved solute in grams, g
  - the volume of solution (or solvent) in cubic decimetres, dm<sup>3</sup>

$$\text{concentration in g/dm}^3 = \frac{\text{mass of solute in g}}{\text{volume in dm}^3}$$

- The units for concentration can also be shown as g dm<sup>-3</sup>, but this means the same as g/dm<sup>3</sup>.



**Q:** 8 g of sodium hydroxide is dissolved in 2 dm<sup>3</sup> of water. Calculate the concentration of the sodium hydroxide solution formed.

**Solution:**

Using formula:

$$\text{concentration in g/dm}^3 = \frac{\text{mass of solute in g}}{\text{volume in dm}^3}$$

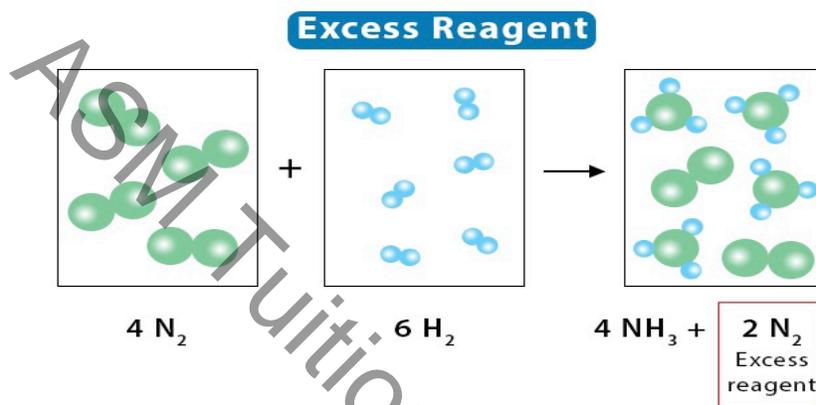
concentration = mass of sodium hydroxide / volume of water

concentration = 8 / 2

concentration = 4 g/dm<sup>3</sup>

## Limiting Reactants

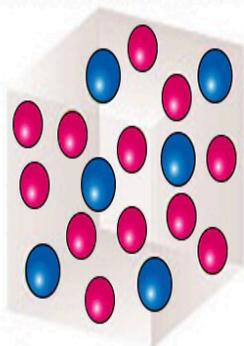
- ▶ A chemical reaction stops when one of the reactants is used up completely. When this happens, we call that reactant the **limited reactant**.
- ▶ The reactant that still remains when the reaction stops is called the **excess reactant**.



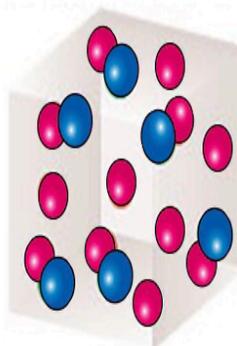
- **Limiting reactants are used up causing reactions to stop.** Lots of reactions have **limiting reactants**. It's common to add an excess of the other reactants, just to make sure that the limiting reactant is completely used up in the reaction.

### LIMITING REAGENT

BEFORE REACTION HAS STARTED



AFTER REACTION IS COMPLETE



### C3: Quantitative

#### Chemistry. ASM Tuition Academy

- The amount of product formed is linked to the amount of limiting reactant. We can call the relationship between amount of limiting reactant and amount of limiting product a **directly proportional** relationship. For example if the limiting reactant is tripled, then the product formed is tripled. Similarly, if you halve the amount of limiting reactant then you will get half the product produced.

### Calculating Product Formation Based on the Limiting Reactant

#### Steps:

1. Write out a balanced equation.
2. Work out the Mr ( relative formula mass) for both reactants and products
3. Calculate moles.
4. Use the balanced equation to find out that how many moles of reactant made how many moles of product.
5. Use the number of moles to calculate the mass

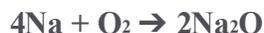
#### EXAMPLE

**Q: Calculate the mass of sodium oxide (Na<sub>2</sub>O) that can be made by completely burning 5.00 g of sodium (Na) in oxygen. Give your answer to 3 significant figures.'**

#### Solution:

##### Step1:

**Write out the balanced equation**



### C3: Quantitative Chemistry.

### ASM Tuition Academy

#### Step 2:

Find the **moles of the known substance**.

In question statement there are **5 g** of sodium (Na), so find how many moles that is

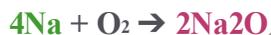
$$\text{moles} = \text{mass} \div \text{Mr}$$

$$\text{moles} = 5 \div 23 = 0.217$$

#### Step 3:

Find the **moles of the unknown substance**.

The unknown substance is sodium oxide (Na<sub>2</sub>O), so use the molar ratio to find the moles of Na<sub>2</sub>O



The molar ratio between **4Na** and **2Na<sub>2</sub>O** is **4:2** which is the same as **2:1**

So divide the moles of Na by 2 to find the moles of Na<sub>2</sub>O

$$0.217 \div 2 = 0.1087 \text{ moles of Na}_2\text{O}$$

#### Step 4:

Find the mass of the Na<sub>2</sub>O (using the moles you just found)

$$\text{mass of Na}_2\text{O} = \text{moles} \times \text{Mr}$$

$$\text{Mr of Na}_2\text{O} = (23 \times 2) + (16) = 62$$

$$\text{mass of Na}_2\text{O} = 0.1087 \times 62$$

$$\text{mass of Na}_2\text{O} = 6.739 \text{ g}$$

#### Step 5:

Give the answer to 3 significant figures

$$\text{mass of Na}_2\text{O} = 6.74 \text{ g}$$

**C3: Quantitative  
Chemistry.**

**ASM Tuition Academy**

ASM Tuition Academy