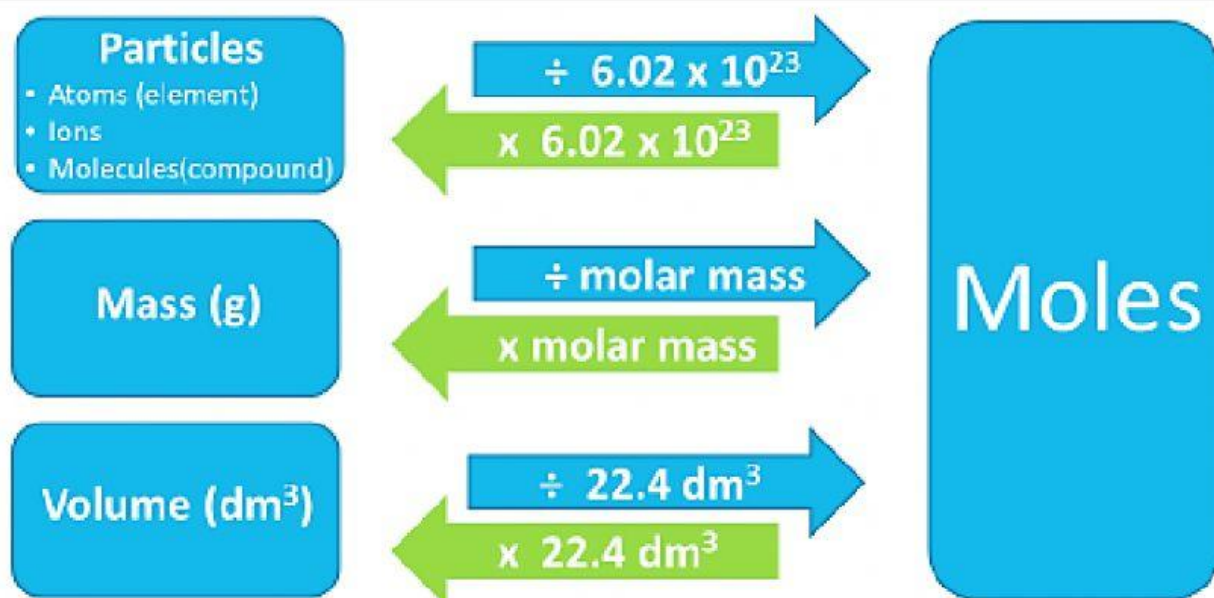


Mole – Part 5

We have now learnt 3 “triangles” for mole calculations:

1. Mass to mole conversion
2. No. of particles to mole conversion
3. Volume (gas) to mole conversion

Mole Conversion Calculations



In this worksheet we will learn the final “triangle” for mole calculations – calculating molar concentration of **SOLUTIONS**.

Solutions:

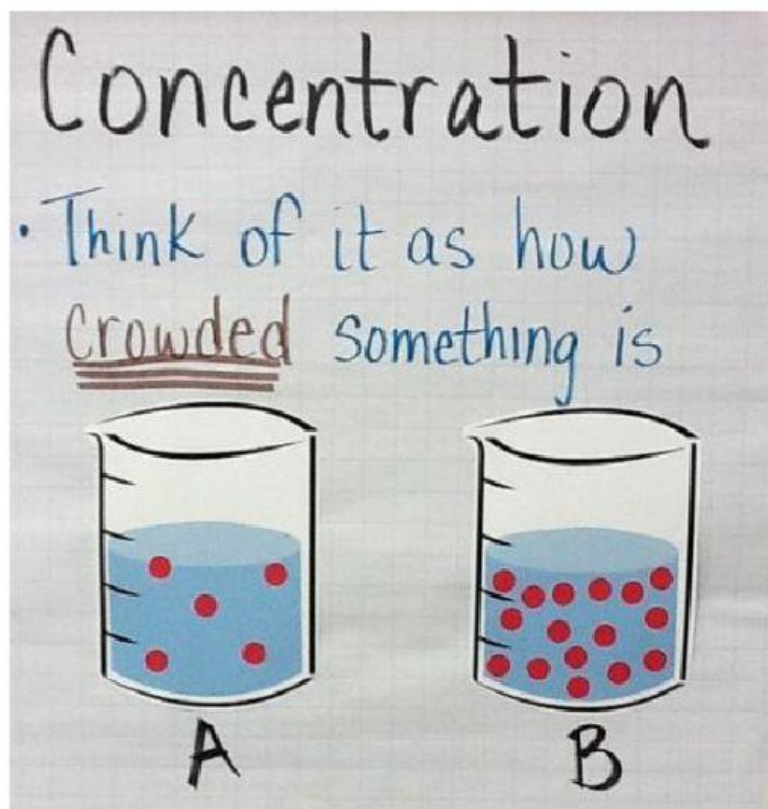
A solution is made up of a SOLUTE dissolved in a SOLVENT.

Concentration: the amount of solute present
per volume of solution

SOLUTE: the substance that has dissolved into the solution

SOLVENT: the liquid that contains the solute

STANDARD SOLUTION: this is an accurately made up solution where the concentration is known precisely.



(<http://www.bondwithjames.com>)

A = low concentration

B = high concentration

Calculating Concentration:

Molar concentration = number of moles of solute per dm^3 (litre) of solvent.

For example:

- 1 mol NaCl per 1 dm^3 (1 litre) solution = concentration of 1 mol.dm^{-3}
- 2 mol NaCl per 1 dm^3 (1 litre) solution = concentration of 2 mol.dm^{-3}
- 2 mol NaCl per 250 cm^3 ($\frac{1}{4}$ litre) solution = concentration of 8 mol.dm^{-3}
- 1,5 mol NaCl per 250 cm^3 ($\frac{1}{4}$ litre) solution = concentration of 6 mol.dm^{-3}

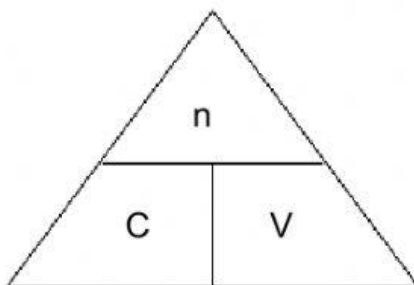
$$C = \frac{n}{V}$$

Where:

C = concentration (mol.dm^{-3})

n = no of moles

V = volume of solvent (dm^3)



Examples:

1. A solution of volume 200 dm³ contains 0,4 mol Na₂CO₃. Calculate the concentration of the solution.

$$C = \frac{n}{V}$$

$$= \text{—}$$

$$= 0,002 \text{ mol.dm}^{-3} \text{ of Na}_2\text{CO}_3$$

2. Calculate the amount (number of moles) of NaOH in 250 cm³ solution with a concentration of 2 mol.dm⁻³.

Note: the volume has been given in cm³ so first we need to convert this to dm³

$$V = 250 \text{ cm}^3 = \frac{250 \text{ cm}^3}{1000 \text{ cm}^3} = \text{—} \text{ dm}^3$$

$$C = 2 \text{ mol.dm}^{-3}$$

$$C = \frac{n}{V}$$

$$n = C \times V$$

$$= \text{—} \times \text{—}$$

$$n = \text{—} \text{ mol NaOH}$$

3. Calculate the concentration of sodium nitrate (NaNO_3) if 4,25 g of NaNO_3 is dissolved in water to make up a 250 cm^3 solution.

Note: you have been given mass and you need to calculate concentration. You will need to use TWO triangles for this. First, mass to moles, then moles to concentration.

$$V = 250 \text{ cm}^3 = \frac{250 \text{ cm}^3}{1000 \text{ cm}^3} = \quad \text{dm}^3$$

$$\{ M(\text{NaNO}_3) = 23 + 14 + 3(16) = \quad \text{g.mol}^{-1} \}$$

$$n = \frac{m}{M} = \quad = \quad \text{mol of NaNO}_3$$

$$C = \frac{n}{V}$$

$$= \quad$$

$$C = \quad \text{mol.dm}^{-3} \text{ of NaNO}_3$$

4. 6,675 g Aluminium chloride (AlCl_3) dissolves in water and the final solution has a volume of 500 cm^3 . Calculate the concentration of the AlCl_3 solution.

$$M(\text{AlCl}_3) = \quad + 3(\quad) = \quad \text{g.mol}^{-1}$$

$$n = \frac{m}{M} = \quad = \quad \text{mol of AlCl}_3$$

$$v = 500 \text{ cm}^3 = \quad \text{dm}^3$$

$$C = \frac{n}{V}$$

$$= \text{---}$$

$$C = \text{--- mol.dm}^{-3} \text{ of AlCl}_3$$

****Do the following exercise in the back of your Chemistry book.
(It comes from pg 135 of your printed notes.)**

Question 8

- 8.1 What is meant by the concentration of a solution?
- 8.2 The concentration of a sodium chloride solution is $0,5 \text{ mol.dm}^{-3}$.
Calculate the number of moles of the solute in:
- 8.2.1 3 dm^3 of the solution
- 8.2.2 20 ml of the solution
- 8.3 Calculate the concentration (in mol.dm^{-3}) of each of the following aqueous solutions:
- 8.3.1 $3,65 \text{ g HCl}$ in 1000 cm^3 solution
- 8.3.2 $1,09 \text{ g KBr}$ in 100 cm^3 solution
- 8.3.3 $1,58 \text{ g KMnO}_4$ diluted to give 500 cm^3 of a solution
- 8.3.4 $9,8 \text{ g H}_2\text{SO}_4$ diluted to give a 250 ml solution
- 8.4 Calculate the mass (in grams) of solute needed to prepare the following solutions:

- 8.4.1 200 cm³ of a 0,1 mol.dm⁻³ NaCl solution
- 8.4.2 100 ml of a 0,5 mol.dm⁻³ KOH solution
- 8.5 A solution has a concentration of 0,7mol.dm⁻³. This solution is diluted by taking 20cm³ of this solution and adding water to it to create a solution with a volume of 90cm³. Calculate the concentration of the diluted solution.
- 8.6 A solution has a concentration of 0,5mol.dm⁻³. This solution is diluted by taking 60cm³ of this solution and adding water to it to create a solution with a concentration of 0,3mol.dm⁻³. Calculate the volume of water that is added to the solution.
- 8.7 A solution with a volume of 200cm³ is created by using a 0,2mol.dm⁻³ solution with a volume of 50cm³ by adding water to the solution.
- 8.8 Calculate the volume of water that needs to be added to a solution with a concentration of 0,3 mol.dm⁻³ and a volume of 100cm³ in order to create a solution with a concentration of 0,1mol.dm⁻³.

More exercises: (pg 152 of printed notes)

1. What is a mole?
2. Calculate the number of mol of the substance that is expressed by each of the given masses:
 - a. 12 g Mg atoms
 - b. 24 g Ammonia (NH₃)
 - c. 6,4 g sulphur dioxide (SO₂)
 - d. 1.5 g water
3. Calculate the mass (in gram) of each of the following substances which make up the following mol quantities:
 - a. 0.6 mol carbon dioxide
 - b. 10 mol HCl
 - c. 0.25 mol CaCO₃
 - d. 1 mol NaOH
4. What is the relationship between Avogadro's constant and a mol?

5. Precisely 1 mol of dicarbondecafluoride (C_2F_{10}) contains:
- How many C_2F_{10} atoms
 - How many C atoms
 - How many F atoms
 - How many atoms in total
- 6.
- Calculate the number of moles of Na atoms in 0.23 g of Na
 - How many atoms are there in 0.23 g of Na?
- 7.
- Calculate the number of moles of H_2 molecules in 4 g of H_2 gas.
 - How many atoms are there in 4 g of H_2 gas?
8. Calculate the mass of 0,6 mol of sulphur dioxide (SO_2)
9. 1 mole of disulphurdecafluoride (C_2F_{10}) contains:
- How many C_2F_{10} molecules?
 - How many C-atoms?
 - How many F-atoms?
 - How many atoms in total?
10. Calculate the mass of $1,806 \times 10^{24}$ Cu atoms.
11. How many hydrogen atoms are there in 5,1 g of NH_3 ?
12. How many atoms are there in 6 g of hydrogen gas?