

CHAPTER 1 QUANTITATIVE CHEMISTRY

(IB TOPIC 1) SUMMARY

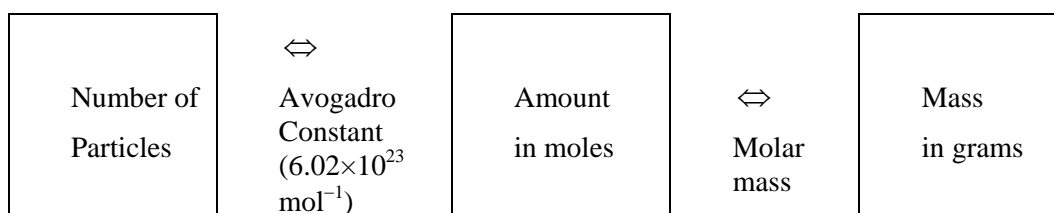


Introduction

- $1 \text{ dm}^3 = 1 \text{ litre} = 1 \times 10^{-3} \text{ m}^3 = 1 \times 10^3 \text{ cm}^3 = 1000 \text{ ml}$
- Amount of substance, n , is measured in moles (mol).
- 1 mol of a chemical species contains the same number of particles as there are atoms in exactly 12 g of C-12 ($^{12}_6\text{C}$) isotope.
- 1 mol of any substance contains 6.02×10^{23} particles; $6.02 \times 10^{23} \text{ mol}^{-1}$ is called Avogadro's Constant (L or N_A)
- A_r , the relative atomic mass of an element is the ratio of the mass of an atom of the element to the mass of one atom of C-12; A_r has no units.
- M_r , the relative molecular mass also has no units.
- M , the molar mass is the mass of one mole of any chemical species and has the units g mol^{-1} .

The amount of substance, n in moles = $\frac{\text{mass (g)}}{\text{molar mass (g mol}^{-1}\text{)}}$;

$$n = \frac{V (\text{dm}^3)}{V_m (\text{dm}^3 \text{ mol}^{-1})}$$



- Use Avogadro Constant to convert between amount and number of particles.
- Use molar mass of substance to convert between amount in moles and mass in grams.
- Empirical formula gives the simplest whole number ratio of atoms in a compound.
- Molecular formula gives the actual number of atoms of each element in the molecule of a compound.

If a molecular formula is given, percentage composition can be calculated.

If the percentage composition is given:

- Consider 100 g of sample, the % of each element becomes its mass.
- Convert the mass of each element to its amount in moles.
- Determine simplest whole number ratio – this is its empirical formula.
- Molecular formula is a whole-number multiple of the empirical formula.
- Substances react by amounts based on a balanced chemical equation.

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If masses are given, convert these to amounts of substances.

- In stoichiometric problems, apply mole ratios as specified in the balanced chemical equation.
- The % yield indicates how efficient a reaction is (given by: $\frac{\text{experimental yield}}{\text{theoretical yield}} \times 100\%$).
- STP for gases is standard temperature (0°C or 273 K) and pressure (1 atmosphere or 101.325 kPa).
- Molar volume, V_m , of any gas at STP = 22.4 dm^3 .

In a balanced chemical equation, coefficients stand for the amount of substance. For gases, these also refer to volumes of gases.

$$\text{Concentration, } c = \frac{\text{amount } n(\text{mol})}{\text{Vol solution}(\text{dm}^3)} = \frac{n}{V} \text{ mol dm}^{-3}.$$

$n = cV$; volume must be in dm^3 .

On dilution, the amount of solute does not change but the volume increases and the concentration decreases

$$\text{Amount } n = \frac{m(\text{g})}{M(\text{g mol}^{-1})}.$$

For a reaction $a\text{A} + b\text{B} \rightarrow \text{products}$, where a and b are coefficients, then $\frac{1}{a}n_{\text{A}} = \frac{1}{b}n_{\text{B}}$.

$$\text{Percentage yield} = \frac{\text{experimental yield}}{\text{theoretical yield}} \times 100\%.$$

(There are many worked examples given in the chapter)