



## IDX G10 Chemistry S Level

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## Chapter 12.1

- The calculations of quantities in chemical reactions is a subject of chemistry called **stoichiometry**.
  - E.g. with a balanced equation we could calculate out the
    - Number of atoms (calculate directly out of the equation)
    - Number of molecules (calculate directly out of the equation)
    - Moles (refers to the periodic table, & 1 mole of any substance have  $6.02 \times 10^{23}$  representative particles)
    - Mass (refers to the periodic table)
    - Volume (1 mol of any gas at STP occupies a volume of 22.4 L)

## Chapter 12.2

The major categories of stoichiometry problems are mole-mole, mass-mass, mass-volume, and volume-volume problems.

- Mole-mole problems
  - E.g. How many moles of O<sub>2</sub> are needed to produce 1 mole of CO<sub>2</sub>?
    - Answer: 1 mole
- Mass-mass
  - E.g. How many grams of water is produced from 1.5 grams of glucose?
    - Answer:  $\frac{1.5 \text{ g}}{(12.01 \times 6 + 1.01 \times 12 + 16.00 \times 6) \text{ g/mol}} \times 6 = 0.05 \text{ mol}$
- Mass-volume
  - E.g. How many liters of CO<sub>2</sub> is produced at STP from 11.2 L of O<sub>2</sub>?
    - Answer:  $n(\text{CO}_2) \times 22.4 \text{ L/mol} = n(\text{O}_2) \times 22.4 \text{ L/mol}$   
 $\text{mol} \frac{11.2 \text{ L}}{22.4 \text{ L/mol}} \times 22.4 \text{ L/mol} = 11.2 \text{ L}$
- Volume-volume
  - How many liters of CO<sub>2</sub> is produced at STP from 1.5 grams of glucose?
    - Answer:  $V(\text{CO}_2) = n(\text{CO}_2) \times 22.4 \text{ L/mol} =$   
 $6 \times n(\text{C}_6\text{H}_{12}\text{O}_6) \times 22.4 \text{ L/mol} = 6 \times$   
 $\frac{1.5 \text{ g}}{(12.01 \times 6 + 1.01 \times 12 + 16.00 \times 6) \text{ g/mol}} \times 22.4 \text{ L/mol} = 1.12 \text{ L}$
- Specifically, all of these stoichiometry questions could be solved with **ratios**
  - E.g. How many moles of HCl are needed to react with 2.3 moles of Zn? The equation for this reaction is:  $2\text{HCl} + \text{Zn} \rightarrow \text{ZnCl}_2 + \text{H}_2$
  - Let the moles of HCl be x, also we get that the molar ratio of HCL to Zn is 2:1 then we get:  $x = 2.3 \times 2 = 4.6 \text{ mol}$

## Chapter 12.3

- In a chemical reaction, an insufficient quantity of any of the reactants will limit the amount of product that forms.
- Limiting reagent: the reactant that determines the amount of product that can be formed by a reaction.
- Excess reagent :The reactant that is not completely used up in a reaction.
- The theoretical yield is the maximum amount of product that could be formed from given amounts of reactants.
- The amount of product that actually forms when the reaction is carried out in the laboratory is called the actual yield.
  - Some reactants may not react or not take part in desired reactions.
  - Some products may be lost during reaction

$$\text{percent yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$$