# GCSE / AS TRANSITION for CHEMISTRY

# Bridging task 2017

# PART 1: MEASURING AMOUNT OF SUBSTANCE

**MASS** **VOLUME** **MOLAR MASS** **AVOGADRO**

**CONCENTRATION** **ATOM** **ION** **MOLECULE**

# MEASUREMENTS IN CHEMISTRY

## Mass

Convert the following into grams:

a) 0.25 kg
b) 15 kg
c) 100 tonnes
d) 2 tonnes

## Volume

Convert the following into $dm^3$:

a) 100 $cm^3$
b) 25 $cm^3$
c) 50 $m^3$
d) 50000 $cm^3$

Tip – always use standard form for very large and very small numbers!

# What is a mole?

Atoms and molecules are very small – far too small to count individually!

It is important to know how much of something we have, but we count particles in MOLES because you get simpler numbers

$$1 \text{ mole} = 6.02 \times 10^{23} \text{ particles}$$

$(6.02 \times 10^{23}$ is known as Avogadro's number)

a) If you have $2.5 \times 10^{21}$ atoms of magnesium, how many moles do you have?

b) If you have 0.25 moles of carbon dioxide, how many molecules do you have?

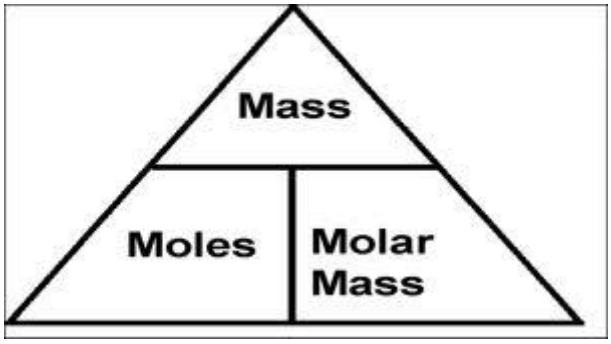
# How can you work out how many moles you have?

## a) From a measurement of **MASS**:

You can find the number of moles of a substance if you are given its **mass** and you know its **molar mass**:

**number of moles = mass/molar mass**

**$n = m/m_r$**




**Mass MUST be measured in grams!**

**Molar mass has units of $gmol^{-1}$**

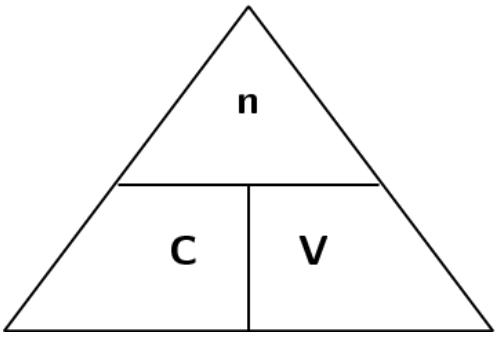
| 1. Calculate the number of moles present in: | 2. Calculate the mass of: | 3. Calculate the molar mass of the following substances: |
|---|---|---|
| a) 2.3 g of Na | a) 0.05 moles of $Cl_2$ | a) 0.015 moles, 0.42 g |
| b) 2.5 g of $O_2$ | b) 0.125 moles of KBr | b) 0.0125 moles, 0.50 g |
| c) 240 kg of $CO_2$ | c) 0.075 moles of $Ca(OH)_2$ | c) 0.55 moles, 88 g |
| d) 12.5 g of $Al(OH)_3$ | d) 250 moles of $Fe_2O_3$ | d) 2.25 moles, 63 g |
| e) 5.2 g of $PbO_2$ | e) 0.02 moles of $Al_2(SO_4)_3$ | e) 0.00125 moles, 0.312 g |

# b) From a measurement of AQUEOUS VOLUME:

You can find the number of moles of a substance dissolved in water (aqueous) if you are given the **volume** of solution and you know its **molar concentration**:

**number of moles = aqueous volume x molar concentration**

**n = V x C**




**Aqueous volume MUST be measured in $dm^3$!**

**concentration has units of $moldm^{-3}$**

**If you know the molar mass of the substance, you can convert the molar concentration into a mass concentration:**

**Molar concentration ($moldm^{-3}$) x $m_r$ = mass concentration ($gdm^{-3}$)**

| 1. Calculate the number of moles of substance present in each of the following solutions: | 2. Calculate the molar concentration and the mass concentration of the following solutions: | 3. Calculate the molar concentration and the mass concentration of the following solutions: |
|---|---|---|
| a) 25 $cm^3$ of 0.1 $moldm^{-3}$ HCl | a) 0.05 moles of HCl in 20 $cm^3$ | a) 35 g of NaCl in 100 $cm^3$ |
| b) 40 $cm^3$ of 0.2 $moldm^{-3}$ $HNO_3$ | b) 0.01 moles of NaOH in 25 $cm^3$ | b) 20 g of $CuSO_4$ in 200 $cm^3$ |
| c) 10 $cm^3$ of 1.5 $moldm^{-3}$ NaCl | c) 0.002 moles of $H_2SO_4$ in 16.5 $cm^3$ | c) 5 g of HCl in 50 $cm^3$ |
| d) 5 $cm^3$ of 0.5 $moldm^{-3}$ $AgNO_3$ | d) 0.02 moles of $CuSO_4$ in 200 $cm^3$ | d) 8 g of NaOH in 250 $cm^3$ |
| e) 50 $cm^3$ of 0.1 $moldm^{-3}$ $H_2SO_4$ | e) 0.1 moles of $NH_3$ in 50 $cm^3$ | e) 2.5 g of $NH_3$ in 50 $cm^3$ |

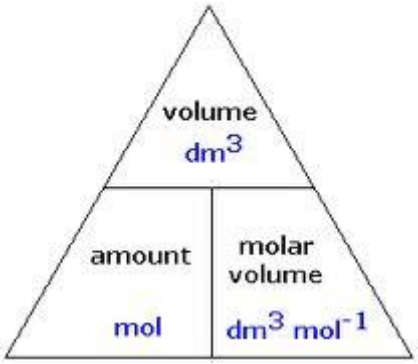
## c) From a measurement of GASEOUS VOLUME:

You can find the number of moles of a gas if you are given the **volume** of the gas:

**number of moles = volume / 24**

**n = V / 24**

**24 $dm^3$ is the volume occupied by 1 mole of any gas at room temperature and pressure**




**Volume MUST be measured in $dm^3$!**

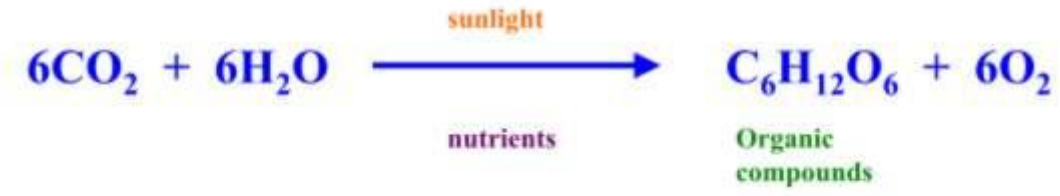
| 1. Calculate the number of moles present in: | 2. Calculate the volume of gas occupied by: | 3. Calculate the mass of the following gas samples: |
|---|---|---|
| a) 48 $dm^3$ of $O_2$ | a) 0.05 moles of $Cl_2$ | a) 48 $dm^3$ of $O_2$ |
| b) 1.2 $dm^3$ of $CO_2$ | b) 0.25 moles of $CO_2$ | b) 1.2 $dm^3$ of $CO_2$ |
| c) 200 $cm^3$ of $N_2$ | c) 28 g of $N_2$ | c) 200 $cm^3$ of $N_2$ |
| d) 100 $dm^3$ of $Cl_2$ | d) 3.2 g of $O_2$ | d) 100 $dm^3$ of $Cl_2$ |
| e) 60 $cm^3$ of $NO_2$ | e) 20 g of $NO_2$ | e) 60 $cm^3$ of $NO_2$ |

**TRANSITION COURSE – END OF PART 1!**

# AS TRANSITION COURSE

# PART 2: USING CHEMICAL EQUATIONS

**MASS** **AQUEOUS VOLUME** ` **MOLAR MASS**




**GASEOUS VOLUME** **MOLES** **CONCENTRATION**

# REVISION FROM LESSON 1

## How many moles?

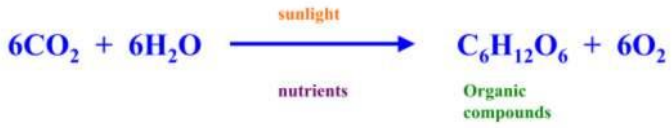
1) Jahin weighs a sample of $CaCO_3$ and records a mass of 5.0 g. How many moles of calcium carbonate are present?

2) Fatima measures out 50 $cm^3$ of 0.1 $moldm^{-3}$ hydrochloric acid. How many moles of hydrochloric acid are present?

3) Hussain collects 48 $cm^3$ of carbon dioxide in a gas syringe. How many moles of carbon dioxide are present?

# Using Chemical Equations

Chemical Equations show the ratio in which different species react in a chemical equation.




This equation shows that **6** moles carbon dioxide of react with **6** mole of water to make **1** mole of glucose and **6** moles of oxygen.

6: 6: 1: 6

a) How many moles of water are needed to react with 0.03 moles of carbon dioxide?
b) How many moles of glucose can you make from 0.03 moles of carbon dioxide?
c) How many moles of oxygen can you make from 0.03 moles of carbon dioxide?

Equation 1: $Mg + 2\,HCl \rightarrow MgCl_2 + H_2$

a) How many moles of magnesium would be needed to react with 0.01 moles of hydrochloric acid?
b) How many moles of hydrogen could be produced from 0.01 moles of hydrochloric acid?

Equation 2: $2\,H_2S + 3\,O_2 \rightarrow 2\,SO_2 + 2\,H_2O$

a) How many moles of oxygen is needed to react with 0.5 moles of hydrogen sulphide?
b) How many moles of sulphur dioxide can be made from 0.5 moles of hydrogen sulphide?

Equation 3: $4\,K + O_2 \rightarrow 2\,K_2O$

a) How many moles of oxygen are needed to react with 0.05 moles of potassium?
b) How many moles of potassium oxide can be made from 0.05 moles of potassium?

# Calculating Reacting Quantities from Chemical Equations

**You perform these calculations in three steps:**

- **calculate the number of moles of one of the substances (you will either be given the mass, or the aqueous volume and the concentration, or the gaseous volume)**
- **use the equation to work out the number of moles of the other substance**
- **use one of the mole relationships to work out the quantity you need**

1) What mass of hydrogen is produced when 192 g of magnesium is reacted with hydrochloric acid?

$$Mg + 2\,HCl \rightarrow MgCl_2 + H_2$$ (3)

2) What mass of oxygen is needed to react with 8.5 g of hydrogen sulphide ($H_2S$)?

$$2\,H_2S + 3\,O_2 \rightarrow 2\,SO_2 + 2\,H_2O$$ (3)

3) What mass of potassium oxide is formed when 7.8 g of potassium is burned in oxygen?

$$4\,K + O_2 \rightarrow 2\,K_2O$$ (3)

4) What mass of oxygen is required to oxidise 10 g of ammonia to NO?

$$4\,NH_3 + 5\,O_2 \rightarrow 4\,NO + 6\,H_2O$$ (3)

5) What mass of aluminium oxide is produced when 135 g of aluminium is burned in oxygen?

$$2\ Al + 3\ O_2 \rightarrow Al_2O_3$$ (3)

6) What mass of iodine is produced when 7.1 g of chlorine reacts with excess potassium iodide?

$$Cl_2 + 2\ KI \rightarrow 2\ KCl + I_2$$ (3)

7) What volume of hydrogen is needed to react with 32 g of copper oxide?

$$CuO + H_2 \rightarrow Cu + H_2O$$ (3)

8) What volume of oxygen is formed when 735 g of potassium chlorate decomposes?

$$2\ KClO_3 \rightarrow 2\ KCl + 3\ O_2$$ (3)

9) What volume of hydrogen is produced when 195 g of potassium is added to water?

$$2\ K + 2\ H_2O \rightarrow 2\ KOH + H_2$$ (3)

10) What mass of calcium carbonate is required to produce 1.2 $dm^3$ of carbon dioxide?

$$CaCO_3 \rightarrow CaO + CO_2$$ (3)

11) What mass of magnesium oxide is formed when magnesium reacts with 6 $dm^3$ of oxygen?

$$2\ Mg + O_2 \rightarrow 2\ MgO$$ (3)

12) What volume of carbon dioxide is produced when 5.6 g of butene ($C_4H_8$) is burnt?

$$C_4H_8 + 6\ O_2 \rightarrow 4\ CO_2 + 4\ H_2O$$ (3)

13) The pollutant sulphur dioxide can be removed from the air by reaction with calcium carbonate in the presence of oxygen. What mass of calcium carbonate is needed to remove 480 $dm^3$ of sulphur dioxide?

$$2\ CaCO_3 + 2\ SO_2 + O_2 \rightarrow 2\ CaSO_4 + 2\ CO_2$$ (3)

14) 25 $cm^3$ of a solution of sodium hydroxide reacts with 15 $cm^3$ of 0.1 mol/$dm^3$ HCl. What is the molar concentration of the sodium hydroxide solution?

$$HCl + NaOH \rightarrow NaCl + H_2O$$ (3)