Chemical Calculations

PART A – ATOMIC MASS

- The Atomic Mass in grams of a substance is the mass of a specific large number of the atom, that is, 6.02 X 10^{23} atoms of that substance.

- The Atomic Mass in grams of 6.02 X 10^{23} atoms of hydrogen is 1 gram.

- The Atomic Mass in grams of 6.02 X 10^{23} atoms of carbon is 12 grams.

- Refer to a Periodic Table of the Elements to complete the atomic masses in the table.

ELEMENT NAME	*ELEMENT SYMBOL*	*ATOMIC MASS IN GRAMS*
Hydrogen	H	1
Carbon	C	12
Calcium		
Nitrogen		
Oxygen		
Sulphur		
Sodium		
Chlorine		
Silver		

PART B – MOLECULAR MASS

The molecular mass in grams is the mass of 6.02×10^{23} molecules of a substance.

Example 1 – To calculate the molecular mass of sodium chloride

Step 1- Write the formula

Na Cl

Step 2 – Find out the atomic mass of each element

Na = 23

Cl = 35.5

Step 3 – Calculate the molecular mass

23 + 35.5 = 58.5

Step 4 – The molecular mass of sodium chloride is 58.5

Example 2 – To calculate the molecular mass of water

Step 1- Write the formula

H_2O

Step 2 – Find out the atomic mass of each element

H = 1

O = 16

Step 3 – Calculate the molecular mass

(2 X 1) + 16 = 18

Step 4 – The molecular mass of water is 18

Complete the table of molecular masses.

COMPOUND NAME	*FORMULA*	*WORKING*	*MOLECULAR MASS*
Sodium chloride	Na Cl	1. Na = 23 Cl = 35.5 2. 23 + 35.5 = 58.5	58.5
Water	H_2O	1. H = 1 O = 16 2. (2 X 1) + 16 = 18	18
Sodium nitrate	$NaNO_3$		
Calcium sulphate	$CaSO_4$		
Sodium hydroxide	Na OH		
Silver nitrate	$AgNO_3$		
Silver hydroxide	Ag OH		
Sodium sulphate	Na_2SO_4		
Calcium nitrate	$Ca(NO_3)_2$		

PART C – PREDICTING MASSES OF REACTANTS ANDPRODUCTS

Example 3 - Question - If 16 grams of methane are burnt, what will be the mass of water produced?

Answer –

Step 1 – Write the balanced equation

$$CH_4 + 2\ O_2 \longrightarrow CO_2 + 2\ H_2O$$

Step 2 – Write down the molecular masses of methane and water

$CH_4 = 16$

$H_2O = 18$

*Step 3 – This means that 16 grams is the molecular mass of methane. However, this mass of methane will produce **twice** the molecular mass of water (2 X 18 = **36 grams of water**)*

Example 4 - Question – In the combustion reaction of ethane, what will be the mass of carbon dioxide produced if 60 grams of ethane are burnt?

Answer –

Step 1 – Write the balanced equation

$$2\ C_2H_6 + 7\ O_2 \longrightarrow 4\ CO_2 + 6\ H_2O$$

Step 2 - Write down the molecular masses of ethane and carbon dioxide

$C_2H_6 = (2 \times 12) + (6 \times 1) = 30$

$CO_2 = (1 \times 12) + (2 \times 16) = 44$

*Step 3 – This means that **twice** the molecular mass of ethane is burnt. As shown in the balanced equation, this will produce **4 times** the molecular mass of carbon dioxide.*

Example 5 - Question – When copper reacts with silver nitrate, 10 grams of silver is produced. What amount of copper is needed for this to occur?

Answer –

Step 1 – Write the balanced equation

$2\ Ag\ NO_3 + Cu \qquad 2\ Ag + Cu\ (NO_3)_2$

Step 2 - Write down the molecular masses of copper and silver

Cu = 63.5

Ag = 107.9

Step 3 – According to the balanced equation, if one molecular mass of copper (63.5 grams) is reacted, then twice the molecular mass of silver (215.8 grams) should be produced.

However, only 10 / 215.8 of the silver is produced. This is the same fraction of copper reacted. Therefore the amount of copper must be 10 / 215.8 X 63.5 grams = ***2.9 grams of copper***

Questions

1. If 120 grams of ethane is burnt, how much water will be produced?

2. If 90 grams of ethane is burnt, how much water will be produced?

3. The balanced equation of the reaction between silver nitrate and copper is…

$2\ Ag\ NO_3 + Cu \longrightarrow 2\ Ag + Cu\ (NO_3)_2$

If 127 grams of copper is reacted, how much silver will be produced?

4. Refer to the balanced equation in Q3. If 30 grams of silver are produced, how much copper was reacted?