

Paper 1

Chapter 3 — Quantitative Chemistry

Relative Formula Mass

What is the relative formula mass (M_r) of the compounds in the table?

H=1 C=12 N=14 O=16 Na=23
Mg=24 S=32 Cl=35.5 Ca=40

Compound	M_r	Compound	M_r
H ₂ O		NH ₃	
CO ₂		CaCO ₃	
NaCl		HCl	
H ₂ SO ₄		Mg(NO ₃) ₂	
MgCl ₂		Na ₂ O	

Moles (HT)

Which 2 of the following 4 numbers are equal to Avogadro constant

6.02×10^{23} 6.02×10^{-23} 602,000,000,000,000,000,000 0.000000000000000000000602

Circle the symbol for the mole? mol m mole ml

The mass of one mole of a substance in g_____ is equal to its r_____ f_____ m_____.

One mole of helium and one mole of water have the same...

Number of atoms Mass Number of particles

Measurement in moles can apply to a____, m_____, i____, e_____, f_____ and e_____.

How many moles? (H=1 C=12 N=14 O=16 Na=23 Mg=24 S=32)

5g of Hydrogen 24g of Carbon 10g of Magnesium

1.8g of Water 3.2kg of Sulfur 22g of CO₂

How many grams (H=1 C=12 N=14 O=16 Na=23 Mg=24 S=32)

5 moles of Hydrogen 10 moles of CO₂ 5 moles of SO₂

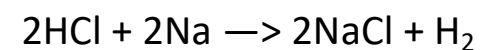
0.5 moles of Sodium 0.2 moles of MgO 0.85 moles of N₂

Amounts of Substances (HT)

For the balanced symbol equation $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$

- Calculate the relative formula mass for each substance.
- How many moles of HCl would react with 5 moles of magnesium?
- What is the mass of 18 moles of HCl?
- How many moles of Mg would have a mass of 2.4g?
- Assuming 100% yield what mass of MgCl₂ would be produced from 2.4g of magnesium?
- How much HCl should be used to react with 4.8g magnesium?
- What is the % yield if 48g of Magnesium produces 95g MgCl₂?
- What is the % yield if 20g of Magnesium produces 40g MgCl₂ to 4sf?

Chemical Measurements



The reaction above should produce 2g of Hydrogen. The reaction is repeated 5 times with the following results.

1.8g 1.7g 1.4g 1.5g 2.7g

Which result is anomalous?

What is the mean?

What is the range?

What is the uncertainty?

Moles to Balance Equations (HT)

Work out the number of moles and write a balanced equation.

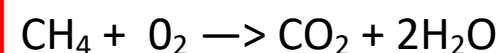
4g of Calcium react with 1.6g of Oxygen (O₂) to produce 5.6g of Calcium Oxide.

1.4 g of Nitrogen (N₂) reacts with 0.3g of Hydrogen (H₂) to produce 1.7g of Ammonia (NH₃)

Conservation of Mass

___ atoms are lost or made during a chemical reaction

The mass of the products _____ the mass of the reactants.



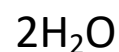
How many atoms on each side of the equation?

Reactants Products

C= H= O= C= H= O=

Is the equation balanced?

If not balance it.



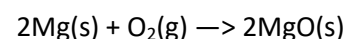
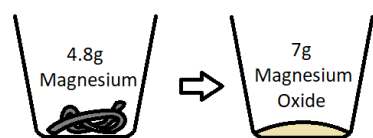
What is the difference between the 2's in the formula?

Normal script 2...

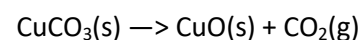
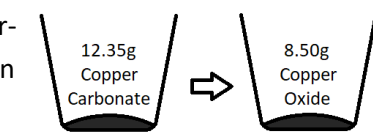
Subscript 2 ...

Mass Changes with Gases

Why does the reaction of magnesium with oxygen appear to gain mass?



Why does the thermal decomposition of copper carbonate appear to lose mass.

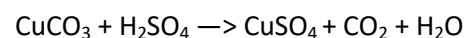


What is the mass of the oxygen used in the first reaction and the carbon dioxide produced in the second?

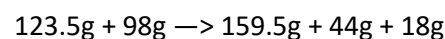
Oxygen = Carbon Dioxide =

Limiting Reactants (HT)

Copper Carbonate reacts with Sulfuric Acid to produce Copper Sulfate, Carbon Dioxide and Water as shown in the equation below



If 1 mole of each substance is used the masses are as follows



The reaction is completed with 12.35g of copper carbonate and 4.9g of Sulfuric Acid.

How many moles of CuCO₃ were used?

How many moles of H₂SO₄ were used?

Which reactant was in excess?

Which reactant was the limiting factor?

Assuming 100% Yield how much Copper Sulfate will be produced?

Why was CuCO₃ used in excess?

Concentrations of Solutions

Circle the volumes 1dm³ is equal to... 1 litre 1000ml 1000cm³

What is the unit for the concentration of a solution ?

What equation can be used to calculate the concentration of a solution? Give the units.

Convert the following to dm³? 150cm³ 750cm³ 20cm³

What is the mass of the solute in 150ml of a 500g/dm³ solution

What is the mass of the solute in 68cm³ of a 150g/dm³ solution

Give the new concentration if a 0.100mol/dm³ had...

- the mass of solute doubled
- the volume of water halved
- the mass of solute halved
- the volume of water doubled

Paper 1

Chapter 3 — Quantitative Chemistry

Relative Formula Mass

What is the relative formula mass (M_r) of the compounds in the table?

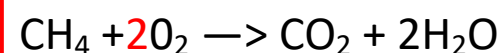
H=1 C=12 N=14 O=16 Na=23
Mg=24 S=32 Cl=35.5 Ca=40

Compound	M_r	Compound	M_r
H ₂ O	18	NH ₃	17
CO ₂	44	CaCO ₃	100
NaCl	58.5	HCl	36.5
H ₂ SO ₄	98	Mg(NO ₃) ₂	148
MgCl ₂	95	Na ₂ O	62

Conservation of Mass

No atoms are lost or made during a chemical reaction

The mass of the products **equals** the mass of the reactants.

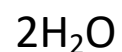


How many atoms on each side of the equation?

Reactants Products
C=1 H=4 O=2 C=1 H=4 O=4

Is the equation balanced? **No**

If not balance it.



What is the difference between the 2's in the formula?

Normal script 2... **2 Molecules of water**

Subscript 2 ... **2 Hydrogen atoms in the molecule**

Moles (HT)

Which 2 of the following 4 numbers are equal to Avogadro constant

6.02×10^{23} 6.02×10^{-23} 602,000,000,000,000,000,000 0.0000000000000000000000602

Circle the symbol for the mole? **mol** m mole ml

The mass of one mole of a substance in **grams** is equal to its **relative formula mass**.

One mole of helium and one mole of water have the same...

Number of atoms Mass **Number of particles**

Measurement in moles can apply to **atoms, molecules, ions, electrons, formulae** and **equations**.

How many moles? (H=1 C=12 N=14 O=16 Na=23 Mg=24 S=32)

5g of Hydrogen **5** 24g of Carbon **2** 10g of Magnesium **0.42**

1.8g of Water **0.1** 3.2kg of Sulfur **100** 22g of CO₂ **0.5**

How many grams (H=1 C=12 N=14 O=16 Na=23 Mg=24 S=32)

5 moles of Hydrogen **5g** 10 moles of CO₂ **440g** 5 moles of SO₂ **320g**

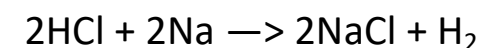
0.5 moles of Sodium **11.5g** 0.2 moles of MgO **8g** 0.85 moles of N₂ **23.8g**

Amounts of Substances (HT)

For the balanced symbol equation $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$

- Calculate the relative formula mass for each substance. **$24 + 73 \rightarrow 95 + 2$**
- How many moles of HCl would react with 5 moles of magnesium? **10**
- What is the mass of 18 moles of HCl? **657g**
- How many moles of Mg would have a mass of 2.4g? **0.1**
- Assuming 100% yield what mass of MgCl₂ would be produced from 2.4g of magnesium? **9.5g**
- How much HCl should be used to react with 4.8g magnesium? **7.3g**
- What is the % yield if 48g of Magnesium produces 95g MgCl₂? **50%**
- What is the % yield if 20g of Magnesium produces 40g MgCl₂ to 4sf? **50.53%**

Chemical Measurements



The reaction above should produce 2g of Hydrogen. The reaction is repeated 5 times with the following results.

1.8g 1.7g 1.4g 1.5g 2.7g

Which result is anomalous? **2.7g**

What is the mean? **1.6g (exclude anomaly)**

What is the range? **1.4g - 1.8g**

What is the uncertainty? **$\pm 0.2\text{g}$ (half the range)**

Moles to Balance Equations (HT)

Work out the number of moles and write a balanced equation.

4g of Calcium react with 1.6g of Oxygen (O₂) to produce 5.6g of Calcium Oxide.

Mass used/Relative mass = moles
 $0.1\text{mol Ca} + 0.05\text{mol O}_2 \rightarrow 0.1\text{mol CaO}$

Number of moles/smallest number of moles = ratio
 $0.1/0.05 : 0.05/0.05 : 0.1/0.05 = 2:1:2$
 $2\text{Ca} + \text{O}_2 \rightarrow 2\text{CaO}$

1.4 g of Nitrogen (N₂) reacts with 0.3g of Hydrogen (H₂) to produce 1.7g of Ammonia (NH₃)

$0.05\text{mol N}_2 + 0.15\text{mol H}_2 \rightarrow 0.05\text{mol NH}_3$

$\text{N}_2 + 3\text{H}_2 \rightarrow \text{NH}_3$

Concentrations of Solutions

Circle the volumes 1dm³ is equal to...

1 litre

1000ml

1000cm³

What is the unit for the concentration of a solution ? **grams per dm³ (g/dm³)**

What equation can be used to calculate the concentration of a solution? Give the units.

$\text{concentration (g/dm}^3\text{)} = \text{mass (g)} / \text{volume (dm}^3\text{)}$

Convert the following to dm³? 150cm³ **0.15dm³** 750cm³ **0.75dm³** 20cm³ **0.02dm³**

What is the mass of the solute in 150ml of a 500g/dm³ solution **75g**

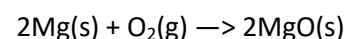
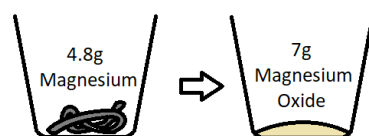
What is the mass of the solute in 68cm³ of a 150g/dm³ solution **10.2g**

Give the new concentration if a 0.100mol/dm³ had...

- a.) the mass of solute doubled **0.200mol/dm³** b.) the volume of water halved **0.200mol/dm³**
c.) the mass of solute halved **0.050mol/dm³** d.) the volume of water doubled **0.050mol/dm³**

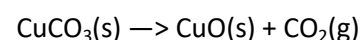
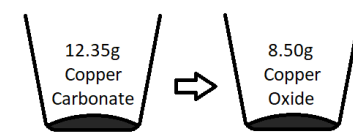
Mass Changes with Gases

Why does the reaction of magnesium with oxygen appear to gain mass?



Oxygen is a gas and was not taken into account in the original mass.

Why does the thermal decomposition of copper carbonate appear to lose mass.



The gas carbon dioxide is produced and escapes into the atmosphere without contributing to the mass of the products.

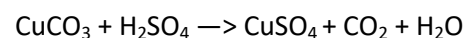
What is the mass of the oxygen used in the first reaction and the carbon dioxide produced in the second?

Oxygen = **2.2g**

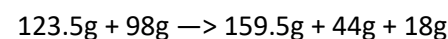
Carbon Dioxide = **3.85g**

Limiting Reactants (HT)

Copper Carbonate reacts with Sulfuric Acid to produce Copper Sulfate, Carbon Dioxide and Water as shown in the equation below



If 1 mole of each substance is used the masses are as follows



The reaction is completed with 12.35g of copper carbonate and 4.9g of Sulfuric Acid.

How many moles of CuCO₃ were used? **0.1**

How many moles of H₂SO₄ were used? **0.05**

Which reactant was in excess? **CuSO₄**

Which reactant was the limiting factor? **H₂SO₄**

Assuming 100% Yield how much Copper Sulfate will be produced? **7.975g**

Why was CuCO₃ used in excess? **To ensure all the sulfuric acid was used up in the reaction.**