



ATOMS & IONS 1

- 1) Complete the following table about some atoms and ions. The first row has been done for you.

Particle	Atom or ion	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electron structure
$^{23}_{11}\text{Na}^+$	ion	11	23	11	12	10	2,8
$^{31}_{15}\text{P}$							
		13	27			10	
	atom	2	4				
				12	12		2,8

- 2) a) Complete the table to show the electron structure of the following ions.

Ion	F^-	Na^+	Al^{3+}	K^+	S^{2-}	H^+
Electron structure						

Ion	O^{2-}	Ca^{2+}	Li^+	Mg^{2+}	Cl^-	Be^{2+}
Electron structure						

- b) i) Complete the table below to show the electronic structure of some Group 0 elements (noble gases).
 ii) Place the ions from part (a) into the correct row of the table.

Element	Electron structure	Ions from part (a) with the same electronic structure
He		
Ne		
Ar		

- c) What is the link between the electronic structure of ions and Group 0 elements (noble gases)?

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- d) i) Complete the table with the ions from part 2a (except H^+). Ions for Group 1 have been done for you.

Group	1	2	3	4	5	6	7	0
Ions	Li^+ Na^+ K^+							
Charge	+1							

- ii) Predict the charge that the following ions would have using the Periodic Table and your table.

strontium ions iodide ions rubidium ions

Area	Strength	To develop	Area	Strength	To develop	Area	Strength	To develop
Done with care and thoroughness			Give electron structure of atoms			Link between ions and PT group		
Good SPG			Give electron structure of ions			Can predict ion charges		
Can work with PNE numbers			Link between ions and Group 0					



ATOMS & IONS 1

- 1) Complete the following table about some atoms and ions. The first row has been done for you.

Particle	Atom or ion	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electron structure
$^{23}_{11}\text{Na}^+$	ion	11	23	11	12	10	2,8
$^{31}_{15}\text{P}$	atom	15	31	15	16	15	2,8,5
$^{27}_{13}\text{Al}^{3+}$	ion	13	27	13	14	10	2,8,3
^4_2He	atom	2	4	2	2	2	2
$^{24}_{12}\text{Mg}^{2+}$	ion	12	24	12	12	10	2,8

- 2) a) Complete the table to show the electron structure of the following ions.

Ion	F^-	Na^+	Al^{3+}	K^+	S^{2-}	H^+
Electron structure	2,8	2,8	2,8	2,8,8	2,8,8	0

Ion	O^{2-}	Ca^{2+}	Li^+	Mg^{2+}	Cl^-	Be^{2+}
Electron structure	2,8	2,8,8	2	2,8	2,8,8	2

- b) i) Complete the table below to show the electronic structure of some Group 0 elements (noble gases).
 ii) Place the ions from part (a) into the correct row of the table.

Element	Electron structure	Ions from part (a) with the same electronic structure
He	2	Li^+ Be^{2+}
Ne	2,8	F^- O^{2-} Na^+ Mg^{2+} Al^{3+}
Ar	2,8,8	S^{2-} Cl^- K^+ Ca^{2+}

- c) What is the link between the electronic structure of ions and Group 0 elements (noble gases)?

Ions have the same electron structure as the noble gases

- d) i) Complete the table with the ions from part 2a (except H^+). Ions for Group 1 have been done for you.

Group	1	2	3	4	5	6	7	0
Ions	Li^+ Na^+ K^+	Be^{2+} Mg^{2+} Ca^{2+}	Al^{3+}			O^{2-} S^{2-}	Cl^-	
Charge	+1	+2	+3			-2	-1	

- ii) Predict the charge that the following ions would have using the Periodic Table and your table.

strontium ions **+2** iodide ions **-1** rubidium ions **+1**

Area	Strength	To develop	Area	Strength	To develop	Area	Strength	To develop
Done with care and thoroughness			Give electron structure of atoms			Link between ions and PT group		
Good SPG			Give electron structure of ions			Can predict ion charges		
Can work with PNE numbers			Link between ions and Group 0					



NAMING SUBSTANCES 2

Name the following substances.

Formula	Name
O ₂	
CuO	
Cu	
CuSO ₄	
CuS	
CuCO ₃	
FeSO ₄	
Fe(NO ₃) ₂	
N ₂	
H ₂ SO ₄	
CO	
CO ₂	
NO ₂	
HCl	
KHCO ₃	
K ₂ CO ₃	
Mg	
AgF	
Ca(OH) ₂	
CaCO ₃	

Name	Formula
Al ₂ O ₃	
Na	
Al ₂ (SO ₄) ₃	
HNO ₃	
I ₂	
Ni	
Al	
Na ₂ O	
NaOH	
NaBr	
Na ₂ CO ₃	
He	
CH ₄	
NH ₃	
NH ₄ Br	
H ₂ Te	
SnCl ₄	
WO ₃	
HgO	
TiC	



NAMING SUBSTANCES 2

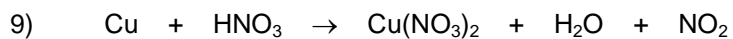
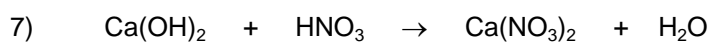
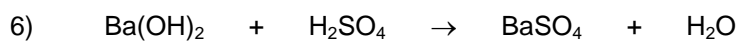
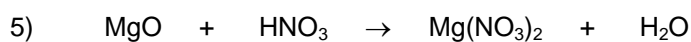
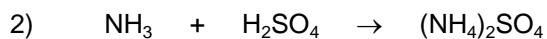
Name the following substances.

Formula	Name
O ₂	Oxygen
CuO	Copper oxide
Cu	Copper
CuSO ₄	Copper sulfate
CuS	Copper sulfide
CuCO ₃	Copper carbonate
FeSO ₄	Iron sulfate
Fe(NO ₃) ₂	Iron nitrate
N ₂	nitrogen
H ₂ SO ₄	Sulfuric acid
CO	Carbon monoxide
CO ₂	Carbon dioxide
NO ₂	Nitrogen dioxide (nitrogen oxide)
HCl	Hydrochloric acid
KHCO ₃	Potassium hydrogencarbonate
K ₂ CO ₃	Potassium carbonate
Mg	Magnesium
AgF	Silver fluoride
Ca(OH) ₂	Calcium hydroxide
CaCO ₃	Calcium carbonate

Name	Formula
Al ₂ O ₃	Aluminium oxide
Na	Sodium
Al ₂ (SO ₄) ₃	Aluminium sulfate
HNO ₃	Nitric acid
I ₂	Iodine
Ni	Nickel
Al	Aluminium
Na ₂ O	Sodium oxide
NaOH	Sodium hydroxide
NaBr	Sodium bromide
Na ₂ CO ₃	Sodium carbonate
He	Helium
CH ₄	methane
NH ₃	Ammonia
NH ₄ Br	Ammonium bromide
H ₂ Te	Hydrogen telluride
SnCl ₄	Tin chloride
WO ₃	Tungsten oxide
HgO	Mercury oxide
TiC	Titanium carbide

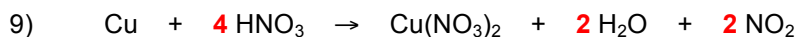
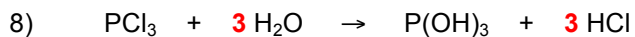
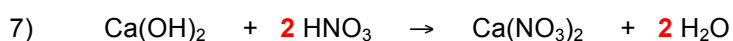
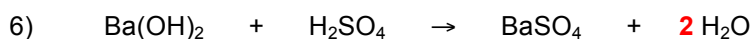
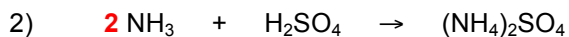


BALANCING EQUATIONS 3



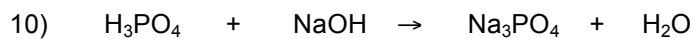
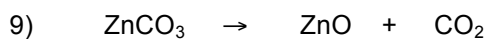
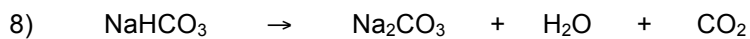
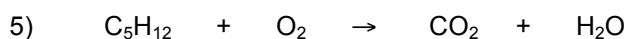
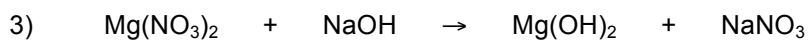
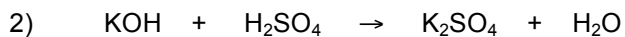
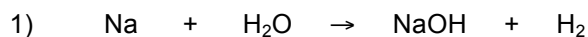


BALANCING EQUATIONS 3



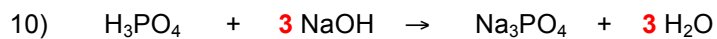
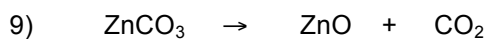
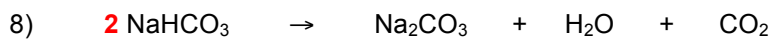
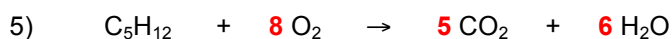
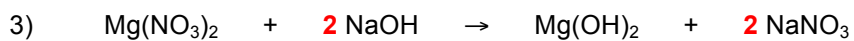
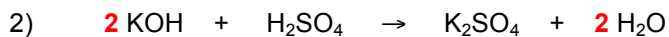
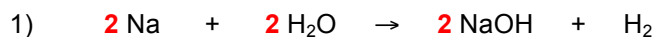


BALANCING EQUATIONS 4





BALANCING EQUATIONS 4





1 Calculate the relative formula mass (M_r) of each of the following substances.

- a CO_2
- b Mg
- c sodium oxide
- d calcium nitrate

2 Calculate the mass in grams of one atom of ^{19}F . Give your answer in standard form to 3 significant figures.
(the Avogadro constant = $6.022 \times 10^{23} \text{ mol}^{-1}$)

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3 One molecule of water has a mass of $2.99 \times 10^{-23} \text{ g}$. Use this to calculate the mass in grams of two moles of water molecules.
(the Avogadro constant = $6.022 \times 10^{23} \text{ mol}^{-1}$)

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- 1 5.2 g of chromium (Cr) reacts with 4.8 g of oxygen (O_2) to form chromium oxide. Find the molar reacting ratio between chromium and oxygen.

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- 2 0.48 g of hydrazine (N_2H_4) decomposes to form 0.14 g of nitrogen (N_2) and 0.34 g of ammonia (NH_3). Find the molar ratios and use this to give the equation for the reaction.

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- 1 5.2 g of chromium (Cr) reacts with 4.8 g of oxygen (O₂) to form chromium oxide. Find the molar reacting ratio between chromium and oxygen.

$$\text{moles Cr} = \frac{\text{mass}}{M_r} = \frac{5.2}{52} = 0.1 \text{ mol}$$

$$\text{moles O}_2 = \frac{\text{mass}}{M_r} = \frac{4.8}{32} = 0.15 \text{ mol}$$

$$\text{reacting ratio Cr : O}_2 = 0.10 : 0.15 = \frac{0.10}{0.10} : \frac{0.15}{0.10} = 1 : 1.5 = 2 : 3$$



- 2 0.48 g of hydrazine (N₂H₄) decomposes to form 0.14 g of nitrogen (N₂) and 0.34 g of ammonia (NH₃). Find the molar ratios and use this to give the equation for the reaction.

$$\text{moles N}_2\text{H}_4 = \frac{\text{mass}}{M_r} = \frac{0.48}{32} = 0.015 \text{ mol}$$

$$\text{moles N}_2 = \frac{\text{mass}}{M_r} = \frac{0.14}{28} = 0.005 \text{ mol}$$

$$\text{moles NH}_3 = \frac{\text{mass}}{M_r} = \frac{0.34}{17} = 0.020 \text{ mol}$$

$$\text{reacting ratio N}_2\text{H}_4 : \text{N}_2 : \text{NH}_3 = 0.015 : 0.005 : 0.020 = \frac{0.015}{0.005} : \frac{0.005}{0.005} : \frac{0.020}{0.005} = 3 : 1 : 4$$





The volume of one mole of any gas at room temperature and pressure is 24 dm^3

- 1 What is the volume of 0.50 moles of hydrogen gas (H_2) at room temperature and pressure?

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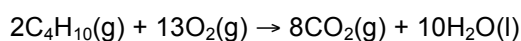
- 2 How many moles in 1.8 dm^3 of helium gas (He) at room temperature and pressure?

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- 3 What is the volume of 7.0 g of nitrogen gas (N_2) at room temperature and pressure?

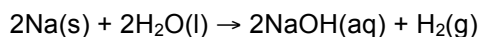
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- 4 What volume of oxygen gas reacts with 100 cm^3 of butane gas, with both gases measured at the same temperature and pressure?



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- 5 What volume of hydrogen gas, measured at room temperature and pressure, is formed when 6.9 g of sodium reacts with water?



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The volume of one mole of any gas at room temperature and pressure is 24 dm^3

- 1 What is the volume of 0.50 moles of hydrogen gas (H_2) at room temperature and pressure?

$$\text{volume of H}_2 = 24 \times \text{moles} = 24 \times 0.50 = 12 \text{ dm}^3$$

- 2 How many moles in 1.8 dm^3 of helium gas (He) at room temperature and pressure?

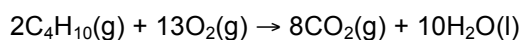
$$\text{moles of He} = \frac{\text{volume}}{24} = \frac{1.8}{24} = 0.075 \text{ mol}$$

- 3 What is the volume of 7.0 g of nitrogen gas (N_2) at room temperature and pressure?

$$\text{moles of N}_2 = \frac{\text{mass}}{M_r} = \frac{7.0}{28} = 0.25 \text{ mol}$$

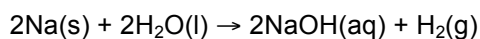
$$\text{volume of N}_2 = 24 \times \text{moles} = 24 \times 0.25 = 6 \text{ dm}^3$$

- 4 What volume of oxygen gas reacts with 100 cm^3 of butane gas, with both gases measured at the same temperature and pressure?



$$\text{volume of O}_2 = \frac{13}{2} \times \text{moles C}_4\text{H}_{10} = \frac{13}{2} \times 100 = 650 \text{ cm}^3$$

- 5 What volume of hydrogen gas, measured at room temperature and pressure, is formed when 6.9 g of sodium reacts with water?



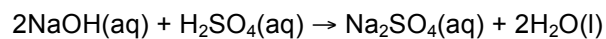
$$\text{moles of Na} = \frac{\text{mass}}{M_r} = \frac{6.9}{23} = 0.30 \text{ mol}$$

$$\text{moles of H}_2 = \frac{1}{2} \times 0.30 = 0.15 \text{ mol}$$

$$\text{volume of H}_2 = 24 \times \text{moles} = 24 \times 0.15 = 3.6 \text{ dm}^3$$



- 1 In a titration, 25.0 cm³ of 0.200 mol/dm³ sodium hydroxide solution reacted with 28.5 cm³ of sulfuric acid. Find the concentration of the sulfuric acid in mol/dm³.



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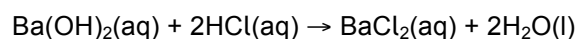
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- 2 In a titration, 25.0 cm³ of 0.040 mol/dm³ barium hydroxide solution reacted with 21.6 cm³ of hydrochloric acid. Find the concentration of the hydrochloric acid in mol/dm³ and g/dm³.



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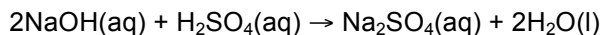
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- 1 In a titration, 25.0 cm³ of 0.200 mol/dm³ sodium hydroxide solution reacted with 28.5 cm³ of sulfuric acid. Find the concentration of the sulfuric acid in mol/dm³.



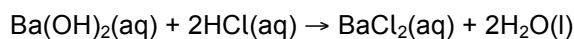
$$\begin{array}{cc} 25.0 \text{ cm}^3 & 28.5 \text{ cm}^3 \\ 0.200 \text{ mol/dm}^3 & \end{array}$$

$$\text{moles NaOH} = \text{conc} \times \text{volume (dm}^3\text{)} = 0.200 \times \frac{25.0}{1000} = 0.0050 \text{ mol}$$

$$\text{moles H}_2\text{SO}_4 = \frac{\text{moles NaOH}}{2} = \frac{0.0050}{2} = 0.0025 \text{ mol}$$

$$\text{concentration H}_2\text{SO}_4 = \frac{\text{moles NaOH}}{\text{volume (dm}^3\text{)}} = \frac{0.0025}{\frac{28.5}{1000}} = 0.0877 \text{ mol/dm}^3$$

- 2 In a titration, 25.0 cm³ of 0.040 mol/dm³ barium hydroxide solution reacted with 21.6 cm³ of hydrochloric acid. Find the concentration of the hydrochloric acid in mol/dm³ and g/dm³.



$$\begin{array}{cc} 25.0 \text{ cm}^3 & 21.6 \text{ cm}^3 \\ 0.040 \text{ mol/dm}^3 & \end{array}$$

$$\text{moles Ba}(\text{OH})_2 = \text{conc} \times \text{volume (dm}^3\text{)} = 0.040 \times \frac{25.0}{1000} = 0.00100 \text{ mol}$$

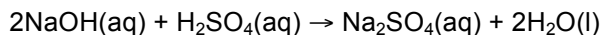
$$\text{moles HCl} = 2 \times \text{moles Ba}(\text{OH})_2 = 2 \times 0.00100 \text{ mol} = 0.00200 \text{ mol}$$

$$\text{concentration HCl in mol/dm}^3 = \frac{\text{moles NaOH}}{\text{volume (dm}^3\text{)}} = \frac{0.00200}{\frac{21.6}{1000}} = 0.0926 \text{ mol/dm}^3$$

$$\text{concentration HCl in g/dm}^3 = M_r \times \text{concentration HCl in mol/dm}^3 = 0.0926 \times 36.5 = 3.38 \text{ g/dm}^3$$



- 1 In a titration, 25.0 cm³ of 0.200 mol/dm³ sodium hydroxide solution reacted with 28.5 cm³ of sulfuric acid. Find the concentration of the sulfuric acid in mol/dm³.



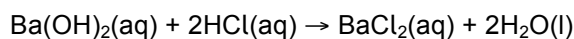
$$\begin{array}{cc} 25.0 \text{ cm}^3 & 28.5 \text{ cm}^3 \\ 0.200 \text{ mol/dm}^3 & \end{array}$$

$$\text{moles NaOH} = \text{conc} \times \text{volume (dm}^3\text{)} = 0.200 \times \frac{25.0}{1000} = 0.0050 \text{ mol}$$

$$\text{moles H}_2\text{SO}_4 = \frac{\text{moles NaOH}}{2} = \frac{0.0050}{2} = 0.0025 \text{ mol}$$

$$\text{concentration H}_2\text{SO}_4 = \frac{\text{moles NaOH}}{\text{volume (dm}^3\text{)}} = \frac{0.0025}{\frac{28.5}{1000}} = 0.0877 \text{ mol/dm}^3$$

- 2 In a titration, 25.0 cm³ of 0.040 mol/dm³ barium hydroxide solution reacted with 21.6 cm³ of hydrochloric acid. Find the concentration of the hydrochloric acid in mol/dm³ and g/dm³.



$$\begin{array}{cc} 25.0 \text{ cm}^3 & 21.6 \text{ cm}^3 \\ 0.050 \text{ mol/dm}^3 & \end{array}$$

$$\text{moles Ba}(\text{OH})_2 = \text{conc} \times \text{volume (dm}^3\text{)} = 0.040 \times \frac{25.0}{1000} = 0.00100 \text{ mol}$$

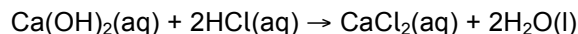
$$\text{moles HCl} = 2 \times \text{moles Ba}(\text{OH})_2 = 2 \times 0.00100 \text{ mol} = 0.00200 \text{ mol}$$

$$\text{concentration HCl in mol/dm}^3 = \frac{\text{moles NaOH}}{\text{volume (dm}^3\text{)}} = \frac{0.00200}{\frac{21.6}{1000}} = 0.0926 \text{ mol/dm}^3$$

$$\text{concentration HCl in g/dm}^3 = M_r \times \text{concentration HCl in mol/dm}^3 = 0.0926 \times 36.5 = 3.38 \text{ g/dm}^3$$



A student carried out a titration to find the concentration of a solution of calcium hydroxide. In each titration, the student used 25.0 cm^3 of the calcium hydroxide solution and titrated it against 0.0100 mol/dm^3 hydrochloric acid solution.



The student's results are shown in the table.

titration	1	2	3
start reading / cm^3	0.00	23.15	0.10
end reading / cm^3	23.15	47.05	23.90
volume added / cm^3			

- a** Find the mean titre to the appropriate number of significant figures and give the uncertainty in this measurement.

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- b** Find the concentration of the calcium hydroxide in mol/dm^3 and g/dm^3 . Give your answers to 3 significant figures.

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- c** Outline the key steps in carrying out this titration.

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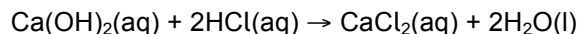
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A student carried out a titration to find the concentration of a solution of calcium hydroxide. In each titration, the student used 25.0 cm^3 of the calcium hydroxide solution and titrated it against 0.0100 mol/dm^3 hydrochloric acid solution.



The student's results are shown in the table.

titration	1	2	3
start reading / cm^3	0.00	23.15	0.10
end reading / cm^3	23.15	47.05	23.90
volume added / cm^3	23.15	23.90	23.80

- a Find the mean titre to the appropriate number of significant figures and give the uncertainty in this measurement.

$$\text{mean} = \frac{23.90 + 23.80}{2} = \mathbf{23.85 \pm 0.05 \text{ cm}^3}$$

- b Find the concentration of the calcium hydroxide in mol/dm^3 and g/dm^3 . Give your answers to 3 significant figures.

$$\text{moles HCl} = \text{conc} \times \text{volume (dm}^3\text{)} = 0.0100 \times \frac{23.85}{1000} = \mathbf{0.0002385 \text{ mol}}$$

$$\text{moles Ca(OH)}_2 = \frac{\text{moles HCl}}{2} = \frac{0.0002385}{2} = \mathbf{0.00011925 \text{ mol}}$$

$$\text{concentration Ca(OH)}_2 \text{ in mol/dm}^3 = \frac{\text{moles Ca(OH)}_2}{\text{volume (dm}^3\text{)}} = \frac{0.00011925}{\frac{25.0}{1000}} = \mathbf{0.00477 \text{ mol/dm}^3}$$

$$\begin{aligned} \text{concentration Ca(OH)}_2 \text{ in g/dm}^3 &= M_r \times \text{concentration Ca(OH)}_2 \text{ in mol/dm}^3 \\ &= \mathbf{0.00477 \times 74 = 0.353 \text{ g/dm}^3} \end{aligned}$$

- c Outline the key steps in carrying out this titration.

- using a pipette
- place 25.0 cm^3 of calcium hydroxide in a conical flask
- add an indicator
- put acid in a burette
- add acid to flask until indicator changes colour
- add drop by drop near the end
- record results
- repeat



1 Calculate the relative formula mass (M_r) of each of the following substances.

a CO_2 $12 + 2(16) = 44$

b Mg 24

c sodium oxide Na_2O $2(23) + 16 = 62$

d calcium nitrate $\text{Ca}(\text{NO}_3)_2$ $40 + 2(14) + 6(16) = 164$

2 Calculate the mass in grams of one atom of ^{19}F . Give your answer in standard form to 3 significant figures.
(the Avogadro constant = $6.022 \times 10^{23} \text{ mol}^{-1}$)

$$\text{mass of one atom} = \frac{19}{6.022 \times 10^{23}} = 3.16 \times 10^{-23} \text{ g}$$

3 One molecule of water has a mass of $2.99 \times 10^{-23} \text{ g}$. Use this to calculate the mass in grams of two moles of water molecules.

$$\text{mass of two moles} = 2 \times 6.022 \times 10^{23} \times 2.99 \times 10^{-23} = 36 \text{ g}$$



1 What is the mass of one mole of CO_2 ?

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2 How many moles are there in 99 g of H_2O ?

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3 What is the mass of 0.250 moles of N_2 ?

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4 How many moles are there in 1.2 kg of Mg?

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5 Calculate the relative formula mass (M_r) of each of the following substances.

- a $\text{Mg}(\text{NO}_3)_2$
- b oxygen
- c potassium sulfate

6 Calculate the mass in grams of one atom of ^{31}P . Give your answer in standard form to 3 significant figures.
(the Avogadro constant = $6.022 \times 10^{23} \text{ mol}^{-1}$)

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- 1 What is the mass of one mole of CO_2 ?

$$M_r = 12 + 2(16) = 44$$

$$\text{mass of 1 mole of CO}_2 = 44 \text{ g}$$

- 2 How many moles are there in 99 g of H_2O ?

$$M_r = 2(1) + 16 = 18$$

$$\text{moles} = \frac{\text{mass}}{M_r} = \frac{99}{18} = 5.5 \text{ moles}$$

- 3 What is the mass of 0.250 moles of N_2 ?

$$M_r = 2(14) = 28$$

$$\text{mass} = M_r \times \text{moles} = 28 \times 0.250 = 7.0 \text{ g}$$

- 4 How many moles are there in 1.2 kg of Mg?

$$M_r = 24$$

$$\text{moles} = \frac{\text{mass}}{M_r} = \frac{1200}{24} = 50 \text{ moles}$$

- 5 Calculate the relative formula mass (M_r) of each of the following substances.

a $\text{Mg}(\text{NO}_3)_2$ $M_r = 24 + 2(14) + 6(16) = 148$

b oxygen O_2 $M_r = 2(16) = 32$

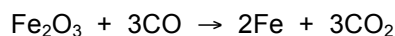
c potassium sulfate K_2SO_4 $M_r = 2(39) + 32 + 4(16) = 174$

- 6 Calculate the mass in grams of one atom of ^{31}P . Give your answer in standard form to 3 significant figures.
(the Avogadro constant = $6.022 \times 10^{23} \text{ mol}^{-1}$)

$$\text{mass of one atom} = \frac{31}{6.022 \times 10^{23}} = 5.15 \times 10^{-23} \text{ g}$$



- 1 What mass of iron is formed when 240 g of iron(III) oxide reacts with carbon monoxide?



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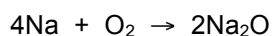
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- 2 What mass of oxygen reacts with 9.2 g of sodium?



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- 3 How many moles in each of the following?

a 12 mg of magnesium

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b 8.0 kg of oxygen

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- 4 What is the mass of each of the following?

a 0.100 moles of calcium hydroxide

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b 0.025 moles of aluminium sulfate

.....



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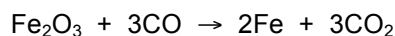
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- 1 What mass of iron is formed when 240 g of iron(III) oxide reacts with carbon monoxide?

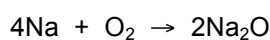


$$\text{moles Fe}_2\text{O}_3 = \frac{\text{mass}}{M_r} = \frac{240}{160} = 1.5 \text{ moles}$$

$$\text{moles Fe} = 2 \times 1.5 = 3.0 \text{ moles}$$

$$\text{mass Fe} = M_r \times \text{moles} = 56 \times 3.0 = 168 \text{ g}$$

- 2 What mass of oxygen reacts with 9.2 g of sodium?



$$\text{moles Na} = \frac{\text{mass}}{M_r} = \frac{9.2}{23} = 0.4 \text{ moles}$$

$$\text{moles O}_2 = \frac{0.4}{4} = 0.1 \text{ moles}$$

$$\text{mass O}_2 = M_r \times \text{moles} = 32 \times 0.1 = 3.2 \text{ g}$$

- 3 How many moles in each of the following?

- a 12 mg of magnesium

$$\text{moles Mg} = \frac{\text{mass}}{M_r} = \frac{0.012}{24} = 0.0005 \text{ moles}$$

- b 8.0 kg of oxygen

$$\text{moles O}_2 = \frac{\text{mass}}{M_r} = \frac{8000}{32} = 250 \text{ moles}$$

- 4 What is the mass of each of the following?

- a 0.100 moles of calcium hydroxide

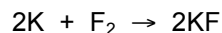
$$\text{mass Ca(OH)}_2 = M_r \times \text{moles} = 74 \times 0.100 = 7.4 \text{ g}$$

- b 0.025 moles of aluminium sulfate

$$\text{mass Al}_2(\text{SO}_4)_3 = M_r \times \text{moles} = 342 \times 0.025 = 8.55 \text{ g}$$



- 1 a What is the maximum mass of potassium fluoride that can be formed when 1.56 g of potassium reacts with fluorine?



$$\text{moles K} = \frac{\text{mass}}{M_r} = \frac{1.56}{39} = 0.04 \text{ moles}$$

$$\text{moles KF} = 0.04 \text{ moles}$$

$$\text{mass KF} = M_r \times \text{moles} = 58 \times 0.04 = 2.32 \text{ g}$$

- b In an experiment, a student reacted 1.56 g of potassium with fluorine and made 1.48 g of potassium fluoride. Calculate the percentage yield.

$$\% \text{ yield} = 100 \times \frac{\text{mass formed}}{\text{maximum mass possible}} = 100 \times \frac{1.48}{2.32} = 63.8\%$$

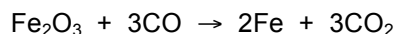
- c Give two reasons why the percentage yield is less than 100%.

incomplete reaction

some products escape / left on apparatus

reaction may be reversible

- 2 Calculate the percentage yield in a reaction where 1.0 kg of iron is made from 1.6 kg of iron(III) oxide.



$$\text{moles Fe}_2\text{O}_3 = \frac{\text{mass}}{M_r} = \frac{1600}{160} = 10 \text{ moles}$$

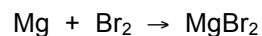
$$\text{moles Fe} = 20 \text{ moles}$$

$$\text{mass Fe} = M_r \times \text{moles} = 56 \times 20 = 1120 \text{ g}$$

$$\% \text{ yield} = 100 \times \frac{\text{mass formed}}{\text{maximum mass possible}} = 100 \times \frac{1000}{1120} = 89.3\%$$

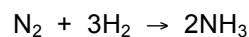


- 1 a How many moles of magnesium bromide are formed when 3.0 moles of magnesium reacts with 2.0 moles of bromine?



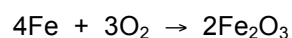
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- b How many moles of ammonia are formed when 4.0 moles of nitrogen reacts with 9.0 moles of hydrogen?



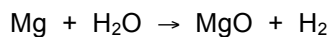
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- c How many moles of iron oxide are formed when 12.0 moles of iron reacts with 6.0 moles of oxygen?



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- 2 4.8 g of magnesium is reacted with 4.5 g of steam. Work out which is the limiting reagent and then calculate the mass of magnesium oxide formed.



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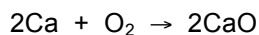
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- 3 2.0 g of calcium is reacted with 0.32 g of oxygen. Work out which is the limiting reagent and then calculate the mass of calcium oxide formed.



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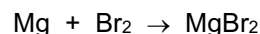
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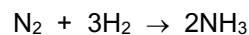


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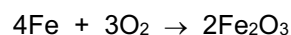
2.0 moles of MgBr₂

- b How many moles of ammonia are formed when 4.0 moles of nitrogen reacts with 9.0 moles of hydrogen?



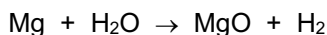
6.0 moles of NH₃

- c How many moles of iron oxide are formed when 12.0 moles of iron reacts with 6.0 moles of oxygen?



4.0 moles of Fe₂O₃

- 2 4.8 g of magnesium is reacted with 4.5 g of steam. Work out which is the limiting reagent and then calculate the mass of magnesium oxide formed.



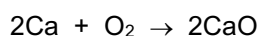
$$\text{moles Mg} = \frac{\text{mass}}{M_r} = \frac{4.8}{24} = 0.2 \text{ mol}$$

$$\text{moles H}_2\text{O} = \frac{\text{mass}}{M_r} = \frac{4.5}{18} = 0.25 \text{ mol}$$

**0.2 moles of Mg needs 0.2 moles of H₂O for all the Mg to react,
there is more than enough H₂O and so the H₂O is in excess, therefore Mg is the limiting reagent
therefore 0.2 moles of Mg reacts with the 0.2 moles of H₂O, and forms 0.2 moles of MgO**

$$\text{mass MgO} = M_r \times \text{moles} = 40 \times 0.2 = 8 \text{ g}$$

- 3 2.0 g of calcium is reacted with 0.32 g of oxygen. Work out which is the limiting reagent and then calculate the mass of calcium oxide formed.



$$\text{moles Ca} = \frac{\text{mass}}{M_r} = \frac{2.0}{40} = 0.05 \text{ mol}$$

$$\text{moles O}_2 = \frac{\text{mass}}{M_r} = \frac{0.32}{32} = 0.01 \text{ mol}$$

**0.05 moles of Ca needs 0.025 moles of O₂ for all the Ca to react, but we don't have this much O₂
therefore O₂ is the limiting reagent (so the Ca is in excess and does not all react)
therefore only 0.02 moles of Ca reacts with the 0.01 moles of O₂, and forms 0.02 moles of CaO**

$$\text{mass CaO} = M_r \times \text{moles} = 56 \times 0.02 = 1.12 \text{ g}$$