

1 a) Complete the following table about protons, neutrons and electrons.

neutron proton electron

relative charge **0 +1 -1**

relative mass 1 1 0.0005

b) Define the term **mass number**. **Number of protons + neutrons**

c) Define the term **atomic number** **Number of protons**

2 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
"F"	F ⁻	ion	9	19	9	10	2,8	
"Ar"	Ar	atom	18	40	18	22	18	2,8,8
"Al"	Al ³⁺	ion	13	27	13	10	2,8	
S ²⁻	S ²⁻	ion	16	34	16	18	2,8,8	
K ⁺	K ⁺	ion	19	39	19	20	2,8,8	
P	P	atom	15	31	15	16	15	2,8,5

3 The element indium consists of two isotopes. 4.3% of the atoms are $^{113}_{49}\text{In}$ and 95.7% of the atoms are $^{115}_{49}\text{In}$.

a) What makes both of these atoms of the element indium? **have 49 protons**

b) What are isotopes **atoms with the same number of protons but different number of neutrons**

c) Calculate the relative atomic mass of indium. Give your answer to 4 significant figures.

$$\begin{aligned} (113 \times 4.3) + (115 \times 95.7) &= 114.9 \\ 4.3 + 95.7 & \end{aligned}$$

4 The diameter of an indium atom is 310 pm.

a) What is the diameter of an indium atom in metres? Give your answer in standard form.

$$310 \times 10^{-12} \text{ m} = 3.10 \times 10^{-10} \text{ m.}$$

b) How many indium atoms would fit in a line 20 cm long? Give your answer to 3 significant figures.

$$0.20 = 6.45 \times 10^8 \text{ atoms } 3.10 \times 10^{-10}$$

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GCSE REVISION 1

Atoms, ions, equations, Periodic Table

5 This question is about the Periodic Table

a) Name each of the following groups.

Group 1 **alkali metals**

Group 7 **halogens**

Group 0 **noble gases**

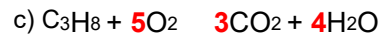
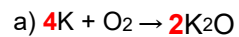
b) Which group would the following elements be in?

element with electron structure 2,8,6 **group 6**

element with electron structure 2,8,8 **group 0**

element with electron structure 2,8,18,3 **group 3**

6 Balance each of the following equations.



Area Strength To develop Area Strength To develop Area Strength To develop

Done with care and thoroughness Can find PNE numbers in ions Can use standard form

Good SPG Knows what determines an element Can convert units

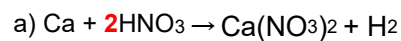
Knows mass and charge of PNE Knows what isotopes are Can name common PT groups

Can define atomic & mass numbers Find A_r from isotope data Determine group from electron structure

Can find PNE numbers in atoms Can use sig figs Balance equations

10000

3 Balance each of the following equations.



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GCSE REVISION 2

Atoms, ions, equations, Periodic Table

4 In each of the following reactions, predict whether electrons will be (1) shared, (2) transferred or (3) no reaction takes place. Place a ✓ in the correct box.

elements	electrons shared	electrons transferred	no reaction
sodium + oxygen	✓		
magnesium + copper		✓	
phosphorus + chlorine	✓		
argon + fluorine	✓		

5 This question is about the elements in Group 1 of the Periodic Table.

a) i) Describe what you see when lithium burns in oxygen.

Burns with red (crimson) flame & forms white powder

ii) Write a balanced equation for this reaction. $4\text{Li} + \text{O}_2 \rightarrow 2\text{Li}_2\text{O}$

b) Which is more reactive, lithium or sodium? Explain why.

Sodium more reactive Sodium atoms are bigger so outer shell electron is further from nucleus Weaker attraction between nucleus and outer electron in sodium So outer electron lost more easily in sodium

6 This question is about the elements in Group 7 of the Periodic Table.

a) Describe what you see when a solution of sodium bromide is mixed with a solution of chlorine.

Yellow solution forms

b) Write a balanced equation for this reaction. $\text{Cl}_2 + 2\text{NaBr} \rightarrow 2\text{NaCl} + \text{Br}_2$

c) Explain fully why this reaction takes place.

chlorine more reactive than bromine chlorine atoms are smaller so the electron gained is closer to the nucleus stronger attraction between nucleus and electron gained in chlorine so chlorine gains electron more easily

Area Strength To develop Area Strength To develop Area Strength To develop

Done with care and thoroughness Find A_r from isotope data What happens when Li reacts with O_2

Good SPG Can use sig figs Write equation when Li reacts with O_2

Can find PNE numbers in atoms Can use standard form Know & explain Group 1 reactivity trend

Can find PNE numbers in ions Can convert units What happens in halogen displacements

Knows what determines an element Balance equations Write halogen displacement reactions

Knows what isotopes are What happens when elements react Know & explain Group 7 reactivity trend

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

	Particle	Atom or ion	Atomic number		electrons	
Mass number					Number of electrons	
					Number of electrons	
					Number of electrons	
	Number of protons					Electron structure
	Number of protons					Electron structure
		Number of neutrons				Electron structure
		Number of neutrons				Electron structure
		Number of neutrons				Electron structure
			Number of			Electron structure
	${}^9_4\text{F}^{+}$	ion	9	9	10	2,8
	${}^{40}_{19}\text{K}^{+}$	ion	19	40	19	21 18 2,8,8
	${}^{27}_{13}\text{Al}$	atom	13	27	13	14 13 2,8,3
	${}^{14}_7\text{N}^{3+}$	ion	7	14	7	7 10 2,8

Electron
structure
Electron
structure
Electron
structure
Electron
structure
Electron
structure

2 The element magnesium consists of three isotopes. 79.0% of the atoms are $^{24}_{12}\text{Mg}$, 10.0% of the atoms are

$^{24}_{12}\text{Mg}$, and 11.0% of the atoms are $^{26}_{12}\text{Mg}$ a) What makes each of these atoms of the element magnesium? **they have 12 protons**

b) What are isotopes? **they have same number of protons, but a different number of neutrons**

c) Calculate the relative atomic mass of magnesium. Give your answer to 3 significant figures.

$$\frac{[79.0 \times 24] + [10.0 \times 25] + [11.0 \times 26]}{79.0 + 10.0 + 11.0} = 24.3$$

d) The diameter of a magnesium atom is 0.15 nm. State this in metres in standard form. **$1.5 \times 10^{-10} \text{ m}$**

e) How many atoms of magnesium would fit in a line 50 cm long? Give your answer to 3 significant figures.

$$0.50 = 3.33 \times 10^9 \cdot 1.5 \times 10^{-10}$$

3 This question is about some non-metals in the Periodic Table.

a) Describe what you see when a solution of sodium iodide is mixed with a solution of chlorine.

brown solution

b) Explain fully why this reaction takes place.

chlorine more reactive than iodine chlorine atoms are smaller so the electron gained is closer to the nucleus
stronger attraction between nucleus and electron gained in chlorine so chlorine gains electron more easily

c) Argon is in Group 0 of the Periodic Table.

i) Name this group. **noble gases**

ii) Explain why argon is unreactive. **stable electron structure**

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GCSE REVISION 3

Atoms, ions, equations, Periodic Table

4 This question is about some metals in the Periodic Table.

a) i) Describe what you see when potassium reacts with water.

K melts, floats, moves on water, fizzes, lilac flame

ii) Write a balanced equation for this reaction. **$2K + 2H_2O \rightarrow 2KOH + H_2$**

b) Which is more reactive, potassium or sodium? Explain why.

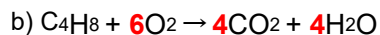
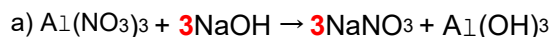
K more reactive K atoms are bigger so outer shell electron is further from nucleus Weaker attraction between nucleus and outer electron in sodium So outer electron lost more easily in sodium

c) Copper is a transition metal. Give three similarities and three differences between copper and potassium.

Similarities Differences

- | | Similarities | Differences |
|---|---|-------------------|
| | • metals | • K very reactive |
| | • conduct heat, electricity | |
| | • react with non-metals to form ionic compounds | |
| • Cu forms more than one ion, K does not | | |
| • Cu has high mpt, K does not | | |
| • Cu has high density, K does not | | |
| • Cu forms coloured compounds, K does not | | |

5 Balance each of the following equations.



Area Strength To develop Area Strength To develop Area Strength To develop

Done with care and thoroughness Can use sig figs What happens when K reacts with H₂O

Good SPG Can use standard form Write equation when K reacts with H₂O

Can find PNE numbers in atoms Can convert units Know & explain Group 1 reactivity trend

Can find PNE numbers in ions What happens in halogen displacements Compare Gp 1 to transition metals

Knows what determines an element Know & explain Group 7 reactivity trend Balance equations

Knows what isotopes are Name common groups in PT

Find A_r from isotope data Explain inert nature of argon

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1 Complete the following table about some atoms and ions.

Mass number	Particle Atom or ion	Atomic number	electrons Number of electrons Number of electrons Number of electrons	Electron structure Electron structure Electron structure Electron structure Electron structure
	Number of protons			
	Number of protons			
	Number of neutrons			
	Number of neutrons			
	Number of neutrons			
	Number of			

$^{39}_{19}\text{K}$ atom 19 41 19 22 19 2,8,8,1

$^{27}_{13}\text{Al}^{3+}$ ion 13 27 13 14 10 2,8

$^{16}_{8}\text{O}^{2-}$ ion 8 16 8 8 10 2,8

2 a) The element potassium consists of two isotopes. 93.3% of the atoms are $^{39}_{19}\text{K}$ and the rest of the atoms are $^{41}_{19}\text{K}$. Calculate the relative atomic mass of potassium. Give your answer to 3 significant figures.

$$\frac{[93.3 \times 39] + [6.7 \times 41]}{100} = 39.1$$

b) The diameter of a potassium atom is 440 pm. State this in metres in standard form. $4.4 \times 10^{-10} \text{ m}$

3 a) i) Describe what you see when sodium burns in oxygen. **Orange-yellow flame, white powder forms**

ii) Write a balanced equation for this reaction. **$4\text{Na} + \text{O}_2 \rightarrow 2\text{Na}_2\text{O}$**

iii) Sodium oxide is formed in this reaction. Explain why this sodium oxide has a high melting point.

Sodium oxide ionic Strong attraction between positive and negative ions

b) Potassium is more reactive than sodium. Explain why.

K more reactive K atoms are bigger so outer shell electron is further from nucleus Weaker attraction between nucleus and outer electron in potassium So outer electron lost more easily in potassium

4 Iron is a transition metal. Give three ways in which transition metals are different to the Group 1 (alkali metals).

- **TM forms more than one ion, Gp1 does not**
- **TM has high mpt, Gp1 does not**
- **TM has high density, Gp1 does not**
- **TM forms coloured compounds, Gp1 does not**
- **Gp1 very reactive, TM is not**

GCSE REVISION 4

Atoms, ions, equations, Periodic Table, mixtures

5 a) Chlorine is a gas at room temperature made of molecules. The boiling point of chlorine is -34°C .

i) Give the formula of chlorine molecules. **Cl_2**

ii) Explain why chlorine has a low boiling point. **Weak forces between molecules**

b) Which is more reactive, chlorine or bromine. Explain your answer.

chlorine more reactive than bromine chlorine atoms are smaller so the electron gained is closer to the nucleus stronger attraction between nucleus and electron gained in chlorine so chlorine gains electron more easily

c) Complete the following equations. Write *no reaction* if there is no reaction.

i) chlorine + sodium fluoride **\rightarrow no reaction**

ii) bromine + potassium iodide **\rightarrow potassium bromide + iodine**

6 Dimitri Mendeleev is known as the "father of the Periodic Table". What did Mendeleev do in terms of the Periodic Table and why were his ideas accepted?

put elements in order of mass with elements with similar properties in same group but did switch around a few elements if it fitted the Group better left gaps for undiscovered elements predicted properties of undiscovered elements elements were discovered with those properties

7 What method would you use to separate each of the following mixtures?

a) water from a solution of salt in water **distillation**

b) octane from a mixture of pentane and octane (they are miscible liquids) **fractional distillation**

c) sodium nitrate from a solution of sodium nitrate in water **evaporation / crystallisation**

d) petrol from a mixture of petrol and water (they are immiscible liquids) **separating funnel**

e) calcium carbonate from a mixture with water (CaCO_3 is insoluble in water) **filtration**

Area Strength To develop Area Strength To develop Area Strength To develop

Done with care and thoroughness Can use standard form Understand term diatomic

Good SPG Can convert units Why molecular substances have low mpt

Can find PNE numbers in atoms What happens when Na reacts with O_2 Know & explain Group 7 reactivity trend

Can find PNE numbers in ions Write equation when Na reacts with O_2 What happens in halogen displacements

Find A_r from isotope data Why ionic substances have high mpt Why Mendeleev's ideas were accepted

Can use sig figs Know & explain Group 1 reactivity trend Can give methods to separate mixtures

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1 Write the formula of the following ionic compounds.

a) sodium sulfate **Na₂SO₄** c) ammonium bromide **NH₄Br**

b) iron(III) oxide **Fe₂O₃** d) aluminium nitrate **Al(NO₃)₃**

2 Write balanced equations for the following equations.

a) $\text{Na} + \text{O}_2 \rightarrow \text{Na}_2\text{O}$ **4Na + O₂ → 2Na₂O**

b) magnesium + nitric acid → magnesium nitrate + hydrogen

Mg + 2HNO₃ → Mg(NO₃)₂ + H₂

3 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
	¹⁹ 9F ⁻ ion	9	19	9	10	10	2,8
	¹³ 13Al ³⁺ ion	13	27	13	14	10	2,8

³⁹39K atom **19 39 19 20 19 2,8,8,1**

³⁴34S²⁻ ion **16 34 16 18 18 2,8,8**

4 What is the structure type of each of the following substances. Tick the correct box.

name aluminium

oxide potassium dioxide sulfur

graphite buckminster

-fullerene helium bromide calcium

sucrose

formula Al₂O₃ K SO₂ C C₆₀ He CaBr₂ C₁₂H₂₂O₁₁

giant covalent ✓

ionic ✓ ✓

metallic ✓

molecular ✓ ✓ ✓

monatomic ✓

5 Oxygen is a molecular substance containing O₂ molecules. Explain why oxygen has a very low boiling point (−183 °C).

weak forces between molecules

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GCSE REVISION 6

Formulae, equations, particles, structure & bonding

6 Diamond and graphite are both forms of carbon. They both have very high melting points but only graphite conducts electricity. Explain this difference by discussing the structure and bonding in each substance.

both are giant covalent so high melting points as need to break covalent bonds graphite conducts as it has delocalised electrons that can move along layers to carry charge diamond has no delocalised electrons

7 Carbon dioxide (CO₂) and silicon dioxide (SiO₂) are both oxides of Group 4 elements. Carbon dioxide has a very low boiling point but silicon dioxide has a very high melting point (1600 °C). Explain this difference by discussing structure and bonding in each substance.

CO₂ is molecular weak forces between molecules SiO₂ is giant covalent high melting point as need to break covalent bonds

8 Aluminium metal is extracted from aluminium oxide by electrolysis. The aluminium oxide must be molten to conduct and melts at 2072 °C. Explain, by discussing structure and bonding, why aluminium oxide must be molten to conduct electricity. It has a high melting point.

must be molten to conduct so ions can move to carry charge through it high melting point as strong attraction between positive and negative ions

Area Strength To develop Area Strength To develop Area Strength To develop

Done with care and thoroughness Can find PNE numbers in atoms Why giant covalent have high mpt

Good SPG Can find PNE numbers in ions Why giant covalent conduct or not

Write formulae Identify structure type from formula Why ionic have high mpt

Write balanced equations Why molecular substance has low mpt Why ionic conduct or not

1 Give the formula of the following ionic substances.

a) potassium oxide **K₂O** d) magnesium hydroxide **Mg(OH)₂**

b) aluminium bromide **AlBr₃** e) ammonium iodide **NH₄I**

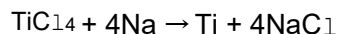
c) iron(III) sulfide **Fe₂S₃** f) calcium nitrate **Ca(NO₃)₂**

2 Calculate the relative formula mass of the following substances.

a) chlorine, Cl₂ **2(35.5) = 71**

b) ammonium sulfate, (NH₄)₂SO₄ **2(14) + 8(1) + 32 + 4(16) = 132**

3 a) What mass of sodium reacts with 95 g of titanium chloride?



mol TiCl₄ = $\frac{95}{190}$

= 0.50 mol **mol Na = 4 x 0.50 = 2.0 mol**

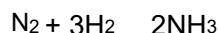
mass Na = 23 x 2.0 = 46 g

b) Calculate the percentage atom economy to make titanium in this reaction.

% atom economy = $100 \times \frac{48}{190}$

= 17.0%

4 Ammonia is made by reaction of nitrogen with hydrogen.



a) Calculate the maximum mass of ammonia that could be formed from reaction of 12 g of hydrogen reacting with nitrogen.

mol H₂ = $\frac{12}{2} = 6.0$ mol **mol NH₃ = 4.0 mol** **mass NH₃ = 17 x 4.0 = 68 g**

b) In this reaction, only 15 g of ammonia was formed. Calculate the percentage yield.

% yield = $100 \times \frac{15}{68} = 22.1\%$

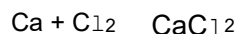
c) Suggest two reasons why the yield was less than 100%.

- **reaction is reversible / incomplete**
- **some products lost**
- **other reactions may take place**

GCSE REVISION 7

Calculations

5 In an experiment, 4.0 g of calcium was reacted with 4.0 g of chlorine. One of the chemicals was in excess. Determine which is the limiting reagent and then calculate the mass of calcium chloride formed.



mol Ca = $\frac{4.0}{40} = 0.10$ mol **mol Cl₂ = $\frac{4.0}{71} = 0.056$ mol** **∴ Ca is in excess and Cl₂ is the limiting reagent**

∴ mol CaCl₂ = 0.056 mol

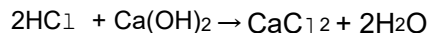
∴ mass CaCl₂ = 111 x 0.056 = 6.25 g

6 25.0 cm³ of a solution of calcium hydroxide was titrated against a solution of 0.100 mol/dm³ hydrochloric acid. 26.3 cm³ of the hydrochloric acid was needed to neutralise the calcium hydroxide.

a) Describe how the titration is done.

- calcium hydroxide measured with pipette
- into conical flask
- indicator added
- acid added from burette
- until colour changes
- drop by drop at the end
- record the result
- repeat

b) Calculate the concentration of the calcium hydroxide in mol/dm³. The equation for the reaction is shown.



$$\text{mol HCl} = 0.100 \times \frac{26.3}{1000}$$

$$= 0.00263 \text{ mol} \quad \text{mol Ca(OH)}_2 = \frac{1}{2} \times 0.00263 = 0.001315 \text{ mol}$$

$$\text{conc Ca(OH)}_2 = \frac{0.001315}{25.0 \times \frac{1000}{1000}}$$

$$= 0.0526 \text{ mol/dm}^3$$

c) Calculate the concentration of the calcium hydroxide in g/dm³.

$$\text{conc Ca(OH)}_2 = 0.0526 \times 74 = 3.89 \text{ g/dm}^3$$

Area Strength To develop Area Strength To develop Area Strength To develop
 Done with care and thoroughness Can work out mass from moles Work out moles for solutions
 Shows suitable working Can work out % atom economy Convert mol/dm³ to g/dm³
 Can write ionic formulae Can work out % yield Does not round too much
 Can work out % Understands why yield < 100% Can use sig figs
 Work out moles from mass Understands limiting reagents Gives units
 Use equation to find reacting moles Can describe how to do a titration

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1 Complete the following table about some atoms and ions.

Particle Atom or ion Atomic number

Mass number
 Number of protons
 Number of neutrons
 Number of electrons
 Electron structure

Al³⁺ ion 13 27 13 14 10 2,8

C atom 6 14 6 8 6 2,4

P³⁻ ion 15 31 15 16 18 2,8,8

O²⁻ ion 8 18 8 10 10 2,8

2 The element indium consists of two isotopes, with 4.3% of the atoms are ¹¹³In and 95.7% of the atoms are ¹¹⁵In.

a) What are isotopes? Atoms with the same number of protons but a different number of neutrons

b) Calculate the relative atomic mass of indium. Give your answer to 4 significant figures.

$$[4.3 \times 113] + [95.7 \times 115] = 114.9$$

$$4.3 + 95.7$$

3 Give the formula and structure type of each of the following substances. Tick the correct box.

name lithium oxide argon ammonia silver(I) nitrate buckminster-

fullerene diamond

formula Li₂O Ar NH₃ AgNO₃ C₆₀ C

giant covalent ✓

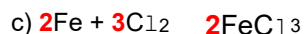
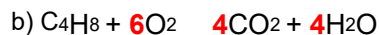
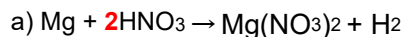
ionic ✓ ✓

metallic

molecular ✓ ✓

monatomic ✓

4 Balance these equations



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GCSE REVISION 8

Atomic structure, structure & bonding, formulae & equations

5 Give the formula of the following ionic substances.

a) iron(III) oxide Fe_2O_3 c) aluminium nitrate $\text{Al}(\text{NO}_3)_3$

b) potassium sulfate K_2SO_4 d) barium hydroxide $\text{Ba}(\text{OH})_2$

6 Sodium chloride has a high melting point (801°C) while water has a low melting point (0°C). Explain this difference.

NaCl: strong attraction between positive and negative ions

ice: weak forces between molecules

7 Aluminium conducts electricity as a solid and when molten. Aluminium oxide does not conduct electricity as a solid but does when molten. Explain this difference.

Al: delocalised electrons can move to carry charge as solid and liquid

Al_2O_3 : ions cannot move as solid but can move as liquid to carry the charge

8 Nickel reacts with copper(II) sulfate to form copper: $\text{Ni} + \text{CuSO}_4 \rightarrow \text{NiSO}_4 + \text{Cu}$

a) Write two half equations for this reaction.



b) Write an ionic equation for this reaction.



c) Explain clearly why this is a redox reaction.

both oxidation and reduction take place Ni atoms lose electrons so oxidised, Cu^{2+} ions gain electrons so reduced

d) Nickel displaces copper in this reaction because it is more reactive than copper. Explain, in terms of electrons, why nickel is more reactive than copper.

nickel atoms lose electrons more easily than copper atoms

Area Strength To develop Area Strength To develop Area Strength To develop

Done with care and thoroughness Can find A_r from isotope abundance Why substances conduct or not

Good SPG Write formulae Write half equations for displacement

Can find PNE numbers in atoms Identify structure type from name Write ionic equation for displacement

Can find PNE numbers in ions Write balanced equations Explain displacement in terms of redox

Knows what isotopes are Why substances have high/low mpts

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1 Give the formula of the following ionic substances.

a) aluminium chloride **AlCl_3** d) calcium nitrate **$\text{Ca}(\text{NO}_3)_2$**

b) potassium sulfide **K_2S** e) magnesium hydroxide **$\text{Mg}(\text{OH})_2$**

c) sodium sulfate **Na_2SO_4** f) iron(II) oxide **FeO**

2 Calculate the relative formula mass of the following substances.

a) fluorine, F_2 **$2(19) = 38$**

b) iron(III) nitrate, $\text{Fe}(\text{NO}_3)_3$ **$56 + 3(14) + 9(16) = 242$**

3 Calcium oxide is made from the thermal decomposition of calcium carbonate: $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$

a) Calculate the maximum mass of calcium oxide that could be formed from heating 500 g of calcium carbonate.

moles $\text{CaCO}_3 = \frac{500}{100}$

$= 5$ moles $\text{CaO} = 5$

$$\text{mass CaO} = 56 \times 5 = 280 \text{ g}$$

b) In a reaction, 250 g of calcium oxide was formed from heating 500 g of calcium carbonate. Calculate the percentage yield for this reaction.

$$\% \text{ yield} = 100 \times \frac{250}{280}$$

$$= 89.3\%$$

c) Suggest two reasons why the yield was less than 100%.

- reaction is reversible / incomplete
- some products lost
- other reactions may take place

d) Calculate the atom economy to make calcium oxide from calcium carbonate by this reaction.

$$\% \text{ atom economy} = 100 \times \frac{56}{100}$$

$$= 56.0\%$$

4 What mass of oxygen reacts with 270 g of aluminium? $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$

$$\text{moles Al} = \frac{270}{27}$$

$$= 10 \quad \text{moles O}_2 = \frac{34}{4} \times 10 = 7.5 \quad \text{mass O}_2 = 32 \times 7.5 = 240 \text{ g}$$

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GCSE REVISION 9

Calculations 2

5 Calculate the volume of the following gases at room temperature and pressure.

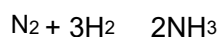
a) 3 moles of oxygen, O_2

$$\text{volume O}_2 = 24 \times 3 = 72 \text{ dm}^3$$

b) 22 g of carbon dioxide, CO_2

$$\text{moles CO}_2 = \frac{22}{44} = 0.5 \quad \text{volume CO}_2 = 24 \times 0.5 = 12 \text{ dm}^3$$

6 What volume of hydrogen gas is needed to react with 10 dm^3 of nitrogen to make ammonia, with the volume of all gases measured at the same temperature and pressure?

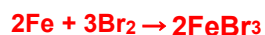


$$\text{volume H}_2 = 10 \times 3 = 30 \text{ dm}^3$$

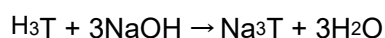
7 5.6 g of iron (Fe) reacts with 24 g of bromine (Br_2) to make a compound containing iron and bromine only. Calculate the molar mass of the compound and use this to determine the balanced equation for the reaction.

$$\text{moles Fe} = \frac{5.6}{56} = 0.1 \quad \text{moles Br}_2 = \frac{24}{160}$$

$$= 0.15 \quad \text{ratio moles Fe : moles Br}_2 = 0.1 : 0.15 = 2 : 3$$



8 25.0 cm^3 of a solution of citric acid, which is represented by H_3T in the equation, reacted with 26.4 cm^3 of $0.100 \text{ mol dm}^{-3}$ sodium hydroxide solution in a titration.



a) Calculate the concentration of the citric acid in mol/dm^3 . Give your answer to 3 significant figures.

$$\text{mol NaOH} = 0.100 \times \frac{26.4}{1000}$$

$$= 0.00264 \text{ mol} \quad \text{mol H}_3\text{T} = \frac{1000}{25.0} \times 0.00264 = 0.00088 \text{ mol} \quad \text{conc H}_3\text{T} = \frac{0.00088}{0.01} = 0.0352 \text{ mol/dm}^3$$

c) Calculate the concentration of the citric acid in g/dm³. The relative formula mass of citric acid is 226. Give your answer to 3 significant figures.

$$\text{conc H}_3\text{T} = 0.0352 \times 226 = 7.96 \text{ g/dm}^3$$

Area Strength To develop Area Strength To develop Area Strength To develop
 Done with care and thoroughness Can work out mass from moles Deduce molar reacting ratio from mass
 Shows suitable working Can work out % atom economy Work out moles for solutions
 Can write ionic formulae Can work out % yield Convert mol/dm³ to g/dm³
 Can work out $\frac{1}{2}$ Understands why yield < 100% Does not round too much
 Work out moles from mass Work out gas volume from mass or mol Can use sig figs
 Use equation to find reacting moles Understands reacting gas volumes Gives units

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1 Complete **word** equations for each of the following reactions. Write **no reaction** if no reaction takes place.

- copper + oxygen → **copper oxide**
- hydrogen sulfide + oxygen → **water + sulfur dioxide**
- potassium + water → **potassium hydroxide + hydrogen**
- calcium carbonate + hydrochloric acid → **calcium chloride + carbon dioxide + water**
- nickel oxide + nitric acid → **nickel nitrate + water**
- magnesium + sulfuric acid → **magnesium sulfate + hydrogen**
- ammonia + hydrochloric acid → **ammonium chloride**
- calcium hydroxide + nitric acid → **calcium nitrate + water**

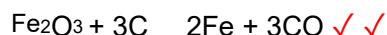
2 Classify each of the following metals as having high / medium / low reactivity.

- silver **low** c) iron **medium** c) lithium **high**
- magnesium **high** d) zinc **medium** e) copper **low**

3 Complete the table about the following reactions by ticking the correct boxes.

equation transfer of type of reaction

protons electrons redox acid-base



4 a) Complete the table to show the products of the electrolysis of the following compounds.

compound state product at positive

electrode

product at negative electrode

potassium bromide molten **bromine potassium**

copper sulfate aqueous **oxygen copper**

sodium iodide aqueous **iodine hydrogen**

b) Write balanced half equations for the following electrolysis conversions.



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GCSE REVISION 10

Chemical Reactions 1



5 When an iron nail is placed in copper(II) sulfate solution, a displacement reaction takes place forming copper metal and iron(II) sulfate.

a) Explain why iron displaces copper in this reaction. **iron is more reactive than copper**

b) Write a balanced equation for this reaction. **$\text{Fe} + \text{CuSO}_4 \rightarrow \text{FeSO}_4 + \text{Cu}$**

c) Write the simplest ionic equation for this reaction. **$\text{Fe} + \text{Cu}^{2+} \rightarrow \text{Fe}^{2+} + \text{Cu}$**

d) Write two half equations to show what happens in this reaction. **$\text{Fe} - 2\text{e}^- \rightarrow \text{Fe}^{2+}$ $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$**

e) Explain clearly why this is a redox reaction.

Fe atoms lose electrons so are oxidised; Cu^{2+} ions gain electrons so is reduced; both oxidation and reduction take place

6 When a aqueous solution of bromine (Br_2) is added dropwise to an aqueous solution of potassium iodide (KI), a displacement reaction takes place forming brown iodine (I_2) and potassium bromide (KBr) in the solution.

a) Explain, **in detail**, why bromine displaces iodine in this reaction.

- **bromine is more reactive than iodine**
- **bromine atoms gain an electron more easily than iodine**
- **as bromine atoms are smaller and so the electron gained is closer to the nucleus**
- **so there is a stronger attraction from the nucleus to the electron**

b) Write a balanced equation for this reaction. **$\text{Br}_2 + 2\text{KI} \rightarrow \text{I}_2 + 2\text{KBr}$**

c) Write the simplest ionic equation for this reaction. **$\text{Br}_2 + 2\text{I}^- \rightarrow 2\text{Br}^- + \text{I}_2$**

d) Write two half equations to show what happens in this reaction. **$\text{Br}_2 + 2\text{e}^- \rightarrow 2\text{Br}^-$ $2\text{I}^- - 2\text{e}^- \rightarrow \text{I}_2$**

e) Explain clearly why this is a redox reaction.

I^- ions lose electrons so are oxidised; Br_2 gains electrons so is reduced; both oxidation and reduction take place

Good SPG Deduce if proton or electron transfer Write half equations for displacement

Write word equations for metal reactions Write half equations Explain displacement in terms of redox

Write word equations for acid reactions Understands why displacement occurs Can explain halogen reactivity trend

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GCSE REVISION 11

Atomic structure, structure & bonding

1 Give the formula of each of the following ions.

ion sodium oxide magnesium nitrate carbonate

formula Na^+ O^{2-} Mg^{2+} NO_3^- CO_3^{2-}

ion hydroxide bromide sulfide aluminium ammonium

formula OH^- Br^- S^{2-} Al^{3+} NH_4^+

2 What is the structure type of each of the following substances? Tick the correct box. Also give the correct formula

name sodium

sulfate potassium dioxide carbon

iodine helium diamond buckminsterfullerene

formula Na_2SO_4 K_2CO_3 I_2 He C C_{60} Al_2O_3

giant covalent ✓

ionic ✓ ✓

metallic ✓

molecular ✓ ✓ ✓

monatomic ✓

3 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

! " ! " Al atom 13 27 13 14 13 2,8,3

! " ! " S²⁻ ion 16 34 16 18 18 2,8,8

³⁷₁₇Cl atom 17 37 17 20 17 2,8,7

²⁴₁₂Mg²⁺ ion 12 24 12 12 10 2,8

4 Water is a molecular substance containing H₂O molecules. Explain why water has a low boiling point (100 °C).

weak forces between molecules

O

H

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5 Calcium oxide has a very high melting point (2572 °C), does not conduct electricity as solid but does when molten. Explain these properties.

CaO is ionic

high melting point as strong forces between positive and negative ions

does not conduct as a solid as ions cannot move

does conduct as a liquid as ions can move

6 Steel is an alloy of iron. Steel is harder than pure iron, which is soft. Explain what an alloy is, why pure iron is soft and why steel is harder.

alloy: mixture of a metal with small amounts of other metals / carbon

iron: soft as atoms are all same size so layers can slide over each other

steel: harder as different sized atoms so layers cannot slide over each other as easily

7 a How much greater is the surface area to volume ratio of a cube with 2 cm sides compared to one with 10 cm sides? Show full working.

2 cm cube: surface area = 6 x 2 x 2 = 24 cm² volume = 2 x 2 x 2 = 8 cm³

surface area : volume ratio = 24 : 8 = 3

10 cm cube: surface area = 6 x 10 x 10 = 600 cm² volume = 10 x 10 x 10 = 1000 cm³

surface area : volume ratio = 600 : 1000 = 6 : 10 = 0.6

surface area : volume ratio of 2 cm cube is 5 times bigger than 10 cm cube

b Explain why nanoparticles of gold have different properties to bulk gold.

Nanoparticles have greater surface area : volume ratio

Area Strength To develop Area Strength To develop Area Strength To develop

Done with care and thoroughness Can find PNE numbers in ions Know what an alloy is

Good SPG Can find PNE numbers in atoms Why alloys are softer than pure metals

Knows formula and charge of ions Why molecular substance has low mpt Calculate surface area : volume ratio

Identify structure type from formula Why ionic substance has high mpt Explain different nanoparticle properties

Write formulae Explain conductivity of substances