



GCSE REVISION 1

Atoms, ions, equations, Periodic Table

- 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
$^{19}_9\text{F}^-$	ion	9	19	9	10	10	2,8
$^{40}_{18}\text{Ar}$	atom	18	40	18	22	18	2,8,8
$^{27}_{13}\text{Al}^{3+}$	ion	13	27	13	14	10	2,8
$^{34}_{16}\text{S}^{2-}$	ion	16	34	16	18	18	2,8,8
$^{39}_{19}\text{K}^+$	ion	19	39	19	20	18	2,8,8
$^{31}_{15}\text{P}$	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.

$$\frac{(113 \times 4.3) + (115 \times 95.7)}{4.3 + 95.7} = 114.9$$

- 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.

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

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**

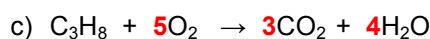
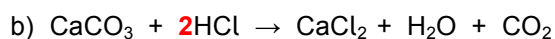
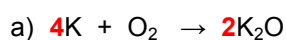
b) Which group would the following elements be in?

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		



GCSE REVISION 2

Atoms, ions, equations, Periodic Table

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
$^{19}_9\text{F}^-$	ion	9	19	9	10	10	2,8
$^{37}_{17}\text{Cl}$	atom	17	37	17	20	17	2,8,7
$^{32}_{16}\text{S}^{2-}$	ion	16	32	16	16	18	2,8,8
$^{21}_{10}\text{Ne}$	atom	10	21	10	11	10	2,8
$^{39}_{19}\text{K}^+$	ion	19	39	19	20	18	2,8,8
$^{16}_8\text{O}^{2-}$	ion	8	16	8	8	10	2,8

2 The element chromium consists of four isotopes. 4.3% of the atoms are $^{50}_{24}\text{Cr}$, 83.8% of the atoms are $^{52}_{24}\text{Cr}$, 9.5% of the atoms are $^{53}_{24}\text{Cr}$ and 2.4% of the atoms are $^{54}_{24}\text{Cr}$.

- a) What are isotopes? **Atoms with the same number of protons but a different number of neutrons**
- b) What makes each of these atoms of the element chromium? **they have 24 protons**
- c) Calculate the relative atomic mass of chromium. Give your answer to 3 significant figures.

$$\frac{[4.3 \times 50] + [83.8 \times 52] + [9.5 \times 53] + [2.4 \times 54]}{4.3 + 83.8 + 9.5 + 2.4} = 52.1$$

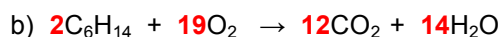
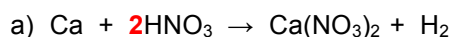
- d) The diameter of a chromium atom is 256 pm. State this in metres in standard form.

$$256 \times 10^{-12} = 2.56 \times 10^{-10} \text{ m}$$

- e) The nucleus of a chromium atom is about 10000 times smaller than the atom. Calculate the diameter of the nucleus in metres in standard form.

$$\frac{2.56 \times 10^{-10}}{10000} = 2.56 \times 10^{-14} \text{ m}$$

3 Balance each of the following equations.



- 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		



GCSE REVISION 3

Atoms, ions, equations, Periodic Table

- 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
${}^{19}_9\text{F}^-$	ion	9	19	9	10	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

- 2** The element magnesium consists of three isotopes. 79.0% of the atoms are ${}^{24}_{12}\text{Mg}$, 10.0% of the atoms are ${}^{25}_{12}\text{Mg}$, 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.

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

- 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**

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
- metals - 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 - K very reactive, Cu is not

5 Balance each of the following equations.

a) $Al(NO_3)_3 + 3NaOH \rightarrow 3NaNO_3 + Al(OH)_3$

b) $C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$

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 H ₂ O		
Good SPG			Can use standard form			Write equation when K reacts with H ₂ O		
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, from isotope data			Explain inert nature of argon					



GCSE REVISION 4

Atoms, ions, equations, Periodic Table, mixtures

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
${}^{41}_{19}\text{K}$	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**

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		



GCSE REVISION 6

Formulae, equations, particles, structure & bonding

1 Write the formula of the following ionic compounds.

a) sodium sulfate **Na_2SO_4**

c) ammonium bromide **NH_4Br**

b) iron(III) oxide **Fe_2O_3**

d) aluminium nitrate **$\text{Al}(\text{NO}_3)_3$**

2 Write balanced equations for the following equations.

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

b) magnesium + nitric acid $\rightarrow$ magnesium nitrate + hydrogen



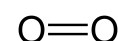
3 Complete the following table about some atoms and ions. The first row has been done for you.

Particle	Atom or ion	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons	Electron structure
${}^{19}_9\text{F}^-$	ion	9	19	9	10	10	2,8
${}^{27}_{13}\text{Al}^{3+}$	ion	13	27	13	14	10	2,8
${}^{39}_{19}\text{K}$	atom	19	39	19	20	19	2,8,8,1
${}^{34}_{16}\text{S}^{2-}$	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	sulfur dioxide	graphite	buckminsterfullerene	helium	calcium bromide	sucrose
formula	Al_2O_3	K	SO_2	C	C_{60}	He	CaBr_2	$\text{C}_{12}\text{H}_{22}\text{O}_{11}$
giant covalent				☒				
ionic	☒						☒	
metallic		☒						
molecular			☒		☒			☒
monatomic						☒		

5 Oxygen is a molecular substance containing O_2 molecules. Explain why oxygen has a very low boiling point (-183°C).



weak forces between molecules

- 6** Diamond and graphite are both forms of carbon. They both have very high melting points but only graphite conducts electricity. Explain these properties 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 (−78°C) while 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 and why 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		



GCSE REVISION 7

Calculations

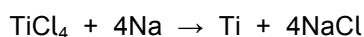
1 Give the formula of the following ionic substances.

- | | | | |
|----------------------|------------------------------------|------------------------|---------------------------------------|
| 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?



$$\text{mol TiCl}_4 = \frac{95}{190} = 0.50 \text{ mol}$$

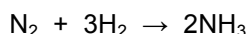
$$\text{mol Na} = 4 \times 0.50 = 2.0 \text{ mol}$$

$$\text{mass Na} = 23 \times 2.0 = 46 \text{ g}$$

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

$$\% \text{ atom economy} = 100 \times \frac{48}{190 + 4(23)} = 17.0\%$$

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.

$$\text{mol H}_2 = \frac{12}{2} = 6.0 \text{ mol}$$

$$\text{mol NH}_3 = 4.0 \text{ mol}$$

$$\text{mass NH}_3 = 17 \times 4.0 = 68 \text{ g}$$

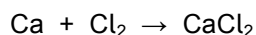
b) In this reaction, only 15 g of ammonia was formed. Calculate the percentage yield.

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

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

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

- 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.



$$\text{mol Ca} = \frac{4.0}{40} = 0.10 \text{ mol}$$

$$\text{mol Cl}_2 = \frac{4.0}{71} = 0.056 \text{ mol}$$

∴ Ca is in excess and Cl₂ is the limiting reagent

$$\therefore \text{mol CaCl}_2 = 0.056 \text{ mol}$$

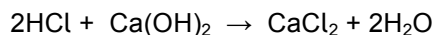
$$\therefore \text{mass CaCl}_2 = 111 \times 0.056 = 6.25 \text{ g}$$

- 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.



$$\text{mol HCl} = 0.100 \times \frac{26.3}{1000} = 0.00263 \text{ mol}$$

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

$$\text{conc Ca(OH)}_2 = \frac{0.001315}{\frac{25.0}{1000}} = 0.0526 \text{ mol/dm}^3$$

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/dm ³ to g/dm ³		
Can write ionic formulae			Can work out % yield			Does not round too much		
Can work out <i>M_r</i>			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					



GCSE REVISION 8

Atomic structure, structure & bonding, formulae & equations

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
${}_{13}^{27}\text{Al}^{3+}$	ion	13	27	13	14	10	2,8
${}_{6}^{14}\text{C}$	atom	6	14	6	8	6	2,4
${}_{15}^{31}\text{P}^{3-}$	ion	15	31	15	16	18	2,8,8
${}_{8}^{18}\text{O}^{2-}$	ion	8	18	8	10	10	2,8

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

- 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.

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

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	buckminsterfullerene	diamond
formula	Li_2O	Ar	NH_3	AgNO_3	C_{60}	C
giant covalent						✓
ionic	✓			✓		
metallic						
molecular			✓		✓	
monatomic		✓				

4 Balance these equations

- a) $\text{Mg} + 2\text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + \text{H}_2$
- b) $\text{C}_4\text{H}_8 + 6\text{O}_2 \rightarrow 4\text{CO}_2 + 4\text{H}_2\text{O}$
- c) $2\text{Fe} + 3\text{Cl}_2 \rightarrow 2\text{FeCl}_3$

5 Give the formula of the following ionic substances.

- a) iron(III) oxide **Fe₂O₃** c) aluminium nitrate **Al(NO₃)₃**
b) potassium sulfate **K₂SO₄** d) barium hydroxide **Ba(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

Al₂O₃: 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.

$\text{Ni} - 2\text{e}^- \rightarrow \text{Ni}^{2+}$ and $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$

b) Write an ionic equation for this reaction.

$\text{Ni} + \text{Cu}^{2+} \rightarrow \text{Ni}^{2+} + \text{Cu}$

c) Explain clearly why this is a redox reaction.

both oxidation and reduction take place

Ni atoms lose electrons so oxidised, Cu²⁺ 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					



GCSE REVISION 9

Calculations 2

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.

$$\text{moles CaCO}_3 = \frac{500}{100} = 5$$

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

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

- 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? $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$

$$\text{moles Al} = \frac{270}{27} = 10$$

$$\text{moles O}_2 = \frac{3}{4} \times 10 = 7.5$$

$$\text{mass O}_2 = 32 \times 7.5 = 240 \text{ g}$$

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

a) 3 moles of oxygen, O₂

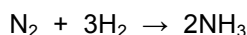
$$\text{volume O}_2 = 24 \times 3 = 72 \text{ dm}^3$$

b) 22 g of carbon dioxide, CO₂

$$\text{moles CO}_2 = \frac{22}{44} = 0.5$$

$$\text{volume CO}_2 = 24 \times 0.5 = 12 \text{ dm}^3$$

6 What volume of hydrogen gas is needed to react with 10 dm³ 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 (Br₂) to make a compound containing iron and bromine only. Calculate the moles of iron and bromine and use this to determine the balanced equation for the reaction.

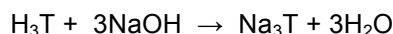
$$\text{moles Fe} = \frac{5.6}{56} = 0.1$$

$$\text{moles Br}_2 = \frac{24}{160} = 0.15$$

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



8 25.0 cm³ of a solution of citric acid, which is represented by H₃T in the equation, reacted with 26.4 cm³ of 0.100 mol dm⁻³ sodium hydroxide solution in a titration.



a) Calculate the concentration of the citric acid in mol/dm³. Give your answer to 3 significant figures.

$$\text{mol NaOH} = 0.100 \times \frac{26.4}{1000} = 0.00264 \text{ mol}$$

$$\text{mol H}_3\text{T} = \frac{1}{3} \times 0.00264 = 0.00088 \text{ mol}$$

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

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/dm ³ to g/dm ³		
Can work out M _r			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		



GCSE REVISION 10

Chemical Reactions 1

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

- a) copper + oxygen → **copper oxide**
- b) hydrogen sulfide + oxygen → **water + sulfur dioxide**
- c) potassium + water → **potassium hydroxide + hydrogen**
- d) calcium carbonate + hydrochloric acid → **calcium chloride + carbon dioxide + water**
- e) nickel oxide + nitric acid → **nickel nitrate + water**
- f) magnesium + sulfuric acid → **magnesium sulfate + hydrogen**
- g) ammonia + hydrochloric acid → **ammonium chloride**
- h) calcium hydroxide + nitric acid → **calcium nitrate + water**

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

- a) silver **low**
- b) magnesium **high**
- c) iron **medium**
- d) zinc **medium**
- e) lithium **high**
- f) 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
$\text{Ca} + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2$		✓	✓	
$\text{Fe}_2\text{O}_3 + 3\text{C} \rightarrow 2\text{Fe} + 3\text{CO}$		✓	✓	
$\text{MgO} + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + \text{H}_2\text{O}$	✓			✓
$\text{Zn} + \text{CuSO}_4 \rightarrow \text{ZnSO}_4 + \text{Cu}$		✓	✓	

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.

- i) $\text{Cu}^{2+} \rightarrow \text{Cu}$ **$\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$**
- iii) $\text{O}^{2-} \rightarrow \text{O}_2$ **$2\text{O}^{2-} - 4\text{e}^- \rightarrow \text{O}_2$**



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

- Explain why iron displaces copper in this reaction. **iron is more reactive than copper**
- Write a balanced equation for this reaction. **$\text{Fe} + \text{CuSO}_4 \rightarrow \text{FeSO}_4 + \text{Cu}$**
- Write the simplest ionic equation for this reaction. **$\text{Fe} + \text{Cu}^{2+} \rightarrow \text{Fe}^{2+} + \text{Cu}$**
- Write two half equations to show what happens in this reaction. **$\text{Fe} - 2\text{e}^- \rightarrow \text{Fe}^{2+}$ $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$**
- 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 to form brown iodine (I_2) and potassium bromide (KBr) in the solution.

- 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**
- Write a balanced equation for this reaction. **$\text{Br}_2 + 2\text{KI} \rightarrow \text{I}_2 + 2\text{KBr}$**
- Write the simplest ionic equation for this reaction. **$\text{Br}_2 + 2\text{I}^- \rightarrow 2\text{Br}^- + \text{I}_2$**
- Write two half equations to show what happens in this reaction. **$\text{Br}_2 + 2\text{e}^- \rightarrow 2\text{Br}^-$ $2\text{I}^- - 2\text{e}^- \rightarrow \text{I}_2$**
- Explain clearly why this is a redox reaction.

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

Area	Strength	To develop	Area	Strength	To develop	Area	Strength	To develop
Done with care and thoroughness			Approx. reactivity of common metals			Write ionic equations for displacement		
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		



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

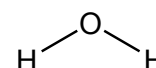
name	sodium sulfate	potassium	carbon dioxide	iodine	helium	diamond	buckminsterfullerene	aluminium oxide
formula	Na_2SO_4	K	CO_2	I_2	He	C	C_{60}	Al_2O_3
giant covalent						✓		
ionic	✓							✓
metallic		✓						
molecular			✓	✓			✓	
monatomic					✓			

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
$^{27}_{13}\text{Al}$	atom	13	27	13	14	13	2,8,3
$^{34}_{16}\text{S}^{2-}$	ion	16	34	16	18	18	2,8,8
$^{37}_{17}\text{Cl}$	atom	17	37	17	20	17	2,8,7
$^{24}_{12}\text{Mg}^{2+}$	ion	12	24	12	12	10	2,8

4 Water is a molecular substance containing H_2O molecules. Explain why water has a low boiling point (100°C).

weak forces between molecules



- 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 = $6 \times 2 \times 2 = 24 \text{ cm}^2$

volume = $2 \times 2 \times 2 = 8 \text{ cm}^3$

surface area : volume ratio = $24 : 8 = 3$

10 cm cube:

surface area = $6 \times 10 \times 10 = 600 \text{ cm}^2$

volume = $10 \times 10 \times 10 = 1000 \text{ cm}^3$

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					