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	Number of electrons	Number of electrons	Electron structure	Electron structure	Electron structure	Electron structure	Electron structure
!"$_{!}$F$^{!}$	ion	9	19	9	10	10	2,8						
^{40} $_{!}$"Ar	**atom**	**18**	**40**	**18**	**22**	**18**	**2,8,8**						
!" $_{!}$"Al$^{!!}$	**ion**	**13**	**27**	**13**	**14**	**10**	**2,8**						
^{34} $_{16}$S$^{2!}$	**ion**	**16**	**34**	16	18	18	**2,8,8**						
^{39} $_{19}$K$^{!}$	**ion**	**19**	**39**	19	20	18	**2,8,8**						
^{31} $_{15}$P	**atom**	**15**	**31**	15	16	15	**2,8,5**						

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

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.

310×10^{-12} m = 3.10×10^{-10} m.

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

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

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.

a) $4K + O_2 \rightarrow 2K_2O$

b) $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

c) $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

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

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

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

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.

[4.3 x 50] + [83.8 x 52] + [9.5 x 53] + [2.4 x 54] = 52.1
4.3 + 83.8 + 9.5 + 2.4

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

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

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

10000

3 Balance each of the following equations.

a) $Ca + 2HNO_3 \rightarrow Ca(NO_3)_2 + H_2$

b) $2C_6H_{14} + 19O_2 \rightarrow 12CO_2 + 14H_2O$

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. **$4Li + O_2 \rightarrow 2Li_2O$**

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. **$Cl_2 + 2NaBr \rightarrow 2NaCl + Br_2$**

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

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
$^{19}_{9}F^{-}$	ion	9	19	9	10	10	2,8
$^{40}_{19}K^{+}$	**ion**	**19**	**40**	**19**	**21**	**18**	**2,8,8**
$^{27}_{13}Al$	**atom**	**13**	**27**	13	14	13	**2,8,3**
$^{14}_{7}N^{3-}$	**ion**	**7**	**14**	7	7	10	**2,8**

2 The element magnesium consists of three isotopes. 79.0% of the atoms are $^{24}_{12}Mg$, 10.0% of the atoms are $^{25}_{12}Mg$, and 11.0% of the atoms are $^{26}_{12}Mg$ 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. **1.5×10^{-10} m**

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

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

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

- **metals**
- **conduct heat, electricity**
- **react with non-metals to form ionic compounds**

- **K very re**

- **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.

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_2O

Good SPG Can use standard form Write equation when K reacts with H_2O

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

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	Number of protons	Number of neutrons	Number of electrons	Number of protons	Number of neutrons	Number of electrons	Number of protons	Number of neutrons	Number of electrons	Electron structure

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

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

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

2 a) The element potassium consists of two isotopes. 93.3% of the atoms are $^{39}_{19}K$ and the rest of the atoms are $^{41}_{19}K$. Calculate the

of potassium. Give your answer to 3 significant figures.

[93.3 x 39] + [6.7 x 41] = 39.1
100

b) The diameter of a potassium atom is 440 pm. State this in metres in standard form. **4.4×10^{-10} 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. **$4Na + O_2 \rightarrow 2Na_2O$**

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 then 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 **→ no reaction**

ii) bromine + potassium iodide **→ 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

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 **$Al(NO_3)_3$**

2 Write balanced equations for the following equations.

a) $Na + O_2 \rightarrow Na_2O$ **$4Na + O_2 \rightarrow 2Na_2O$**

b) magnesium + nitric acid → magnesium nitrate + hydrogen

$Mg + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2$

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
$^{19}_{9}F^-$	ion	9	19	9	10	10	2,8
$^{27}_{13}Al^{3+}$	**ion**	**13**	**27**	**13**	**14**	**10**	**2,8**
$^{39}_{19}K$	atom	**19**	**39**	19	20	**19**	**2,8,8,1**
$^{34}_{16}S^{2-}$	**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	potassium	dioxide	sulfur	graphite	buckminster -fullerene	helium	bromide	calcium	sucrose
formula	Al_2O_3	K	SO_2	C	C_{60}	He	$CaBr_2$	$C_{12}H_{22}O_{11}$		
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

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. Exp 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 delocalis that can move along layers to carry charge diamond has no delocalised electrons

7 Carbon dioxide (CO_2) and silicon dioxide (SiO_2) are both oxides of Group 4 elements. Carbon dioxide has a very low boi silicon dioxide has a very high melting point (1600 °C). Explain this difference by discussing structure and bonding in each substance.

CO_2 is molecular weak forces between molecules SiO_2 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 condu 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 **K_2O** d) magnesium hydroxide **$Mg(OH)_2$**

b) aluminium bromide **$AlBr_3$** e) ammonium iodide **NH_4I**

c) iron(III) sulfide **Fe_2S_3** f) calcium nitrate **$Ca(NO_3)_2$**

2 Calculate the relative formula mass of the following substances.

a) chlorine, Cl_2 **2(35.5) = 71**

b) ammonium sulfate, $(NH_4)_2SO_4$ **2(14) + 8(1) + 32 + 4(16) = 132**

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

$TiCl_4 + 4Na \rightarrow Ti + 4NaCl$

mol $TiCl_4$ = $\frac{95}{190}$ **= 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 x $\frac{48}{190!4(23)}$ **= 17.0%**

4 Ammonia is made by reaction of nitrogen with hydrogen.

$N_2 + 3H_2 \rightarrow 2NH_3$

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

mol H_2 = $\frac{12}{2}$ **= 6.0 mol mol NH_3 = 4.0 mol mass NH_3 = 17 x 4.0 = 68 g**

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

% yield = 100 x $\frac{15}{68}$ **= 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.

$Ca + Cl_2 \rightarrow CaCl_2$

mol Ca = $\frac{4.0}{40}$ **= 0.10 mol mol Cl_2 =** $\frac{4.071}{}$ **= 0.056 mol ∴ Ca is in excess and Cl_2 is the limiting reagent**

∴ mol $CaCl_2$ = 0.056 mol

∴ mass $CaCl_2$ = 111 x 0.056 = 6.25 g

6 25.0 cm^3 of a solution of calcium hydroxide was titrated against a solution of 0.100 mol/dm^3 hydrochloric acid. 26.3 cm^3 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/dm^3. The equation for the reaction is shown.

$2HCl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O$

mol HCl = 0.100 x $\frac{26.3}{1000}$ = 0.00263 mol **mol $Ca(OH)_2$ = $\frac{1}{2}$ x 0.00263 = 0.001315 mol**

conc $Ca(OH)_2$ = $\frac{0.001315}{25.0 \ 1000}$ = 0.0526 mol/dm$_3$

c) Calculate the concentration of the calcium hydroxide in g/dm^3.

conc $Ca(OH)_2$ = 0.0526 x 74 = 3.89 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 M_r 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

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

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

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.

[4.3 x 113] + [95.7 x 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	**Li_2O**	**Ar**	**NH_3**	**$AgNO_3$**	**C_{60}**	**C**

giant covalent ✓

ionic ✓ ✓

metallic

molecular ✓ ✓

monatomic ✓

4 Balance these equations

a) $Mg + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2$

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

c) $2Fe + 3Cl_2 \rightarrow 2FeCl_3$

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 **$Al(NO_3)_3$**

b) potassium sulfate **K_2SO_4** d) barium hydroxide **$Ba(OH)_2$**

6 Sodium chloride has a high melting point (801 ℃) while water has a low melting point (0 ℃). 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: $Ni + CuSO_4 \rightarrow NiSO_4 + Cu$

a) Write two half equations for this reaction.

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

b) Write an ionic equation for this reaction.

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

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

1 Give the formula of the following ionic substances.

a) aluminium chloride **$AlCl_3$** d) calcium nitrate **$Ca(NO_3)_2$**

b) potassium sulfide **K_2S** e) magnesium hydroxide **$Mg(OH)_2$**

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, $Fe(NO_3)_3$ **56 + 3(14) + 9(16) = 242**

3 Calcium oxide is made from the thermal decomposition of calcium carbonate: $CaCO_3 \rightarrow CaO + CO_2$

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

moles $CaCO_3$ = $\frac{500}{100}$ **= 5 moles CaO = 5**

mass CaO = 56 x 5 = 280 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.

% yield = 100 x $\frac{250}{280}$ = 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.

% atom economy = 100 x $\frac{56}{100}$ = 56.0%

4 What mass of oxygen reacts with 270 g of aluminium? $4Al + 3O_2 \rightarrow 2Al_2O_3$

moles Al = $\frac{270}{27}$ = 10 moles O_2 = $\frac{3}{4}$ x 10 = 7.5 mass O_2 = 32 x 7.5 = 240 g

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

volume O_2 = 24 x 3 = 72 dm^3

b) 22 g of carbon dioxide, CO_2

moles CO_2 = $\frac{22}{44}$ = 0.5 volume CO_2 = 24 x 0.5 = 12 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?

$N_2 + 3H_2 \rightarrow 2NH_3$

volume H_2 = 10 x 3 = 30 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 r bromine and use this to determine the balanced equation for the reaction.

moles Fe = $\frac{5.6}{56}$ = 0.1 moles Br_2 = $\frac{24}{160}$ = 0.15 ratio moles Fe : moles Br_2 = 0.1 : 0.15 = 2 : 3

$2Fe + 3Br_2 \rightarrow 2FeBr_3$

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 mol dm^{-3} sodium hydroxide solution in a titration.

$H_3T + 3NaOH \rightarrow Na_3T + 3H_2O$

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

mol NaOH = 0.100 x $\frac{26.4}{}$

1000 **= 0.00264 mol** **mol H_3T =** 13 **x 0.00264 = 0.00088 mol conc H_3T =** 0.00088

25.0 1000 **= 0.0352 mol/dm_3**

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

conc H_3T = 0.0352 x 226 = 7.96 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

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** c) iron **medium** c) lithium **high**
b) 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

$Ca + 2HCl \rightarrow CaCl_2 + H_2$ ✓ ✓

$Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$ ✓ ✓

$MgO + H_2SO_4 \rightarrow MgSO_4 + H_2O$ ✓ ✓

$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$ ✓ ✓

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 iodinde aqueous **iodine hydrogen**

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

i) $Cu^{2+} \rightarrow Cu$ **$Cu^{2+} + 2e^- \rightarrow Cu$** iii) $O^{2-} \rightarrow O_2$ **$2O^{2-} - 4e^- \rightarrow O_2$**

GCSE REVISION 10

Chemical Reactions 1

ii) $Cl^- \rightarrow Cl_2$ **$2Cl^- - 2e^- \rightarrow Cl_2$** iv) $H^+ \rightarrow H_2$ **$2H^+ + 2e^- \rightarrow H_2$**

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

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

b) Write a balanced equation for this reaction. **$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$**

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

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

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 plac

6 When a aqueous solution of bromine (Br_2) is added dropwise to an aqueous solution of potassium iodide (KI), a displacemen form 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. **$Br_2 + 2KI \rightarrow I_2 + 2KBr$**

c) Write the simplest ionic equation for this reaction. **$Br_2 + 2I^- \rightarrow 2Br^- + I_2$**

d) Write two half equations to show what happens in this reaction. **$Br_2 + 2e^- \rightarrow 2Br^-$ $2I^- - 2e^- \rightarrow I_2$**

e) 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 dioxide carbon

iodine helium diamond buckminster -fullerene

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

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

!" !"S^{2}! **ion 16 34 16 18 18 2,8,8**

$^{37}_{17}Cl$ **atom 17 37** 17 20 17 **2,8,7**

$^{24}_{12}Mg^{2+}$ **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

O

H

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 cm^2 volume = 2 x 2 x 2 = 8 cm^3

surface area : volume ratio = 24 : 8 = 3

10 cm cube: surface area = 6 x 10 x 10 = 600 cm^2 volume = 10 x 10 x 10 = 1000 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 ionicr substance has high mpt Explain different nanoparticle properties

Write formulae Explain conductivity of substances