

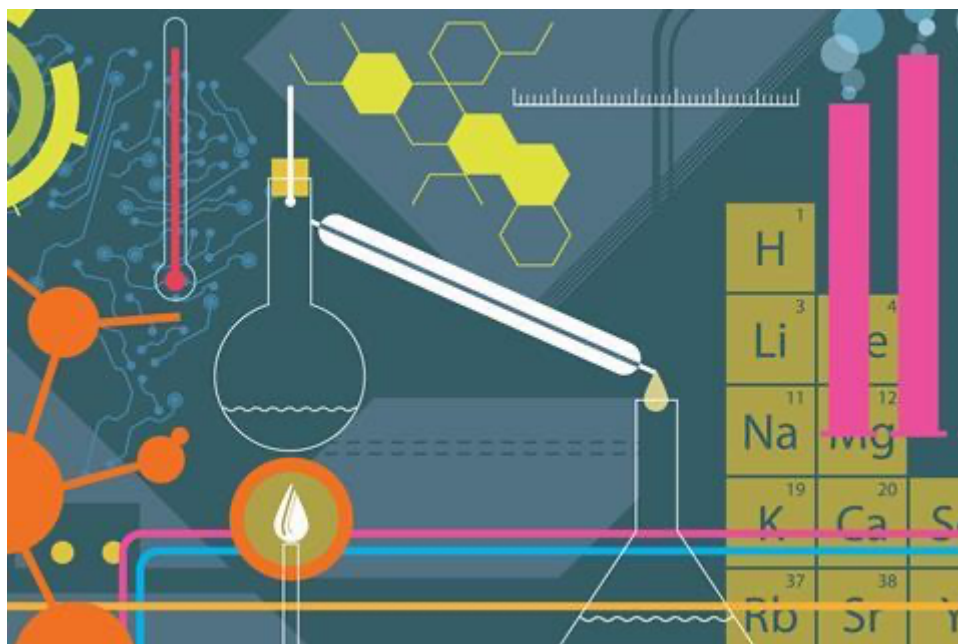


Westcliff High School for Boys

A-LEVEL CHEMISTRY

A Level Induction Summer Work

Foundation Topics from GCSE



Student Name: _____

Westcliff High School for Boys

Chemistry Department



Summer Work

I would like to start by welcoming you to Westcliff High School for Boys and am delighted that you are considering undertaking the next steps in your education with us.

The work contained in this booklet consists of GCSE material with a high degree of competency assumed at the start of any A Level Chemistry course. Many of you joining the Sixth Form will have not done any Chemistry for several months, nor been examined, formally at least, in the subject.

We ask all students who wish to study the Chemistry A Level course at WHSB to complete the exercises contained in this booklet and familiarise themselves with the content over the summer months. Mark schemes will be provided shortly before the start of the Autumn Term, and we will ask to see evidence of your work in the first few lessons in September. There will be a baseline test that examines GCSE knowledge at the start of the course, topics included in this summer work will be relevant to your preparations. Your score in the baseline test will be used to judge your suitability for the course in the Phase 1 indicator report that is issued to your parents.

As you transition from GCSE to A Level, you will find that there is a big jump in the pace, level of work and in the expectations of you as a student. You may have to re-assess the methods in which you work and in how you study and how you organise your notes as you develop better skills in working independently. As outlined in the Sixth Form Handbook, students should devote four hours of independent study per subject studied, this is good advice indeed. Your timetable will provide you with free periods and I urge you to make good use of them.

A common query from students is about resources in preparing for the Edexcel Chemistry (2015) course.

The following table is a list of resources that are useful, you will note that we will provide you a variety of textbooks at the start of the course. We will also provide you with course booklets for each topic throughout.

Resource	ISBN number	Issued to students
Edexcel A Level Chemistry Student Book 1	978-1447991168	Yes
Edexcel A Level Chemistry Student Book 2	978-1-447-991175	Yes
Calculations in AS / A Level Chemistry	978-0582411272	Yes
<i>Edexcel Student Guide – Practical Chemistry</i>	978-1-4718-8567-9	No
<i>Alternate version</i> <i>Edexcel A Level Chemistry Student Book 1 (Hodder)</i>	978-1471807466	No
<i>Alternate version</i> <i>Edexcel A Level Chemistry Student Book 2 (Hodder)</i>	978-1471807497	No
<i>Revise Edexcel AS/A Level Chemistry Revision Workbook: For the 2015 Qualifications</i>	978-1447989943	No
<i>Head Start to A-Level Chemistry (with Online Edition) (CGP A-Level Chemistry)*</i>	978-1782942801	No

**This book might be useful in transitioning from GCSE to A-level. However be wary of CGP guides, they are not a substitute for the textbook merely an enhancement. Textbooks contain more information for a reason.*

Do ensure to take the necessary time to relax during the Summer Holidays, however you will benefit greatly by completing this work to make a good start in September.

I wish you a restful and hopefully enjoyable summer and look forward to welcoming you in the new academic year.

Mr D Wightman
Head of Chemistry

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FORMULA LITERACY (GCSE) - INTRODUCTION

It is vital as a chemistry student that you know the formulas of common substances. Here is a list of substances whose formulas you should know at all times.

Elements				Compounds	
Al	aluminium	Mg	magnesium	NH ₃	ammonia
Ar	argon	Hg	mercury	CaCO ₃	calcium carbonate
Br ₂	bromine	Mg	magnesium	CO	carbon monoxide
Ca	calcium	Ne	neon	CO ₂	carbon dioxide
C	carbon	Ni	nickel	CuSO ₄	copper sulfate
Cl ₂	chlorine	N ₂	nitrogen	HCl	hydrochloric acid
Cr	chromium	O ₂	oxygen	CH ₄	methane
Co	cobalt	P ₄	phosphorus	HNO ₃	nitric acid
Cu	copper	Pt	platinum	NO	nitrogen monoxide
F ₂	fluorine	K	potassium	NO ₂	nitrogen dioxide
Au	gold	Si	silicon	NaCl	sodium chloride
He	helium	Ag	silver	NaOH	sodium hydroxide
H ₂	hydrogen	Na	sodium	SO ₂	sulfur dioxide
I ₂	iodine	S ₈	sulfur	H ₂ SO ₄	sulfuric acid
Fe	iron	Sn	tin	H ₂ O	water
Pb	lead	Ti	titanium		
Li	lithium	Zn	zinc		

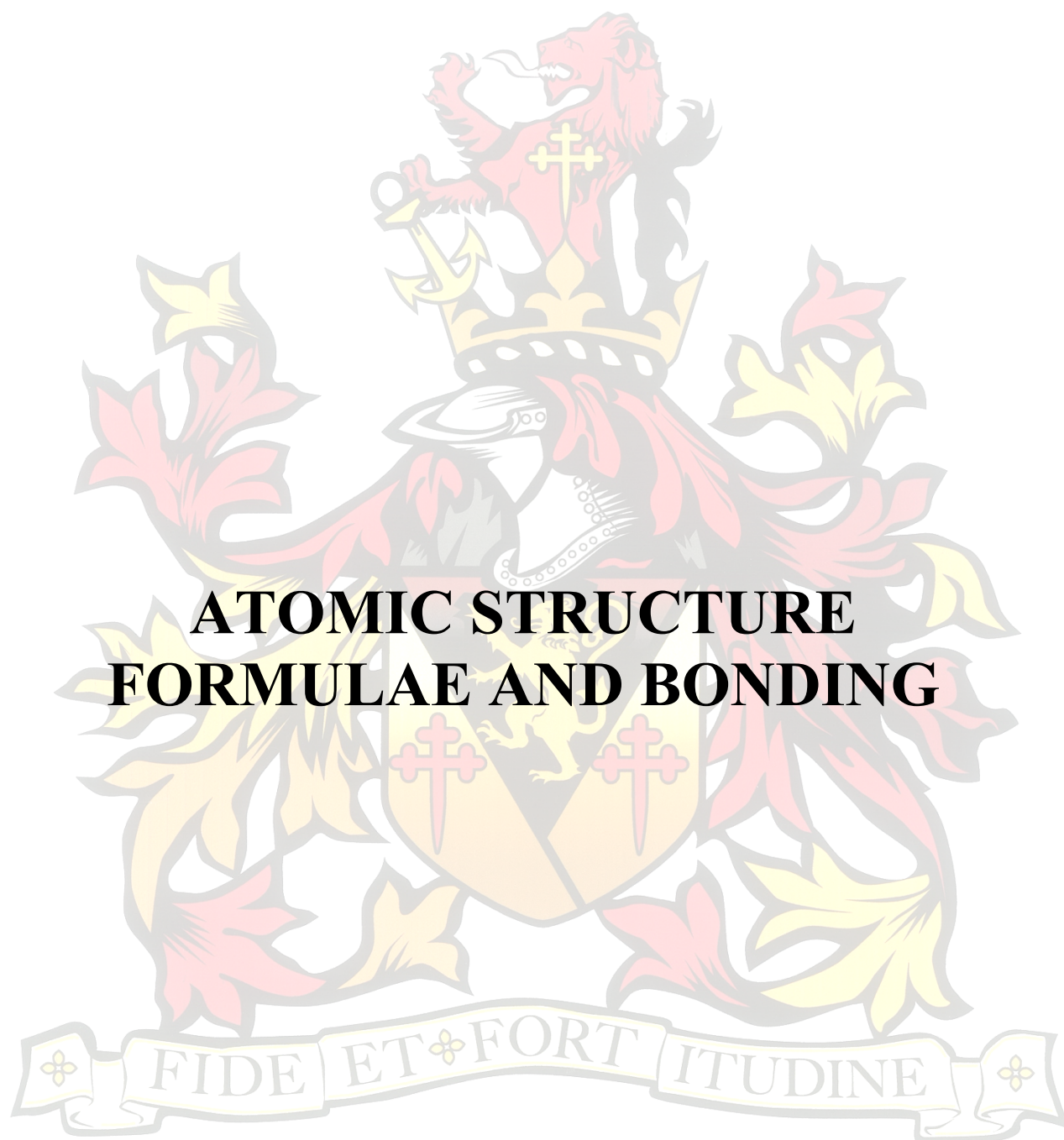
You also need to be able to work out the formula of ionic compounds. To do this you need to know the charges on ions. Many of these can be worked out from the position in the Periodic Table or from the number in roman numerals after a name (e.g. iron (III) sulfate contains Fe³⁺ ions; iron (II) sulfate contains Fe²⁺ ions).

+1	H ⁺ hydrogen ions NH ₄ ⁺ ammonium ions Group 1 ions (e.g. Na ⁺ sodium ions)
+2	Group 2 ions (e.g. Ca ²⁺ calcium ions)
+3	Group 3 ions (e.g. Al ³⁺ aluminium ions)

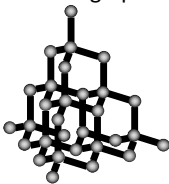
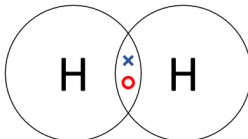
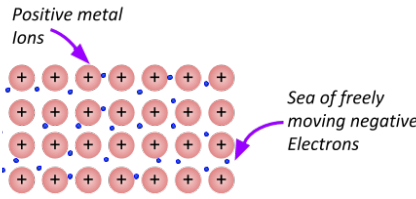
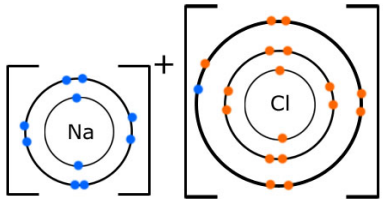
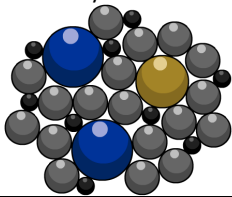
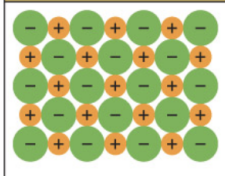
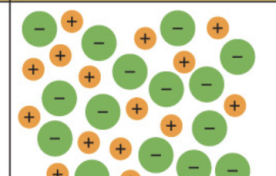
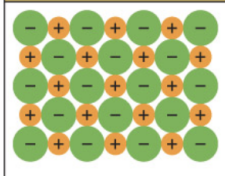
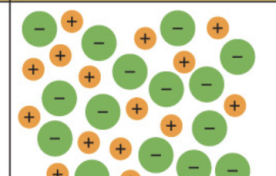
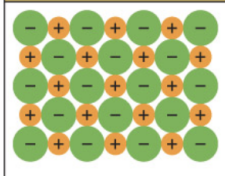
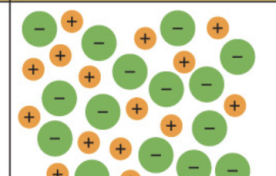
-1	NO ₃ ⁻ nitrate ions OH ⁻ hydroxide ions Group 7 ions (e.g. Br ⁻ bromide ions)
-2	CO ₃ ²⁻ carbonate ions SO ₄ ²⁻ sulfate ions
-3	PO ₄ ³⁻ phosphate ions

The formula is then worked out by balancing the number of + and – charges. For example:

sodium oxide	contains Na ⁺ and O ²⁻ ions	need ions in ratio: 2Na ⁺ : 1O ²⁻	formula = Na ₂ O
aluminium bromide	contains Al ³⁺ and Br ⁻ ions	need ions in ratio: 1Al ³⁺ : 3Br ⁻	formula = AlBr ₃
calcium hydroxide	contains Ca ²⁺ and OH ⁻ ions	need ions in ratio: 1Ca ²⁺ : 2OH ⁻	formula = Ca(OH) ₂
magnesium nitrate	contains Mg ²⁺ and NO ₃ ⁻ ions	need ions in ratio: 1Mg ²⁺ : 2NO ₃ ⁻	formula = Mg(NO ₃) ₂
iron(III) sulfate	contains Fe ³⁺ and SO ₄ ²⁻ ions	need ions in ratio: 2Fe ³⁺ : 3SO ₄ ²⁻	formula = Fe ₂ (SO ₄) ₃



ATOMIC STRUCTURE FORMULAE AND BONDING

Bonding	Covalent		Metallic	Ionic				
Definition	Sharing a pair of electrons (1) Between two positive nuclei (1)		Layers of positive ions (1) Surrounding by a sea of delocalised electrons (1)	Electrostatic attraction (1) between oppositely charged ions (1)				
How to spot it (look at Periodic Table)	Commonly non-metal elements only		Metallic elements only	Commonly non-metal and metallic elements Metals form positive ions (cations) Non-metals form negative ions (anions)				
Structure type	Giant/ lattice (limitless)	Simple (molecular) covalent (restricted to a number of atoms)	Giant/ lattice (limitless) <i>Alloys are a mixture of metals combined</i>	Giant/ lattice (limitless)				
Examples of structure and/ or bonding	Diamond, Silica (SiO ₂), graphite, graphene  (diamond)	H ₂ , H ₂ O, CO ₂ , O ₂ , N ₂ halogens (Cl ₂ , F ₂), Fullerenes 	 The cations do not move. <i>At least 3 rows of ions drawn in the diagram.</i>	 This is an empirical formula for NaCl <i>In reality, more than one ionic bond is formed</i>				
Physical properties	High melting and boiling point (due to lots of strong covalent bonds) Hard and strong Insulator (although graphite conducts) Graphite: conducts as there is a spare electron per Carbon atom between layers forming delocalised electrons, and can act as a lubricant (layers slide due to weak forces between layers) Graphite is also soft	Low boiling points (intermolecular forces <u>between molecules</u> are easily overcome) Insulator (no free electrons) Typically a gas at room temperature. Some solid examples include: iodine, buckminsterfullerene, cylindrical fullerenes	High melting and boiling points (due to strong attraction between positive ions and sea of negative electrons) Conducts – delocalised electrons are free to move <u>through the whole structure</u> Malleable and ductile – layers of similar size ions can slide over one another Alloys are stronger due to distortion in the lattice prevents layers from sliding: 	High melting and boiling points (due to lots of strong ionic bonds in all directions around ions) Brittle (as like-like charges repel) Does not conduct when solid (ions are fixed) Conducts only when molten or aqueous as ions are then free to move <table data-bbox="1545 869 2054 1117"><tr><th>Solid</th><th>Liquid</th></tr><tr><td></td><td></td></tr></table>	Solid	Liquid		
Solid	Liquid							
								
Words/ phrases you can say ✓	Covalent bond, Giant structure/ lattice, Bonds are strong, atom Giant covalent structure	Covalent bond(s) Intermolecular forces are weak molecule	Metallic bond(s), positive ions, layers, electrostatic attraction Giant metallic structure	Ionic bond(s), electrostatic attraction Giant ionic structure, ions, cation, anion, Strong bonds				
Words/ phrases you cannot say (loss of marks) X	Intermolecular force Covalent bonds are weak Ionic, ions, molecule , simple Has a giant covalent <i>bond</i>	Covalent bonds break and are weak when melting, intermolecular forces are strong	Intermolecular forces , covalent, ionic, negative ions/ anions, atoms, molecule , bonds are weak	Intermolecular forces , atoms, covalent, metallic bonds, ionic bonds are weak, molecule , simple. Delocalised electrons. Has a giant ionic <i>bond</i>				



1 This question is about the structure of atoms.

a Name the three particles that are found inside atoms.

.....

b Which of these particles are found inside the nucleus of the atom.

.....

c Which of these particles is neutral?

d Which of these particles has a negative electric charge?

e Which of these particles has a positive electric charge?

2 This question is about ${}_{13}^{27}\text{Al}$ atoms.

a How many protons, neutrons and electrons are in this atom?

protons = neutrons = electrons =

b What is it that makes this an atom of aluminium?

.....

3 Geiger and Marsden carried out an experiment where they fired alpha particles at a thin piece of gold. A small number of alpha particles were deflected or bounced back. This experiment led to Rutherford developing a new model of the atom.

a Why do most of the alpha particles pass straight through the gold atoms?

.....

.....

b Why do some of the alpha particles deflect or bounce back?

.....

.....

c Give two key differences between Rutherford's model of the atom and the Thomson's plum pudding model that it replaced.

1.....

2.....

4 a Define the term atomic number.

b Define the term mass number.



GCSE REVISION 1

Atoms, ions, equations, Periodic Table

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

	neutron	proton	electron
relative charge			
relative mass			

- b) Define the term **mass number**.

.....

- c) Define the term **atomic number**.

.....

- 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
${}^{40}_{18}\text{Ar}$							
${}^{27}_{13}\text{Al}^{3+}$							
				16	18	18	
				19	20	18	
				15	16	15	

- 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?

.....

- b) What are isotopes?

.....

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

.....

.....

.....

.....

.....

.....

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.

.....

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

.....

.....

.....

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5 This question is about the Periodic Table

a) Name each of the following groups.

Group 1

Group 7

Group 0

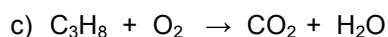
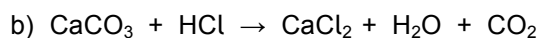
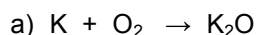
b) Which group would the following elements be in?

element with electron structure 2,8,6

element with electron structure 2,8,8

element with electron structure 2,8,18,3

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		



Ionic Bonding and Formulae

PART 1 – Ionic Bonding

a	What is the definition of an ionic bond?	
b	What type of elements do ionic bonds normally occur between?	
c	What is the difference between an atom and an ion?	
d	Magnesium chloride contains magnesium ions (Mg^{2+}) and chloride ions (Cl^-). Describe, in terms of electrons, what happens when a magnesium atom reacts with chlorine atoms to produce magnesium chloride.	
e	Draw diagrams to show how the magnesium atom becomes a magnesium ion and how the chlorine atom becomes a chloride ion. Show all electron shells. (Easiest option if completing online is to do on paper and upload and insert a picture into the document)	
f	Hence, what is the formula for magnesium chloride?	
g	Ionic formulae are said to be empirical formula, what is the definition of empirical formula?	

H	What is the electron configuration for a nitrogen atom and a nitrogen ion?	
I	The nitrogen ion is said to be isoelectronic to Neon, what does this mean?	
j	What is wrong in the following sentence? Chlorine reacts with potassium bromine to become potassium chloride and bromide	

PART 2 – Ionic Formulae

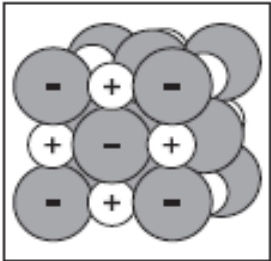
	Name	formula
1	sodium ion	
2	chloride ion	
3	sulfate ion	
4	cobalt(II) ion	
5	potassium oxide	
6	calcium hydroxide	
7	iron(III) oxide	
8	aluminium bromide	
9	magnesium nitrate	
10	lithium carbonate	



Ionic Bonding and Structure

PART 1 – Ionic Structure and properties

The numbers act as a guide to inform you of the number of key points you should be making in your answer

a	Describe the structure of ionic compounds (3)		
b	Why do ionic compounds have high melting points? (3) <i>Type/ Strength/ Energy</i>		
c	Do ionic substances conduct electricity when they are a solid/ (s)? <i>Add an explanation as to whether they do or don't. (2)</i>		
d	Do ionic substances conduct electricity when they are a liquid/ molten/ (l)? <i>Add an explanation as to whether they do or don't. (2)</i>		
e	Do ionic substances conduct electricity when they are dissolved/ aqueous/ (aq)? <i>Add an explanation as to whether they do or don't. (2)</i>		
f	What is wrong with this sentence: <i>ionic compounds conduct electricity when molten as electrons are free to move (1)</i>		
g	Ionic substances are said to be brittle, explain why. (2)		

h	Ionic compounds tend to be soluble, explain why. (2)	
---	--	--

PART 2 – Ionic Formulae

a	Ionic formulae are often represented as an empirical formula. What is an empirical formula? (2)	
b	What is wrong with the following equation:	
	$\text{Mg} + \text{HCl} = \text{MgCl} + \text{H}_2$	
	Give the correction below and explain your answer with reasons that relate to groups on the Periodic table and their charges associated.	



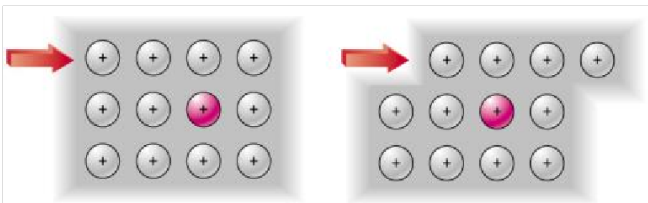
METALLIC BONDING AND STRUCTURE

PART 1 – THE SOURCE OF METALS

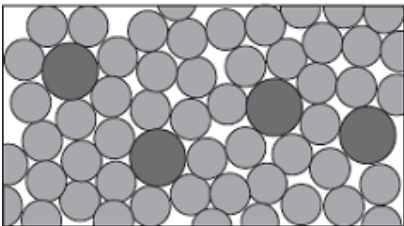
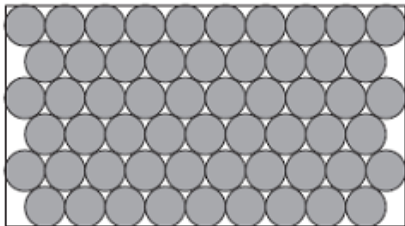
a	What are ores?	
b	Some metals are obtained by removing oxygen from the metal oxide. What name do we give to this chemical reaction?	
c	Name one metal which must be extracted from its melted ore by electrolysis rather than by using carbon.	

PART 2 – PROPERTIES AND STRUCTURE OF METALS

a	Describe the structure of metals and what is metallic bonding?	
b	Why do metals conduct electricity?	
c	Why do metals have high melting points?	
d	Explain why the melting point of Sodium Na (89°C) is lower than the melting point of Magnesium (650°C)	
e	Explain why metals are good conductors of electricity and suggest why this conductivity increases across the periodic table from sodium to magnesium to aluminium. <i>Hint: it is to do with their cation charge and electrons released</i>	

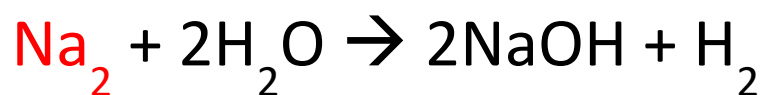
f	Why are metals soft and malleable?	
g	Metals form cations, what is a cation?	

PART 3 – ALLOYS

a	What is an alloy?	
b	Why are alloys harder than pure metals?	Alloy  Pure iron 
c	What happens if too much carbon is added?	

PART 4 – FORMULAE (PowerPoint slides – Metallic Formulae)

What is wrong with the formula of sodium in this equation and what is the correction?:



Answer:	
---------	--



COVALENT BONDING - DRAWING MOLECULES 1

When non-metals combine with other non-metals, the atoms share electrons to form a molecule. The atoms are held together by these shared electrons which are known as covalent bonds.

Molecule = a non-metal particles made up of atoms joined by covalent bonds

Covalent bond = 2 shared electrons

How many covalent bonds?

(Refer to the Periodic Table or use the table below)

Atoms	Number of electrons in outer shell	Number of extra electrons needed to fill the outer shell	Number of covalent bonds formed
Group 7 (e.g. F, Cl, Br, I)	7	1	1
Group 6 (e.g. O, S)	6	2	2
Group 5 (e.g. N, P)	5	3	3
Group 4 (e.g. C, Si)	4	4	4
H	1	1	1

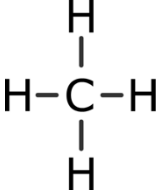
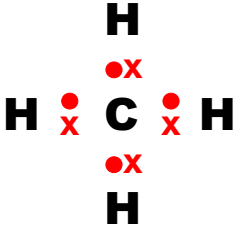
TASK - Drawing stick diagrams & dot-cross diagrams

BBC link to covalent bonding: <https://www.bbc.co.uk/bitesize/guides/z373h39/revision/2>

Stick diagrams – these show each covalent bond as a stick.

Dot-cross diagrams – these show the outer shell electrons only

- 1 Draw a stick diagram
- 2 Re-draw the stick diagram without the sticks
- 3 Replace the stick with a **X●** which represents the two electrons in the bond (**X** represents electrons from one atom, and **●** represents the electron from the other atom). (Show outermost electrons only)
- 4 Add in any other outer shell electrons from each atom (electrons are always in pairs)
- 5 CHECK that there are 8 electrons around each atom (except H where there should be 2 electrons)

Stick diagram	Molecule	Dot-cross diagram
e.g. 	CH ₄	Show outer most electrons only 

	Stick diagram	Molecule	Dot-cross diagram
a		NH ₃	
b		O ₂	
c		HCl	
d		Br ₂	
e		PH ₃	
f		CO ₂	

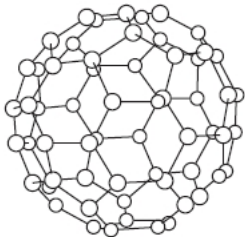
	Stick diagram	Molecule	Dot-cross diagram
g		SiH ₄	
h		H ₂ O	
i		N ₂	
j		C ₂ H ₄	
k		C ₂ H ₂	



SIMPLE MOLECULAR STRUCTURES

Properties of simple covalent molecules

The numbers act as a guide to inform you of the number of key points you should be making in your answer

	Question	Answer
a	Explain why carbon dioxide has a low boiling point. (2)	
b	Fullerene has a simple molecular structure. Explain why it has a low melting point. (2)  fullerene molecule	
c	Explain whether pure water conducts electricity (2)	
d	Give 5 examples of simple molecules (5)	
e	Identify the chemicals from the list that are not molecules CH₄ , O₂ , Ne, Cl₂ , C, SiO₂ , CO₂ , C₄H₁₀	

Correcting a student answer 1

Read the following student answer for the question "explain why nitrogen is a gas at room temperature"

Nitrogen has a simple covalent ~~gas~~ bond where 3 pairs of electrons are shared between two positive nuclei. These ~~bonds~~ ~~are~~ are weak intermolecular forces between the atoms, therefore they can be easily separated therefore they're a gas at room temperature.

Identify the student errors and write an improvement

Answer:

Correcting a student answer 2

Read the following student answer for the question "explain why nitrogen is a gas at room temperature"

Nitrogen is covalently bonded but it is simple molecular so it has weak intermolecular forces. This means it takes little energy to overcome these bonds so it has a low boiling point.

Identify the student errors and write an improvement
(there is only one major error)

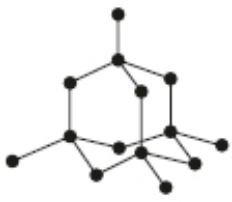
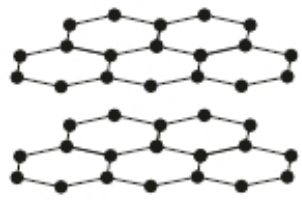
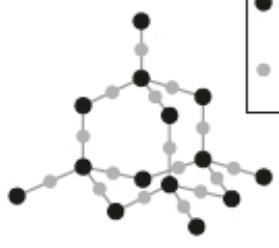
Answer:

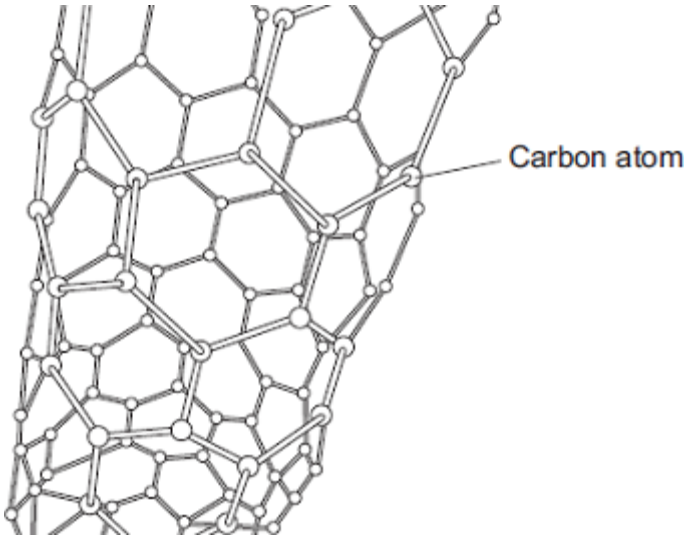


GIANT COVALENT STRUCTURES

PART 1 – Covalent Bonding and Structure

The numbers act as a guide to inform you of the number of key points you should be making in your answer

a	What is covalent bonding? (2)	
b	Diamond, graphite and silicon dioxide all have giant covalent structures. The diagram shows the structures of these three substances.  diamond  graphite  silicon dioxide key ● silicon ● oxygen	
b (i)	Explain why silicon dioxide has a high melting point. (3) <i>Refer to the type of bonding/ Strength of bonds/ Energy required to break bonds</i>	
b (ii)	Explain why graphite conducts electricity. (2)	
b (iii)	State why diamond is hard but graphite is soft. Diamond: (2), Graphite: (2) <i>(2 comments relating to each)</i>	
b (iv)	How many bonds does each Carbon make in diamond? (1)	
b (v)	Diamond and Graphite are allotropes, what is an allotrope? (1)	

c	Aeroplanes contain many miles of electrical wiring made from copper. This adds to the mass of the aeroplane. It has been suggested that the electrical wiring made from copper could be replaced by carbon nanotubes which are less dense than copper. The diagram shows the structure of a carbon nanotube: Please note: do not call GIANT STRUCTURES molecules, however Fullerenes and Nanotubes form large molecules	
c (i)	What does the term 'nano' tell you about the carbon nanotubes? (1)	
c (ii)	Like graphite, each carbon atom in the carbon nanotube is joined to three other carbon atoms. Explain why the carbon nanotube can conduct electricity. (2)	



WRITING EQUATIONS

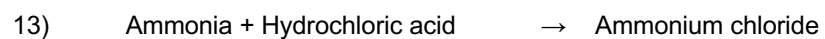
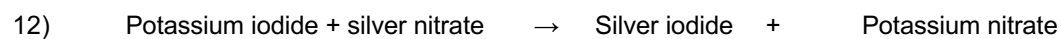
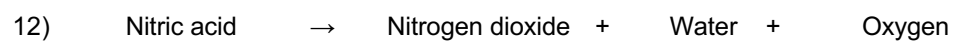
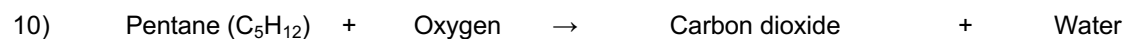
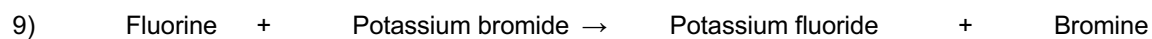
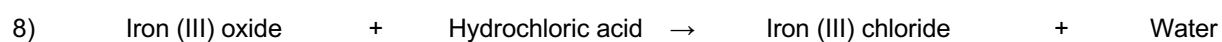
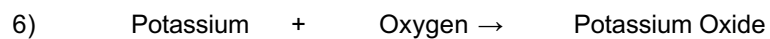
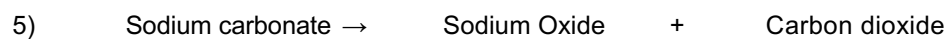
- An equation is balanced when there are the same number of atoms of each type on both sides of the equation.
- An equation can only be balanced by putting numbers in front of formulas – you cannot change the formula itself.
- Equations can be written with state symbols: (s) = solid, (l) = liquid, (g) = gas, (aq) = aqueous (dissolved in water).

How to balance an equation:

- Write the formulae correctly – Use the Periodic Table to help you and learn the polyatomic ions off by heart:
Sulfate = SO_4^{2-} Carbonate = CO_3^{2-} Nitrate = NO_3^- Hydroxide = OH^- Ammonium = NH_4^+
- Learn other important formulae and rules:
 H_2 N_2 F_2 O_2 I_2 Cl_2 Br_2
Transition metals usually are +2 or (the roman numeral tells you of the charge, e.g (II) = +2)
Silver, (Ag) however is always +1
Lead, (Pb) is usually a +2
Ammonia = NH_3
Common acids: Nitric: HNO_3 Sulfuric: H_2SO_4 Hydrochloric: HCl
- Once the formulae is correct, calculate how many atoms of each type are on each side of the equation.
If the numbers are the same then the equation is balanced, you may have to revisit again to check.
- If the numbers are not the same, then big numbers are put in front of the substance).
You cannot change the formulae (this would make a different substance).
Hint – start with unbalanced elements that only appear in one substance on each side of the equation.
- Keep doing this until the equation is balanced.

Questions

- Calcium + Oxygen $\rightarrow$ Calcium oxide
- Sodium Oxide + water $\rightarrow$ sodium hydroxide
- Aluminium + Oxygen $\rightarrow$ Aluminium oxide
- Sodium + Chlorine $\rightarrow$ Sodium chloride





WRITING IONIC EQUATIONS

Warm up - writing equations and balancing

- 1) Sodium + Water → Sodium hydroxide + Hydrogen
- 2) Potassium carbonate + Sulfuric acid → Potassium sulfate + Water + Carbon dioxide
- 3) Aluminium + Chlorine → Aluminium chloride

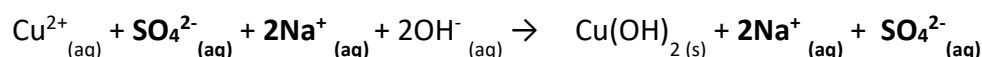
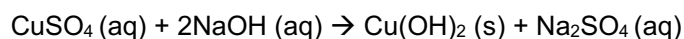
How to balance an ionic equation:

- a) The technique of how to write an ionic formula needs to be known along with the polyatomic ion charges (shown below):
Sulfate = SO_4^{2-} Carbonate = CO_3^{2-} Nitrate = NO_3^- Hydroxide = OH^- Ammonium = NH_4^+
- b) Remember, when hydrogen, nitrogen etc are “on their own”, they exist in pairs (diatomic molecules)
e.g. H_2 N_2 F_2 O_2 I_2 Cl_2 Br_2
- c) The state symbols need to be known, for simplicity, the state symbols will be provided.
- d) The equations written previously are called “full balanced chemical equations” – i.e they use symbols.

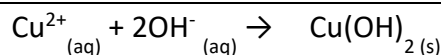
An **ionic** equation is a simplified version of a **full** equation other removing **spectator ions** – we will see what this is in a moment.

- a. Determine the “charges” present in the formulae by using the Periodic Table – do not give elements that are on their own a charge (such as sodium or hydrogen)
- b. Split up all chemicals that are **ionic** (for GCSE this is compound consisting of a non-metal and a metal) **and** have the state symbol “aqueous”, (aq). .i.e. water H_2O , is covalent, **do not** split it up.
- c. **Keep polyatomic ions together** e.g. CuSO_4 becomes Cu^{2+} and SO_4^{2-}
- d. Remove **spectator ions**

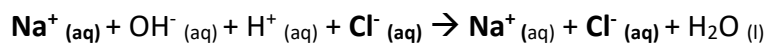
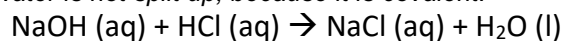
Example 1:



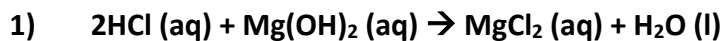
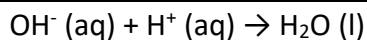
Sulfate ions and sodium ions are the same on either side of the equation and thus cancel out.



Example 2: notice that water is not split up, because it is covalent.



Remove spectator ions: $\text{Na}^+ + \text{OH}^- + \text{H}^+ + \text{Cl}^- \rightarrow \text{Na}^+ \text{Cl}^- + \text{H}_2\text{O}$

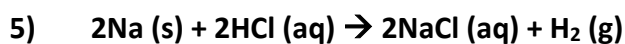
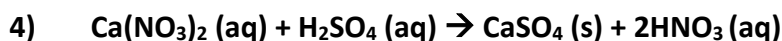
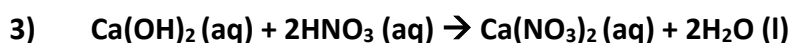
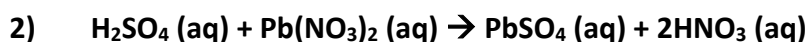


Step 1: Write down all the ions found in the substances

*(be careful of formulae, chloride ions should be represented as 2Cl^- **not** Cl_2^-)*

Step 2: Remove spectator ions

Step 3: Re-write equation, include the original state symbols and balance!





REDOX REACTIONS

Reduction and oxidation usually happen together. Reactions where both **re**duction and **ox**idation take place are called **redox** reactions.

There are two definitions of reduction and oxidation.

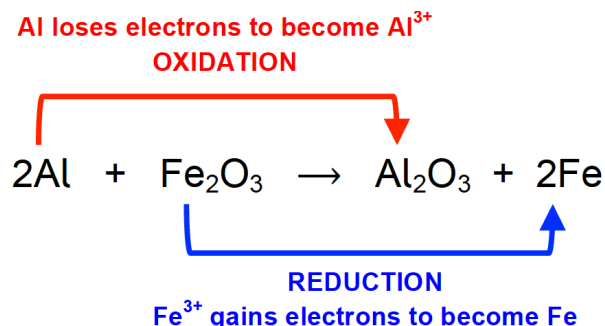
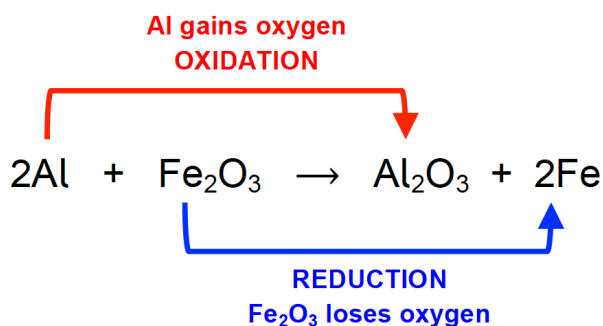
	Oxidation	Reduction
In terms of oxygen	adding oxygen	taking oxygen away
In terms of electrons	loss of electrons	gain of electrons

Oxidation
Is
Loss

Reduction
Is
Gain

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of electrons



Half equations and ionic equations

We can write two half equations for each redox reaction; one for the reduction process and one for the oxidation process.

Each Al atom each loses 3 electrons to form the Al ³⁺ ions in Al ₂ O ₃	$\text{Al} - 3\text{e}^- \rightarrow \text{Al}^{3+}$	oxidation as Al atoms lose electrons
Each Fe ³⁺ ion in Fe ₂ O ₃ gains 3 electrons to form the Fe atoms	$\text{Fe}^{3+} + 3\text{e}^- \rightarrow \text{Fe}$	reduction as Fe ³⁺ ions gain electrons

We can combine the two half equations to make an overall ionic equation.

In this equation, two Al atoms react with the two Fe ³⁺ ions in Fe ₂ O ₃ to make two Al ³⁺ ions in Al ₂ O ₃ and two Fe atoms	$2\text{Al} - 6\text{e}^- + 2\text{Fe}^{3+} + 6\text{e}^- \rightarrow 2\text{Al}^{3+} + 2\text{Fe}$
the electrons cancel out giving	$2\text{Al} + 2\text{Fe}^{3+} \rightarrow 2\text{Al}^{3+} + 2\text{Fe}$
we can cancel down to remove the 2s	$\text{Al} + \text{Fe}^{3+} \rightarrow \text{Al}^{3+} + \text{Fe}$

This overall ionic equation leaves out any ions that do not change. It just shows what happens to anything that changes. In this example, the oxide ions start as O²⁻ and end as O²⁻ and so do not change. As they do not change, we can leave them out of equation.

	Question	Space for working
1	$\text{Cu} + 2\text{AgNO}_3 \rightarrow \text{Cu}(\text{NO}_3)_2 + 2\text{Ag}$	
	<i>half equation</i>	
	<i>half equation</i>	
	<i>ionic equation</i>	
2	$\text{Mg} + \text{ZnO} \rightarrow \text{MgO} + \text{Zn}$	
	<i>half equation</i>	
	<i>half equation</i>	
	<i>ionic equation</i>	
3	$\text{Fe} + \text{CuSO}_4 \rightarrow \text{Cu} + \text{FeSO}_4$	
	<i>half equation</i>	
	<i>half equation</i>	
	<i>ionic equation</i>	
4	$\text{Pb} + 2\text{AgNO}_3 \rightarrow \text{Pb}(\text{NO}_3)_2 + 2\text{Ag}$	
	<i>half equation</i>	
	<i>half equation</i>	
	<i>ionic equation</i>	
5	$\text{Al} + 3\text{AgNO}_3 \rightarrow \text{Al}(\text{NO}_3)_3 + 3\text{Ag}$	
	<i>half equation</i>	
	<i>half equation</i>	
	<i>ionic equation</i>	
6	$2\text{Al} + 3\text{ZnSO}_4 \rightarrow \text{Al}_2(\text{SO}_4)_3 + 3\text{Zn}$	
	<i>half equation</i>	
	<i>half equation</i>	
	<i>ionic equation</i>	



GCSE REVISION 6

Formulae, equations, particles, structure & bonding

1 Write the formula of the following ionic compounds.

- a) sodium sulfate c) ammonium bromide
b) iron(III) oxide d) aluminium nitrate

2 Write balanced equations for the following equations.

- a) $\text{Na} + \text{O}_2 \rightarrow \text{Na}_2\text{O}$
b) magnesium + nitric acid $\rightarrow$ magnesium nitrate + hydrogen
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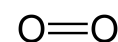
3 Complete the following table about some atoms and ions. The first row has been done for you.

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
${}^{27}_{13}\text{Al}^{3+}$							
	atom			19	20		
				16	18	18	

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).



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- 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.

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- 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.

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- 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.

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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 11

Atomic structure, structure & bonding

1 Give the formula of each of the following ions.

ion	sodium	oxide	magnesium	nitrate	carbonate
formula					

ion	hydroxide	bromide	sulfide	aluminium	ammonium
formula					

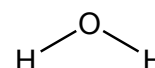
2 What is the structure type of each of the following substances? Tick the correct box. Also give the correct formula

name	sodium sulfate	potassium	carbon dioxide	iodine	helium	diamond	buckminsterfullerene	aluminium oxide
formula								
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
$^{27}_{13}\text{Al}$							
$^{34}_{16}\text{S}^{2-}$							
				17	20	17	
				12	12	10	

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



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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.

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- 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.

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- 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.

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

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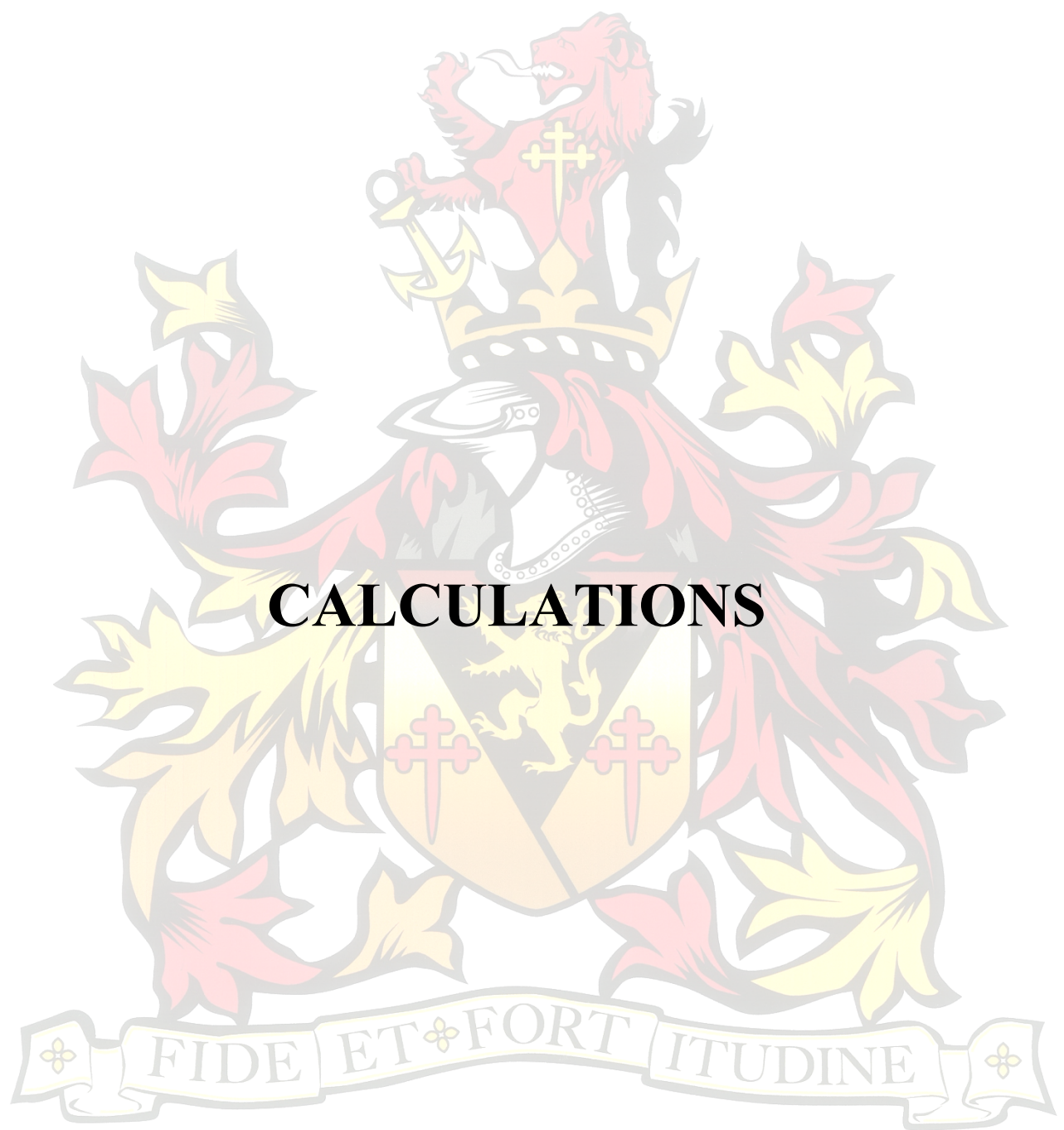
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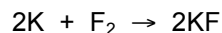
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Area	Strength	To develop	Area	Strength	To develop	Area	Strength	To develop
Done with care and thoroughness			Can find PNE numbers in ions			Know what an alloy is		
Good SPG			Can find PNE numbers in atoms			Why alloys are softer than pure metals		
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					





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



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

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

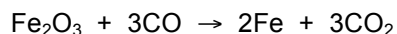
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- 2 Calculate the percentage yield in a reaction where 1.0 kg of iron is made from 1.6 kg of iron(III) oxide.



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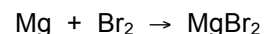
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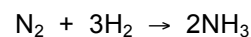


- 1 a How many moles of magnesium bromide are formed when 3.0 moles of magnesium reacts with 2.0 moles of bromine?



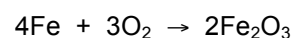
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- b How many moles of ammonia are formed when 4.0 moles of nitrogen reacts with 9.0 moles of hydrogen?



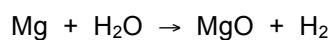
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- c How many moles of iron oxide are formed when 12.0 moles of iron reacts with 6.0 moles of oxygen?



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



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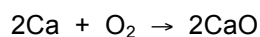
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- 3 2.0 g of calcium is reacted with 0.32 g of oxygen. Work out which is the limiting reagent and then calculate the mass of calcium oxide formed.



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

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

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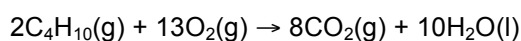
- 2 How many moles in 1.8 dm^3 of helium gas (He) at room temperature and pressure?

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

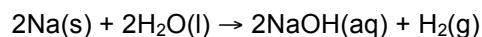
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- 4 What volume of oxygen gas reacts with 100 cm^3 of butane gas, with both gases measured at the same temperature and pressure?



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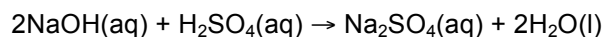
- 5 What volume of hydrogen gas, measured at room temperature and pressure, is formed when 6.9 g of sodium reacts with water?



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



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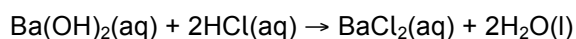
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- 2 In a titration, 25.0 cm³ of 0.040 mol/dm³ barium hydroxide solution reacted with 21.6 cm³ of hydrochloric acid. Find the concentration of the hydrochloric acid in mol/dm³ and g/dm³.



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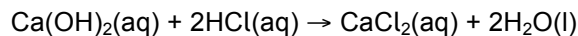
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A student carried out a titration to find the concentration of a solution of calcium hydroxide. In each titration, the student used 25.0 cm^3 of the calcium hydroxide solution and titrated it against 0.0100 mol/dm^3 hydrochloric acid solution.



The student's results are shown in the table.

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

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

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

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

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GCSE REVISION 7

Calculations

1 Give the formula of the following ionic substances.

- | | |
|----------------------------|------------------------------|
| a) potassium oxide | d) magnesium hydroxide |
| b) aluminium bromide | e) ammonium iodide |
| c) iron(III) sulfide | f) calcium nitrate |

2 Calculate the relative formula mass of the following substances.

- a) chlorine, Cl_2
- b) ammonium sulfate, $(\text{NH}_4)_2\text{SO}_4$

3 a) What mass of sodium reacts with 95 g of titanium chloride? $\text{TiCl}_4 + 4\text{Na} \rightarrow \text{Ti} + 4\text{NaCl}$

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

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4 Ammonia is made by reaction of nitrogen with hydrogen. $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$

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

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

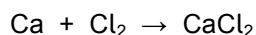
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c) Suggest two reasons why the yield was less than 100%.

- 1
- 2

- 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.



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- 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.

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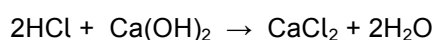
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- b) Calculate the concentration of the calcium hydroxide in mol/dm³. The equation for the reaction is shown.



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

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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 9

Calculations 2

1 Give the formula of the following ionic substances.

- | | |
|-----------------------------|------------------------------|
| a) aluminium chloride | d) calcium nitrate |
| b) potassium sulfide | e) magnesium hydroxide |
| c) sodium sulfate | f) iron(II) oxide |

2 Calculate the relative formula mass of the following substances.

- a) fluorine, F_2
- b) iron(III) nitrate, $Fe(NO_3)_3$

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.

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- 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.

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

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

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

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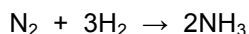
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5 Calculate the volume of the following gases at room temperature and pressure.

- a) 3 moles of oxygen, O₂
-
- b) 22 g of carbon dioxide, CO₂
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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?



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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.

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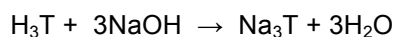
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8 25.0 cm³ of a solution of citric acid, which is represented by H₃T in the equation, reacted with 26.4 cm³ of 0.100 mol dm⁻³ sodium hydroxide solution in a titration.



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

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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.

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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 13

Calculations 3

1 Give the formula of the following ionic substances.

- a) copper(II) oxide c) aluminium nitrate
b) calcium hydroxide d) lithium carbonate

2 Calculate the relative formula mass of the following substances.

- a) nitrogen, N_2
b) calcium nitrate, $Ca(NO_3)_2$

3 What mass of hydrogen reacts with 140 g of nitrogen to make ammonia? $N_2 + 3H_2 \rightarrow 2NH_3$

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4 Calcium hydroxide is made by reaction of calcium oxide with water: $CaO + H_2O \rightarrow Ca(OH)_2$

- a) Calculate the maximum mass of calcium hydroxide that could be formed from 1.12 kg of calcium oxide.

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- b) In a reaction, 1440 g of calcium hydroxide was formed from reaction of 1.12 kg of calcium oxide with water. Calculate the percentage yield for this reaction.

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- c) Suggest one reason why the yield was less than 100%.

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5 Calculate the atom economy to make titanium in this reaction: $TiCl_4 + 2Mg \rightarrow Ti + 2MgCl_2$

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6 What volume of oxygen gas is needed to react with 4 dm³ of propane with complete combustion, with the volume of all gases measured at the same temperature and pressure? $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

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

- a) 2.5 moles of carbon dioxide, CO₂
- b) 10 g of argon, Ar
-

8 5.1 g of the vanadium (a transition metal, symbol = V) reacts with 4.0 g of oxygen (O₂) to make an oxide of vanadium. Calculate the moles of vanadium and oxygen and use this to determine the balanced equation for the reaction.

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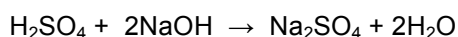
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9 25.0 cm³ of a solution of sodium hydroxide was neutralised by 23.6 cm³ of 0.400 mol dm⁻³ sulfuric acid in a titration.



- a) Calculate the concentration of the sodium hydroxide in mol/dm³. Give your answer to 3 significant figures.

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- b) Calculate the concentration of the sodium hydroxide in g/dm³. Give your answer to 3 significant figures.

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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 <i>M_r</i>			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 18

Calculations 4

- 1) a) How many moles in 33.0 kg of ammonium sulfate $(\text{NH}_4)_2\text{SO}_4$.
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- b) What is the mass of 0.040 moles of oxygen, O_2 ?
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- 2) a) What maximum mass of methanol that can be made when 12 g of hydrogen reacts with an excess of carbon monoxide? $\text{CO} + 2\text{H}_2 \rightarrow \text{CH}_3\text{OH}$
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- b) In a reaction, 60 g of methanol was formed from 12 g of hydrogen. Calculate the percentage yield.
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- 3) Calculate the percentage atom economy to make iron from iron(III) oxide by reaction with carbon monoxide. $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$
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- 4) What volume of hydrogen gas is formed, measured at room temperature and pressure, when 0.65 g of zinc reacts with sulfuric acid? $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$
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- 5) What volume of carbon dioxide gas is formed when 100 cm^3 of propane gas burns (both gases are at room temperature and pressure)? $\text{C}_3\text{H}_8 + 5\text{O}_2 \rightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$
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- 6) 0.595 g of tin (Sn) reacts with 0.71 g of chlorine (Cl₂) to form tin chloride. Find the simplest molar ratio in which tin reacts with chlorine and use it to find the formula of the tin chloride. Finally, write a balanced equation for the reaction.

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- 7) Lead reacts with chlorine to form lead(II) chloride. When 6.21 g of lead reacts with 2.84 g of chlorine, which is the limiting reagent and what mass of lead(II) chloride is formed? $\text{Pb} + \text{Cl}_2 \rightarrow \text{PbCl}_2$

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- 8) Find the concentration of oxalic acid (H₂C₂O₄) in mol/dm³ and g/dm³ given that 25.0 cm³ of this solution reacts with 22.8 cm³ 0.100 mol/dm³ sodium hydroxide solution in a titration. $\text{H}_2\text{C}_2\text{O}_4 + 2\text{NaOH} \rightarrow \text{Na}_2\text{C}_2\text{O}_4 + 2\text{H}_2\text{O}$

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Area	Strength	To develop	Area	Strength	To develop	Area	Strength	To develop
Done with care and thoroughness			Can work out % atom economy			Understands limiting reagents		
Shows suitable working			Can work out % yield			Work out moles for solutions		
Can work out <i>M_r</i>			Understands why yield < 100%			Convert mol/dm ³ to g/dm ³		
Work out moles from mass			Work out gas volume from mass or mol			Does not round too much		
Can work out mass from moles			Understands reacting gas volumes			Gives units		
Use equation to find reacting moles			Deduce molar reacting ratio from mass					



GCSE REVISION 27

More calculations

1 Calculate the relative formula mass of the following substances.

- a) bromine, Br_2
- b) iron(III) sulfate, $\text{Fe}_2(\text{SO}_4)_3$
- c) sodium nitrate

2 Sodium carbonate can be made from sodium chloride: $2\text{NaCl} + \text{CaCO}_3 \rightarrow \text{CaCl}_2 + \text{Na}_2\text{CO}_3$

- a) Calculate the mass of sodium carbonate that can be made by reacting 585 g of sodium chloride with excess calcium carbonate.

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- b) Calculate the percentage atom economy to make sodium carbonate in this reaction.

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3 Calcium sulphate can be made from calcium sulfide: $\text{CaS} + 2\text{O}_2 \rightarrow \text{CaSO}_4$

Calculate the mass of oxygen needed to react with 3.6 kg of calcium sulfide.

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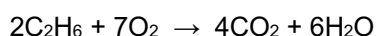
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4 What volume of oxygen gas reacts with 100 cm^3 of ethane (C_2H_6) with the volume of all gases measured at the same temperature and pressure.



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- 5** Calculate the volume of 88 g of carbon dioxide (CO₂) gas at room temperature and pressure.

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- 6** In a reaction, 11.2 g of iron reacts with 4.8 g of oxygen. Find the molar ratio in which the iron and oxygen react and use this to deduce the formula of the iron oxide formed.

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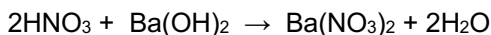
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- 7** 25.0 cm³ of a solution of nitric acid was titrated against a solution of 0.0200 mol/dm³ barium hydroxide. 28.2 cm³ of the barium hydroxide was needed to neutralise the acid. Calculate the concentration of the nitric acid in mol/dm³. The equation for the reaction is shown. Give your answer to 3 significant figures.



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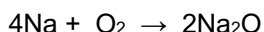
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- 8** In an experiment, 11.5 g of sodium was reacted with 3.2 g of oxygen. One of the chemicals was in excess. Determine which is the limiting reagent and then calculate the mass of sodium oxide formed.



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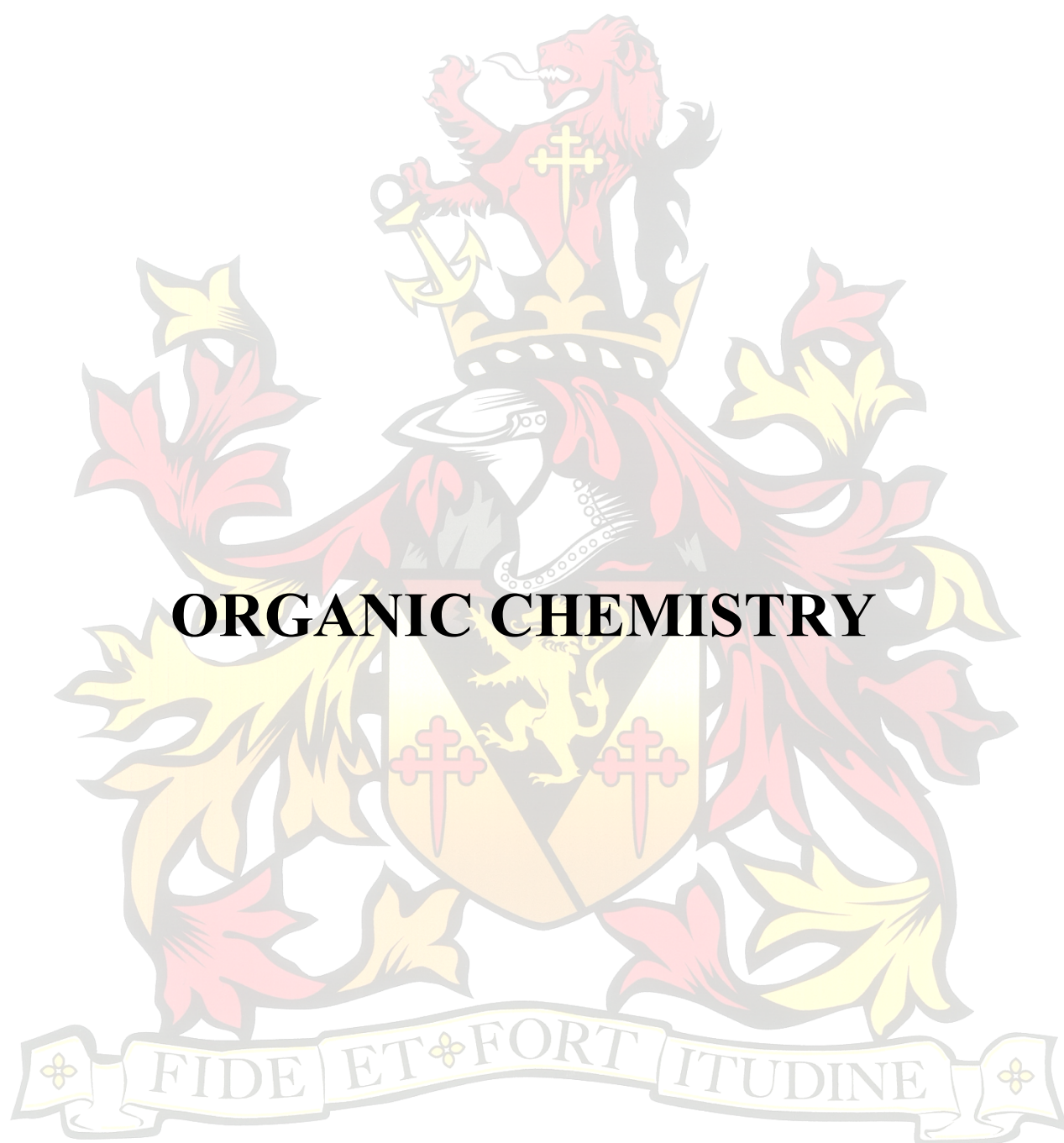
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Area	Strength	To develop	Area	Strength	To develop	Area	Strength	To develop
Done with care and thoroughness			Can work out mass from moles			Determine formula from reacting ratios		
Shows suitable working			Can work out % atom economy			Solution calculations		
Can write ionic formulae			Convert units			Understands limiting reagents		
Can work out M_r			Understands reacting gas volumes			Does not round too much		
Work out moles from mass			Can work out gas volumes			Can use sig figs		
Use equation to find reacting moles			Can determine reacting ratios			Gives units		



ORGANIC CHEMISTRY



1 Complete this table with the names and structures of some alkanes.

Displayed formula	<pre> H H H-C---C-H H H</pre>		<pre> H H H H-C---C---C-H H H H</pre>
Name		butane	

2 Define the following terms.

a hydrocarbon

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b saturated

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3 Hexane is an alkane containing 6 carbon atoms. Give its molecular formula.

4 Complete the table (using a ✓ in the relevant boxes) to compare two alkanes.

	most flammable	highest boiling point	most viscous	burns with cleanest flame
pentane (C ₅ H ₁₂)				
octane (C ₈ H ₁₈)				

5 a Write a balanced equation for the complete combustion of pentane (C₅H₁₂).

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b Write a balanced equation for the incomplete combustion of pentane (C₅H₁₂) to form carbon monoxide.

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GCSE REVISION 17

Organic Chemistry 1

1 Draw the displayed structure of each of the following molecules in the boxes.

methanol	butane
propene	ethyl ethanoate

2 Hexane is an alkane. Hexene is an alkene. They both contain six carbon atoms.

a) What is the molecular formula of hexane?

b) Alkanes are saturated hydrocarbons. Explain these terms.

hydrocarbon

saturated

c) Describe a test what you could use to distinguish hexane from hexene. Give the result for each compound.

test

hexane result

hexene result

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3 a) Ethanoic acid is a weak acid. Draw its structure.

b) What are weak acids?

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- 4 Ethene can be made by cracking of long alkanes. Describe **why** this is done and **one way** in which this is done.

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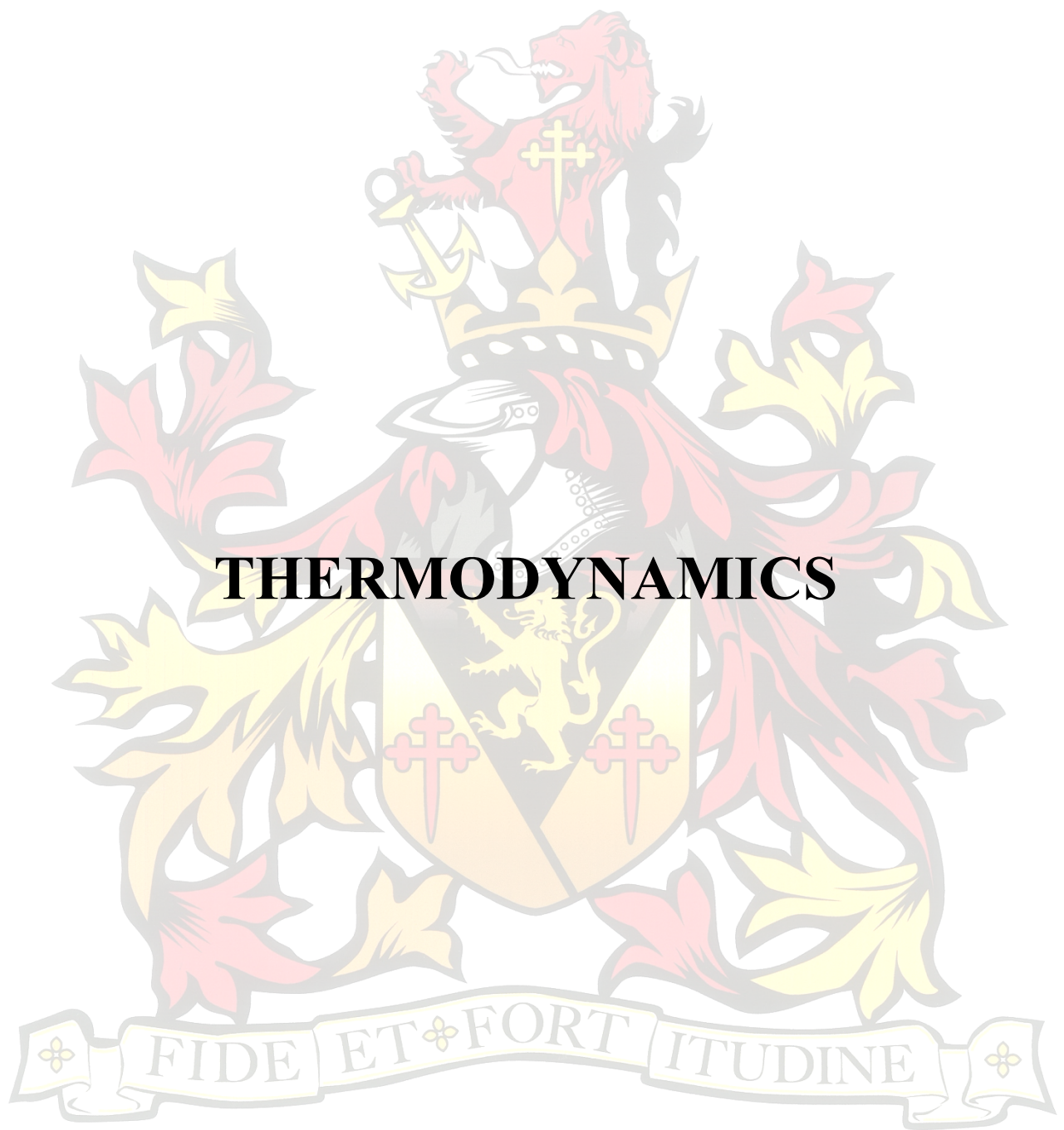
- 5 Name the monomers that these polymers are made from.

polymer	starch	proteins	poly(ethene)	DNA
monomer				

- 6 Draw the structure of the polymers formed from these monomers:, and state whether they are addition or condensation polymers.

monomer structure(s)	polymer structure	polymer type
$ \begin{array}{c} \text{H} \quad \text{F} \\ \quad \\ \text{C} = \text{C} \\ \quad \\ \text{H} \quad \text{F} \end{array} $		
$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{O} \\ \quad \quad \\ \text{H}-\text{N}-\text{C}-\text{C}-\text{O}-\text{H} \\ \\ \text{H} \end{array} $		
$ \begin{array}{c} \text{H} \quad \text{O} \quad \text{H} \quad \text{H} \quad \text{H} \quad \text{O} \\ \quad \quad \quad \quad \\ \text{H}-\text{O}-\text{C}-\text{O}-\text{H} \quad \text{H}-\text{O}-\text{C}-\text{C}-\text{C}-\text{C}-\text{O}-\text{H} \\ \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \end{array} $		

Area	Strength	To develop	Area	Strength	To develop	Area	Strength	To develop
Done with care and thoroughness			Test for C=C with Br ₂ (aq)			Draw addition polymers		
Good SPG			Understands strong and weak acids			Draw condensation polymers		
Can draw organic molecules			Knows how cracking is done			Identify addition/condensation polymers		
Knows organic definitions			Knows why cracking is done					
Write molecular formula of alkanes			Identify monomers for natural polymers					



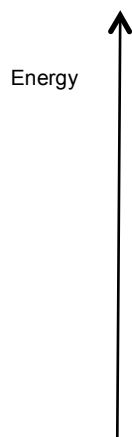
THERMODYNAMICS



- 1 Tick to show if the following are exothermic or endothermic reactions.

	exothermic	endothermic
energy change is positive		
products have more chemical energy than reactants		
$\text{CuCO}_3 \rightarrow \text{CuO} + \text{CO}_2$		
$\text{H}_2\text{SO}_4 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$		
$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$		
$\text{HNO}_3 + \text{NaHCO}_3 \rightarrow \text{NaNO}_3 + \text{H}_2\text{O} + \text{CO}_2$		

- 2 a Sketch an energy level diagram for this exothermic reaction: $\text{CuSO}_4 + \text{Zn} \rightarrow \text{ZnSO}_4 + \text{Cu}$



- b Draw a labelled arrow on your energy diagram to show the overall energy change.
- c Draw a labelled arrow on your energy diagram to show the activation change.
- d Write an ionic equation for this reaction.
- e Write two half equations for this reaction.

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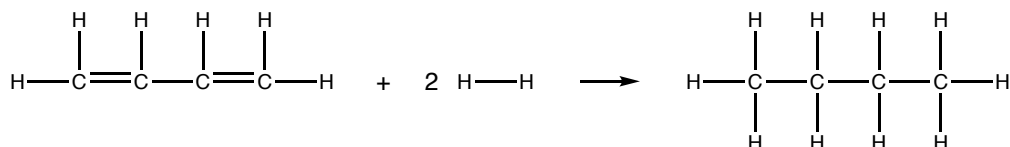


GCSE REVISION 14

Energy changes 1

- 1 a Calculate the energy change in the following reaction using the bond energies given.

[C–C = 348, C–H = 412, C=C = 612, H–H = 436 kJ/mol]



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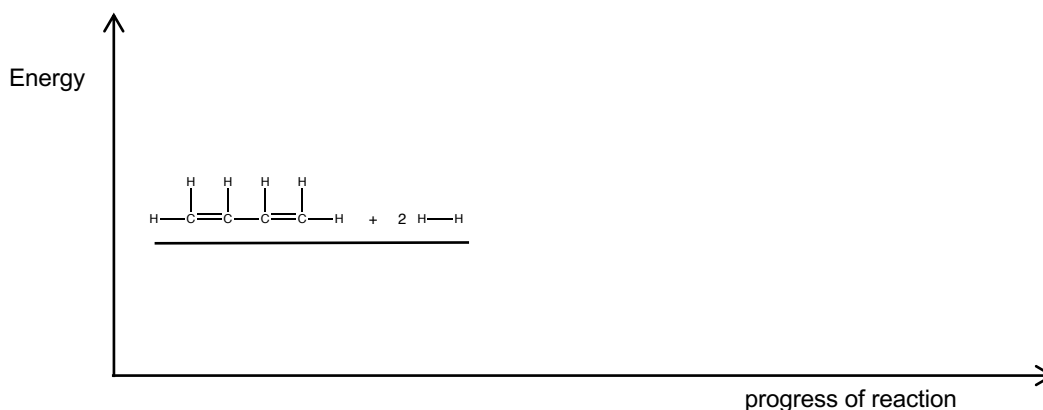
- b Explain whether this reaction is exothermic or endothermic by discussing bond breaking and making.

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- c Complete the energy profile for this reaction. Draw arrows to show the overall energy change (label "OEC") and the activation energy (label "AE")



- 2 Tick the correct box to show whether each of the following relates to an exothermic or an endothermic reaction.

	exothermic	endothermic
energy change is +72 kJ		
products have more energy than reactants		
neutralisation of hydrochloric acid by sodium hydroxide		
thermal decomposition of copper carbonate		

3 Fuel cells have a number of advantages over non-rechargeable and rechargeable cells. The hydrogen fuel cell is the most common fuel cell.

a Give one advantage and one disadvantage of hydrogen fuel cells compared to rechargeable cells.

advantage

disadvantage

b Give the half equations for the reactions that take place at the electrodes in hydrogen fuel cells.

anode cathode

4 A simple cell can be made by placing two different metals (as electrodes) in a salt solution (as electrolyte). A student made some cells in this way and measured the voltage (potential difference) in each case. The table shows which electrode was connected to which terminal of the voltmeter.

positive electrode	negative electrode	voltage (V)
nickel	iron	+0.19
iron	zinc	+0.32
iron	cobalt	+0.16

a What is an electrolyte?

b Place the four metals in order of reactivity, with the most reactive first.

most least

c What would the voltage be if a cell was made using cobalt and nickel, with cobalt connected to the negative terminal of the voltmeter.

d To create the cell the greatest voltage with a positive voltage when connected to a voltmeter:

i) which two metals would you use?

ii) what would the voltage be?

iii) which metal would be the positive electrode?

Area	Strength	To develop	Area	Strength	To develop	Area	Strength	To develop
Done with care and thoroughness			Can draw energy profiles			Use voltage to order metal reactivity		
Shows suitable working			Can label activation / energy change			Work out voltage in cells		
Calculate energy change using bonds			Pros and cons of fuel cells			Use voltage data to solve problems		
Deduce if exo/endothermic			Fuel cell electrode equations					
Explain if exo/endothermic using bonds			Knows what an electrolyte is					

The Periodic Table of Elements

12345670 (8)

1.0
H
hydrogen
1

relative atomic mass
atomic symbol
name
atomic (proton) number

Key																	
(1)	(2)																
6.9 Li lithium 3	9.0 Be beryllium 4																
23.0 Na sodium 11	24.3 Mg magnesium 12																
		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	95.9 Mo molybdenum 42	[98] Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La* lanthanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

* Lanthanide series
* Actinide series

140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	[147] Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	163 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
232 Th thorium 90	[231] Pa protactinium 91	238 U uranium 92	[237] Np neptunium 93	[242] Pu plutonium 94	[243] Am americium 95	[247] Cm curium 96	[245] Bk berkelium 97	[251] Cf californium 98	[254] Es einsteinium 99	[253] Fm fermium 100	[256] Md mendelevium 101	[254] No nobelium 102	[257] Lr lawrencium 103