

# CHEMISTRY

## COMBINED SCIENCE STUDY PACK CHEMISTRY REVISION

AQA GCSE Combined Science: Trilogy 8464

Paper	Exam Date
<u>Chemistry Paper 1</u> 5.1 Atomic Structure and the Periodic Table 5.2 Bonding, Structure and the Properties of Matter 5.3 Quantitative Chemistry 5.4 Chemical Changes 5.5 Energy Changes	
<u>Chemistry Paper 2</u> 5.6 The Rate and Extent of Chemical Change 5.7 Organic Chemistry 5.8 Chemical Analysis 5.9 Chemistry of the Atmosphere 5.10 Using Resources	

Name \_\_\_\_\_

## Contents Page

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2	How to use your study pack
3	GCSE Command Words
4	<u>Particles and Bonding</u> Atomic Structure Structure and Bonding Organic Chemistry Chemical Analysis
30	<u>Quantitative Chemistry</u> Chemical Measurements Amount of substance
37	<u>Trends and Patterns</u> The Periodic Table Chemical Changes Electrolysis Chemistry of the Atmosphere Using Resources
63	<u>Physical Chemistry</u> Energy Changes Rate of Reaction
77	Reflections Page

# How To Use Your Study Pack

This tells you which bit of the **specification** you are studying. If says here if it is a triple only topic.

This is the **big idea** this topic is part of

This is the **topic** you are studying

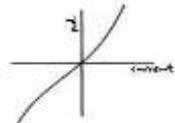
Topic		Spec Ref	Big Idea
Triple only		4.2.4.2	Uses of Nanoparticles
WS1.3 WS1.4 WS1.5		1. State 3 uses of nanoparticles. 2. Suggest 2 disadvantages of using nanoparticles.	1. Sun cream 2. Computer parts 3. Deodorant
		1. Undiscovered harmful effects to human health 2. Get washed off skin and could harm ecosystems	
		3. Suggest 2 advantages of using nanoparticles.	
		1. Can react quickly 2. Can be used to make materials stronger and lighter	
		<b>Prove It!</b>	
		Give one advantage of using nanoparticles in sun creams.	
		Protects skin from harmful UV rays	(1)
		Give one disadvantage of using nanoparticles in sun creams.	
		Might damage cells in your body.	(1)
		<b>Maths Skills</b>	
		What is 1nm in m? Give your answer in decimal form.	
		0.000000001m	
		What is 50nm in m? Give your answer in standard form.	
		5x10 <sup>-8</sup> m	
		What is 1µm in m? Give your answer in decimal form.	
		Which is larger 1µm or 1nm?	
		How many nm is 2.5x10 <sup>-4</sup> m? Give your answer in standard form.	
		6. What is 600,000nm in cm? Give your answer in decimal form.	

1. Try and answer the questions in this box.
2. Use your **revision guide** to check your answers and correct any you got wrong.
3. Use the **revision guide** to help you answer the questions you didn't know.

Answer the exam question in the '**prove it**' section to show you understand the topic. You can mark this bit using the **marking scheme**.

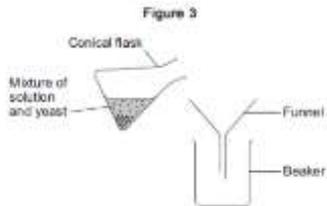
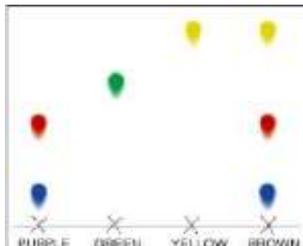
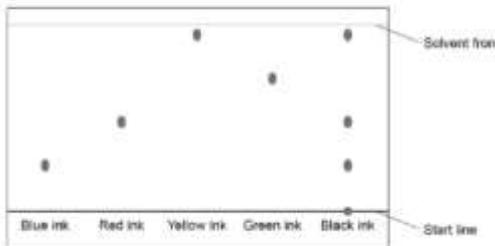
This section will help you prepare for any questions that involve **maths** in the exam.

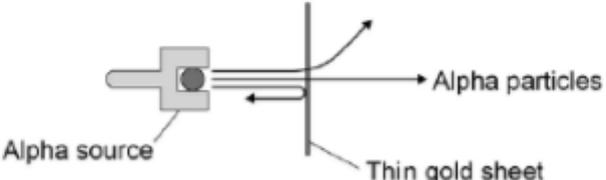
## GCSE Command Words

Command Word	Definition	Example Question	Example Answer
State, give, name, write down	Short answer only and does not require an explanation.	<b>State</b> the units for acceleration.	$m/s^2$
Describe (not graphs or practical)	Recall facts, events or process in an accurate way.	<b>Describe</b> how quadrats should be used to estimate the number of plants in a field.	Place a large number of quadrats randomly in the field. Count the number of plants in the quadrat. Calculate the mean number in each quadrat then use the area of the quadrat and field to estimate the number of plants.
Describe (graphs)	Identify the pattern in the graph and use numbers from the graph to make this clear.	<b>Describe</b> the pattern of tooth decay in Figure 3 for water without fluoride.	The percentage of tooth decay increases with age by 4% for each age group in figure 3.
Describe (practical)/ Plan	Write the method for the practical or the results that you would expect to see.	<b>Plan</b> an experiment to test the hypothesis "the higher the temperature, the faster the rate of reaction".	Measure the rate of reaction by adding a set amount of metal to set type, volume and concentration of acid and time how long it takes to stop fizzing. Repeat the experiment at 5 different temperatures.
Determine	Use given data or information to obtain and answer.	<b>Determine</b> the half-life of a sample if it decreases from 1000g to 250g in 2.6million years.	1.3 million years
Explain	Make something clear or state the reasons for something happening. You will need to state what is happening and then say why it happens.	<b>Explain</b> why soot forms.	Soot forms during incomplete combustion when not enough oxygen is present.
Evaluate	Use the information supplied and your own knowledge to consider the evidence for and against a point. You may also be required to include a <i>justified conclusion</i> .	A company stated: 'A Life Cycle Assessment shows that using plastic bags has less environmental impact than using paper bags'. <b>Evaluate</b> this statement.	Paper bags are made from a renewable resource whereas plastic bags are made from finite resources. However paper bags are bad because they produce much more solid waste and more $CO_2$ is released when they are produced therefore the negative impacts of paper bags outweigh the problem of plastic coming from a finite resource.
Compare	Describe the similarities and/or differences between things. Avoid writing about just one.	<b>Compare</b> the differences between cracking and distillation.	Cracking involves a catalyst whereas distillation does not.
Sketch	Draw approximately.	<b>Sketch</b> a current-potential difference graph for a filament lamp.	

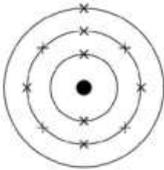


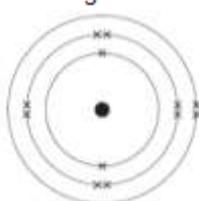
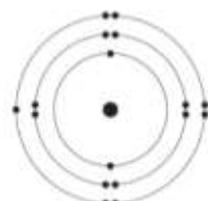
Particles and Bonding																								
Book Ref.	Spec. Ref.	Atoms, Elements and Compounds																						
	CS 5.1.1.1  Triple 4.1.1.1	1. What is the smallest part of an element that can exist?  2. Define the term compound and give an example.  3. Complete the table below:																						
		<table border="1"> <thead> <tr> <th>Name</th> <th>Formulae</th> <th>Element or compound?</th> <th>Number of atoms?</th> <th>Number of elements?</th> </tr> </thead> <tbody> <tr> <td>Oxygen</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td>CaCl<sub>2</sub></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Sodium sulfate</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Name	Formulae	Element or compound?	Number of atoms?	Number of elements?	Oxygen						CaCl <sub>2</sub>				Sodium sulfate						
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Oxygen																								
	CaCl <sub>2</sub>																							
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		<b>Prove It!</b>																						
		When sulfuric acid is added to sodium hydroxide a reaction occurs to produce two products.  The equation is:  $\text{H}_2\text{SO}_4 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$ How many elements are in the formula H <sub>2</sub> SO <sub>4</sub> ?  Tick one box.																						
		3 <input type="checkbox"/>  4 <input type="checkbox"/>  6 <input type="checkbox"/>  7 <input type="checkbox"/>		(1)																				
		<b>Maths Skills</b>																						
		Balance the following equations:																						
		$\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}$																						
		$\text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$																						
		$\text{Na} + \text{Cl}_2 \rightarrow \text{NaCl}$																						
		$\text{Fe} + \text{O}_2 \rightarrow \text{Fe}_2\text{O}_3$																						
		$\text{Al} + \text{Br}_2 \rightarrow \text{AlBr}_3$																						
		$\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2$																						

Particles and Bonding																	
Book Ref.	Spec. Ref.	Mixtures															
	CS 5.1.1.2	1. Define the term mixture and give an example.															
	Triple 4.1.1.2	2. When mixtures are separated is this a physical or chemical process?															
	WS2.7 MS2c	3. Complete the table below:															
		<table border="1"> <thead> <tr> <th>Substances to be separated</th> <th>Name of separating technique</th> <th>Description of how the technique works.</th> </tr> </thead> <tbody> <tr> <td>Sand and water</td> <td></td> <td></td> </tr> <tr> <td>Salt and water</td> <td></td> <td></td> </tr> <tr> <td>Water and ethanol</td> <td></td> <td></td> </tr> <tr> <td>Mixture of food colourings</td> <td></td> <td></td> </tr> </tbody> </table>	Substances to be separated	Name of separating technique	Description of how the technique works.	Sand and water			Salt and water			Water and ethanol			Mixture of food colourings		
Substances to be separated	Name of separating technique	Description of how the technique works.															
Sand and water																	
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		<p>4. What is wrong with the setup of the equipment below to separate the solid yeast from the solution?</p> <p>The student wanted to separate the solid yeast from the solution.</p> <p>Figure 3 shows the apparatus used.</p>  <p>Figure 3</p> <p>Conical flask</p> <p>Mixture of solution and yeast</p> <p>Funnel</p> <p>Beaker</p> <p>5. Which property of substances in a mixture allows distillation to work?</p> <p>6. How many colours make up brown? How do you know? Which colour is the most soluble?</p> 															
		<p style="text-align: center;"><b>Prove It!</b></p> <p>The figure below shows a paper chromatogram of five different inks.</p>  <p style="text-align: right;">Solvent front</p> <p style="text-align: left;">Blue ink   Red ink   Yellow ink   Green ink   Black ink</p> <p style="text-align: right;">Start line</p> <p style="text-align: center;"><b>Analyse the chromatogram. Describe and explain the result for black ink. (4)</b></p>															

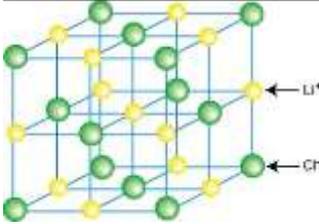
Particles and Bonding		
Book Ref.	Spec. Ref.	The Development of the Model of the Atom
	CS 5.1.1.3  Triple 4.1.1.3  WS1.1 WS1.2	<ol style="list-style-type: none"> <li>Which model describes the atom as a ball of positive charge with negative electrons embedded in it?</li> <li>Name the experiment which led scientists to believe the mass of an atom was mostly in the centre.</li> <li>What evidence led them to believe there was a positive nucleus?</li> <li>What was the name of the model resulting from the experiment above?</li> <li>How did Niels Bohr improve the nuclear model?</li> <li>Which scientist provided evidence to show the nucleus contained neutrons as well as protons?</li> </ol>
<b>Prove It!</b>		
<p>In 1911 the scientists Geiger and Marsden investigated the effect of firing alpha particles at very thin sheets of gold foil.</p> <p>Their experiment is shown in Figure 2. The arrows show the paths taken by alpha particles in the experiment.</p> <p style="text-align: center;"><b>Figure 2</b></p>  <p style="text-align: center;">(a) Explain why scientists replaced the plum pudding model of the atom with the nuclear model of the atom as a result of the experiment.</p>		
(4)		

Particles and Bonding																								
Book Ref.	Spec. Ref.	Atoms																						
	CS 5.1.1.4 5.1.1.5  Triple 4.1.1.4 4.1.1.5	<p>1. Complete the table to show the names of the 3 sub-atomic particles and their relative charges and masses.</p> <table border="1"> <thead> <tr> <th>Sub-Atomic Particle</th> <th>Relative Mass</th> <th>Relative Charge</th> </tr> </thead> <tbody> <tr> <td></td> <td>1</td> <td></td> </tr> <tr> <td>electron</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td>+1</td> </tr> </tbody> </table> <p>2. In terms of sub-atomic particles, define the following terms:                      a) atomic number                      b) mass number</p> <p>3. Where is the majority of mass found in an atom?</p> <p>4. What is the approximate radius of:                      a) an atom?                      b) the nucleus of an atom?  <b>Give your answer in standard form.</b></p> <p>5. Define the term isotope and give an example.</p>	Sub-Atomic Particle	Relative Mass	Relative Charge		1		electron					+1										
Sub-Atomic Particle	Relative Mass	Relative Charge																						
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		<p style="text-align: center;"><b>Prove It!</b></p> <p>Explain the difference between the two isotopes of carbon below in terms of their sub atomic particles.</p> ${}^1_6\text{C} \quad {}^{13}_6\text{C}$																						
	MS 1b	<p style="text-align: center;"><b>Maths Skills</b></p> <p>Convert the following numbers into standard form and vice versa:</p> <table border="1"> <thead> <tr> <th>Ordinary Number</th> <th>Standard Form</th> </tr> </thead> <tbody> <tr> <td>80000000</td> <td></td> </tr> <tr> <td>724000</td> <td></td> </tr> <tr> <td>371.45</td> <td></td> </tr> <tr> <td>1200</td> <td></td> </tr> <tr> <td>400</td> <td></td> </tr> <tr> <td></td> <td><math>2.168 \times 10^7</math></td> </tr> <tr> <td></td> <td><math>7 \times 10^2</math></td> </tr> <tr> <td></td> <td><math>8.1 \times 10^3</math></td> </tr> <tr> <td></td> <td><math>3 \times 10^5</math></td> </tr> <tr> <td></td> <td><math>5.4718 \times 10^2</math></td> </tr> </tbody> </table>	Ordinary Number	Standard Form	80000000		724000		371.45		1200		400			$2.168 \times 10^7$		$7 \times 10^2$		$8.1 \times 10^3$		$3 \times 10^5$		$5.4718 \times 10^2$
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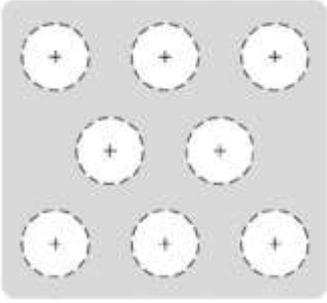
Particles and Bonding																										
Book Ref.	Spec. Ref.	RAM and Electronic Structure																								
	CS 5.1.1.6 5.1.1.7  Triple 4.1.1.6 4.1.1.7  WS1.2	<ol style="list-style-type: none"> <li>Define the term relative atomic mass.</li> <li>Explain why the relative atomic mass of chlorine is not a whole number.</li> <li>Name the element that has its electron configuration shown below.                             <div style="text-align: center; margin: 10px 0;">  </div> </li> <li>On the diagram above, label the lowest and highest energy levels (shells). Which shell is filled first?</li> </ol>																								
		<p style="text-align: center;"><b>Maths Skills</b></p> <p>Balance the following equations:</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Element</th> <th>Isotopes</th> <th>Percentage Abundance</th> <th>Relative atomic mass</th> </tr> </thead> <tbody> <tr> <td rowspan="2"><b>Lithium</b></td> <td><math>{}^6_3\text{Li}</math></td> <td>7.6%</td> <td rowspan="2"></td> </tr> <tr> <td><math>{}^7_3\text{Li}</math></td> <td>92.4%</td> </tr> <tr> <td rowspan="3"><b>Magnesium</b></td> <td><math>{}^{24}_{12}\text{Mg}</math></td> <td>79%</td> <td rowspan="3"></td> </tr> <tr> <td><math>{}^{25}_{12}\text{Mg}</math></td> <td>10%</td> </tr> <tr> <td><math>{}^{26}_{12}\text{Mg}</math></td> <td>11%</td> </tr> <tr> <td rowspan="2"><b>Copper</b></td> <td><math>{}^{63}_{29}\text{Cu}</math></td> <td>70%</td> <td rowspan="2"></td> </tr> <tr> <td><math>{}^{65}_{29}\text{Cu}</math></td> <td>30%</td> </tr> </tbody> </table>	Element	Isotopes	Percentage Abundance	Relative atomic mass	<b>Lithium</b>	${}^6_3\text{Li}$	7.6%		${}^7_3\text{Li}$	92.4%	<b>Magnesium</b>	${}^{24}_{12}\text{Mg}$	79%		${}^{25}_{12}\text{Mg}$	10%	${}^{26}_{12}\text{Mg}$	11%	<b>Copper</b>	${}^{63}_{29}\text{Cu}$	70%		${}^{65}_{29}\text{Cu}$	30%
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Particles and Bonding																		
Book Ref.	Spec. Ref.	Chemical Bonds and Ionic Bonding																
	CS 5.2.1.1 5.2.1.2  Triple 4.2.1.1 4.2.1.2	<p>1. Tick the correct box to show which bond occurs between which types of atom</p> <table border="1"> <thead> <tr> <th>Type of bond</th> <th>Non-metal + Non-metal</th> <th>Metal + Metal</th> <th>Metal + Non-metal</th> </tr> </thead> <tbody> <tr> <td>Ionic</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Covalent</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Metallic</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>2. How is a positively charged ion formed? Give an example of a positive ion. State the electron configuration.</p> <p>3. How is a negatively charged ion formed? Give an example of a negative ion. State the electron configuration.</p> <p>4. What do you notice about the electron configurations of the ions? HINT: Are they similar to another group in the Periodic table?</p> <p>5. Describe what happens to electrons when an ionic bond is formed?</p> <p>6. Draw a dot and cross diagram for a sodium atom and a fluorine atom.</p> <p>7. Draw a dot and cross diagram to show sodium fluoride. Include charges on the ions.</p>	Type of bond	Non-metal + Non-metal	Metal + Metal	Metal + Non-metal	Ionic				Covalent				Metallic			
Type of bond	Non-metal + Non-metal	Metal + Metal	Metal + Non-metal															
Ionic																		
Covalent																		
Metallic																		
		<p style="text-align: center;"><b>Prove It!</b></p> <p>The diagram shows an atom of magnesium and an atom of chlorine.</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>Magnesium</p> </div> <div style="text-align: center;">  <p>Chlorine</p> </div> </div> <p>Describe, in terms of electrons, how magnesium atoms and chlorine atoms change into ions to produce magnesium chloride (MgCl<sub>2</sub>).</p> <p style="text-align: right;">(4)</p>																

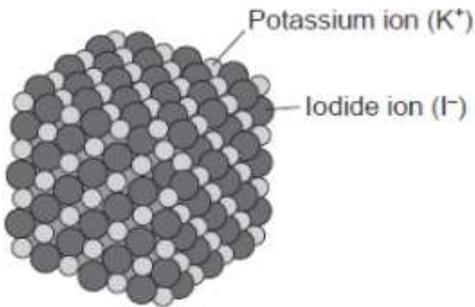
Particles and Bonding																																									
Book Ref.	Spec. Ref.	Ions																																							
	CS 5.2.1.1 5.2.1.2	1. Do metals form positive or negative ions? Why?																																							
	Triple 4.2.1.1 4.2.1.2	2. Do non-metals form positive or negative ions? Why?																																							
		3. Complete the table to show the ion formed from each atom?																																							
		<table border="1"> <thead> <tr> <th>Atom</th> <th>Number of electrons in outer shell</th> <th>Ion</th> </tr> </thead> <tbody> <tr> <td>Lithium</td> <td>1</td> <td>Li<sup>+</sup></td> </tr> <tr> <td></td> <td></td> <td>Cl<sup>-</sup></td> </tr> <tr> <td>Aluminium</td> <td></td> <td></td> </tr> <tr> <td>Hydrogen</td> <td></td> <td></td> </tr> <tr> <td>Bromine</td> <td></td> <td></td> </tr> <tr> <td>Calcium</td> <td></td> <td></td> </tr> <tr> <td>Oxygen</td> <td></td> <td></td> </tr> <tr> <td>Barium</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td>NO<sub>3</sub><sup>-</sup></td> </tr> <tr> <td>Sulfate</td> <td></td> <td></td> </tr> <tr> <td>Phosphate</td> <td></td> <td></td> </tr> <tr> <td>Phosphide</td> <td></td> <td></td> </tr> </tbody> </table>	Atom	Number of electrons in outer shell	Ion	Lithium	1	Li <sup>+</sup>			Cl <sup>-</sup>	Aluminium			Hydrogen			Bromine			Calcium			Oxygen			Barium					NO <sub>3</sub> <sup>-</sup>	Sulfate			Phosphate			Phosphide		
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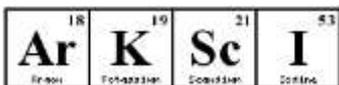
Particles and Bonding		
Book Ref.	Spec. Ref.	Ionic Compounds
	CS 5.2.1.3  Triple 4.2.1.3	<ol style="list-style-type: none"> <li>1. What structure do ionic compounds form?</li> <li>2. Name the force that holds oppositely charged ions together?</li> <li>3. <u>Using the diagram below</u>, state the empirical formula for lithium chloride.                             <div style="text-align: center;">  </div> </li> <li>4. Draw a diagram to represent the 3D structure of sodium chloride.</li> </ol>
		<p style="text-align: center;"><b>Maths Skills</b></p> <p>Work out the formulae for the following compounds:</p> <ol style="list-style-type: none"> <li>a) lithium chloride</li> <li>b) sodium bromide</li> <li>c) magnesium fluoride</li> <li>d) potassium oxide</li> <li>e) calcium chloride</li> <li>f) beryllium sulphide</li> <li>g) aluminium chloride</li> <li>h) aluminium oxide</li> </ol>

Particles and Bonding		
Book Ref.	Spec. Ref.	Covalent Bonding
	CS 5.2.1.4	1. Give an example of a molecule that is covalently bonded.
	Triple 4.2.1.4	2. How is a covalent bond formed between 2 hydrogen atoms? Draw a dot and cross diagram to help explain your answer.
		3. Draw a dot and cross diagram to show the bonding in methane (CH <sub>4</sub> ).
		4. Draw a dot and cross diagram to show the bonding in oxygen (O <sub>2</sub> ).
		5. Suggest 3 limitations of the dot and cross model.
		6. Use the diagram to work out <ol style="list-style-type: none"> <li>the molecular formula of ammonia.</li> <li>the number of atoms in ammonia.</li> <li>the number of elements in ammonia.</li> </ol>
		$  \begin{array}{c}  \times \times \\  \text{H} \times \quad \text{N} \quad \times \text{H} \\  \times \text{O} \\  \text{H}  \end{array}  $
		d) What is a polymer? Draw a diagram showing poly(ethene).

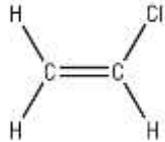
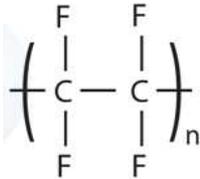
Particles and Bonding		
Book Ref.	Spec. Ref.	Metallic Bonding
	CS 5.2.1.5  Triple 4.2.1.5	<p>1. Name the bonding shown in the diagram below.</p> <div style="text-align: center;">  </div> <p>2. Describe the structure of a compound containing this type of bonding. Include a labelled diagram in your answer.</p>
		<b>Prove It!</b>
		<p>Glass can be coloured using tiny particles of gold. Gold is a metal.</p> <p>Describe the structure of a metal.</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p style="text-align: right;">(3)</p>

Particles and Bonding								
Book Ref.	Spec. Ref.	States of Matter						
	CS 5.2.2.1 5.2.2.2  Triple 4.2.2.1 4.2.2.2	1. What are the 3 states of matter? Draw particle diagrams for each state in the table below. <table border="1" style="margin: 10px auto; width: 60%;"> <tr> <td style="text-align: center;">Solid</td> <td style="width: 50px; height: 20px;"></td> <td style="width: 50px; height: 20px;"></td> </tr> <tr> <td style="width: 100px; height: 60px;"></td> <td style="width: 50px; height: 60px;"></td> <td style="width: 50px; height: 60px;"></td> </tr> </table> 2. What do the following state symbols mean; (g), (l), (s), (aq)?  3. Name the process when a ... a) gas becomes a liquid. b) solid becomes a liquid. c) liquid becomes a solid. d) liquid becomes a gas.  4. What affects the amount of energy needed for a substance to change state?  5. <b>HT only: give three limitations of the particle model?</b>	Solid					
Solid								
<b>Prove It!</b>								
The structures of four substances, A, B, C and D, are represented in Figure 1.								
<b>Figure 1</b>								
Use the correct letter A,B,C or D to answer each question i) Which substance is a gas? ii) Which substance is a liquid? iii) Which substance is an element? iv) Which substance is made of ions?								
<b>Maths Skills</b>								
What state is each of the following substance at room temperature (20°C).								
<b>Substance</b>	<b>Melting Point (°C)</b>	<b>Boiling Point (°C)</b>	<b>State of matter at room temperature</b>					
Helium	-272	-268						
Sulfur	112	444						
Bromine	-7	59						

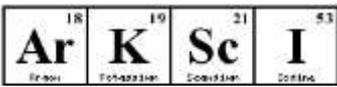
Particles and Bonding		
Book Ref.	Spec. Ref.	Properties of Ionic Compounds
	CS 5.2.2.3  Triple 4.2.2.3	<ol style="list-style-type: none"> <li>1. What causes a substance to have a high melting point or boiling point?</li> <li>2. What enables a substance to conduct electricity?</li> <li>3. Do giant ionic substances have high or low melting points? Explain why.</li> <li>4. Do giant ionic substances conduct electricity? Explain your answer.</li> </ol>
<b>Prove It!</b>		
<p>The diagram shows the structure of potassium iodide.</p> <div style="text-align: center;">  </div> <p>Explain why a high temperature is needed to melt potassium iodide.</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p style="text-align: right;">(2)</p> <p>Solid sodium iodide does not conduct electricity.</p> <p>Why does sodium iodide solution conduct electricity?</p> <p>.....</p> <p>.....</p> <p style="text-align: right;">(1)</p>		



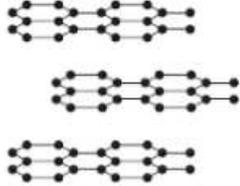
Particles and Bonding		
Book Ref.	Spec. Ref.	Properties of Small Molecules
	CS 5.2.2.4  Triple 4.2.2.4	<ol style="list-style-type: none"> <li>1. Give an example of a simple molecular substance.</li> <li>2. Do giant molecular substances have high or low melting points? Explain why.</li> <li>3. Why does <math>C_2H_6</math> have a lower melting point than <math>C_5H_{12}</math>?</li> <li>4. Do simple molecular substances conduct electricity? Explain your answer.</li> </ol>
<b>Prove It!</b>		
<p>Why is hydrogen chloride a gas at room temperature (20 °C)?</p> <p>Tick (✓) <b>two</b> boxes.</p> <p>Hydrogen chloride has a low boiling point. <input type="checkbox"/></p> <p>Hydrogen chloride has a high melting point. <input type="checkbox"/></p> <p>Hydrogen chloride is made of simple molecules. <input type="checkbox"/></p> <p>Hydrogen chloride does not conduct electricity. <input type="checkbox"/></p> <p>Hydrogen chloride has a giant structure. <input type="checkbox"/></p>		

Particles and Bonding		
Book Ref.	Spec. Ref.	Polymers
	CS 5.2.2.5  Triple 4.2.2.5	<ol style="list-style-type: none"> <li>Give one example of a polymer.</li> <li>What are polymer chains made of?</li> <li>What sort of bonding is present in polymers?</li> <li>Why do polymers have high melting points?</li> <li>Draw the repeating unit for this monomer.                             <div style="text-align: center; margin: 10px 0;">  </div> </li> <li>Draw the following polymer as a monomer.                             <div style="text-align: center; margin: 10px 0;">  </div> </li> </ol>
		<b>Prove It!</b>
		<p>(i) Poly(ethene) is often used for packaging. Poly(ethene) is made from ethene. Ethene is an alkene with the chemical formula C<sub>2</sub>H<sub>4</sub> Draw the displayed structure for ethene. <span style="float: right;">(1)</span></p> <p>(ii) Poly(ethene) is formed from ethene in a polymerisation reaction. Describe, in terms of molecules, what happens in a polymerisation reaction.</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p style="text-align: right;">(3)</p>

Particles and Bonding		
Book Ref.	Spec. Ref.	Giant Covalent Structures
	CS 5.2.2.6  Triple 4.2.2.6	<p>1. State the names of the 3 giant structures below?</p> <div style="text-align: center;"> </div> <p>2. Name the strong bonds that link the atoms in the diagrams above?</p> <p>3. Do the structures above have high or low melting points? Explain your answer.</p>
		<p><b>Prove It!</b></p> <p>The structures above and the simple molecular substances both contain the same type of bonding but the structures above are solid at room temperature whereas the simple molecular substances are mostly liquids or gases at room temperature. Explain this difference.</p> <p style="text-align: right;">(6)</p>

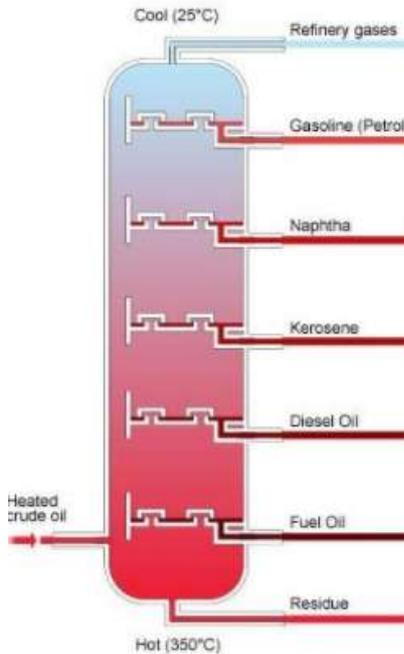


Particles and Bonding		
Book Ref.	Spec. Ref.	Properties of Metals
	CS 5.2.2.7 5.2.2.8  Triple 4.2.2.7 4.2.2.8	<ol style="list-style-type: none"><li>1. Why do metals have high melting and boiling points?</li><li>2. Draw a diagram to show the structure of a pure metal and another diagram to show the structure of an alloy. Label the diagram.</li><li>3. Using your diagrams above, explain why alloys are harder than pure metals.</li><li>4. Why are metals good conductors of heat?</li><li>5. Do metals conduct electricity? Explain your answer.</li></ol>
		<p style="text-align: center;"><b>Prove It!</b></p> <p>Explain why titanium conducts electricity.</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p style="text-align: right;"><b>(3)</b></p>

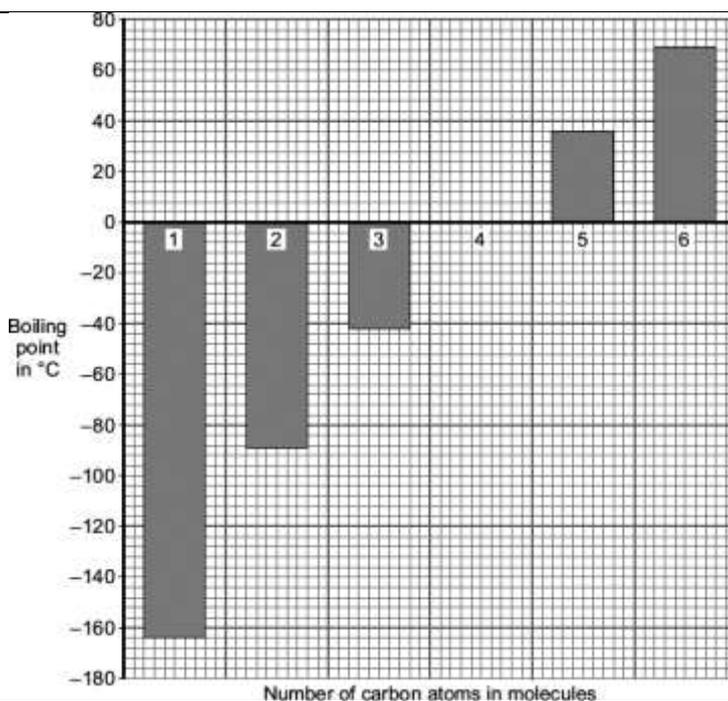
Particles and Bonding		
Book Ref.	Spec. Ref.	Diamond and Graphite
	CS 5.2.3.1 5.2.3.2  Triple 4.2.3.1 4.2.3.2  MS5b	<ol style="list-style-type: none"> <li>State 3 properties of diamond.</li> <li>Explain how the structure and bonding of diamond leads to these properties.</li> <li>Describe the structure of graphite.</li> <li>Explain why graphite is able to conduct electricity but diamond is not.</li> <li>Explain why graphite is soft.</li> </ol>
<b>Prove It!</b>		
The diagrams show the structures of diamond and graphite.		
		
		
<div style="display: flex; justify-content: space-around;"> <span>Diamond</span> <span>Graphite</span> </div>		
(a) Diamond and graphite both contain the same element. What is the name of this element? ..... (1)		
(b) Use the diagrams above and your knowledge of structure and bonding to explain why:		
<ul style="list-style-type: none"> <li>- Graphite is very soft.</li> <li>- Diamond is very hard.</li> <li>- Graphite conducts electricity.</li> </ul> <div style="text-align: right;">(6)</div>		



Particles and Bonding																	
Book Ref.	Spec. Ref.	Crude Oil and Alkanes															
	CS 5.7.1.1	1. What is crude oil made up of?															
	Triple 4.7.1.1	2. Define the term hydrocarbon?															
	WS1.2 MS5b	3. How was crude oil formed?															
		4. What is the general formula for an alkane?															
		5. Complete the table below:															
		<table border="1"> <thead> <tr> <th>Name</th> <th>Molecular Formula</th> <th>Structural Formula</th> </tr> </thead> <tbody> <tr> <td>Methane</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td> <math display="block">  \begin{array}{c}  \text{H} \quad \text{H} \\    \quad   \\  \text{H}-\text{C}-\text{C}-\text{H} \\    \quad   \\  \text{H} \quad \text{H}  \end{array}  </math> </td> </tr> <tr> <td>Propane</td> <td></td> <td></td> </tr> <tr> <td></td> <td>C<sub>4</sub>H<sub>10</sub></td> <td></td> </tr> </tbody> </table>	Name	Molecular Formula	Structural Formula	Methane					$  \begin{array}{c}  \text{H} \quad \text{H} \\    \quad   \\  \text{H}-\text{C}-\text{C}-\text{H} \\    \quad   \\  \text{H} \quad \text{H}  \end{array}  $	Propane				C <sub>4</sub> H <sub>10</sub>	
Name	Molecular Formula	Structural Formula															
Methane																	
		$  \begin{array}{c}  \text{H} \quad \text{H} \\    \quad   \\  \text{H}-\text{C}-\text{C}-\text{H} \\    \quad   \\  \text{H} \quad \text{H}  \end{array}  $															
Propane																	
	C <sub>4</sub> H <sub>10</sub>																
		<p style="text-align: center;"><b>Prove It!</b></p> <p>What is the formula of propane?</p> <p>..... (1)</p> <p>Butane has the formula C<sub>4</sub>H<sub>10</sub></p> <p>Complete the displayed (structural) formula for one molecule of butane.</p> $  \begin{array}{c}  \text{H} \\    \\  \text{H}-\text{C} \\    \\  \text{H}  \end{array}  $ <p style="text-align: right;">(1)</p>															

Particles and Bonding		
Book Ref.	Spec. Ref.	Fractional Distillation
	CS 5.7.1.2  Triple 4.7.1.2	<ol style="list-style-type: none"> <li>Which process separates crude oil into groups of compounds with a similar number of carbon atoms?</li> <li>Name 3 fuels that are produced from crude oil by this process.</li> <li>Outline the steps in the process above. Use the diagram to help you.</li> </ol>
		
		<p style="text-align: center;"><b>Prove It!</b></p> <p>Describe and explain how petrol is separated from the mixture of hydrocarbons in crude oil.</p> <p style="text-align: right;">(6)</p>

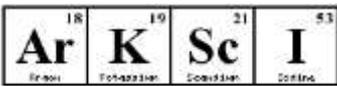
Particles and Bonding														
Book Ref.	Spec. Ref.	Properties of Hydrocarbons												
	CS 5.7.1.3  Triple 4.7.1.3	<p>1. Complete the following table to define the key properties of hydrocarbons</p> <table border="1"> <thead> <tr> <th>Property</th> <th>Definition</th> <th>What happens to the property as the carbon chain increases</th> </tr> </thead> <tbody> <tr> <td>Viscosity</td> <td></td> <td></td> </tr> <tr> <td>Boiling Point</td> <td></td> <td></td> </tr> <tr> <td>Flammability</td> <td></td> <td></td> </tr> </tbody> </table> <p>2. Write a word equation to show the complete combustion of methane.</p> <p>3. Write a balanced symbol equation to show the complete combustion of undecane (<math>C_{11}H_{24}</math>).</p> <p style="text-align: center;"><b>Prove It!</b></p> <p>Suggest <b>two</b> reasons why all of the butane is a better fuels than the alkane with the formula <math>C_{30}H_{62}</math></p>	Property	Definition	What happens to the property as the carbon chain increases	Viscosity			Boiling Point			Flammability		
Property	Definition	What happens to the property as the carbon chain increases												
Viscosity														
Boiling Point														
Flammability														
		<p style="text-align: right;"><b>Maths Skills</b></p> <p>1. Describe the pattern between the number of carbon atoms in a molecule and its boiling point.</p> <p>2. Predict the boiling point of a molecule with 7 carbon atoms in it.</p>												



Particles and Bonding								
Book Ref.	Spec. Ref.	Cracking and Alkenes						
	CS 5.7.1.4  Triple 4.7.1.4	<p>1. Which process breaks down large hydrocarbons into smaller, more useful molecules?</p> <p>2. What are the 2 products of cracking?</p> <p>3. Describe the tests you could carry out to identify each product in Q2?</p> <p>4. Complete the table to summarise the conditions needed for each type of cracking.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;">Method</th> <th>Conditions Required</th> </tr> </thead> <tbody> <tr> <td>Thermal</td> <td></td> </tr> <tr> <td>Catalytic</td> <td></td> </tr> </tbody> </table> <p>5. Describe how both products of cracking can be useful.</p>	Method	Conditions Required	Thermal		Catalytic	
Method	Conditions Required							
Thermal								
Catalytic								
		<b>Prove It!</b>						
		<p>Paraffin contains decane. The cracking of decane can be represented by the equation below. A decane molecule is split into two smaller molecules.</p> <p>Complete the equation by adding the formula of the other product.</p> $\text{C}_{10}\text{H}_{22} \text{ (l)} \rightarrow \dots\dots\dots \text{ (l)} + \text{C}_2\text{H}_4 \text{ (g)}$ <p style="text-align: center;">decane</p> <p style="text-align: right;"><b>(1)</b></p> <p>Explain, as fully as you can, why cracking is used in the oil industry.</p> <p style="text-align: right;"><b>(3)</b></p> <p>Describe how fuel oil is broken down into smaller, more useful molecules such as gasoline (petrol).</p> <p style="text-align: right;"><b>(2)</b></p>						

Particles and Bonding														
Book Ref.	Spec. Ref.	Pure Substances and Formulations												
	CS 5.8.1.1 5.8.1.2  Triple 4.8.1.1 4.8.1.2	<ol style="list-style-type: none"> <li>What is a pure substance? Give an example.</li> <li>How could you tell if a substance is pure or a mixture?</li> <li>What is a formulation? Give 2 examples.</li> </ol>												
		<b>Prove It!</b>												
		Aqamed is a medicine for children. <p>(a) The medicine is a formulation.</p> What is meant by a formulation? <p>.....</p> <p>.....</p> <p style="text-align: right;">(1)</p> <p>(b) Children often do not like taking medicine.</p> Suggest a substance that could be added to Aqamed to increase the desire for children to take it.                     Give a reason for your suggestion.                     Substance .....                     Reason ..... <p>.....</p> <p style="text-align: right;">(2)</p>												
		<b>Maths Skills</b>												
		2 samples of copper chloride are made. Look at the data and explain which of the 2 samples is purer.												
		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;"></th> <th style="width: 30%;">Melting Point (°C)</th> <th style="width: 30%;">Boiling Point (°C)</th> </tr> </thead> <tbody> <tr> <td><b>Sample A</b></td> <td>494</td> <td>995</td> </tr> <tr> <td><b>Sample B</b></td> <td>475</td> <td>1000-1005</td> </tr> <tr> <td><b>Pure copper chloride</b></td> <td>498</td> <td>993</td> </tr> </tbody> </table>		Melting Point (°C)	Boiling Point (°C)	<b>Sample A</b>	494	995	<b>Sample B</b>	475	1000-1005	<b>Pure copper chloride</b>	498	993
	Melting Point (°C)	Boiling Point (°C)												
<b>Sample A</b>	494	995												
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<b>Pure copper chloride</b>	498	993												

Particles and Bonding		
<b>Book Ref.</b>	<b>Spec. Ref.</b>	<b>CS: RPA12</b> <b>Triple: RPA6</b>
		<b>Required Practical</b>
	CS 5.8.1.3  Triple 4.8.1.3  AT1 AT4 WS2.2 WS2.3 WS2.6	Investigate how paper chromatography can be used to separate and tell the difference between coloured substances.  <b>Method</b> You have been given 4 samples of food colouring of known colour and 1 sample of unknown colour. You also have a solvent, a piece of filter paper and capillary tubes. Outline a method that would allow you to get the results below.
		<p style="text-align: center;"><b>Results</b></p> <p>A sample set of results are shown below:</p> <div style="text-align: center;"> <p>The diagram shows a rectangular piece of paper with a horizontal line at the bottom labeled 'Start line' and a horizontal line at the top labeled 'Solvent front'. Below the start line, five spots of ink are placed, labeled from left to right: 'Blue ink', 'Red ink', 'Yellow ink', 'Green ink', and 'Unknown ink'. The 'Unknown ink' spot has moved the furthest, reaching a height approximately 80% of the way to the solvent front. It has separated into three distinct spots: one at the top (near the solvent front), one in the middle (at the same height as the Red ink spot), and one at the bottom (near the start line). The other four ink samples (Blue, Red, Yellow, Green) have each moved to a single distinct spot at different heights.</p> </div> <ol style="list-style-type: none"> <li>1) Identify the colours present in the unknown ink.</li> <li>2) Explain which colour is the most soluble.</li> <li>3) Calculate the R<sub>f</sub> value for the red ink.</li> <li>4) Identify the mobile phase and the stationary phase.</li> </ol>

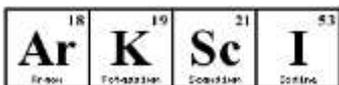


Particles and Bonding																							
Book Ref.	Spec. Ref.	Identification of Common Gases																					
	CS 5.8.2.1 5.8.2.2 5.8.2.3 5.8.2.4  Triple 4.8.2.1 4.8.2.2 4.8.2.3 4.8.2.4	Complete the table to summarise the test for the following gases and the positive result.																					
		<table border="1"> <thead> <tr> <th>Name of Gas</th> <th>Formula of Gas</th> <th>Description of Test</th> <th>Positive Result</th> </tr> </thead> <tbody> <tr> <td>Hydrogen</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Oxygen</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Carbon Dioxide</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Chlorine</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Name of Gas	Formula of Gas	Description of Test	Positive Result	Hydrogen				Oxygen				Carbon Dioxide				Chlorine				
Name of Gas	Formula of Gas	Description of Test	Positive Result																				
Hydrogen																							
Oxygen																							
Carbon Dioxide																							
Chlorine																							



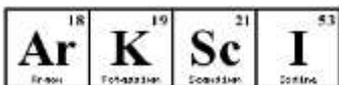
Quantitative Chemistry		
Book Ref.	Spec. Ref.	Conservation of Mass and RFM
	CS 5.3.1.1 5.3.1.2  Triple 4.3.1.1 4.3.1.2	<ol style="list-style-type: none"> <li>In a reaction, why does the mass of reactants always equal the mass of products?</li> <li>In the equation: <math>2\text{Li} + \text{F}_2 \rightarrow 2\text{LiF}</math> <ol style="list-style-type: none"> <li>What does the 2 in front of LiF mean?</li> <li>What does the 2 mean in <math>\text{F}_2</math>?</li> </ol> </li> <li>Explain why the following equation needs to be balanced:   <math>2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}</math> </li> </ol> <div style="border: 1px solid black; padding: 5px; margin-top: 10px; text-align: center;"> <b>Prove It!</b> </div> <p>The chemical equation for the reaction of titanium(IV) chloride with sodium is:</p> $\text{TiCl}_4 + 4\text{Na} \rightarrow \text{Ti} + 4\text{NaCl}$ <p style="text-align: center;">titanium(IV) chloride + sodium <math>\rightarrow</math> titanium + sodium chloride</p> <p>For one reaction:</p> <ul style="list-style-type: none"> <li>1615 kg titanium(IV) chloride reacted completely with 782 kg sodium</li> <li>1989 kg sodium chloride was produced.</li> </ul> <p>Calculate the mass of titanium produced from this reaction.</p> <p>.....</p> <p>.....</p> <p style="text-align: right;">Mass of titanium = ..... kg <span style="float: right;">(1)</span></p> <p>The figure below represents a molecule of paracetamol.</p> <div style="text-align: center;"> </div> <p>Give the molecular formula of paracetamol.</p> <p>Calculate its relative formula mass (<math>M_r</math>).</p>
		<b>Maths Skills</b>
		<p>Calculate the relative formula mass of the following compounds:</p> <ol style="list-style-type: none"> <li><math>\text{H}_2</math></li> <li><math>\text{H}_2\text{O}</math></li> <li><math>\text{CaCl}_2</math></li> <li><math>\text{CO}_2</math></li> <li><math>\text{CaCO}_3</math></li> <li><math>\text{Ca(OH)}_2</math></li> </ol>

Quantitative Chemistry																											
Book Ref.	Spec. Ref.	Mass Change and Chemical Measurements																									
	CS 5.3.1.3 5.3.1.4  Triple 3.3.1.3 3.3.1.4  WS3.4 WS3.7	<ol style="list-style-type: none"> <li>In a reaction, the mass of the products must always equal the mass of the reactant. However if a gas is involved in can often look like the mass has gone up or down.                             <ol style="list-style-type: none"> <li>Give an example of a reaction where it appears the mass of the product is greater than the reactant.</li> <li>Give an example of a reaction where it appears the mass of the reactant is greater than the product.</li> </ol> </li> <li>Give 2 reasons why a set of results will contain uncertainty.</li> <li>If you have higher uncertainty in your results, does that mean they are more or less precise? Why?</li> </ol>																									
		<b>Prove It!</b>																									
		A student heated 5g of calcium in an unsealed test tube so that it reacted with oxygen. At the end of the reaction, the mass of the product inside the test tube was 7g. Explain this observation.																									
		The student repeated the experiment twice more and found the mass of the product was 7.1g and 6.8g for these experiments. Calculate the uncertainty and suggest what might have caused it.																									
		<b>Maths Skills</b>																									
		Calculate the uncertainty for the following sets of data:																									
		<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Repeat 1</th> <th>Repeat 2</th> <th>Repeat 3</th> <th>Mean</th> <th>Uncertainty</th> </tr> </thead> <tbody> <tr> <td>2.30</td> <td>2.35</td> <td>2.38</td> <td>2.34</td> <td></td> </tr> <tr> <td>111</td> <td>121</td> <td>109</td> <td>114</td> <td></td> </tr> <tr> <td>0.02</td> <td>0.03</td> <td>0.02</td> <td>0.02</td> <td></td> </tr> <tr> <td>49.1</td> <td>58.1</td> <td>48.7</td> <td>52.0</td> <td></td> </tr> </tbody> </table>	Repeat 1	Repeat 2	Repeat 3	Mean	Uncertainty	2.30	2.35	2.38	2.34		111	121	109	114		0.02	0.03	0.02	0.02		49.1	58.1	48.7	52.0	
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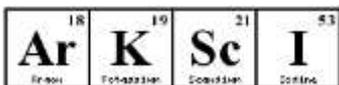


Quantitative Chemistry		
Book Ref.	Spec. Ref.	Moles
	<p><b>CS</b> <b>5.3.2.1</b> <b>(HT only)</b></p> <p><b>Triple</b> <b>4.3.2.1</b> <b>(HT only)</b></p>	<ol style="list-style-type: none"> <li>What is the mass of 1 mole of a substance in grams equal to?</li> <li>What is the equation that links number of moles, mass and relative formula mass?</li> <li>What is the name of the constant that tells us the number of atoms, particles, molecules or ions in a mole of any given substance? What is the value of this constant?</li> <li>How would you calculate the number of molecules present in a substance if you were given the mass of the substance?</li> </ol>
		<p><b>Prove It!</b></p> <p>Calculate the <b>number of molecules</b> in 14 g of carbon dioxide.</p> <p>Give your answer in standard form.</p> <p>Relative atomic masses (<math>A_r</math>): C = 14; O = 16</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p style="text-align: right;">Answer = ..... molecules</p> <p style="text-align: right;"><b>(4)</b></p>
	MS3b MS3c	<p style="text-align: center;"><b>Maths Skills</b></p> <p>Complete the following mole calculations using the equation you wrote above:</p> <ol style="list-style-type: none"> <li>How many moles are there in 42g of carbon?</li> <li>How many moles are there in 66g of carbon dioxide?</li> <li>What is the mass in g of 0.80 moles of sulfuric acid (<math>H_2SO_4</math>)?</li> <li>What is the mass in g of 1.6 moles of ammonia (<math>NH_3</math>)?</li> <li>Prove that the relative formula mass of NaCl is 58.5 if you know that you have 23.4g in 0.4 moles.</li> </ol>





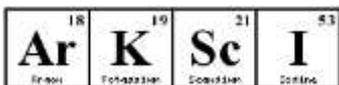
Quantitative Chemistry		
Book Ref.	Spec. Ref.	Maths Skills (Balancing Equations Using Moles)
	<b>CS 5.3.2.3 (HT only)</b>  <b>Triple 4.3.2.3 (HT only)</b>	<p>1. 8.1g of zinc oxide reacts completely with 0.60g of carbon to form 2.2g of carbon dioxide and 6.5g of zinc. Balance the symbol equation below.</p> $\text{ZnO} + \text{C} \rightarrow \text{CO}_2 + \text{Zn}$ <p>2. Potassium nitrate (<math>\text{KNO}_3</math>) decomposes on heating to give potassium nitrite (<math>\text{KNO}_2</math>) and oxygen (<math>\text{O}_2</math>). When 4.04 g of <math>\text{KNO}_3</math> is heated, 3.40 g of <math>\text{KNO}_2</math> is produced. Write a balanced equation for this reaction.</p> <p>3. 2.7g of an element, X, reacts completely with 2.4g of oxygen to form 5.1g of an oxide, X oxide. Write a balanced equation for this reaction.</p> <p>4. Iron(III) oxide (<math>\text{Fe}_2\text{O}_3</math>) is reduced by carbon on heating to give iron metal (Fe) and carbon dioxide (<math>\text{CO}_2</math>). When 480 g of <math>\text{Fe}_2\text{O}_3</math> is heated with carbon, 336 g of Fe and 198 g of <math>\text{CO}_2</math> are produced. Write a balanced equation for this reaction.</p>



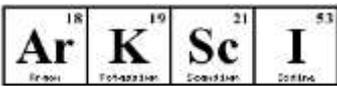
Quantitative Chemistry		
Book Ref.	Spec. Ref.	Limiting Reactants and Concentration of Solutions
	CS <b>5.3.2.4</b> (HT only)  Triple <b>4.3.2.4</b> (HT only)	<ol style="list-style-type: none"> <li>Why do chemical reactions sometimes stop? For example, when you add magnesium to acid it eventually stops fizzing.</li> <li>What is a limiting reactant? Why is it called this?</li> <li>In the example in question 1, which reactant is usually in excess, acid or metal, and which is the limiting reactant?</li> <li>Does the limiting reactant or the reactant in excess determine how much product can be formed? Explain your answer.</li> <li>When 2.24g of iron were reacted with an excess of copper sulfate solution, 2.54g of copper were produced. How much copper would be produced if 6.72g of iron were reacted in an excess of copper sulfate solution?</li> <li>What is the equation that links concentration, mass of solute and volume of solution?</li> <li>If the mass is measured in grams and the volume in <math>\text{dm}^3</math>, what are the units of concentration?</li> <li>If you increase the mass of solute in a solution, what happens to the concentration?</li> </ol>
	CS 5.3.2.5  Triple 4.3.2.5  MS3b MS3c  WS4.5	<p style="text-align: center;"><b>Maths Skills (Concentration)</b></p> <ol style="list-style-type: none"> <li>What is <math>2300\text{cm}^3</math> in <math>\text{dm}^3</math>?</li> <li>What is the concentration of a solution of sodium chloride solution that is made by dissolving 30g of sodium chloride in <math>0.20\text{dm}^3</math> of water?</li> <li>What is the concentration in <math>\text{g}/\text{dm}^3</math> of a solution of iron chloride solution that is made by dissolving 10g of iron chloride in <math>25\text{cm}^3</math> of water?</li> <li>What is the mass of copper chloride in <math>20\text{cm}^3</math> of an <math>80\text{g}/\text{dm}^3</math> solution of copper chloride?</li> </ol>





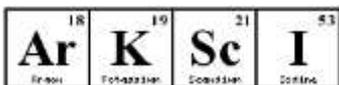


Trends and Patterns		
Book Ref.	Spec. Ref.	Metals, Non-metals and Group 0
	CS 5.1.2.3 5.1.2.4  Triple 4.1.2.3 4.1.2.4	<ol style="list-style-type: none"><li>1. Where are metals found on the periodic table? What sort of ions do they form? Give an example.</li><li>2. Where are non-metals found on the periodic table? What sort of ions do they form? Give an example.</li><li>3. What is another name for the group 0 elements?</li><li>4. How is the electron configuration of group 0 elements similar?</li><li>5. How does the electron configuration of group 0 elements affect their reactivity?</li><li>6. Does neon or krypton have a higher boiling point? What is the trend as you go down the group?</li></ol>
<b>Prove It!</b>		
Explain why Group 0 elements are monatomic.		
<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>		
<b>(2)</b>		



Trends and Patterns																		
Book Ref.	Spec. Ref.	Group 1																
	CS 5.1.2.5 5.1.2.6  Triple 4.1.2.5 4.1.2.6	<ol style="list-style-type: none"> <li>State the other name for the group 1 elements.</li> <li>How many electrons do group 1 elements have on their outer shell?</li> <li>Describe and explain the trend in the reactivity of group 1 metals as you descend group 1?</li> <li>Which group 1 element is the least reactive? Why?</li> <li>Complete the table to describe the reactions of the first 3 group 1 elements with oxygen, chlorine and water.</li> </ol> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">Group 1 Metal</th> <th style="width: 25%;">Reaction with oxygen</th> <th style="width: 25%;">Reaction with chlorine</th> <th style="width: 25%;">Reaction with water</th> </tr> </thead> <tbody> <tr> <td>Lithium</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Sodium</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Potassium</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Group 1 Metal	Reaction with oxygen	Reaction with chlorine	Reaction with water	Lithium				Sodium				Potassium			
Group 1 Metal	Reaction with oxygen	Reaction with chlorine	Reaction with water															
Lithium																		
Sodium																		
Potassium																		
		<p style="text-align: center;"><b>Prove It!</b></p> <p>Potassium is also in Group 1 of the periodic table.            Potassium reacts with water in a similar way to lithium.</p> <p>Write down two differences you would see between the reactions of potassium and lithium with water.</p> <p>1 .....</p> <p>.....</p> <p>2 .....</p> <p>.....</p> <p style="text-align: right;">(2)</p>																

Trends and Patterns																		
Book Ref.	Spec. Ref.	Group 7																
	CS 5.1.2.5 5.1.2.6  Triple 4.1.2.5 4.1.2.6	<ol style="list-style-type: none"> <li>What is another name for the group 7 elements?</li> <li>How many electrons do group 7 elements have on their outer shell?</li> <li>Write the formula for a <b>molecule</b> of chlorine.</li> <li>Which group 7 element                             <ol style="list-style-type: none"> <li>has the highest melting point?</li> <li>has the lowest boiling point?</li> </ol> </li> <li>Why is fluorine the most reactive halogen?</li> <li>Would a displacement reaction take place if chlorine gas was reacted with potassium bromide? Explain your answer.</li> </ol>																
<b>Prove It!</b>																		
<p>A student put some potassium bromide solution in a test tube.</p> <p>She added a few drops of chlorine solution and observed the result.</p> <p>She repeated the process using different potassium halide salts and different halogens.</p> <p>The table below shows the student's results.</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="width: 25%;">Solution of halogen</th> <th style="width: 25%;">Potassium chloride solution</th> <th style="width: 25%;">Potassium bromide solution</th> <th style="width: 25%;">Potassium iodide solution</th> </tr> </thead> <tbody> <tr> <td>Chlorine</td> <td style="background-color: #cccccc;"></td> <td>Orange colour forms</td> <td>Brown colour forms</td> </tr> <tr> <td>Bromine</td> <td>No reaction</td> <td style="background-color: #cccccc;"></td> <td>Brown colour forms</td> </tr> <tr> <td>Iodine</td> <td>No reaction</td> <td>No reaction</td> <td style="background-color: #cccccc;"></td> </tr> </tbody> </table> <p>Give the order of reactivity of the halogens from the results in the table above.</p> <p>Explain how you used the results to show this order of reactivity.</p> <p>Order .....</p> <p>Explanation .....</p> <p>.....</p> <p>.....</p> <p style="text-align: right;">(2)</p> <p>Explain the order of reactivity of Group 7 elements.</p> <p>Include information about atomic structure.</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p style="text-align: right;">(2)</p>			Solution of halogen	Potassium chloride solution	Potassium bromide solution	Potassium iodide solution	Chlorine		Orange colour forms	Brown colour forms	Bromine	No reaction		Brown colour forms	Iodine	No reaction	No reaction	
Solution of halogen	Potassium chloride solution	Potassium bromide solution	Potassium iodide solution															
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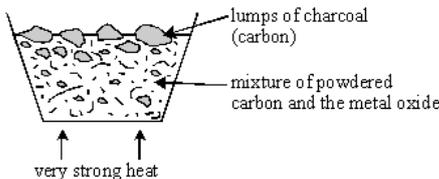


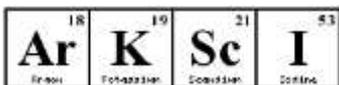
**Trends and Patterns**

Book Ref.	Spec. Ref.	Reactivity of metals
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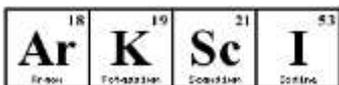
- |  |  |  |
|--|--|--|
|  | CS<br>5.4.1.1<br>5.4.1.2<br><br>Triple<br>4.4.1.1<br>4.4.1.2 | 1. What is the general equation for the reaction of:<br>metal + oxygen →<br><br>2. Complete the equations:<br>a) zinc + oxygen →<br>b) copper + ..... → copper oxide<br>c) ..... + ..... → magnesium oxide<br><br>3. Define oxidation and reduction in terms of oxygen.<br><br>4. For the equation in 2a, identify the species that gets oxidised.<br><br>5. Explain why the reaction between zinc and hydrochloric acid is a redox reaction<br><br>6. Put the following metals into order of reactivity: magnesium, calcium, copper, zinc, iron, aluminium, potassium and sodium. Include the position of non-metals carbon and hydrogen.<br><br>7. Why is potassium more reactive than sodium?<br><br>8. Complete the equations:<br>a) zinc + iron sulfate →<br>b) zinc + copper sulfate →<br>c) magnesium + iron (II) chloride →<br><br>9. Explain why the above equations are called 'displacement reactions'<br><br>10. Summarise the reactions of metals of acid and water |
|--|--|--|

Metal	Reaction with water	Reaction with dilute acid
potassium		
lithium		
magnesium		
zinc		
Iron		
copper		
Gold		

Trends and Patterns		
Book Ref.	Spec. Ref.	Reactivity of metals
	CS 5.4.1.3  5.4.1.4 (HT)  Triple 4.4.1.3  4.4.1.4 (HT)	<ol style="list-style-type: none"> <li>1. Define the term metal ore</li> <li>2. Platinum is found in its native state. What does this tell you about its reactivity?</li> <li>3a. What does it mean to reduce zinc oxide?</li> <li>3b. Zinc oxide, ZnO, can be reduced to zinc by heating it in a furnace with carbon. Write a balanced symbol equation for this reaction, labelling what is reduced and what is oxidised</li> <li>4. Explain why carbon can reduce zinc oxide but magnesium cannot.</li> <li>5.                             <ol style="list-style-type: none"> <li>a. (HT only) Write an ionic equation, including state symbols for the reaction between zinc and iron (II) sulfate</li> <li>b. Explain in terms of the transfer of electrons which species is oxidised and which is reduced in this reaction (Hint: OILRIG).</li> </ol> </li> </ol>
<b>Prove It!</b>		
<p>A student was trying to extract the metals from lead oxide and aluminium oxide. She heated each oxide with carbon in a fume cupboard as shown below. She was able to extract lead from lead oxide but not aluminium from aluminium oxide. Explain the results of these experiments [3]</p>		
		

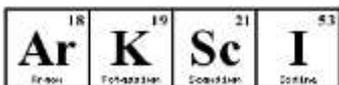


Trends and Patterns		
Book Ref.	Spec. Ref.	Reactions of acids with metals
	CS 5.4.2.1	1. Write the general equation for the reaction: acid + metal $\rightarrow$
	Triple 4.4.2.1	2. Write a balanced <b>symbol equation</b> , including state symbols, for: a) iron + sulfuric acid  b) zinc + hydrochloric acid
		3. Why can't copper sulfate be prepared by adding copper metal to dilute sulfuric acids?
		4. Why can't potassium chloride be prepared by adding potassium to dilute hydrochloric acid?
		5. What gas is produced when a metal and acid are reacted together? What would you <b>see</b> ?
		6. (HT only) Using the reaction of zinc and dilute hydrochloric acid: a) Write an ionic equation for the reaction with state symbols  b) From your answer to part a, construct two half equations showing the electron transfers taking place.  c) Explain why this is a redox reaction in terms of electron transfer.

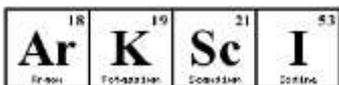


Trends and Patterns										
Book Ref.	Spec. Ref.	Neutralisation of acids and salt production								
	CS 5.4.2.2	1. What is a neutralisation reaction? Give an example.								
	Triple 4.4.2.2	2. Complete the general word equations for neutralisation: acid + base → acid + alkali → acid + metal carbonate →								
		3. Define and give an example of: <ul style="list-style-type: none"> <li>a. Acid</li>   <li>b. Alkali</li>   <li>c. Base</li> </ul>								
		4. Name the salts formed when a lithium is reacted with the following acids:								
		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">Acid</th> <th style="text-align: center;">Lithium salt formed</th> </tr> </thead> <tbody> <tr> <td>Hydrochloric acid</td> <td></td> </tr> <tr> <td>Sulfuric acid</td> <td></td> </tr> <tr> <td>Nitric acid</td> <td></td> </tr> </tbody> </table>	Acid	Lithium salt formed	Hydrochloric acid		Sulfuric acid		Nitric acid	
Acid	Lithium salt formed									
Hydrochloric acid										
Sulfuric acid										
Nitric acid										
		5. Write the word equation for the reaction between zinc oxide and dilute hydrochloric acid.								
		6. Write the word equation for the reaction between calcium carbonate and dilute sulfuric acid,								
		7. What is the formulae for the following salts: <ul style="list-style-type: none"> <li>a) sodium bromide</li>   <li>b) potassium nitrate</li>   <li>c) magnesium sulfate</li> </ul>								
		8. Write a balanced symbol equation, including state symbols for the reaction of lithium oxide (in excess) and dilute hydrochloric acid.								

Trends and Patterns																				
Book Ref.	Spec. Ref.	CS: RPA8 Triple: RPA1																		
	CS 5.4.2.3  Triple 4.4.2.3  AT 2,4,6  WS 2.2 WS 2.3	<p style="text-align: center;"><b>Required Practical</b></p> <p>Preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate using a Bunsen burner to heat dilute acid and a water bath or electric heater to evaporate the solution.</p> <hr/> <p style="text-align: center;"><b>Method</b></p> <p>Describe a safe method for making pure, dry crystals of copper sulfate. You should identify the chemicals and apparatus you will use.</p>																		
	WS3.6 WS3.7	<p style="text-align: center;"><b>Evaluating Data</b></p> <p>1. 2 students did the experiment using the same quantities of reactants and compared the amount of product they made. Student 1 got closest to the theoretical yield. Student 1 said they were more precise than student 2 but student 2 thought they should have used the word accurate.</p> <p>Who was correct? Explain your answer.</p> <p>2. A student made a hypothesis "the greater the mass of sodium carbonate used, the greater the mass of carbon dioxide formed". Using the data below explain if and to what extent the student was correct.</p> <p>The student's results are shown in the table below.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Mass of sodium carbonate in g</th> <th>Volume of carbon dioxide gas in cm<sup>3</sup></th> </tr> </thead> <tbody> <tr><td>0.07</td><td>16.0</td></tr> <tr><td>0.12</td><td>27.5</td></tr> <tr><td>0.23</td><td>52.0</td></tr> <tr><td>0.29</td><td>12.5</td></tr> <tr><td>0.34</td><td>77.0</td></tr> <tr><td>0.54</td><td>95.0</td></tr> <tr><td>0.59</td><td>95.0</td></tr> <tr><td>0.65</td><td>95.0</td></tr> </tbody> </table>	Mass of sodium carbonate in g	Volume of carbon dioxide gas in cm <sup>3</sup>	0.07	16.0	0.12	27.5	0.23	52.0	0.29	12.5	0.34	77.0	0.54	95.0	0.59	95.0	0.65	95.0
Mass of sodium carbonate in g	Volume of carbon dioxide gas in cm <sup>3</sup>																			
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0.65	95.0																			



Trends and Patterns																	
Book Ref.	Spec. Ref.	Strong and weak acids (HT only)															
	CS 5.4.2.5 (HT)  Triple 4.4.2.6 (HT)	<ol style="list-style-type: none"> <li>1. Define the term strong acid and give an example.</li> <li>2. Define the term weak acid and give an example.</li> <li>3. What is the relationship between acid strength and pH?</li> <li>4. As the pH decreases by one unit what does the hydrogen ion concentration of solution increase by?</li> <li>5. Explain the difference between a strong acid and a concentrated acid. Can you have a weak concentrated acid?</li> </ol>															
		<b>Prove It!</b>															
		<p>Acids of the same concentration were reacted with magnesium ribbon. The volume of gas produced after 5 minutes was recorded. The results are shown in the table.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 33%;">Acid</th> <th style="width: 33%;">pH</th> <th style="width: 33%;">Volume of gas in cm<sup>3</sup></th> </tr> </thead> <tbody> <tr> <td>A</td> <td>2</td> <td>18</td> </tr> <tr> <td>B</td> <td>5</td> <td>6</td> </tr> <tr> <td>C</td> <td>1</td> <td>24</td> </tr> <tr> <td>D</td> <td>4</td> <td>12</td> </tr> </tbody> </table> <p>Use the results to arrange the acids in order of decreasing acid strength</p> <p style="text-align: center;">Most acidic..... Least acidic</p> <p>Complete the sentence:            A solution with more hydrogen ions than hydroxide ions is.....</p>	Acid	pH	Volume of gas in cm <sup>3</sup>	A	2	18	B	5	6	C	1	24	D	4	12
Acid	pH	Volume of gas in cm <sup>3</sup>															
A	2	18															
B	5	6															
C	1	24															
D	4	12															
		<b>Maths skills</b>															
	MS1a MS1b	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;">Concentration of H<sup>+</sup> (aq) ions in mol/dm<sup>3</sup></th> <th style="width: 40%;">pH value</th> </tr> </thead> <tbody> <tr> <td>0.10</td> <td>1.0</td> </tr> <tr> <td>0.010</td> <td>2.0</td> </tr> <tr> <td>0.0010</td> <td>3.0</td> </tr> <tr> <td>0.00010</td> <td>4.0</td> </tr> </tbody> </table> <p>A solution of sodium chloride is neutral, what will be the concentration of hydrogen ions in the solution? Give your answer in mol/dm<sup>3</sup> in decimal form and in standard form.</p>	Concentration of H <sup>+</sup> (aq) ions in mol/dm <sup>3</sup>	pH value	0.10	1.0	0.010	2.0	0.0010	3.0	0.00010	4.0					
Concentration of H <sup>+</sup> (aq) ions in mol/dm <sup>3</sup>	pH value																
0.10	1.0																
0.010	2.0																
0.0010	3.0																
0.00010	4.0																

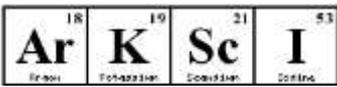


Trends and Patterns		
Book Ref.	Spec. Ref.	Electrolysis
	CS 5.4.3.1 5.4.3.2  Triple 4.4.3.1 4.4.3.2	<ol style="list-style-type: none"> <li>1. Complete the sentence below. Electrolysis is the splitting apart of a ..... using .....</li> <li>2. What do you call the substance being electrolysed?</li> <li>3. What type of bonding is present in compounds that can be electrolysed? What must happen to these compounds before they can be electrolysed?</li> <li>4. What is the name given to the negative electrode? What is the name given to the positive electrode?</li> <li>5. Explain which type of ion moves to the positive electrode and what happens to that ion.</li> <li>6. Predict the product formed at the cathode and anode when molten lead bromide (PbBr<sub>2</sub>) is electrolysed. Describe what you would observe at each electrode.</li> <li>7. Solid ionic substances do not conduct electricity. Explain why they can conduct when molten or in aqueous solution, but not when solid.</li> </ol>
<b>Prove It!</b>		
		<p>Sodium chloride is an ionic compound. It contains sodium ions, Na<sup>+</sup>, and chloride ions, Cl<sup>-</sup>. When <b>molten</b> sodium chloride is electrolysed, sodium metal and chlorine gas are formed. Describe how the sodium ions and chloride ions in solid sodium chloride are converted into sodium and chlorine by electrolysis.</p> <p style="text-align: right;">(6)</p>

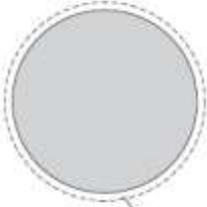
Trends and Patterns		
Book Ref.	Spec. Ref.	Electrolysis of Aluminium Oxide
	CS 5.4.3.3  5.4.3.5 (HT)  Triple 4.4.3.3  4.4.3.5 (HT)	<ol style="list-style-type: none"> <li>Why would you use electrolysis to obtain the metal from sodium chloride but not from zinc chloride?</li> <li>Why is aluminium oxide dissolved in molten cryolite before being electrolysed?</li> <li>Why are the carbon anodes regularly replaced in the industrial electrolysis of aluminium oxide?</li> <li>(HT only) Write half equations for the changes at each electrode in the electrolysis of molten aluminium oxide. Identify each reaction as either reduction or oxidation.</li> <li>Explain why the extraction of aluminium requires so much energy</li> </ol>
<b>Prove It!</b>		
<p>The flow chart shows the main steps in the extraction of aluminium from aluminium ore. Aluminium is recycled by melting scrap aluminium at 700 °C. Use your own knowledge and the information given to answer. Suggest why most aluminium is recycled.</p> <div style="text-align: center;"> <pre> graph TD     A[Aluminium oxide is separated from bauxite ore.] --&gt; B[Aluminium oxide is purified.]     B --&gt; C[Aluminium oxide is mixed with cryolite.]     C --&gt; D[The mixture is heated to 950 °C to melt it.]     D --&gt; E[Aluminium is extracted by electrolysis.]                     </pre> </div>		

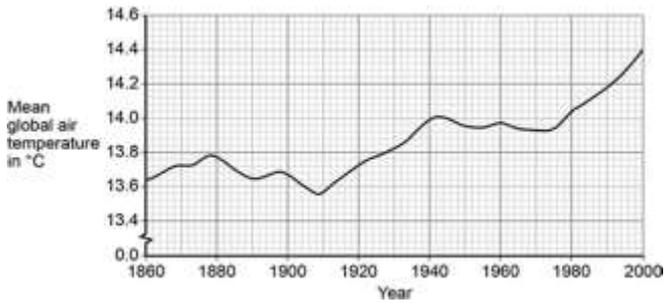
Trends and Patterns		
Book Ref.	Spec. Ref.	Electrolysis of Aqueous Compounds
	CS 5.4.3.4	1. Name the four ions present in sodium chloride <b>solution</b> .
	5.4.3.5 (HT)	2. Which of these positive ions is discharged at the negative electrode during electrolysis? Explain how you know which positive ion is reduced when there is more than one positive ion in a solution.
	Triple 4.4.3.4	
	4.4.3.5 (HT)	3. Which of these negative ions is discharged at the positive electrode? Explain how you know which negative ion is oxidised when there is more than one negative ion in a solution.
		4. What happens to the 2 remaining ions?
		5. (HT only) Write the half equations, including state symbols, for the reactions at the anode and at the cathode of sodium chloride solution.
		6. Predict the 3 products that would be formed if aqueous lithium bromide solution was electrolysed.
		<b>Prove It!</b>
		Sodium sulfate solution contains sodium ions, Na <sup>+</sup> , sulfate ions, SO <sub>4</sub> <sup>2-</sup> , hydrogen ions, H <sup>+</sup> , and hydroxide ions, OH <sup>-</sup> . Hydrogen is produced at one electrode and oxygen is produced at the other electrode. Explain how these products are formed from the ions in the electrolysis process, indicating how you would identify the products. You may give ionic equations in your answer.
		(6)

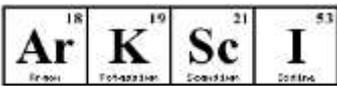
Trends and Patterns		
Book Ref.	Spec. Ref.	Required practical activity 9 (CS) Required practical 3 (Triple)
	CS 5.4.3.4	Investigate what happens when aqueous solutions are electrolysed using inert electrodes. This should be an investigation involving developing a hypothesis.
	Triple 4.4.3.4	1. Suggest a hypothesis for the electrolysis of potassium chloride solution
	AT 3 AT 7	2. Suggest what the pH around the cathode would be?
	WS2.1	3. What chemical test could you perform to confirm your hypothesis to Q2?
		4. Write the half equations, including state symbols, for the changes at the anode and cathode.
		5. Suggest a hypothesis for each experiment below.
		Magnesium chloride can be electrolysed.
		The diagram below shows two experiments for electrolysis of magnesium chloride.
		<div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p><b>Experiment 1</b></p> </div> <div style="text-align: center;"> <p><b>Experiment 2</b></p> </div> </div>



Trends and Patterns		
Book Ref.	Spec. Ref.	Chemistry of the atmosphere The composition and evolution of the Earth's atmosphere
	CS 5.9.1.1 5.9.1.2	1. What is the approximate percentage of nitrogen and oxygen in the atmosphere today?
	Triple 4.9.1.1 4.9.1.2	2. Other than those gases named above, what other gases are present in the atmosphere today?
		3. Describe what the early atmosphere was made up of. Which planets' atmosphere today is it like?
		4. Explain how the Earth's early atmosphere was probably formed during its first billion years of existence.
		5. Explain how the oceans formed.
		6. What effect did the formation of the oceans have on the levels of carbon dioxide in the air? Explain your answer.
		7. Why have theories about the Earth's early atmosphere and how it has changed developed over time?
		<p style="text-align: center;"><b>Prove it!</b></p> <p>For the last 200 million years the amount of carbon dioxide in the atmosphere has remained almost the same. Describe the natural processes which remove carbon dioxide from the atmosphere. (6)</p>

Trends and Patterns		
Book Ref.	Spec. Ref.	The composition of the Earth's atmosphere
	CS 5.9.1.3 5.9.1.4  Triple 4.9.1.3 4.9.1.4	<ol style="list-style-type: none"> <li>1. Explain how levels of oxygen in our atmosphere increased.</li> <li>2. Write the word and symbol equation for photosynthesis.</li> <li>3. What were the first organisms to produce oxygen called? How long ago did this happen?</li> <li>4. Explain why the increase in oxygen was important to life on Earth today.</li> <li>5. Explain 4 factors that contributed to decrease in levels of carbon dioxide.</li> </ol> <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p style="text-align: center;"><b>Prove it!</b></p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p><b>The early Earth</b> Most of the surface was covered by volcanoes</p>  <p>Most of the atmosphere was carbon dioxide and water vapour.</p> </div> <div style="text-align: center;"> <p><b>The Earth today</b> Most of the surface is covered by oceans</p>  <p>Most of the atmosphere is nitrogen and oxygen.</p> </div> </div> <p style="text-align: center; margin-top: 10px;">Describe and explain how the surface of the early Earth and its atmosphere have changed to form the surface of the Earth and its atmosphere today (6)</p> </div>
Trends and Patterns		

Book Ref.	Spec. Ref.	Carbon dioxide and methane as greenhouse gases																		
	<p>CS 5.9.2.1 5.9.2.2</p> <p>Triple 4.9.2.1 4.9.2.2</p> <p>WS1.6</p>	<ol style="list-style-type: none"> <li>1. Explain what is meant by the term 'greenhouse gas' and name 3 greenhouse gases.</li> <li>2. What is the greenhouse effect?</li> <li>3. Explain the greenhouse effect in terms of short and long wavelength radiation and matter.</li> <li>4. Describe two human activities that increase the amount of carbon dioxide in the atmosphere.</li> <li>5. Describe two human activities that increase the amount of methane in the atmosphere.</li> <li>6. A scientist peer reviewed some work on the greenhouse effect. What does 'peer review' mean? Why is it important this is done?</li> <li>7. What do most scientists believe is the relationship between greenhouse gases and global temperatures? Why do some members of the public not believe this to be true?</li> </ol>																		
	WS3.5	<p style="text-align: center;"><b>Prove it!</b></p> <p>The figure below shows the change in mean global air temperature from 1860 to 2000. Explain how human activities have contributed to the main trend shown from 1910 in the figure below (4)</p> <div style="text-align: center;">  <table border="1"> <caption>Approximate data from the mean global air temperature graph</caption> <thead> <tr> <th>Year</th> <th>Mean global air temperature (°C)</th> </tr> </thead> <tbody> <tr><td>1860</td><td>13.6</td></tr> <tr><td>1880</td><td>13.7</td></tr> <tr><td>1900</td><td>13.6</td></tr> <tr><td>1910</td><td>13.5</td></tr> <tr><td>1940</td><td>14.0</td></tr> <tr><td>1960</td><td>13.9</td></tr> <tr><td>1980</td><td>14.1</td></tr> <tr><td>2000</td><td>14.4</td></tr> </tbody> </table> </div>	Year	Mean global air temperature (°C)	1860	13.6	1880	13.7	1900	13.6	1910	13.5	1940	14.0	1960	13.9	1980	14.1	2000	14.4
Year	Mean global air temperature (°C)																			
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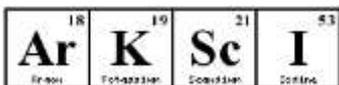


Trends and Patterns		
Book Ref.	Spec. Ref.	Carbon dioxide and methane as greenhouse gases
	CS 5.9.2.3 5.9.2.4	1. What is meant by the term 'global climate change'?
	Triple 4.9.2.3 4.9.2.4	2. Describe four potential effects of global climate change
	WS1.4 WS1.6	3. Describe why these consequences are difficult to predict.
		4. What is meant by the term 'carbon footprint'?
		5. Describe two actions that can reduce emission of carbon dioxide and methane.
		6. Suggest two problems representatives of countries face in reaching international agreements such as the Paris climate agreement.
		7. Suggest and explain the relationship between a nation's wealth and its emissions of carbon dioxide.
		8. What can be the problems of only using the media as your source of knowledge about climate change?

Trends and Patterns		
Book Ref.	Spec. Ref.	Common atmospheric pollutants and their sources
	CS 5.9.3.1 5.9.3.2  Triple 4.9.3.1 4.9.3.2	<ol style="list-style-type: none"> <li>1. What are the products of the complete combustion of a hydrocarbon e.g. methane (CH<sub>4</sub>)?</li> <li>2. What are the products of the incomplete combustion of a hydrocarbon?</li> <li>3. Some fossil fuels contain impurities that can produce an acidic gas. Name the element, the gas formed and the pollution problem it contributes to.</li> <li>4. Which other non-metal oxides released from cars also cause this pollution problem? How is this non-metal oxide formed?</li> <li>5. What health problems are caused by the substances named in Q3. and Q4.?</li> <li>6. What other substance may be released that form particulates in the atmosphere? What problems can these cause?</li> <li>7. Why is carbon monoxide dangerous?</li> </ol>
		<div style="border: 1px solid black; padding: 10px;"> <p style="text-align: center;"><b>Prove it!</b></p> <p>Complete and balance the symbol equation for the complete combustion of methane.</p> <math display="block">\text{CH}_4 + \dots \longrightarrow \text{CO}_2 + \dots</math> <p style="text-align: right;">(2)</p> <p>Explain why the <b>incomplete</b> combustion of methane is dangerous.</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p style="text-align: right;">(2)</p> </div>

Trends and Patterns		
Book Ref.	Spec. Ref.	Using Resources Using the Earth's resources and obtaining potable water
	CS 5.10.1.1  Triple 4.10.1.1	<ol style="list-style-type: none"> <li>1. Define finite resources and give two examples.</li> <li>2. Define renewable resources and give two examples.</li> <li>3. Explain what is meant by "sustainability".</li> <li>4. Give an example of a natural product that is supplemented or replaced by agricultural products.</li> <li>5. Give an example of a natural product that is supplemented or replaced by synthetic products</li> </ol>
	MS2h	<p style="text-align: center;"><b>Maths skills</b></p> <p>As a rough estimate, there is <math>1.5 \times 10^{16}</math> metric tonnes of fossil carbon on Earth. In 2014, it was also estimated that <math>9,2 \times 10^9</math> metric tonnes of carbon were burned worldwide that year. Assuming that the 2013 rate of carbon use was to continue calculate an order of magnitude estimate of how long carbon will last.</p>

Trends and Patterns		
Book Ref.	Spec. Ref.	Using the Earth's resources and obtaining potable water
	CS 5.10.1.2 5.10.1.3  Triple 4.10.1.2 4.10.1.3	<ol style="list-style-type: none"> <li>1. Define potable water.</li> <li>2. Define pure water.</li> <li>3. Describe the method used to produce potable water in the UK, explaining the reason for each step. You could use a flow chart.</li> <li>4. Identify three sterilising agents.</li> <li>5. If supplies of fresh water are limited, what alternate water sources may be used?</li> <li>6. Define desalination and describe the 2 methods of how it is carried out.</li> <li>7. Describe two differences between the treatment of ground water and salty water.</li> <li>8. Why does waste water require treatment at a sewage works before being released into the environment?</li> <li>9. Draw a basic flow diagram listing the main steps used in sewage treatment plant to make waste water safe</li> </ol> <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p style="text-align: center;"><b>Prove it!</b></p> <p>Explain why it is more difficult to produce drinking water from waste water than from water in lakes.</p> </div>
Trends and Patterns		

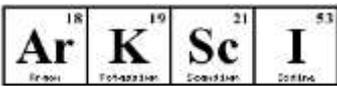


Book Ref.	Spec. Ref.	<b>Triple RPA8</b> <b>CS RPA13</b> <b>Analysis and purification of water samples from different sources, including pH, dissolved solids and distillation.</b>
	CS 5.10.1.2 5.10.1.3  Triple 4.10.1.2 4.10.1.3  WS2.2 WS2.5 WS3.7	<ol style="list-style-type: none"> <li>1. How do you test the pH of water? How would you adjust it if necessary?</li> <li>2. How do you test if water contains salt (sodium chloride)? How would you remove this if present?</li> <li>3. Some countries add chlorine to their water. Why do they do this? How do you test for it?</li> <li>4. A student wanted to collect 25cm<sup>3</sup> of water. What piece of equipment should they use? If the piece of equipment was faulty and the student took 10 samples, what sort of error would they have?</li> <li>5. A student took 10 samples of water from the same source and tested them. Only 1 result gave an acidic pH but all the others were neutral. What is this type of result called? What should they do about it?</li> <li>6. A different student only took 1 sample of water and tested it. Is this a sufficient sample? Why?</li> <li>7. A student wanted to heat the water to exactly 30°C. They used a Bunsen burner but their teacher told them there was a better way. What should they have done? Why would it be better?</li> </ol>

Trends and Patterns		
Book Ref.	Spec. Ref.	Using the Earth's resources and obtaining potable water
	<p><b>CS</b> <b>5.10.1.4</b> <b>(HT)</b></p> <p><b>Triple</b> <b>4.10.1.4</b> <b>(HT)</b></p>	<ol style="list-style-type: none"> <li>1. Why is copper important in our technological society?</li> <li>2. Describe how these two main methods can obtain copper metal from its ore:                             <ol style="list-style-type: none"> <li>a) smelting</li> <li>b) electrolysis</li> </ol> </li> <li>3. (HT only) Copper ores are becoming scarce and phytomining and bioleaching are two new methods of extraction. Describe both phytomining and bioleaching.</li> <li>4. (HT only) State one advantage of extracting copper using these methods in Q3. over traditional methods.</li> <li>5. (HT only) Describe one disadvantage of bioleaching.</li> <li>6. (HT only) Once the metal compound is obtained, how can the metal be extracted from the compound?</li> </ol> <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p style="text-align: center;"><b>Prove it!</b></p> <p>(HT only) Soil near copper mines is often contaminated with low percentages of copper compounds. Phytomining is a new way to extract copper compounds from soil. Describe how copper compounds are extracted by phytomining</p> </div>

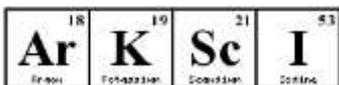
**Trends and Patterns**

Book Ref.	Spec. Ref.	Life cycle assessment																								
	CS 5.10.2.1  Triple 4.10.2.1	<ol style="list-style-type: none"> <li>Why are life cycle assessments (LCAs) carried out?</li> <li>Using a simple flowchart outline the stages in an LCA.</li> <li>Name the input showing on an LCA report that would be the raw material mined to produce aluminium in an alloy to make the wings of an aeroplane.</li> <li>Name the output shown on a LCS that would be:                             <ol style="list-style-type: none"> <li>the greenhouse gas given off when a product is distributed from a factory to shops around the country on lorries</li> <li>the gas that causes acid rain given off as result of using electricity generated in a coal-fired power station when making a product</li> </ol> </li> <li>Explain why parts of some LCAs may not be totally objective.</li> <li>Carry out a simplified LCA for a supermarket that is deciding whether to use plastic, poly(ethene) bags or paper bags at its checkouts.</li> </ol> <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p style="text-align: center;"><b>Prove it!</b></p> <p>The table below gives information about milk bottles.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">Glass milk bottle</th> <th style="text-align: center;">Plastic milk bottle</th> </tr> </thead> <tbody> <tr> <td>Raw materials</td> <td style="text-align: center;">Sand, limestone, salt</td> <td style="text-align: center;">Crude oil</td> </tr> <tr> <td>Bottle material</td> <td style="text-align: center;">Soda-lime glass</td> <td style="text-align: center;">HD poly(ethene)</td> </tr> <tr> <td>Initial stage in production of bottle material</td> <td style="text-align: center;">Limestone and salt used to produce sodium carbonate.</td> <td style="text-align: center;">Production of naphtha fraction.</td> </tr> <tr> <td>Maximum temperature in production process</td> <td style="text-align: center;">1600 °C</td> <td style="text-align: center;">850 °C</td> </tr> <tr> <td>Number of times bottle can be used for milk</td> <td style="text-align: center;">25</td> <td style="text-align: center;">1</td> </tr> <tr> <td>Size(s) of bottle</td> <td style="text-align: center;">0.5 dm<sup>3</sup></td> <td style="text-align: center;">0.5 dm<sup>3</sup>, 1 dm<sup>3</sup>, 2 dm<sup>3</sup>, 3 dm<sup>3</sup></td> </tr> <tr> <td>Percentage (%) of recycled material used in new bottles</td> <td style="text-align: center;">50 %</td> <td style="text-align: center;">10 %</td> </tr> </tbody> </table> <p>Evaluate the production and use of bottles made from soda-lime glass and those made from HD poly(ethene).</p> <p>Use the information given and your knowledge and understanding to justify your choice of material for milk bottles.</p> </div>		Glass milk bottle	Plastic milk bottle	Raw materials	Sand, limestone, salt	Crude oil	Bottle material	Soda-lime glass	HD poly(ethene)	Initial stage in production of bottle material	Limestone and salt used to produce sodium carbonate.	Production of naphtha fraction.	Maximum temperature in production process	1600 °C	850 °C	Number of times bottle can be used for milk	25	1	Size(s) of bottle	0.5 dm <sup>3</sup>	0.5 dm <sup>3</sup> , 1 dm <sup>3</sup> , 2 dm <sup>3</sup> , 3 dm <sup>3</sup>	Percentage (%) of recycled material used in new bottles	50 %	10 %
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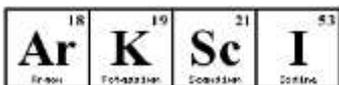


Trends and Patterns		
Book Ref.	Spec. Ref.	Reducing Use of Resources
	CS 5.10.2.2  Triple 4.10.2.2	<ol style="list-style-type: none"><li>1. Suggest 4 reasons why it is important that people recycle materials?</li><li>2. Name 2 other methods of conserving limited resources.</li><li>3. Name a negative impact of extracting limited resources from the Earth.</li><li>4. Glass bottles are made from a limited resource. Describe how we can conserve this limited resource.</li></ol> <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"><p style="text-align: center;"><b>Prove it!</b></p><p>When a car reaches the end of its useful life, the car body can be recycled, reused, or sent to landfill. Give <b>three</b> reasons why a steel car body should be recycled and <b>not</b> reused or sent to landfill.</p></div>





Physical Chemistry														
Book Ref.	Spec. Ref.	Energy changes Exothermic and endothermic reactions												
	CS 5.5.1.1  Triple 4.5.1.1	<ol style="list-style-type: none"> <li>1. What is meant by the law of conservation of energy?</li> <li>2. Define an exothermic reaction in terms of energy transfer.</li> <li>3. Give 2 examples of exothermic reactions and an everyday use.</li> <li>4. Define an endothermic reaction in terms of energy transfer.</li> <li>5. Give 2 examples of endothermic reactions and an everyday use.</li> </ol>												
	WS3.3 WS3.4 WS3.7	<p style="text-align: center;"><b>Maths Skills</b></p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Experiment</th> <th style="text-align: center;">Decrease in temperature of water in °C</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">5.9</td> </tr> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;">5.7</td> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">7.2</td> </tr> <tr> <td style="text-align: center;">4</td> <td style="text-align: center;">5.6</td> </tr> <tr> <td style="text-align: center;">5</td> <td style="text-align: center;">5.8</td> </tr> </tbody> </table> <ol style="list-style-type: none"> <li>1. Is the data in the table above showing an endo or exothermic reaction?</li> <li>2. Calculate the mean decrease in temperature of water excluding an anomalous results. Give your answer to an appropriate number of significant figures.</li> <li>3. The uncertainty of the thermometer is +/- 0.05°C. Calculate the uncertainty of the results in the table.</li> <li>4. One student did all 5 experiments using the same equipment. Explain whether her results are repeatable, reproducible, both or neither.</li> </ol>	Experiment	Decrease in temperature of water in °C	1	5.9	2	5.7	3	7.2	4	5.6	5	5.8
Experiment	Decrease in temperature of water in °C													
1	5.9													
2	5.7													
3	7.2													
4	5.6													
5	5.8													



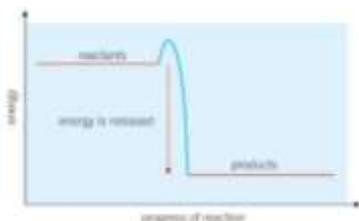
Physical Chemistry		
Book Ref.	Spec. Ref.	Required practical 10 (CS) Required practical 4 (Triple)
	CS 5.5.1.1	Investigate the variables that affect temperature changes in reacting solutions for e.g. acid + metal, acid + carbonates, neutralisations, displacement of metals.
	Triple 4.5.1.1	A student conducted an experiment to find out which metal was the most reactive. They did this by selecting a range of metals (copper, zinc, tin and magnesium), adding them to an acid and measuring the temperature rise in 120 seconds.
	AT 1,3, 5 and 6	<ol style="list-style-type: none"> <li>1. Identify the independent variable.</li> <li>2. Identify the dependent variable.</li> </ol>
	WS3.7 WS2.2	<ol style="list-style-type: none"> <li>3. Suggest as many control variables as possible. Why do they need to be controlled?</li> </ol>
		<ol style="list-style-type: none"> <li>4. Draw a results table that the students could put their results in (not forgetting to include units in the headings where appropriate).</li> </ol>
		<ol style="list-style-type: none"> <li>5. Suggest a common source of error for this experiment and suggest what could be done to reduce this error.</li> </ol>

**Physical Chemistry**
**Book Ref.**
**Spec. Ref.**
**Exothermic and endothermic reactions**

 CS  
5.5.1.2

 Triple  
4.5.1.2

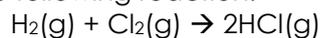
1. What must happen to particles in order for them to react?
2. Define the term activation energy.



3. Is the following endothermic or exothermic? Explain why.

4. Draw a simple reaction profile diagram for an exothermic reaction. Show the relative energies of reactants and products, the activation energy and the overall energy change, with a curved line to show how the energy as the reaction proceeds

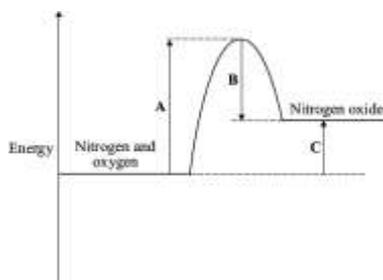
5. Draw a reaction profile for the following reaction:



The energy transferred to the surroundings is +184kJ/mol

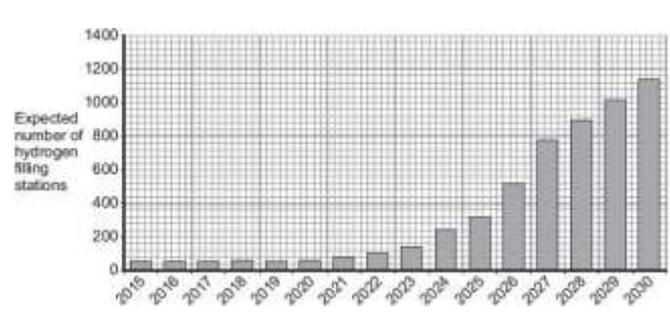
**Prove it!**

The energy level diagram for the reaction between nitrogen and oxygen is shown:

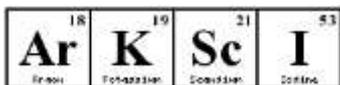


Use the energy level diagram to help you to answer these questions.

- (i) Which energy change, **A**, **B** or **C**, represents the *activation energy*?
- (ii) Which energy change, **A**, **B** or **C**, shows that this reaction is *endothermic*?

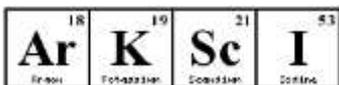
Physical Chemistry																																				
Book Ref.	Spec. Ref.	Chemical cells and fuel cells																																		
	4.5.2.2	<ol style="list-style-type: none"> <li>Define the term 'fuel cell'.</li> <li>In a hydrogen fuel cell, which gases are pumped into the fuel cell?</li> <li>What is the waste product of the fuel cell?</li> <li>Write a word equation for the overall reaction in the fuel cell.</li> <li>(HT only) Write two half equations that show what happens to both hydrogen and oxygen gases in a hydrogen fuel cell.</li> <li>Identify 3 advantages of hydrogen fuel cells.</li> <li>Identify 3 disadvantages of hydrogen fuel cells.</li> </ol>																																		
<p><b>Prove it!</b></p> <p>Owners of cars powered by fuel cells buy hydrogen from hydrogen filling stations. <b>Figure 2</b> shows how the number of hydrogen filling stations in the UK is expected to increase up to the year 2030.</p>  <table border="1"> <caption>Data for Figure 2: Expected number of hydrogen filling stations in the UK</caption> <thead> <tr> <th>Year</th> <th>Expected number of hydrogen filling stations</th> </tr> </thead> <tbody> <tr><td>2015</td><td>50</td></tr> <tr><td>2016</td><td>60</td></tr> <tr><td>2017</td><td>70</td></tr> <tr><td>2018</td><td>80</td></tr> <tr><td>2019</td><td>100</td></tr> <tr><td>2020</td><td>120</td></tr> <tr><td>2021</td><td>150</td></tr> <tr><td>2022</td><td>200</td></tr> <tr><td>2023</td><td>250</td></tr> <tr><td>2024</td><td>300</td></tr> <tr><td>2025</td><td>350</td></tr> <tr><td>2026</td><td>500</td></tr> <tr><td>2027</td><td>750</td></tr> <tr><td>2028</td><td>900</td></tr> <tr><td>2029</td><td>1000</td></tr> <tr><td>2030</td><td>1150</td></tr> </tbody> </table> <p>Use the information in <b>Figure 2</b> and your own knowledge to answer this question. Suggest <b>two</b> reasons why the UK government might encourage the building of more hydrogen filling stations. (2)</p>			Year	Expected number of hydrogen filling stations	2015	50	2016	60	2017	70	2018	80	2019	100	2020	120	2021	150	2022	200	2023	250	2024	300	2025	350	2026	500	2027	750	2028	900	2029	1000	2030	1150
Year	Expected number of hydrogen filling stations																																			
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2027	750																																			
2028	900																																			
2029	1000																																			
2030	1150																																			

Physical Chemistry		
Book Ref.	Spec. Ref.	The rate and extent of chemical change Calculating Rates of Reaction and Factors Affecting Rate
	CS 5.6.1.1 5.6.1.2  Triple 4.6.1.1 4.6.1.2	1. What is meant by 'rate of a chemical reaction'?  2. What are the two ways to work out the rate of a chemical reaction? Give the units.  3. (HT only) What does the gradient of the line on a graph plotting [product] against time tell you about the rate of reaction?  4. What are the 5 factors that affect rate of reaction (be specific to the state of matter where appropriate).
	MS2a MS2b MS4e	<p style="text-align: center;"><b>Maths Skills</b></p> <p>(e) Another student investigated the rate of reaction by measuring the change in mass.</p> <p>Figure 3 shows the graph plotted from this student's results.</p> <p style="text-align: center;">Figure 3</p> <p>e) Calculate the mean rate of the reaction up to the time the reaction is complete. Give your answer to 3 significant figures. (4)</p> <p>f) Determine the rate of reaction at 150 seconds. Show your working on the graph above. Give your answer in standard form (4)</p>

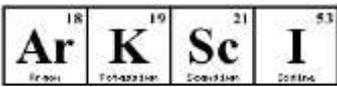


Physical Chemistry		
Book Ref.	Spec. Ref.	Collision Theory and Activation Energy
	CS 5.6.1.3  Triple 4.6.1.3	<ol style="list-style-type: none"> <li>1. Use the collision theory to explain why only some collisions result in a chemical reaction.</li> <li>2. Define the term activation energy.</li> <li>3. How do the following affect the rate of reaction in terms of increasing frequency of collisions:               <ol style="list-style-type: none"> <li>a) Increase in pressure</li> <li>b) Increase in surface area</li> <li>c) Decrease in concentration</li> <li>d) Use of a catalyst</li> </ol> </li> <li>4. Explain <b>2 reasons</b> why increasing the temperature increases the rate of reaction.</li> <li>5. What is the relationship between the size of pieces of solid material and its surface area to volume ratio?</li> </ol>
	MS5c MS1d	<p style="text-align: center;"><b>Maths skills</b></p> <p>In an investigation of the reaction between zinc and dilute sulfuric acid, a student compared the rates of reaction by measuring the time taken for a set volume of hydrogen gas (250cm<sup>3</sup>) to be given off. The student tested 2 different sized zinc granules and then zinc pellets of equal mass. The granules took 225s to disappear and the pellets took 113s</p> <ol style="list-style-type: none"> <li>1. Calculate the mean rate of reaction with the granules and with the pellets. Include units.</li> <li>2. Estimate how much larger the surface area to volume ratio is for the pellets compared to the granules.</li> <li>3. Imagine the granules were cubes with sides of 0.1mm. Calculate the surface area, the volume and the surface area to volume ratio for 1 granule of zinc.</li> </ol>

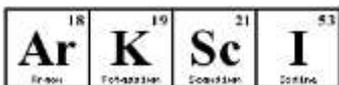
Physical Chemistry		
Book Ref.	Spec. Ref.	Required practical 11 (CS) Required practical 5 (Triple)
	CS 5.6.1.2	Investigate how changes in concentration affect the rates of reaction by a method involving the volume of a gas produced and a method involving a change in colour or turbidity.
	Triple 4.6.1.2	1. What does the term 'turbidity' mean? How could you use this to measure a rate of reaction for a give chemical change?
	AT 1,3,5 and 6	2. Suggest another method of measuring the rate of reaction that involves a gas syringe.
	WS2.2	3. A student investigated the rate of reaction of magnesium and hydrochloric acid. $\text{Mg(s)} + 2\text{HCl(aq)} \longrightarrow \text{MgCl}_2\text{(aq)} + \text{H}_2\text{(g)}$ The student studied the effect of changing the concentration of the hydrochloric acid. She measured the time for the magnesium to stop reacting.  <p style="text-align: center;"> <span style="margin-right: 20px;">0.5</span> <span style="margin-right: 20px;">1.0</span> <span style="margin-right: 20px;">1.5</span> <span>2.0</span> </p> <p style="margin-left: 20px;">                         Concentration of hydrochloric acid in moles per dm<sup>3</sup> </p>
		(a) The student changed the concentration of the hydrochloric acid. Give <b>two</b> variables that the student should control. 1 ..... 2 ..... <span style="float: right;"><b>(2)</b></span>
		(b) (i) The rate of reaction increased as the concentration of hydrochloric acid increased. Explain why. <span style="float: right;"><b>(2)</b></span>
		(ii) Explain why increasing the temperature would increase the rate of reaction. <span style="float: right;"><b>(3)</b></span>



Physical Chemistry										
Book Ref.	Spec. Ref.	Rate of reaction								
	CS 5.6.1.4  Triple 4.6.1.4	<ol style="list-style-type: none"> <li>1. What is a catalyst?</li> <li>2. How does a catalyst affect the rate of a chemical reaction? How does it do this?</li> <li>3. Why is a catalyst not included in the reactants of a word equation for a reaction?</li> <li>4. What are enzymes?</li> <li>5. Draw a reaction profile for an endothermic reaction showing the activation energy with a catalyst and without a catalyst.</li> <li>6. Explain catalytic action in terms of activation energy.</li> </ol>								
		<div style="border: 1px solid black; padding: 10px;"> <p style="text-align: center;"><b>Prove it!</b></p> <p>Nitrogen and hydrogen are passed over iron to produce ammonia in the Haber Process.</p> <p>Balance the equation for the reaction.</p> <math display="block">\text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3</math> <p style="text-align: right;">(1)</p> <p>What is iron used for in the Haber process?</p> <p>Tick <b>one</b> box.</p> <table style="width: 100%;"> <tr> <td style="width: 80%;">catalyst</td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>fuel</td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>monomer</td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td>reactant</td> <td style="text-align: center;"><input type="checkbox"/></td> </tr> </table> <p style="text-align: right;">(1)</p> </div>	catalyst	<input type="checkbox"/>	fuel	<input type="checkbox"/>	monomer	<input type="checkbox"/>	reactant	<input type="checkbox"/>
catalyst	<input type="checkbox"/>									
fuel	<input type="checkbox"/>									
monomer	<input type="checkbox"/>									
reactant	<input type="checkbox"/>									



Physical Chemistry		
Book Ref.	Spec. Ref.	Reversible reactions and dynamic equilibrium
	CS 5.6.2.1 5.6.2.2 5.6.2.3  Triple 4.6.2.1 4.6.2.2 4.6.2.3	<ol style="list-style-type: none"> <li>Define a reversible reaction.</li> <li>Write a word equation for hydrated copper sulfate becoming anhydrous copper sulfate and water. Include the reversible reaction symbol.</li> <li>Add the colours of the compounds to the equation above.</li> <li>If the forward direction of a reversible reaction is exothermic, what must the backward reaction be?</li> <li>A reaction takes in 203kJ of energy in the forward reaction. What will happen when the reaction is reversed?</li> <li>Under what conditions will equilibrium be reached?</li> </ol>
		<div style="border: 1px solid black; padding: 10px;"> <p style="text-align: center;"><b>Prove it!</b></p> <p>Hydrated copper sulphate is a blue solid. When it is heated, white solid anhydrous copper sulphate is made. This is a reversible reaction.</p> <p style="text-align: center;">             hydrated copper sulphate [ + heat energy ] <math>\rightleftharpoons</math> anhydrous copper sulphate + water              (blue) (white)           </p> <p>(a) To make the forward reaction work, the hydrated copper sulphate must be heated all the time.</p> <p>What type of reaction is this?</p> <p>.....</p> <p>.....</p> <p style="text-align: right;">(1)</p> <p>(b) Anhydrous copper sulphate can be used in a test for water. What <b>two</b> things will happen when water is added to anhydrous copper sulphate?</p> <p>1 .....</p> <p>.....</p> <p>2 .....</p> <p>.....</p> <p style="text-align: right;">(2)</p> </div>



Physical Chemistry		
Book Ref.	Spec. Ref.	Reversible reactions and dynamic equilibrium (HT only)
	CS 5.6.2.4 (HT) 5.6.2.5 (HT)  Triple 4.6.2.4 (HT) 4.6.2.5 (HT)	<ol style="list-style-type: none"> <li>Describe Le Chatelier's Principle.</li> <li>How will a system respond if the concentration of a reaction is increased?</li> <li>How will a system respond if the concentration of reaction is decreased?</li> <li>An equilibrium mixture is set up in a closed system with iodine monochloride, chlorine gas, and iodine trichloride.               <math display="block">\text{ICl} + \text{Cl}_2 \rightarrow \text{ICl}_3</math> <p>In order to make more iodine trichloride, would you pump more gas into the mixture or remove chlorine gas? Explain your answer using Le Chatelier's Principle.</p> </li> </ol>
	MS3a	Maths Skills  What do the following symbols mean: a) = b) < c) << d) >> e) > f) ~ g) $\propto$

**Physical Chemistry**
**Book Ref.**
**Spec. Ref.**
**Reversible reactions and dynamic equilibrium (HT only)**

1. Complete the table to describe the effect of temperature change on the amount of products in a reaction:

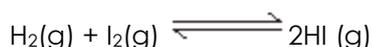
	Increase Temperature	Decrease Temperature
Exothermic Forward Reaction		
Endothermic Forward Reaction		

2. Look at the reaction below:



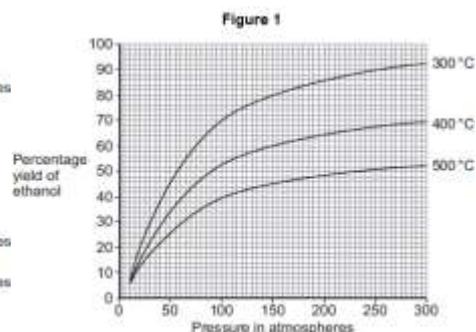
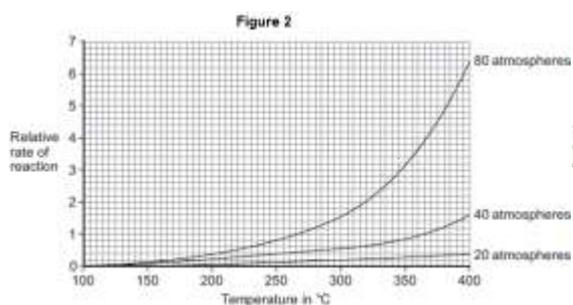
The forward reaction is endothermic. Describe how the amount of  $\text{H}_2(\text{g})$  will change if temperature is increased.

3. Explain what effect increasing the pressure would have on the equilibrium mixture below:


**Prove it!**

Ethanol can be made by reacting ethene with steam in the presence of a catalyst with the following equation:  $\text{C}_2\text{H}_4(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{C}_2\text{H}_5\text{OH}(\text{g})$

**Figure 1** shows how the percentage yield of ethanol changes as the pressure is changed at three different temperatures. **Figure 2** shows how the rate of reaction changes as the temperature changes at three different pressures.



In one process for the reaction of ethene with steam the conditions are; 300 °C, 65 atmospheres, a catalyst.

Use the information in **Figure 1** and **Figure 2**, and your own knowledge, to justify this choice of conditions. (6)

Physical Chemistry																				
Book Ref.	Spec. Ref.	Graph Skills																		
WS3.1 WS3.2  MS4a MS4c		<table border="1" style="width: 100%; border-collapse: collapse; margin-bottom: 10px;"> <thead> <tr> <th style="width: 50%; padding: 5px;">Mass of lithium carbonate in g</th> <th style="width: 50%; padding: 5px;">Volume of gas in cm<sup>3</sup></th> </tr> </thead> <tbody> <tr><td style="text-align: center;">0.0</td><td style="text-align: center;">0</td></tr> <tr><td style="text-align: center;">0.1</td><td style="text-align: center;">22</td></tr> <tr><td style="text-align: center;">0.2</td><td style="text-align: center;">44</td></tr> <tr><td style="text-align: center;">0.3</td><td style="text-align: center;">50</td></tr> <tr><td style="text-align: center;">0.4</td><td style="text-align: center;">88</td></tr> <tr><td style="text-align: center;">0.5</td><td style="text-align: center;">96</td></tr> <tr><td style="text-align: center;">0.6</td><td style="text-align: center;">96</td></tr> <tr><td style="text-align: center;">0.7</td><td style="text-align: center;">96</td></tr> </tbody> </table> <p><b>On Figure 3:</b></p> <ul style="list-style-type: none"> <li>• Plot these results on the grid.</li> <li>• Complete the graph by drawing <b>two</b> straight lines of best fit.</li> </ul> <div style="text-align: center; margin-top: 20px;"> </div>	Mass of lithium carbonate in g	Volume of gas in cm <sup>3</sup>	0.0	0	0.1	22	0.2	44	0.3	50	0.4	88	0.5	96	0.6	96	0.7	96
Mass of lithium carbonate in g	Volume of gas in cm <sup>3</sup>																			
0.0	0																			
0.1	22																			
0.2	44																			
0.3	50																			
0.4	88																			
0.5	96																			
0.6	96																			
0.7	96																			
		(4)																		

**Physical Chemistry**

**Graph Skills**

Book Ref.

Spec. Ref.

The table below shows the student's results.

Time in s	Volume of gas in dm <sup>3</sup>
0	0.000
30	0.030
60	0.046
90	0.052
120	0.065
150	0.070
180	0.076
210	0.079
240	0.080
270	0.080

On Figure 2:

- Plot these results on the grid.
- Draw a line of best fit.

**Figure 2**

Volume of gas in dm<sup>3</sup>



Time in s

(4)

