GCSE

WJEC GCSE in

CHEMISTRY

APPROVED BY QUALIFICATIONS WALES

SAMPLE ASSESSMENT MATERIALS

Teaching from 2016

This Qualifications Wales regulated qualification is not available to centres in England.

For teaching from 2016
For award from 2018

GCSE CHEMISTRY

SAMPLE ASSESSMENT MATERIALS

Contents

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

CHEMISTRY

UNIT 1: CHEMICAL SUBSTANCES, REACTIONS AND ESSENTIAL RESOURCES
FOUNDATION TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 45 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**7**	
3.	**8**	
4.	**7**	
5.	**6**	
6.	**5**	
7.	**8**	
8.	**9**	
9.	**9**	
10.	**11**	
Total	**80**	

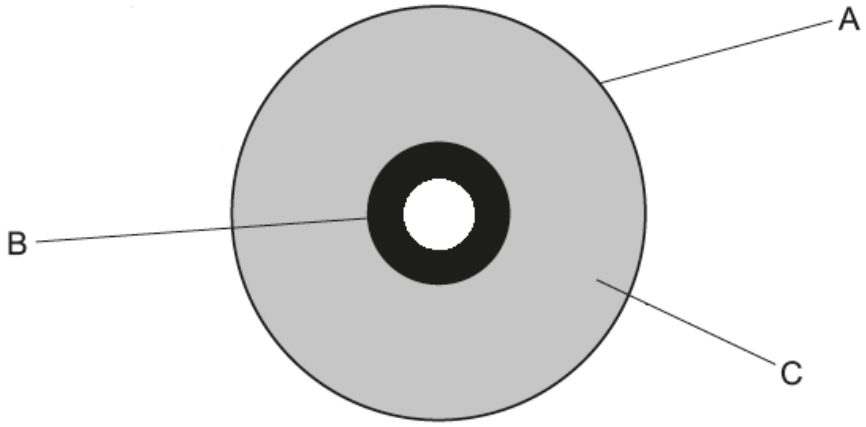
ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **5** is a quality of extended response (QER) question where your writing skills will be assessed.

Answer **all** *questions.*

1. The layered structure of the Earth is shown in the diagram.

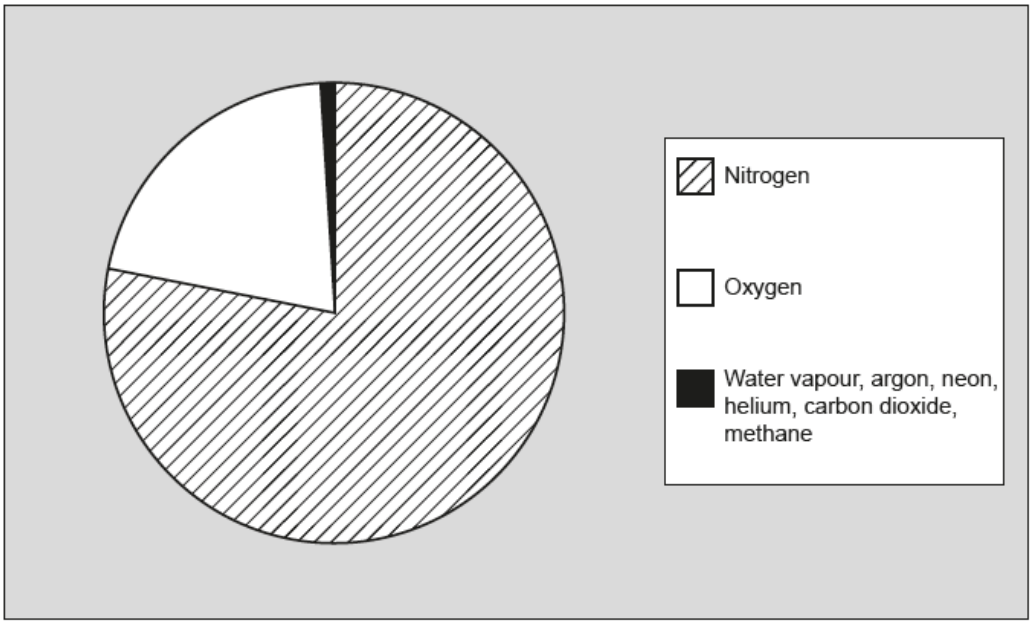


Earth

(a) Draw a line from each letter to the correct name of layer. [3]

A	**mantle**
B	**crust**
C	**outer core**
	inner core

(b) The chart shows the gases present in today's atmosphere.



The named gases have many uses. Select the correct gas from the chart to match each of the following descriptions.

Each gas may be used once, more than once or not at all.

(i) The gas used in weather balloons. …… [1]

(ii) One of the gases that formed the early atmosphere. [1]

……

(iii) The gas produced by burning natural gas and responsible for global warming. [1]

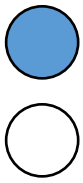
……

(c) Describe the test that can be used in the laboratory to test for oxygen gas. Include the observation that tells you the gas is oxygen. [2]

…….....

……..

(d) Use the following key to draw diagrams to represent molecules of oxygen gas (O_2) and carbon dioxide (CO_2). [2]



carbon

oxygen

oxygen	carbon dioxide

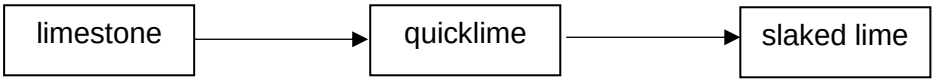
10

2. Limestone has many different uses.

(a) Tick (✓) the **two** boxes that show a use of limestone. [2]

making dyes	☐
making glass	☐
extraction of aluminium	☐
making cement	☐
making plastics	☐

(b) The flowchart shows the materials that can be formed from limestone.



(i) What is done to limestone to change it to quicklime? [1]

……

……

(ii) Water is added to quicklime to form slaked lime. Give **two** observations you would make during this reaction. [2]

……

……

(c) Limestone is obtained by quarrying. State and explain **one** argument used by people who oppose the opening of a quarry in their area. [2]

……..

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……..

7

3. The Sun contains mainly the elements hydrogen and helium.

(a) State what you understand by the term *element.* [2]

……..

……..

(b) The diagrams show an atom of hydrogen and an atom of helium. Use the diagrams to help you complete the sentences below.

(i) The symbol ● represents a ……. [1]

(ii) The mass number of this helium atom is …… [1]

(c) The Sun is 72 % hydrogen and 26 % helium. The rest is made from other elements. Calculate the percentage of other elements in the Sun. [1]

percentage = ……%

(d) Neon is directly below helium in the Periodic Table. It has three stable isotopes – neon-20, neon-21 and neon-22.

(i) Draw a diagram to show the electronic structure of neon. [1]

(ii) Describe how the nuclei of neon-20, neon-21 and neon-22 are similar and how they are different. [2]

……..

……..

……..

8

4. This question is about elements, compounds and mixtures.

(a) Refer to the table of common ions and the Periodic Table to answer parts (i)-(iv).

(i) Name the metal that has an atomic number of 64. [1]

……..

(ii) Name a non-metal which is found in Period 3 of the Periodic Table. [1]

……..

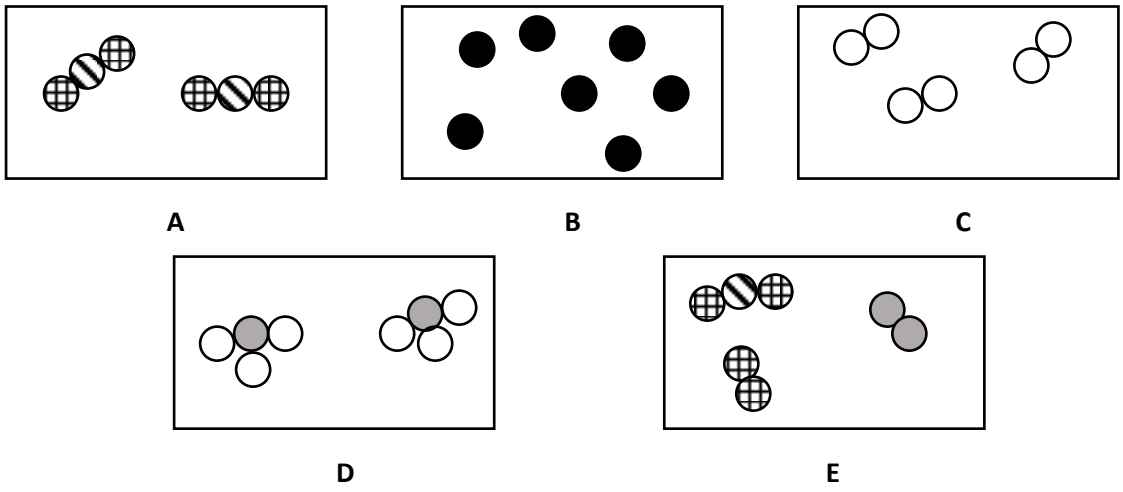
(iii) Give the chemical formula of the product formed when lithium reacts with oxygen. [1]

……..

(iv) Give the chemical formula of the compound in a solution which gives an apple-green flame test and a white precipitate with silver nitrate solution. [2]

……..

(b) Five different substances (**A**, **B**, **C**, **D** and **E**) are shown in the diagrams.



Identify the substances which are compounds and those which are mixtures. Write the appropriate letters in the correct columns. [2]

Compound	**Mixture**

5. Burning fossil fuels such as coal causes acid rain. Describe how acid rain is formed and its effects on the environment. [6 QER]

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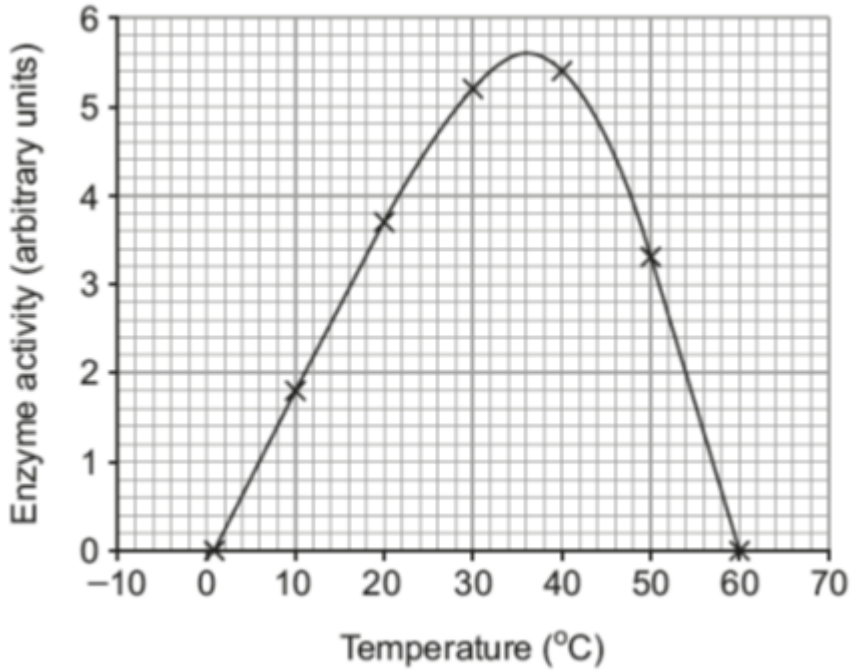
6

6. The activity of an enzyme at various temperatures is shown in the graph.



Use the graph to answer parts (a)-(c).

(a) State the temperature at which the enzyme activity is highest. [1]

temperature = …… °C

(b) Calculate the difference between the enzyme activity at 10 °C and 30 °C. [2]

difference = ……. arbitrary units

(c) Pepsin is an enzyme which breaks down proteins in the stomach. Its optimum activity is pH 2. Describe how this property of pepsin is different from most enzymes. [2]

……..

……..

……..

5

7. Potassium reacts vigorously with water forming potassium hydroxide and hydrogen gas, H_2.

(a) Complete and balance the symbol equation for this reaction. [2]

$2K + 2H_2O \rightarrow$ …….. + ……

(b) Give **two** observations made when potassium reacts with water in a large trough. [2]

1. ……..

2. ……..

(c) Caesium is an element in the same group as potassium. State why the reaction of caesium with water is not shown as a classroom demonstration. [1]

……..

……..

(d) Potassium hydroxide reacts with nitric acid forming potassium nitrate (KNO_3) and with sulfuric acid forming potassium sulfate (K_2SO_4).

A student told her teacher that K_2SO_4 contains a greater percentage by mass of oxygen than is found in KNO_3. Is she correct? Show your working. [3]

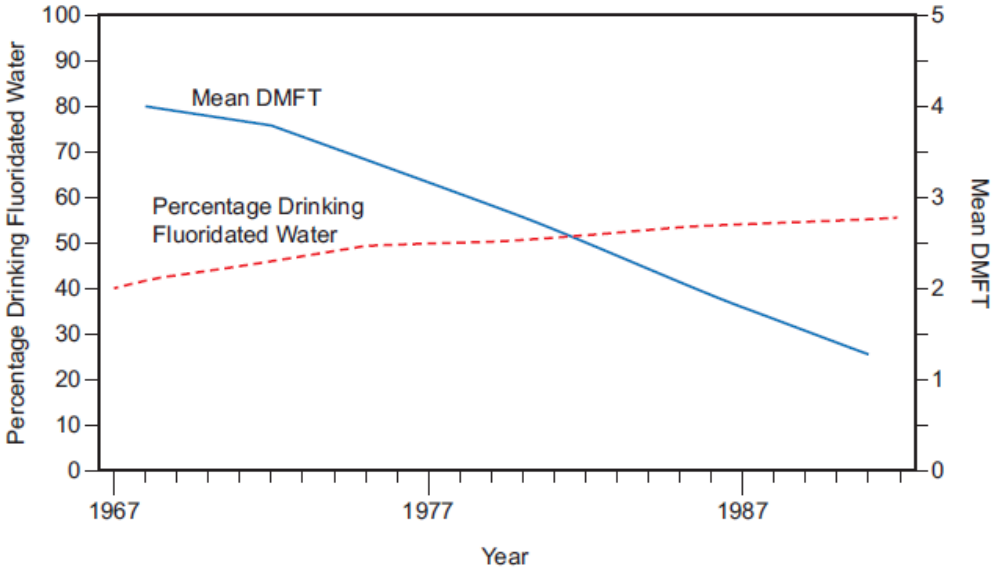
A_r(K) = 39 A_r(N) = 14 A_r(O) = 16 A_r(S) = 32

……..

……..

8

8. (a) The graphs show the percentage of people drinking fluoridated water in the U.S.A. and the mean number of decayed, missing or filled teeth (DMFT) among children aged 12 years between 1967 and 1992.



(i) Describe the relationship between the percentage of people drinking fluoridated water and the mean DMFT between 1967 and 1992. [1]

……

……

(ii) Which of the following would have provided the data plotted in these graphs? Tick (✓) two boxes. [2]

Internet search	☐
Dental records	☐
Water company records	☐
Experiments	☐
Newspapers	☐

(iii) Explain why the graphs alone do not provide enough evidence to support the fluoridation of drinking water. [3]

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……

(b) The table below shows the volume of soap solution required by different samples of water to form a permanent lather. In each case 25 cm^3 of the water samples were used and the soap solution was added 1 cm^3 at a time.

Sample	**Mean volume of soap solution added (cm^3)**
distilled water	2
A before boiling	8
B before boiling	11
C before boiling	14
A after boiling	8
B after boiling	6
C after boiling	2

(i) State which of water samples **A**, **B** or **C** is the least hard **before** boiling. Give the reason for your answer. [1]

……

……

(ii) Why was each sample boiled? [1]

……

(iii) State which of samples **A**, **B** or **C** contains both temporary and permanent hardness. Give the reason for your answer. [1]

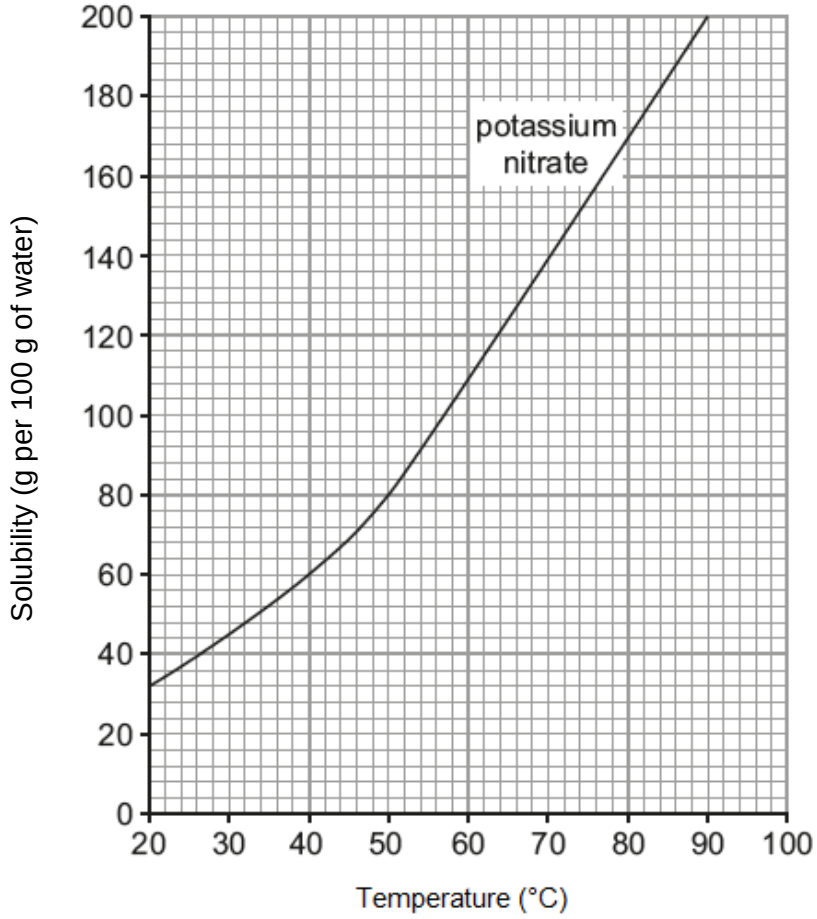
……

……

……

9

9. The graph shows the solubility curve of potassium nitrate.



(a) The table shows the solubility of lead nitrate at different temperatures.

Temperature (°C)	20	40	60	80	100
Solubility of lead nitrate (g per 100 g of water)	52	72	90	112	136

(i) Plot the solubility of lead nitrate on the grid above. [3]

(ii) Using the graphs, compare the solubilities of potassium nitrate and lead nitrate between 20 °C and 100 °C. [3]

……..

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……

(b) Lucy wanted to find the solubility of substance **X** at room temperature. She measured 20.0 g of the substance into a conical flask and added 50.0 g of water. She stirred the mixture carefully until no more solid dissolved. She then separated the undissolved solid using a filter paper and dried the paper and solid overnight before weighing.

Her results were as follows.

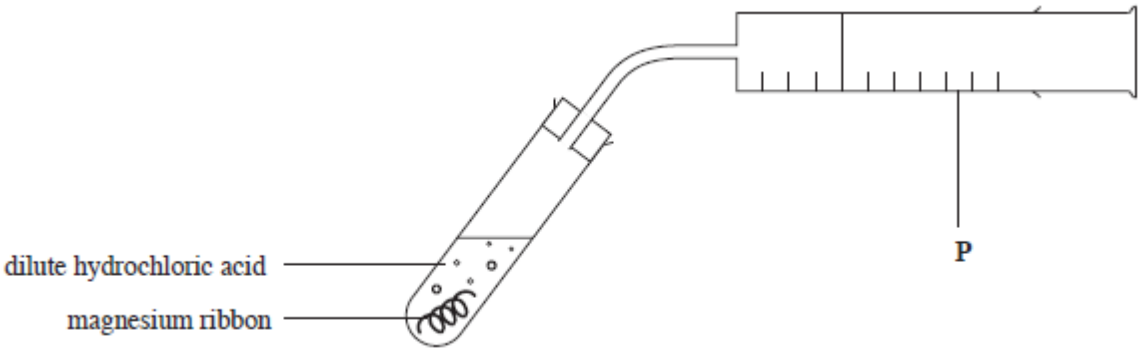
Mass of dry filter paper + substance **X** = 5.1 g
Mass of dry filter paper = 0.2 g

Use this information to calculate the solubility of substance **X** in g per 100 g of water. [3]

solubility = …… g per 100 g of water

9

10. Trystan carried out an investigation into the reaction between dilute hydrochloric acid (HCl) and magnesium ribbon. He reacted the magnesium with five different concentrations of acid and measured the volume of hydrogen gas produced after 30 s using the apparatus below.



(a) Name apparatus **P**. …….. [1]

(b) Trystan's result are shown below.

Concentration of HCl (mol/dm^3)	**Volume of H_2 gas produced (cm^3)**
0.2	8
0.5	17
1.0	26
1.5	30
2.0	30

(i) State what can be concluded about the effect of concentration of acid on the rate of the reaction. Explain this effect using your understanding of particle theory. [3]

……

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(ii) Trystan initially measured the volume of gas collected in 60 s. Explain why he amended his plan after making these measurements. [2]

……

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……

(iii) State **two** factors other than concentration which could affect the rate of the reaction between hydrochloric acid and magnesium. [2]

Factor 1……

Factor 2……

(c) Limestone is made of calcium carbonate. It reacts slowly with acid rain and is gradually eaten away.

Design an experiment based on this reaction to identify which of three samples of rainwater is the most acidic. [3]

……

……

……

……

END OF PAPER

FORMULAE FOR SOME COMMON IONS

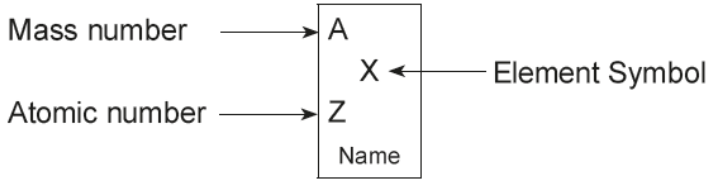
POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^-
Ammonium	NH_4^+	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^-
Calcium	Ca^{2+}	Fluoride	F^-
Copper(II)	Cu^{2+}	Hydroxide	OH^-
Hydrogen	H^+	Iodide	I^-
Iron(II)	Fe^{2+}	Nitrate	NO_3^-
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^+	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^+		
Silver	Ag^+		
Sodium	Na^+		
Zinc	Zn^{2+}		

Avogadro's number, $L = 6 \times 10^{23}$

PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:



UNIT 1: CHEMICAL SUBSTANCES, REACTIONS AND ESSENTIAL RESOURCES
FOUNDATION TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

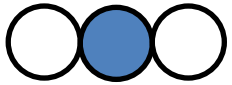
Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

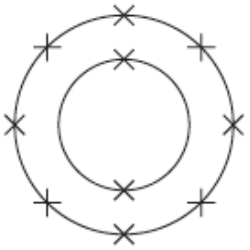
Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			Award (1) for each correct answer **A** – Crust **B** – Outer core **C** – Mantle	3			3		
	(b)	(i)		Helium	1			1		
		(ii)		Award (1) for any of following Carbon dioxide Water vapour Methane	1			1		
		(iii)		Carbon dioxide	1			1		
	(c)			Glowing / smouldering splint (1) Reignites (1)	2			2		2
	(d)			Award (1) for each correct diagram  oxygen  carbon dioxide		2		2		
				Question 1 total	**8**	**2**	**0**	**10**	**0**	**2**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			Award (1) for each correct answer [max (1) if three boxes ticked] Making glass Making cement	2			2		
	(b)	(i)		Heated strongly / for several minutes	1			1		1
		(ii)		Award (1) for each of following Goes crumbly / breaks up / puffs up Forms steam / hisses	2			2		2
	(c)			Award (1) for disadvantage and (1) for sensible development of point e.g. Creates dust – from blasting, lorries Creates noise – from blasting, lorries Ruins landscape – unpleasant for residents, affects property prices Destroys habitats – harms wildlife	2			2		
				Question 2 total	**7**	**0**	**0**	**7**	**0**	**3**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			Award (1) for each point Substance that contains one type of atom Cannot be broken down by chemical means / to a simpler substance	2			2		
	(b)	(i)		Neutron	1			1		
		(ii)		3		1		1	1	
	(c)			2		1		1	1	
	(d)	(i)				1		1		
		(ii)		All three have 10 protons (1) Neon-20 has 10 neutrons, neon-21 has 11 and neon-22 has 12 (1)		2		2	1	
				Question 3 total	**3**	**5**	**0**	**8**	**3**	**0**

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks Available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>4</td><td>(a)</td><td>(i)</td><td></td><td>Barium</td><td></td><td>1</td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>Any of following for (1)
Phosphorus
Sulfur
Chlorine
Argon</td><td></td><td>1</td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td></td><td>Li_2O</td><td></td><td>1</td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(iv)</td><td></td><td>$BaCl_2$ (2)

If formula is incorrect award (1) for identification of either barium or chloride ions</td><td></td><td>2</td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td></td><td><table><tr><th>Compound</th><th>Mixture</th></tr><tr><td>A, D (1)
Both needed</td><td>E (1)</td></tr></table></td><td></td><td>2</td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 4 total</td><td>0</td><td>7</td><td>0</td><td>7</td><td>0</td><td>0</td></tr>
</table>

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5				***Indicative content*** • All rainwater is slightly acidic • Sulfur is present as an impurity in coal and forms sulfur dioxide gas when it burns • $S + O_2 \rightarrow SO_2$ • Sulfur dioxide enters the atmosphere and reacts with / dissolves in rainwater • Produces significantly acidic solution / sulfuric acid which falls as acid rain • Acid rain erodes limestone statues and buildings, corrodes metal structures such as bridges • Acid rain damages plants and vegetation and aquatic life **5–6 marks** Comprehensive description of the formation of acid rain, including the presence of sulfur impurities in fossil fuels; sulfur combustion equation; at least three effects on the environment, including one effect on a material and one effect on a living organism *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3–4 marks** Basic description involving formation of sulfur dioxide gas which dissolves in rainwater; at least one effect on a material and one effect on a living organism *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1–2 marks** Reference to formation of sulfur dioxide gas or sulfur dioxide dissolving in rainwater; one effect of acid rain *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure*. *The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks** *No attempt made or no response worthy of credit.*	6			6		
				Question 5 total	**6**	**0**	**0**	**6**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			36 °C Accept 35-37		1		1	1	
	(b)			3.4 (2) If answer is incorrect award (1) for indication that 1.8 and 5.2 have been read from graph		2		2	2	
	(c)			Award (1) for each of following pH 2 is low / strongly acidic Most enzymes are active at pH close to neutral / at pH around 6-8		1	1	2		2
				Question 6 total	**0**	**4**	**1**	**5**	**3**	**2**

Question				Marking details	Marks Available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
7	(a)			$2KOH + H_2$ (2) If equation is incorrect award (1) for correct formulae of both products		2		2	1	
	(b)			Award (1) each for any two of following Floats Moves around on surface Melts into ball Ignites and burns with lilac flame Fizzing / hissing noise	2			2		2
	(c)			Reaction too vigorous/explosive/dangerous		1		1		1
	(d)			$M_r(KNO_3)$ is 101 (1) $M_r(K_2SO_4)$ is 174 (1) Conclusion – 48 % oxygen in KNO_3 and 37 % oxygen in K_2SO_4 therefore she is not correct (1)			3	3	3	
				Question 7 total	**2**	**3**	**3**	**8**	**4**	**3**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)	(i)		As the percentage of people drinking fluoridated water increases the mean DMFT decreases			1	1		
		(ii)		Award (1) for each correct answer [max (1) if three boxes ticked] Dental records Water company records		2		2		
		(iii)		Award (1) for each of following Other factors may affect DMFT People may have got fluoride from other sources e.g. toothpaste / mouthwash Could be negative side-effects			3	3		
	(b)	(i)		**A** because it requires the smallest volume of soap to form a permanent lather			1	1		
		(ii)		To remove any temporary hardness	1			1		
		(iii)		**B** because it requires less soap after boiling but still requires more than distilled water			1	1		
				Question 8 total	**1**	**2**	**6**	**9**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)	(i)		All 5 points plotted correctly (2) [Credit (1) for 3 or 4 correct points] Straight line of best fit attempted (1)		2 1		3	3	3
		(ii)		Both increase as temperature increases (1) Any two of following for (1) each Solubilities the same at 50 °C KNO_3 more soluble than $Pb(NO_3)_2$ above 50 °C / KNO_3 less soluble than $Pb(NO_3)_2$ below 50°C KNO_3 increases much more than $Pb(NO_3)_2$		 2	1	 3	 1	
	(b)			4.9 g of substance **X** undissolved (1) 15.1 g of substance **X** has dissolved (in 50 g of water) (1) 30.2 (1) Award (3) for correct answer only		 3		 3	 3	 3
				Question 9 total	**0**	**7**	**2**	**9**	**7**	**6**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)			Gas syringe	1			1		1
	(b)	(i)		As concentration of acid increases the rate of reaction increases (1) Greater number of acid particles at higher concentration (1) Greater chance of (successful) collisions with magnesium / more (successful) collisions per second (1)	 1 1		1	 3		
		(ii)		No useful data was collected / 30 cm^3 of gas collected in most experiments (1) All the magnesium was used up well before 60 s / the final volume of gas was collected well before 60 s / the reaction was over well before 60 s (1)			 2	 2	1	 2
		(iii)		Temperature of the acid (1) Surface area of the magnesium (1)	 2			 2		
	(c)			Method – add three samples to water and measure loss of mass (1) Controlled variables – award (1) each for up to two of the following: same volume of each water sample same amount of time samples of same or similar size/shape/mass		 2	1	 3		3
				Question 10 total	**5**	**2**	**4**	**11**	**1**	**6**

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	8	2	0	10	0	2
2	7	0	0	7	0	3
3	3	5	0	8	3	0
4	0	7	0	7	0	0
5	6	0	0	6	0	0
6	0	4	1	5	3	2
7	2	3	3	8	4	3
8	1	2	6	9	0	0
9	0	7	2	9	7	6
10	5	2	4	11	1	6
TOTAL	32	32	16	80	18	22

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

CHEMISTRY

UNIT 1: CHEMICAL SUBSTANCES, REACTIONS AND ESSENTIAL RESOURCES
HIGHER TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 45 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**9**	
2.	**11**	
3.	**7**	
4.	**10**	
5.	**5**	
6.	**7**	
7.	**8**	
8.	**6**	
9.	**10**	
10.	**7**	
Total	**80**	

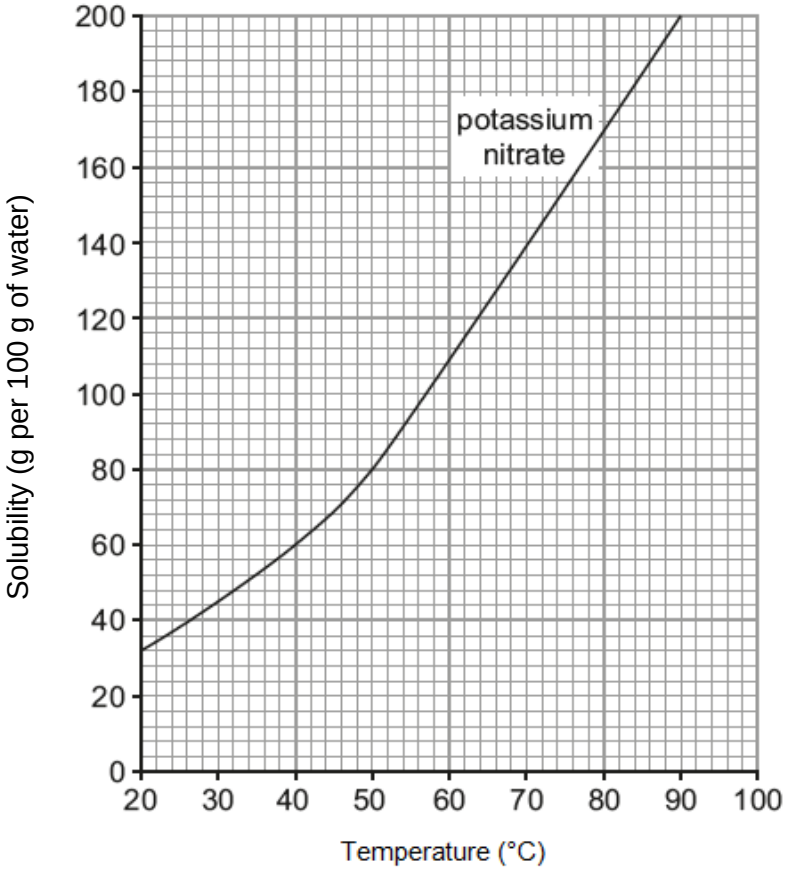
ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **8** is a quality of extended response (QER) question where your writing skills will be assessed.

Answer **all** *questions.*

1. The graph shows the solubility curve of potassium nitrate.



(a) The table shows the solubility of lead nitrate at different temperatures.

Temperature (°C)	20	40	60	80	100
Solubility of lead nitrate (g per 100 g of water)	52	72	90	112	136

(i) Plot the solubility of lead nitrate on the grid above. [3]

(ii) Using the graphs, compare the solubilities of potassium nitrate and lead nitrate between 20 °C and 100 °C. [3]

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(b) Lucy wanted to find the solubility of substance **X** at room temperature. She measured 20.0 g of the substance into a conical flask and added 50.0 g of water. She stirred the mixture carefully until no more solid dissolved. She then separated the undissolved solid using a filter paper and dried the paper and solid overnight before weighing.

Her results were as follows.

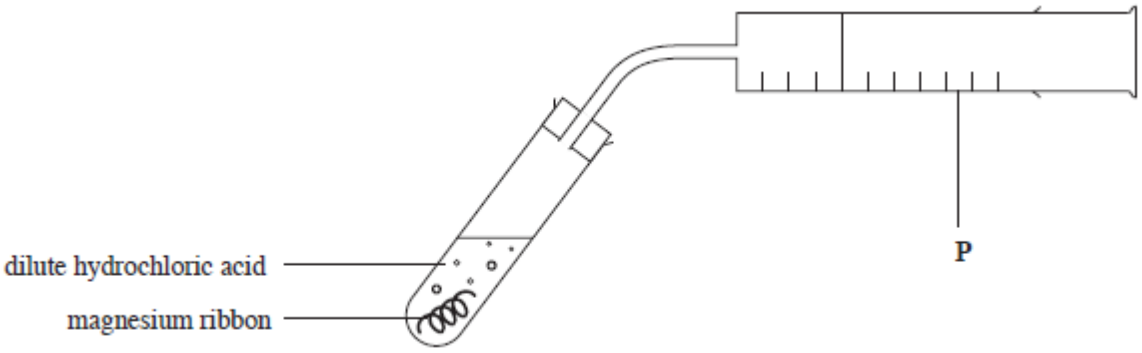
Mass of dry filter paper + substance **X** = 5.1 g
Mass of dry filter paper = 0.2 g

Use this information to calculate the solubility of substance **X** in g per 100 g of water. [3]

solubility = …… g per 100 g of water

9

2. Trystan carried out an investigation into the reaction between dilute hydrochloric acid (HCl) and magnesium ribbon. He reacted the magnesium with five different concentrations of acid and measured the volume of hydrogen gas produced after 30 s using the apparatus below.



(a) Name apparatus **P**. …….. [1]

(b) Trystan's result are shown below.

Concentration of HCl (mol/dm^3)	**Volume of H_2 gas produced (cm^3)**
0.2	8
0.5	17
1.0	26
1.5	30
2.0	30

(i) State what can be concluded about the effect of concentration of acid on the rate of the reaction. Explain this effect using your understanding of particle theory. [3]

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(ii) Trystan initially measured the volume of gas collected in 60 s. Explain why he amended his plan after making these measurements. [2]

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(iii) State **two** factors other than concentration which could affect the rate of the reaction between hydrochloric acid and magnesium. [2]

Factor 1……

Factor 2……

(c) Limestone is made of calcium carbonate. It reacts slowly with acid rain and is gradually eaten away.

Design an experiment based on this reaction to identify which of three samples of rainwater is the most acidic. [3]

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3. (a) Carbon dioxide and oxygen levels in the atmosphere are kept in balance by the carbon cycle. State and explain how **two** *biological* processes help keep this balance. [2]

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(b) Many scientists believe that an increase in the use of fossil fuels has led to global warming.

(i) Describe how global warming is different to the greenhouse effect. [1]

……

……

(ii) Describe **two** possible consequences of continued global warming over the next century. [2]

……

……

……

(iii) Explain the principle of carbon capture and storage as a method of limiting future global warming. [2]

……

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……

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7

4. (a) When a metal carbonate undergoes thermal decomposition it releases a gas and forms a metal oxide. The table gives the temperature at which some carbonates decompose.

Metal carbonate	**Decomposition temperature (˚C)**
calcium carbonate	840
copper(II) carbonate	290
magnesium carbonate	350
potassium carbonate	890

(i) State which carbonate is the most stable and give a reason for your answer. [1]

……

……

(ii) Describe an experiment to show the thermal decomposition of copper(II) carbonate. Include the observations made and state how you would collect and identify the gas formed.

You may include a diagram in your answer. [4]

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(iii) A student was given samples of each of these carbonates labelled **A**, **B**, **C** and **D**. He made the following observations.

Metal carbonate	Appearance	Colour seen in flame test
A	white powder	brick-red
B	white powder	lilac
C	green powder	green
D	white powder	no colour

State the conclusions that he should draw from both sets of observations. [2]

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(b) Metal nitrates, such as potassium nitrate, also undergo thermal decomposition.

(i) Balance the chemical equation for this reaction. [1]

$\square\ KNO_3 \rightarrow \square\ KNO_2 + O_2$

(ii) Calculate the percentage of oxygen present in KNO_3. [2]

A_r(K) = 39 A_r(N) = 14 A_r(O) = 16

percentage = …… %

10

5. Name **two** different types of tectonic plate boundary linked to volcanic activity. Describe and explain the processes taking place at both. [5]

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5

6. The table below shows information about three Group 7 elements.

Name	Melting point (°C)	Boiling point (°C)	Colour
bromine	–7	59	orange-brown
chlorine	–107	–35	yellow-green
iodine	114	184	grey

(a) Using the information in the table state the trend in melting points down Group 7 and give the physical states of each element at room temperature (20 °C). [3]

Trend in melting points ……

……

Physical states ……

……

……

(b) Astatine lies below iodine in the Periodic Table. Predict the melting point of astatine. Explain how you reach this conclusion. [1]

Melting point ……

Explanation ……...

……

(c) Chlorine has two naturally occurring isotopes – ^{35}Cl and ^{37}Cl. The isotope containing 18 neutrons makes up 75 % of all chlorine atoms.

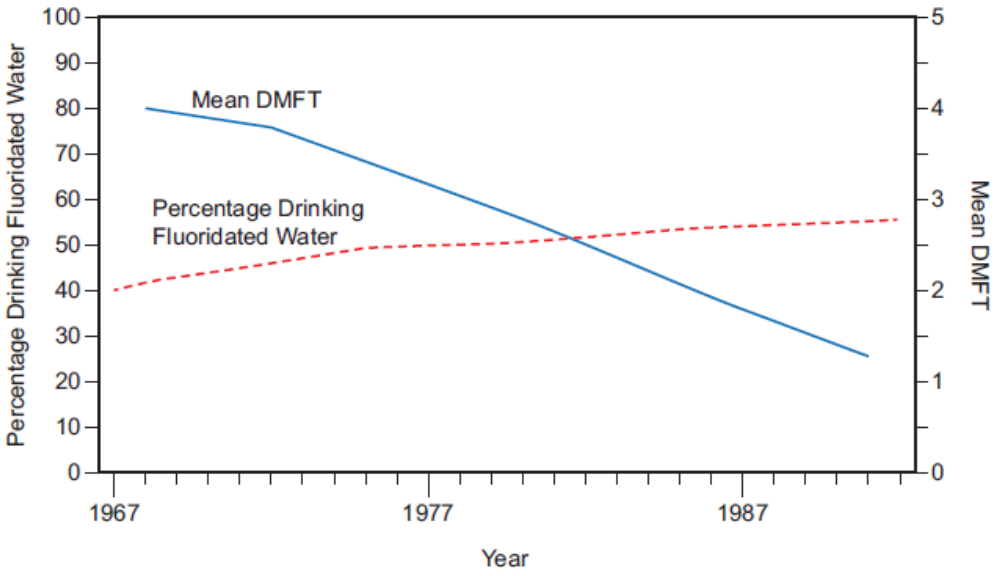
Calculate the relative atomic mass (A_r) of chlorine. [3]

A_r = …….

7

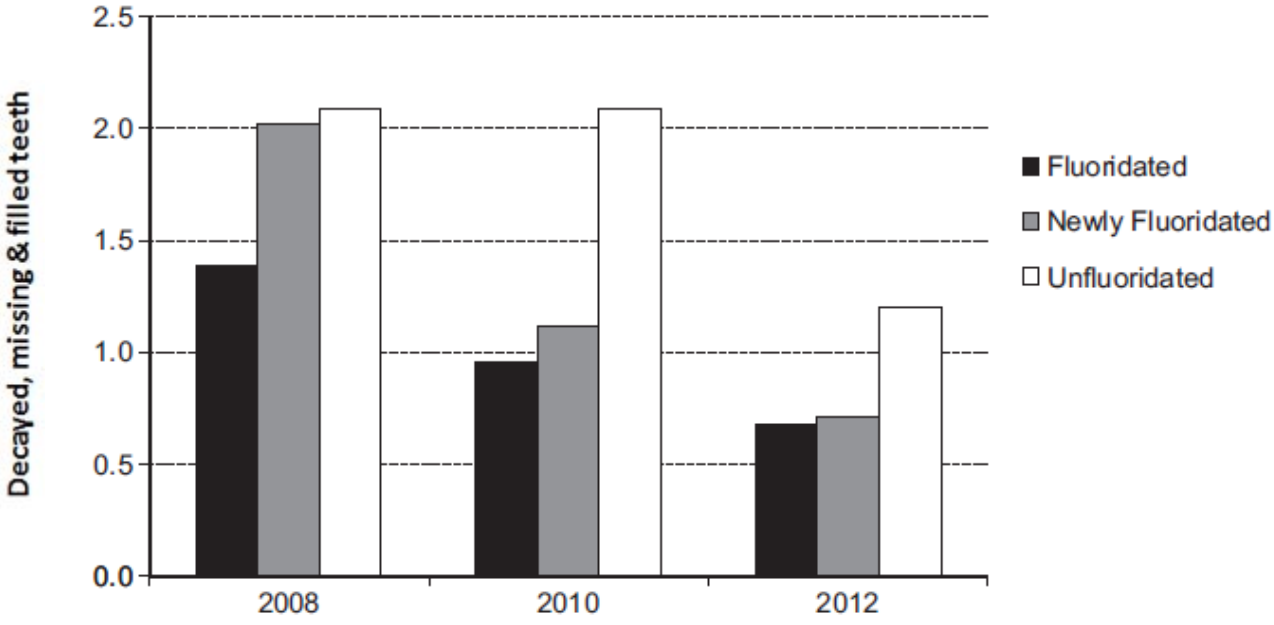
7. The graphs below show data on fluoridation of water and numbers of decayed, missing and filled teeth (DMFT) seen in the population of children aged 12.

Graph 1 shows data collated by the *Center of Disease Control* in the U.S.A. from 1967-1992.



Graph 1

Graph 2 shows data from an Australian dental paper comparing mean numbers of DMFT in three different areas. The fluoridated water area has had fluoride added to its water supply for over 20 years. The newly fluoridated area has had fluoride added since 2008. The unfluoridated area has never had fluoride added to its supply.



Graph 2

(a) Calculate the percentage decrease in mean DMFT in the newly fluoridated area between 2008 and 2010. [2]

decrease = …… %

(b) Suggest a possible reason why the levels of DMFT decreased in the unfluoridated area between 2010 and 2012. Explain your reasoning. [2]

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(c) A student claims that water should be fluoridated in order to decrease mean DMFT. Use the data from both graphs and your own knowledge to evaluate this claim. [4]

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8. Discuss the methods used to soften hard water. [6 QER]

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9. (a) The reactivity of Group 7 elements was investigated by reacting each halogen with solutions of each halide.

(i) Complete the table below by adding a tick (✓) to indicate that a reaction takes place and a cross (**×**) where no reaction occurs. [2]

Halogen	**Solution of halide ion**		
	sodium chloride	sodium iodide	sodium bromide
bromine, Br_2			
chlorine, Cl_2		✓	
iodine, I_2			

(ii) Explain the trend in reactivity in Group 7 in terms of electronic structure. [3]

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(iii) Write the balanced **symbol** equation for the reaction that takes place between chlorine and sodium iodide. [2]

…… + …… → …… + ……

(b) Bromine and fluorine can react together to form two different compounds. One of them has a relative molecular mass (M_r) of 137 while the other is formed from 355 g of bromine and 430 g of fluorine.

Deduce the formulae of both of these compounds. Show your working throughout. [3]

A_r(Br) = 80 A_r(F) = 19

Compound 1 ……

Compound 2 ……

10

10. (a) The contact process is used to produce sulfuric acid. One step in this process is the production of sulfur trioxide shown in the following equation.

$$SO_2 + O_2 \rightarrow SO_3$$

A catalyst of vanadium pentoxide is used in this step.

State the purpose of the catalyst and explain how it is effective in **this** reaction. [2]

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(b) The sulfur dioxide required in the above reaction, can be produced by heating sulfide ores such as iron sulfide, FeS_2, in oxygen.

$$4FeS_2(s) + 11O_2(g) \rightarrow 2Fe_2O_3(s) + 8SO_2(g)$$

(i) Calculate the number of moles in 176 tonnes of SO_2. [3]

1 tonne = 1×10^9 g

A_r(S) = 32 A_r(O) = 16

number of moles = …… mol

(ii) Use you answer to part (i) to calculate the minimum mass of iron sulfide, FeS_2, required to produce 176 tonnes of SO_2. [2]

A_r(Fe) = 56 A_r(S) = 32 A_r(O) = 16

mass = …… tonnes

7

END OF PAPER

FORMULAE FOR SOME COMMON IONS

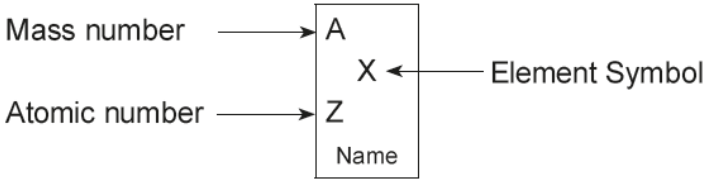
POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

Avogadro's number, $L = 6 \times 10^{23}$

PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0
									$^{1}_{1}$H Hydrogen								$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:



UNIT 1: CHEMICAL SUBSTANCES, REACTIONS AND ESSENTIAL RESOURCES
HIGHER TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)	(i)		All 5 points plotted correctly (2) [Credit (1) for 3 or 4 correct points] Straight line of best fit attempted (1)		2 1		3	3	3
		(ii)		Both increase as temperature increases (1) Any two of following for (1) each Solubilities the same at 50°C KNO_3 more soluble than $Pb(NO_3)_2$ above 50°C / KNO_3 less soluble than $Pb(NO_3)_2$ below 50°C KNO_3 increases much more than $Pb(NO_3)_2$		2	1	3	1	
	(b)			4.9 g of substance **X** undissolved (1) 15.1 g of substance **X** has dissolved (in 50 g of water) (1) 30.2 (1) Award (3) for correct answer only		3		3	3	3
				Question 1 total	**0**	**7**	**2**	**9**	**7**	**6**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)			Gas syringe	1			1		1
	(b)	(i)		As concentration of acid increases the rate of reaction increases (1) Greater number of acid particles at higher concentration (1) Greater chance of (successful) collisions with magnesium / more (successful) collisions per second (1)	 1 1		1	 3		
		(ii)		No useful data was collected / 30 cm^3 of gas collected in most experiments (1) All the magnesium was used up well before 60 s / the final volume of gas was collected well before 60 s / the reaction was over well before 60 s (1)			 2	 2	1	 2
		(iii)		Temperature of the acid (1) Surface area of the magnesium (1)	 2			 2		
	(c)			Method – add three samples to water and measure loss of mass (1) Controlled variables – award (1) each for up to two of the following: same volume of each water sample same amount of time samples of same or similar size/shape/mass		 2	1	 3		3
				Question 2 total	**5**	**2**	**4**	**11**	**1**	**6**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			Respiration takes in oxygen and produces carbon dioxide (1) Photosynthesis takes in carbon dioxide and produces oxygen (1)	2			2		
	(b)	(i)		Greenhouse effect is a natural process but global warming occurs when this effect becomes stronger as a result of increased amounts of carbon dioxide / greenhouse gases being released to the atmosphere	1			1		
		(ii)		Any two of following for (1) each **More** extreme weather/storms/floods/droughts Animals lose habitat Unable to grow crops Sea levels rise Credit other sensible points	2			2		
		(iii)		Stop carbon dioxide gas escaping to the atmosphere / trap carbon dioxide gas (1) Store it in some form e.g. by pumping it into empty oil wells / reacting it with other chemicals to form solid products (1) Accept any sensible suggestion	2			2		
				Question 3 total	**7**	**0**	**0**	**7**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		Potassium carbonate – **highest** decomposition temperature/needs **most** heat to decompose		1		1		1
		(ii)		Award up to (2) for method Heat in a tube (1) Gas collected – delivery tube, teat pipette or sensible method (1) Award up to (2) for observations Green powder turns black (1) Test gas with limewater – turns milky showing gas to be carbon dioxide (1)	1 1	 1 1		 4		 4
		(iii)		Appearance – **C** is copper(II) carbonate (1) Flame test – **A** is calcium carbonate, **B** is potassium carbonate and **D** is magnesium carbonate (1)			2	2		2
	(b)	(i)		**2**KNO_3 → **2**KNO_2 + O_2		1		1	1	
		(ii)		47.5% (2) Accept 48% If answer is incorrect award (1) for calculation of M_r of 101		2		2	2	
				Question 4 total	**2**	**6**	**2**	**10**	**3**	**7**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5				Constructive / divergent plate boundary (1) Plates move apart and magma rises forming new rock as it cools (1) Destructive / convergent plate boundary (1) Plates move together and subduction occurs / less dense plate forced underneath more dense plate (1) Subducted plate melts with magma creating volcanoes (1) Max (3) if reference to conservative plate boundary	5			5		
				Question 5 total	**5**	**0**	**0**	**5**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)			Melting points increase going down the group (1) At 20 °C Chlorine is a gas Bromine is a liquid Iodine is a solid Award (2) for all three states correct Any (1) for any two correct		3		3	2	
	(b)			Credit sensible **explanation** if melting point value given in the range 180-260 °C e.g. difference between chlorine-bromine and bromine-iodine melting points is approximately 100 °C therefore approximately 100 °C higher again			1	1	1	
	(c)			35.5 (3) If answer is incorrect award (1) for each of following Indication that ^{37}Cl is the isotope making up 25 % of all atoms (35 × 75) **and** (37 × 25) or 2625 **and** 925		3		3	3	
				Question 6 total	**0**	**6**	**1**	**7**	**6**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)			45 % (2) Accept values in the range 42-48 If answer is incorrect award (1) for One value correctly read from graph		2		2	2	
	(b)			Award (1) for sensible reason and further (1) for linked point / explanation e.g. People got fluoride from other sources – toothpaste/mouthwash Better dental care – less tooth decay	2			2		
	(c)			Both graphs suggest that fluoridation leads to decrease in DMFT (1) However Graph 2 shows that DMFT has also decreased in unfluoridated areas (1) Any two of following for (1) each Other factors may be involved e.g. dental care More data should be collected / examined Possible side effects should be considered Accept other sensible points			4	4		
				Question 7 total	**2**	**2**	**4**	**8**	**2**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8				***Indicative content*** • Ion exchange – resin containing sodium ions exchange with calcium/magnesium ions in hard water; removes permanent and temporary hardness; column re-charged with saturated sodium chloride solution • Boiling – decomposes hydrogencarbonate ions to form scale on heating elements; removes temporary hardness only; expensive method • Distillation – water is boiled and steam collected; all ions left behind therefore removes all hardness; expensive method • Washing soda – reacts with calcium and magnesium ions to form insoluble salts (scum); effectively removes temporary and permanent hardness **5–6 marks** Good description of minimum of three methods including details of how they work and which type of hardness is removed *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3–4 marks** Basic description of minimum of two methods discussed with reference to how one of them works; reference to removal of temporary and permanent hardness *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.* **1–2 marks** Basic reference to one method used with some indication of how it works or the type of hardness removed *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure*. *The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks** *No attempt made or no response worthy of credit.*	6			6		
				Question 8 total	**6**	**0**	**0**	**6**	**0**	**0**

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks Available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>9</td><td>(a)</td><td>(i)</td><td></td><td>
<table>
<tr><th rowspan="2">Halogen</th><th colspan="3">Solution of halide ion</th></tr>
<tr><th>sodium chloride</th><th>sodium iodide</th><th>sodium bromide</th></tr>
<tr><td>bromine, Br_2</td><td>×</td><td>✓</td><td></td></tr>
<tr><td>chlorine, Cl_2</td><td></td><td>✓</td><td>✓</td></tr>
<tr><td>iodine, I_2</td><td>×</td><td></td><td>×</td></tr>
</table>
All five ✓/ × correct (2)
Any four correct (1)</td><td>2</td><td></td><td></td><td>2</td><td></td><td>2</td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>Reactivity decreases down the group (1)

Going down the group the size of the atom increases / distance between (positive) nucleus and (negative) electrons increases (1)

Therefore more difficult to attract an electron into outer shell (1)</td><td>2</td><td>1</td><td></td><td>3</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(iii)</td><td></td><td>$Br_2 + 2NaI \rightarrow 2NaBr + I_2$ (2)

If equation not correct award (1) if all formulae are correct</td><td></td><td>2</td><td></td><td>2</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td></td><td>BrF_3 with working showing $80 + (3 \times 19)$ (1)

Br → 355/80 = 4.44 and F → 430/19 = 22.6 (1)

Ratio 1:5 therefore BrF_5 (1)</td><td></td><td></td><td>3</td><td>3</td><td>3</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 9 total</td><td>4</td><td>3</td><td>3</td><td>10</td><td>4</td><td>2</td></tr>
</table>

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)			Catalyst increases the rate of reaction (1) Lowers the energy required for a successful collision between SO_2 and O_2 molecules (1)	1	1		2		
	(b)	(i)		2.75×10^9 mol (3) If answer is incorrect award (1) for each of following $M_r(SO_2) = 64$ Indication of 176/64 **or** 2.75		3		3	3	
		(ii)		165 tonnes (2) If answer is incorrect award (1) for either 1.375×10^9 mol **or** Indication that mass in grams multiplied by 120 Error carried forward from part (i)		2		2	2	
				Question 10 total	**1**	**6**	**0**	**7**	**5**	**0**

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	0	7	2	9	7	6
2	5	2	4	11	1	6
3	7	0	0	7	0	0
4	2	6	2	10	3	7
5	5	0	0	5	0	0
6	0	6	1	7	6	0
7	2	2	4	8	2	0
8	6	0	0	6	0	0
9	4	3	3	10	4	2
10	1	6	0	7	5	0
TOTAL	32	32	16	80	28	21

Surname	Centre Number	Candidate Number
Other Names		

GCSE

CHEMISTRY

UNIT 2: CHEMICAL BONDING, APPLICATION OF CHEMICAL REACTIONS AND ORGANIC CHEMISTRY
FOUNDATION TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 45 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**6**	
3.	**8**	
4.	**8**	
5.	**9**	
6.	**6**	
7.	**6**	
8.	**6**	
9.	**6**	
10.	**10**	
11.	**10**	
Total	**80**	

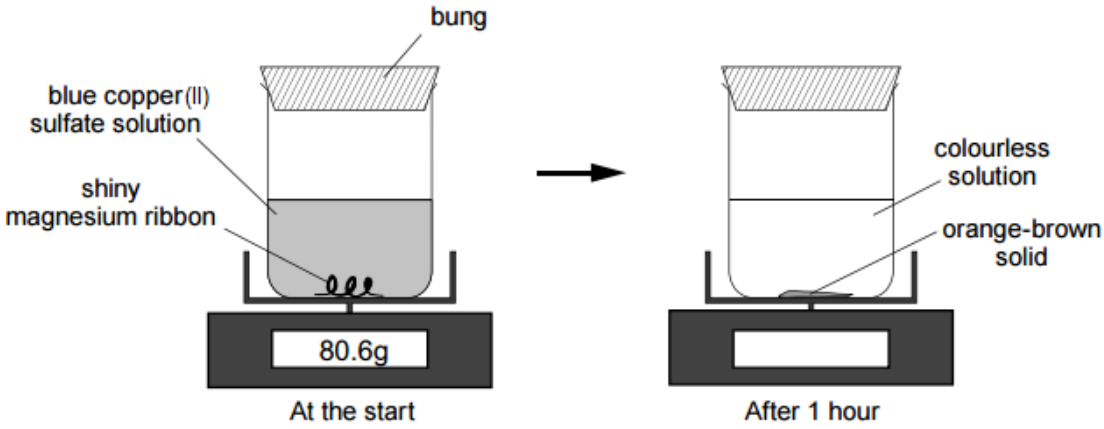
ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **9** is a quality of extended response (QER) question where your writing skills will be assessed.

Answer **all** *questions.*

1. (a) Some pupils were asked to investigate what happens when a piece of shiny magnesium ribbon is added to copper(II) sulfate solution. They set up the apparatus shown below. The mass was recorded at the start and again after one hour.



(i) **Circle** the name for the type of reaction taking place. [1]

neutralisation displacement combustion

(ii) Put a tick (✓) in the box next to the mass of the beaker and its contents after 1 hour.

more than 80.6 g ☐ equal to 80.6 g ☐ less than 80.6 g ☐

Give the reason for your choice. [1]

.....

.....

(iii) The experiment was repeated using sodium sulfate solution instead of copper(II) sulfate solution. No reaction took place.

Put the metals copper, magnesium and sodium in order of reactivity. [1]

Most reactive .....

.....

Least reactive .....

(b) Rust is iron(III) oxide, Fe_2O_3. It is formed when iron comes into contact with water and oxygen.

Some iron nails were weighed before and after being exposed to water and oxygen for 1 week. The results are given below.

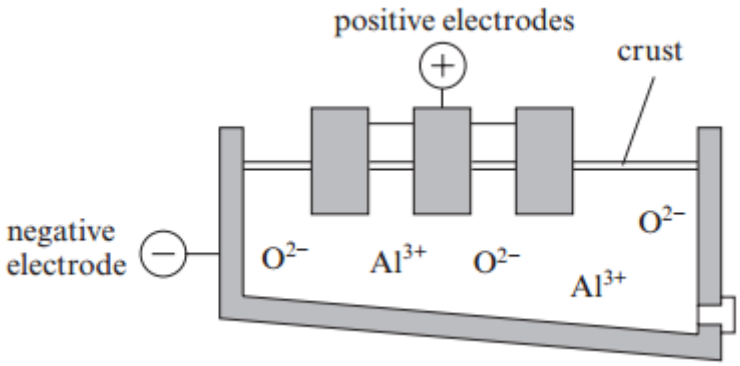
Time of weighing	**Mass of nails (g)**
before exposure to water and oxygen	28
after exposure to water and oxygen	40

Use this information to calculate the percentage increase in mass of the nails after they had been exposed to water and oxygen. [2]

percentage increase in mass = ... %

5

2. (a) Electrolysis is also used to extract aluminium from molten aluminium oxide. On melting, aluminium oxide releases aluminium ions, Al^{3+}, and oxide ions, O^{2-}.



(i) By drawing an arrow from the formula of **each ion** in the diagram, show the direction of movement of **all** the ions when the current is switched on. [1]

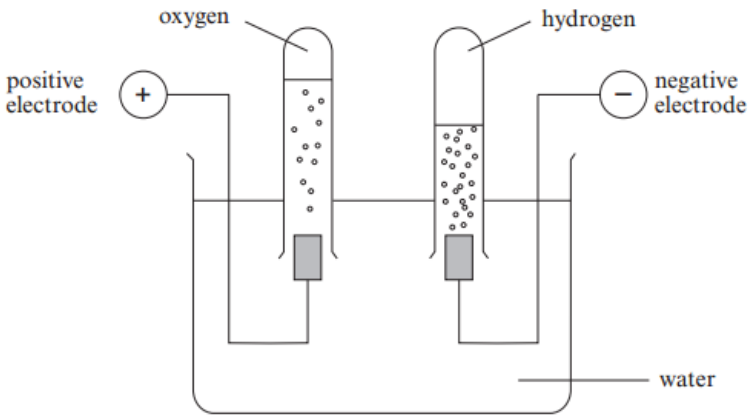
(ii) Balance the symbol equation for the overall reaction occurring. [1]

$$\boxed{2}\ Al_2O_3 \longrightarrow \boxed{\ \ }\ Al + \boxed{\ \ }\ O_2$$

(iii) Give the **main** reason why this process is expensive. [1]

.....

(b) A teacher demonstrated how water can be broken down into its elements by electrolysis. She set up the following apparatus.



(i) What name is given to the negative electrode? [1]

.....

(ii) Describe the test used to identify hydrogen gas. [1]

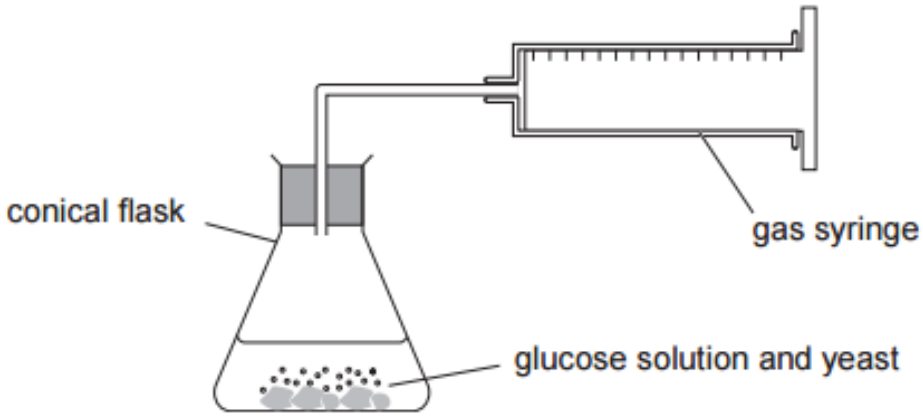
.....

(iii) When 36 g of water is broken down into its elements, 4 g of hydrogen is produced. Calculate the mass of oxygen produced. [1]

mass = ... g

6

3. A pupil investigated the effect of temperature on the rate of fermentation using the apparatus shown below.



The experiment was carried out three times at five different temperatures. The volume of gas collected after 10 minutes was recorded each time. The results are shown below.

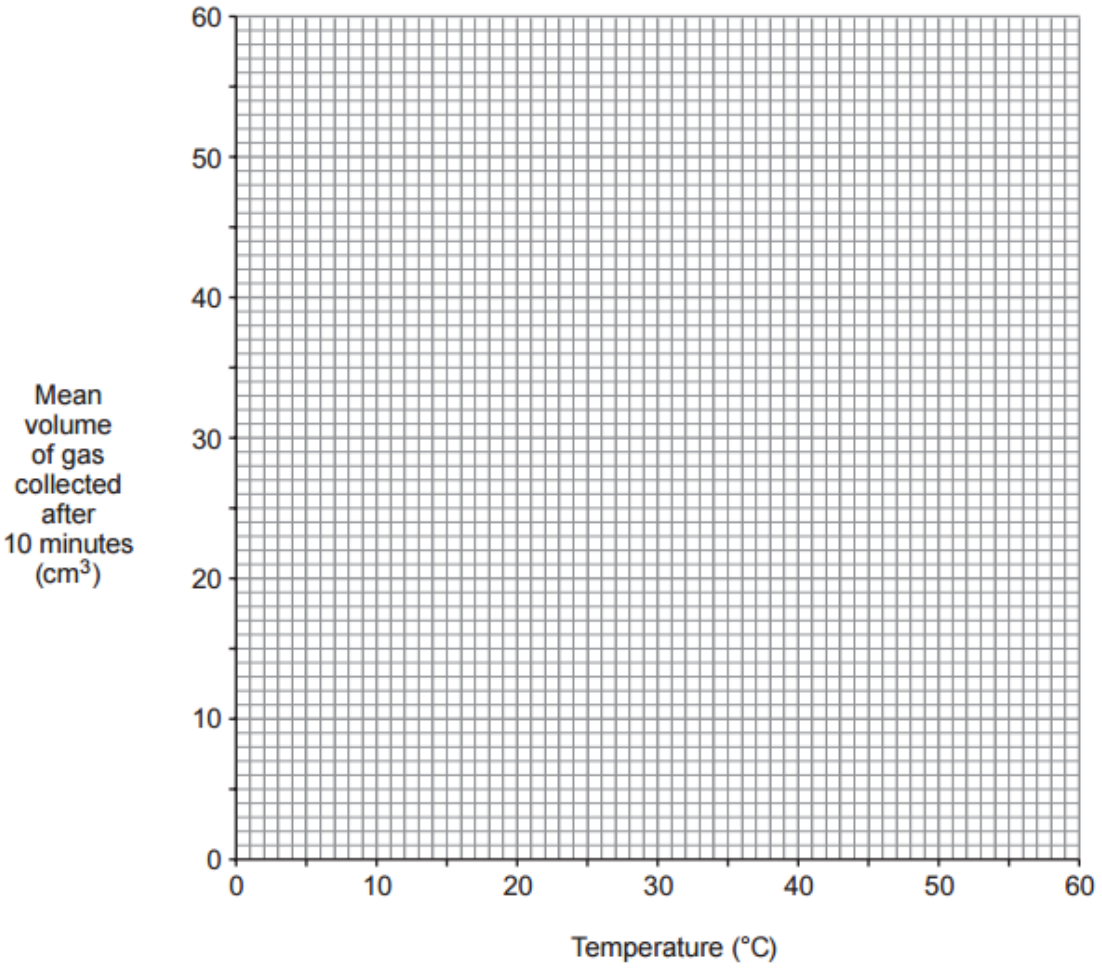
Temperature (°C)	**Volume of gas collected after 10 minutes (cm^3)**			
	1	**2**	**3**	**Mean**
20	9	8	7	8
30	38	40	(32)	39
40	52	53	54	53
50	35	32	33	33
60	12	11	12	12

(a) Suggest why the circled value is considered to be anomalous. [1]

……..

……..

(b) Plot a graph of the **mean** volume of gas collected against temperature on the grid below. [2]



(c) State what conclusions can be drawn from the graph. [2]

……..

……..

……..

(d) Write a **word** equation for the reaction taking place. [2]

…… $\xrightarrow{\text{yeast}}$ …… + ……

(e) Yeast produces a catalyst that allows this reaction to take place. Name the **type** of catalyst produced by yeast. [1]

……

8

4. (a) The table below shows some tests that can be carried out to identify ions.

Positive ion	**Test to identify the ion**	**Observation**
Na^+	flame test	yellow flame
K^+	flame test	lilac flame
Ca^{2+}	flame test	brick-red flame
Cu^{2+}	add sodium hydroxide solution	blue precipitate
Fe^{2+}	add sodium hydroxide solution	green precipitate
Mg^{2+}	add sodium hydroxide solution	white precipitate

Negative ion	**Test to identify the ion**	**Observation**
CO_3^{2-}	add dilute hydrochloric acid	bubbles formed
SO_4^{2-}	add barium chloride solution	white precipitate
Cl^-	add by silver nitrate solution	white precipitate

Use only the information in the tables to answer parts (i) and (ii).

(i) Caroline carried out the two tests needed to identify a compound thought to be iron(II) sulfate. Give the expected observations for the tests that were carried out. [2]

Add sodium hydroxide solution ……

Add barium chloride solution ……

(ii) Gareth carried out two different tests to identify a second compound. The observations for these tests are given below.

Flame test: yellow flame produced

Add hydrochloric acid: bubbles formed

Name the compound he identified. ..... [2]

(b) (i) A pupil was given a gas jar containing ammonia gas. Describe a test that could be carried out to prove that it was ammonia. Give the expected result for the test. [2]

.....

.....

.....

(ii) Ammonium hydroxide solution reacts with hydrochloric acid according to the following equation.

ammonium hydroxide + hydrochloric acid → ammonium chloride + water

I. Give the general name for the type of reaction taking place. [1]

……

II. Give the chemical formula of the ammonium chloride formed during the reaction. [1]

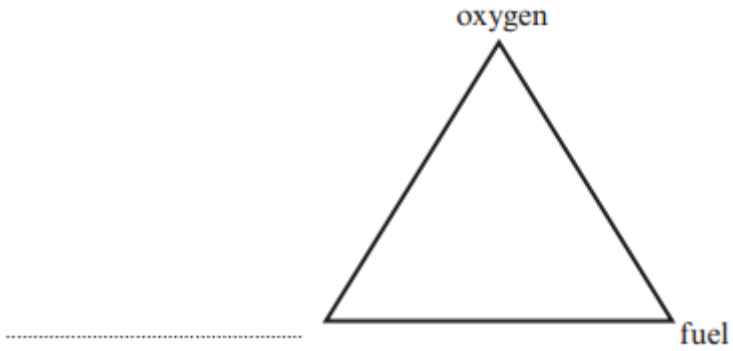
……

8

5. (a) Use your knowledge of hydrocarbons and the trends in the data to complete the following table. [3]

Hydrocarbon	methane	ethane	propane	butane	pentane
Molecular formula	CH_4	C_2H_6	.....	C_4H_{10}	C_5H_{12}
Boiling point (°C)	–164	–87	–42	.....	36
State at 20 °C	gas	gas	gas	gas	.....

(b) The fire triangle can be used to explain how fires can be extinguished.



(i) Complete the fire triangle by adding the missing factor in the diagram. [1]

(ii) A beaker of ethanol caught fire in a laboratory. Suggest how a teacher would safely extinguish the fire. Give a reason for your answer. [2]

.....

.....

(c) Methane gas is used as a fuel. It burns in oxygen giving out energy.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

Breaking the bonds in the methane and oxygen molecules uses 2640 kJ of energy.

(i) Use the information in the equation above and the table to calculate the total amount of energy released in making the bonds in the carbon dioxide and water molecules. [2]

Bond made	**Energy released in making bond**	**Number of bonds made**
C = O	740	**?**
O—H	460	4

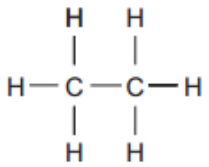
energy released = …… kJ

(ii) Calculate the overall energy released during the reaction. [1]

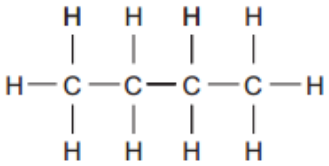
overall energy released = …… kJ

9

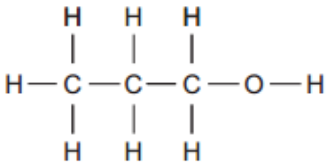
6. (a) The structural formulae of some organic compounds are shown below.



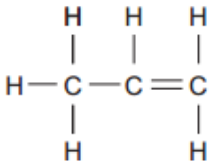
A



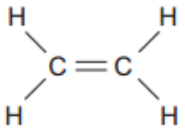
B



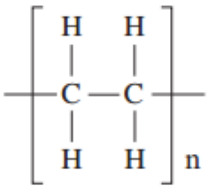
C



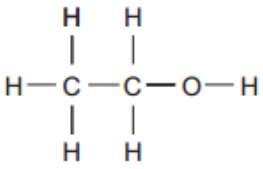
D



E



F



G

(i) Give the letters, **A**-**G**, which represent the following:

two alkenes, ... and .....

two alcohols, ... and .....

a polymer. ..... [3]

(ii) Give the letter of **one** compound that can undergo polymerisation and give a reason for your answer. [2]

.....

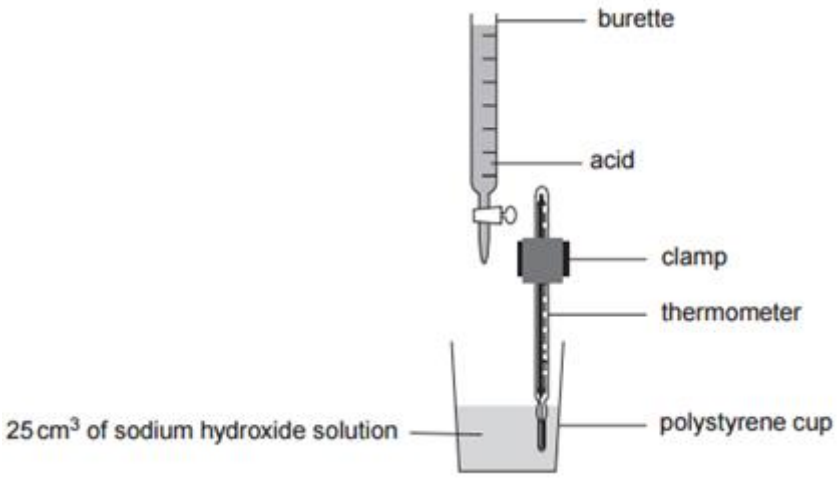
.....

(b) Dodecane is an alkane with 12 carbon atoms. Calculate the number of hydrogen atoms present in a molecule of dodecane. [1]

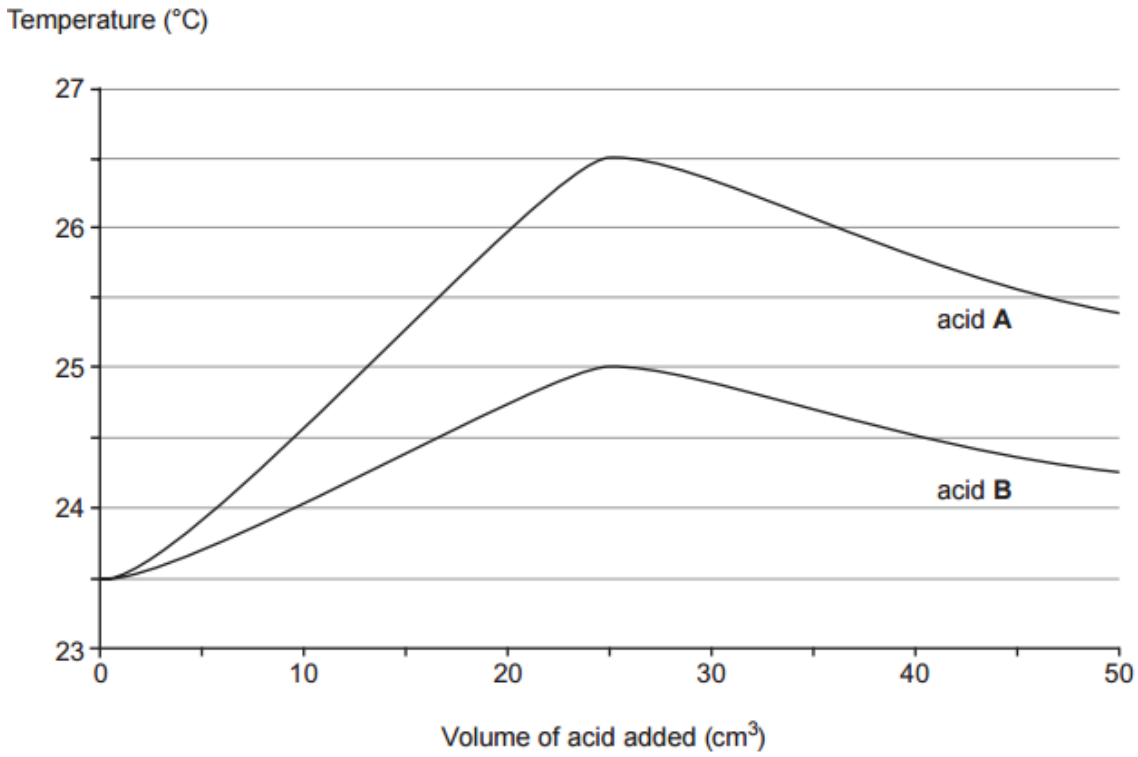
number of hydrogen atoms = ...

6

7. The apparatus below can be used to measure the temperature as a neutralisation reaction takes place.



The graphs below show how the temperature changes when acids **A** and **B** are added separately to 25 cm^3 of sodium hydroxide solution.



(a) Use the graphs opposite to find:

(i) the volume of acid required to neutralise the sodium hydroxide solution in both experiments; [1]

…… cm^3

(ii) the maximum temperature **rise** for acid **B**. [1]

…… °C

(b) State which acid, **A** or **B**, is stronger and give a reason for your answer. [1]

Stronger acid ……

Reason ……..

…….

(c) Describe how an indicator could be used to find the exact volume of acid needed for neutralisation. [3]

……..

……..

……..

……..

6

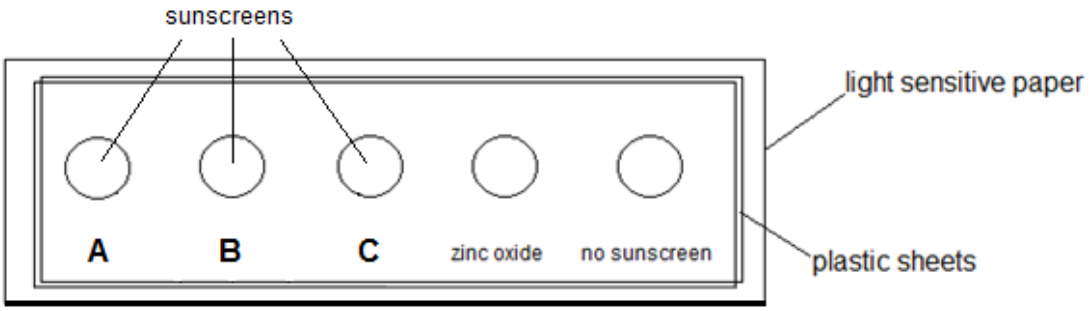
8. Nanoparticles are widely used in our everyday lives. They are used in deodorant sprays, plasters and sunscreens and in manufacturing self-cleaning windows.

Nano-sized zinc oxide particles are used in many sunscreens because they are known to block sunlight.

Rebecca and Jonathan set up an investigation to compare three sunscreens, **A**, **B** and **C**. They wanted to find out which was most effective in providing protection against UV rays.

Between two plastic sheets, they placed a sample of each of the sunscreens, as well as a sample of zinc oxide. Each of the samples was labelled. An area with no sunscreen was also labelled.

The plastic sheets were then placed on top of a sheet of light-sensitive paper and put into direct sunlight.



Light-sensitive paper changes from white to black, depending on its exposure to sunlight.

(a) Which **one** of these statements is a scientific description of the role of the 'zinc oxide' and 'no sunscreen' areas in comparing the effectiveness of the sunscreens? Tick (✓) the correct answer. [1]

'zinc oxide' and 'no sunscreen' are both factors being tested ☐

'no sunscreen' is a factor being tested and 'zinc oxide' is a reference substance ☐

'no sunscreen' is a reference substance and 'zinc oxide' is a factor being tested ☐

'no sunscreen' and 'zinc oxide' are both reference substances ☐

(b) Which **one** of these questions were Rebecca and Jonathan trying to answer? Tick (✓) the correct answer. [1]

how does the protection for each sunscreen compare with the others? ☐

how do sunscreens protect your skin from ultraviolet radiation? ☐

is there any sunscreen that gives less protection than no sunscreen? ☐

is there any sunscreen lotion that gives more protection than zinc oxide? ☐

(c) Why were the samples placed between two sheets of plastic? Tick (✓) the correct answer. [1]

to stop the samples from drying out ☐

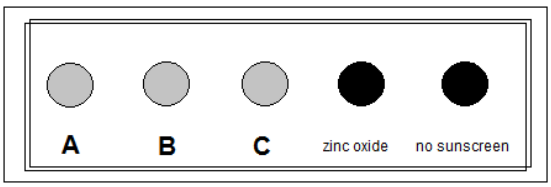
to spread the samples out as far as possible ☐

to keep the samples inside the marked circles ☐

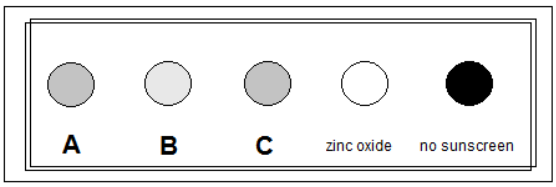
to make the samples the same thickness ☐

(d) The light-sensitive paper is white and gradually changes to grey then black, depending on its exposure to sunlight.

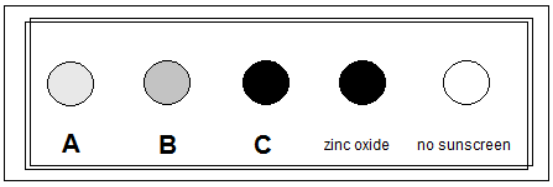
Which one of these diagrams shows the result set that might occur? Explain your choice. [3]



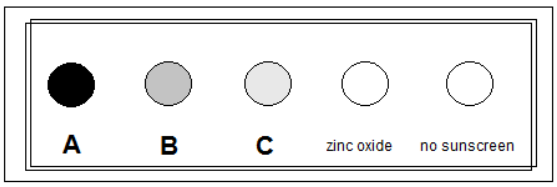
Result Set 1



Result Set 2



Result Set 3



Result Set 4

Answer ……

Explanation ……...

……

……

……

6

9. Explain why plastics have replaced traditional materials such as iron, glass, wood and paper for making everyday objects. [6 QER]

.....

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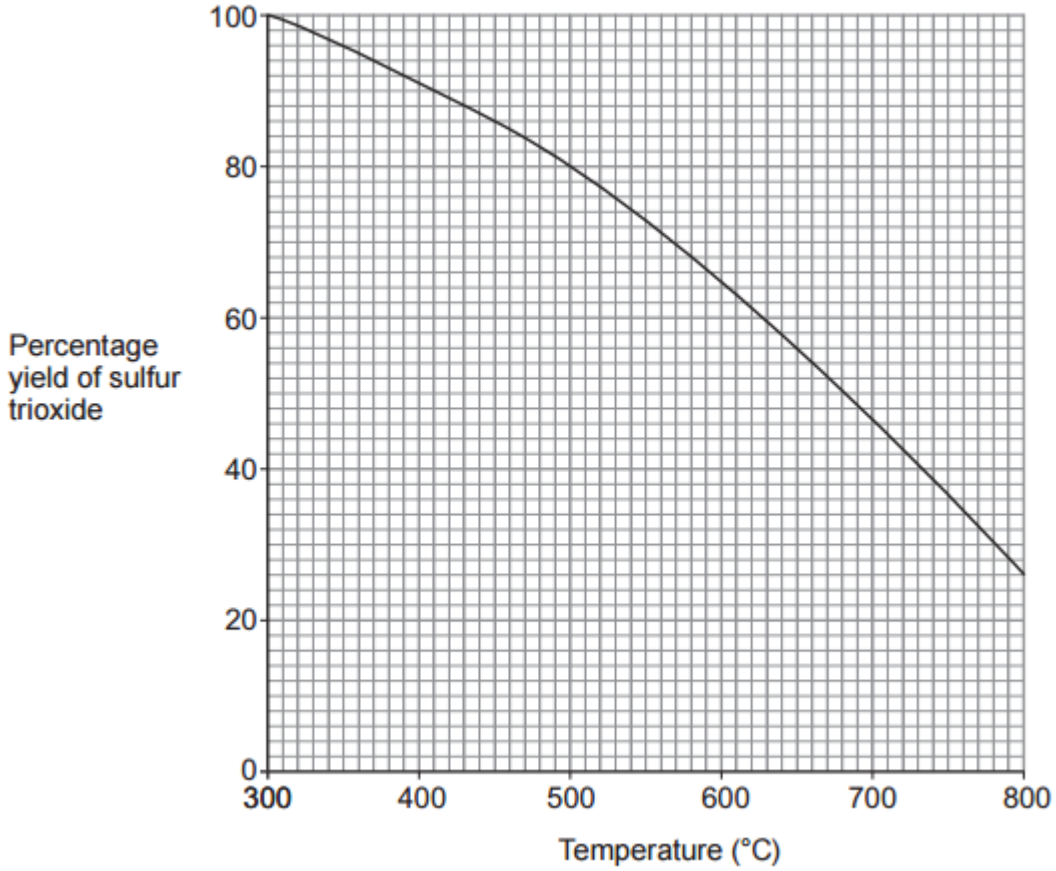
6

10. (a) One of the main stages in the manufacture of sulfuric acid is the reaction between sulfur dioxide and oxygen to form sulfur trioxide.

(i) Write the balanced **symbol** equation which represents this reaction.[3]

..... + ... ⇋ .....

(ii) The graph below shows how the percentage yield of sulfur trioxide changes with temperature between 300°C and 800°C.



Use the graph to find the increase in percentage yield if the temperature is reduced from 650 °C to 450 °C. [2]

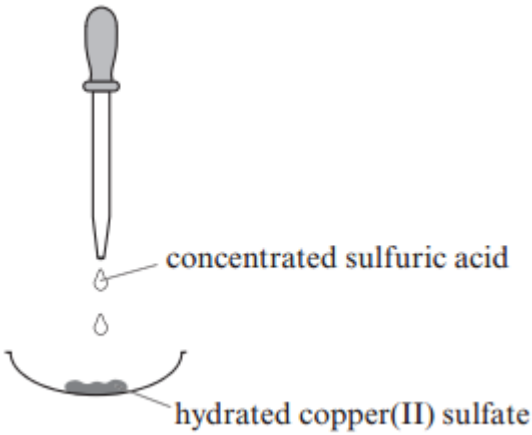
increase in percentage yield =..... %

(iii) One molecule of sulfur trioxide reacts with one molecule of sulfuric acid to form one molecule of oleum as the **only** product.

Write a balanced **symbol** equation for this reaction. [2]

..... + ... → .....

(b) A few drops of concentrated sulfuric acid were added to some crystals of hydrated copper(II) sulfate, $CuSO_4.5H_2O$.



Describe **two** changes that would be seen in the appearance of the copper(II) sulfate and state the property that the concentrated sulfuric acid displaying.

[3]

……..

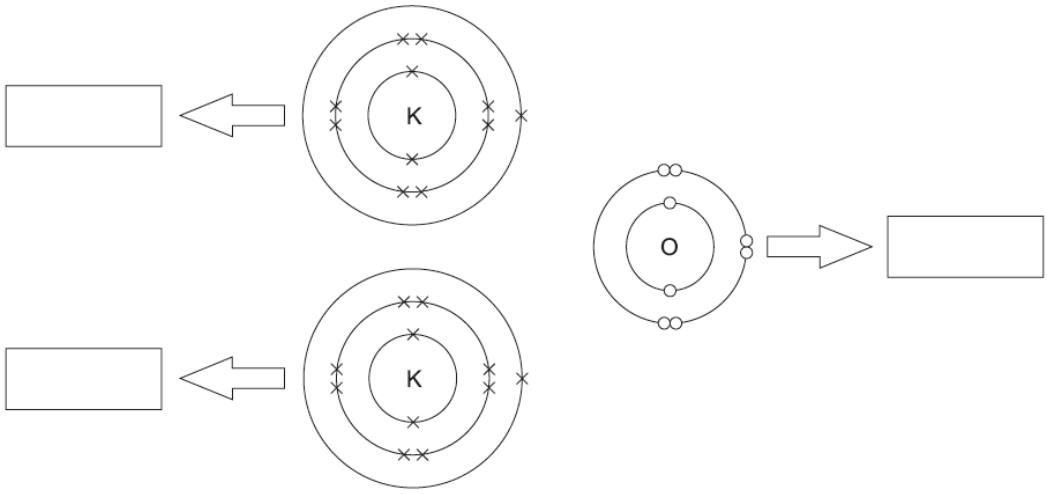
……..

……..

……..

10

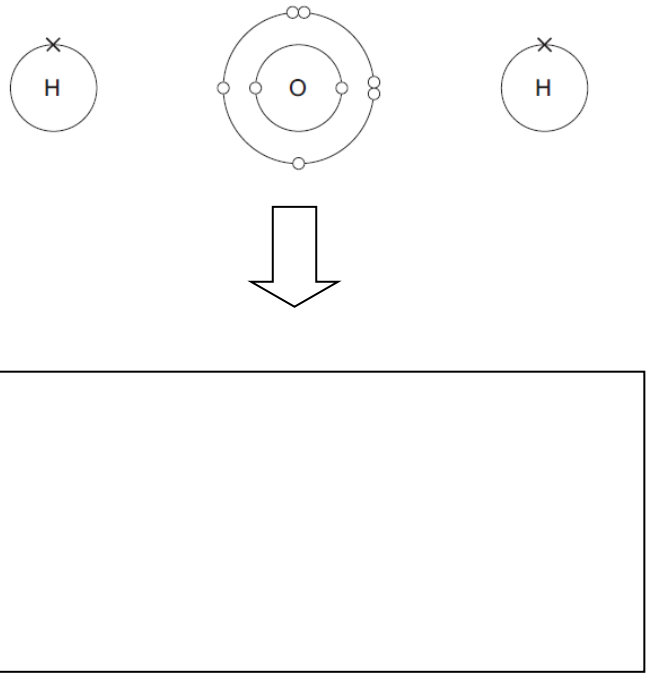
11. (a) Potassium reacts with oxygen to form potassium oxide. The diagram below can be used to show the electronic changes that take place as potassium oxide is formed.



(i) **Draw arrows on the diagram** to show the movement of electrons that leads to the formation of ions. [1]

(ii) **Write in the boxes**, the electronic configurations of the potassium and oxide **ions** formed. Include the charges on these ions. [2]

(b) Using the electronic structures shown, complete the diagram to show the covalent bonding in a molecule of water, H_2O. [2]



(c) **Table 1** shows some properties associated with three different types of structure.

Structure	Particle model	Melting point and boiling point	Electrical conductivity
giant ionic	consists of charged ions	high	only when molten or in solution
giant covalent	single molecules consisting of very many atoms	high	poor
simple covalent	small molecules, each consisting of a few atoms	low	poor

Table 1

Table 2 lists some properties of four substances, **A**, **B**, **C** and **D**.

Substance	Melting point (°C)	Boiling point (°C)	Electrical conductivity
A	–182	–161	poor
B	3550	4827	poor
C	1085	2562	good
D	801	1413	good when dissolved

Table 2

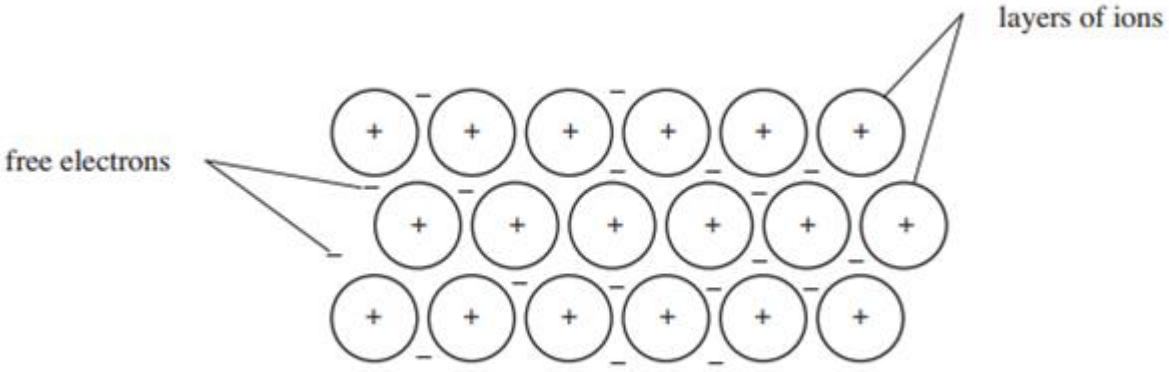
Give the letter of the substance, **A**, **B**, **C** or **D** that does not have a structure listed in **Table 1**. Give the reason for your answer. [2]

Substance .....

Reason .....

.....

(d) The diagram shows a model that can be used to represent the structure of a metal.



Use this model to explain **three** properties that are typical of metals. [3]

……..

……..

……..

……..

10

END OF PAPER

FORMULAE FOR SOME COMMON IONS

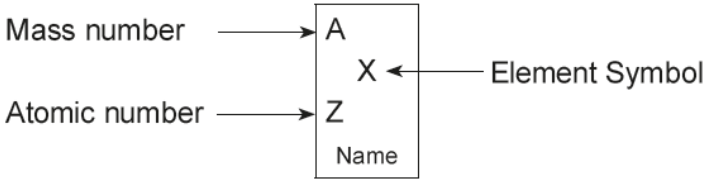
POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

Avogadro's number, $L = 6 \times 10^{23}$

PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0
									$^{1}_{1}$H Hydrogen								$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:



UNIT 2: CHEMICAL BONDING, APPLICATION OF CHEMICAL REACTIONS AND ORGANIC CHEMISTRY
FOUNDATION TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

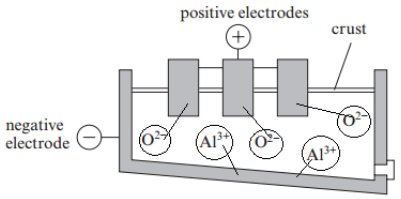
A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)	(i)		Displacement	1			1		
		(ii)		More than 80.6g ☐ equal to 80.6g ☑ less than 80.6g ☐ If correct box ticked award (1) for any of following Atoms are not created or destroyed Same atoms present before and after Atoms are re-arranged during reaction Nothing has entered or left the beaker	1			1		1
		(iii)		Sodium Magnesium Copper All three correct for (1)			1	1		
	(b)			43 (2) Accept 42.9 / 42.85 If answer is incorrect award (1) for 12 g increase		2		2	2	
				Question 1 total	**2**	**2**	**1**	**5**	**2**	**1**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		 Both Al^{3+} ions shown going to the negative electrode **and** all three O^{2-} ions shown going to the positive electrode	1			1		
		(ii)		$\boxed{2}\ Al_2O_3 \longrightarrow \boxed{4}\ Al + \boxed{3}\ O_2$		1		1	1	
		(iii)		<u>Large amounts</u> of electricity needed	1			1		
	(b)	(i)		Cathode	1			1		
		(ii)		Lighted splint → goes 'pop'	1			1		1
		(iii)		32	1			1	1	
				Question 2 total	**5**	**1**	**0**	**6**	**2**	**1**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	(a)			Significantly different to the other two readings at that temperature			1	1		1
	(b)			All points plotted correctly (2) Any 3 or 4 points correct (1) Ignore any curve drawn		2		2	2	
	(c)			Rate / volume collected increases as temperature increases up to an optimum temperature then decreases (1) Optimum temperature at around 40 °C (1) Award (2) for rate increases as temperature increases up to around 40 °C then decreases		2		2		
	(d)			Glucose → carbon dioxide + ethanol (2) If equation is incorrect award (1) for correct reactant **or** products	2			2		
	(e)			Enzyme	1			1		
				Question 3 total	**3**	**4**	**1**	**8**	**2**	**1**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		Green precipitate (1) White precipitate (1)		2		2		2
		(ii)		Sodium carbonate (2) If compound is incorrect award (1) for sodium **or** carbonate			2	2		2
	(b)	(i)		Damp red litmus paper (1) Accept damp pH paper Must be correct for second mark to be awarded Turns blue (1) Accept blue/purple for pH paper	2			2		2
		(ii)	I	Neutralisation	1			1		
			II	NH_4Cl Accept $NH_4^+ Cl^-$		1		1		
				Question 4 total	**3**	**3**	**2**	**8**	**0**	**6**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)			C_3H_8 (1) Any value between −41 °C and 19 °C (1) Liquid (1)		1	 1 1	 3	 1	
	(b)	(i)		Heat	1			1		
		(ii)		Cover with damp cloth / fire proof mat / fire blanket / sand (1) Accept carbon dioxide fire extinguisher Removes oxygen (1) Second mark may be awarded without correct method	 1	1		 2		 1
	(c)	(i)		3320 (2) If answer is incorrect award (1) for (4 × 460)		2		2	2	
		(ii)		680 Error carried forward from (i)		1		1	1	
				Question 5 total	**2**	**5**	**2**	**9**	**4**	**1**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)		**D** and **E** (1) both needed **C** and **G** (1) both needed **F** (1)	1 1 1			3		
		(ii)		**D** or **E** (1) It is an unsaturated compound / contains a double bond between carbon atoms (1)	 1	1		2		
	(b)			26		1		1	1	
				Question 6 total	**4**	**2**	**0**	**6**	**1**	**0**

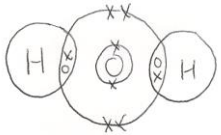
Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)		$25 \pm 1\,cm^3$			1	1	1	
		(ii)		1.5 °C		1		1	1	
	(b)			Acid **A** because temperature rise is greater / it produces more heat			1	1		
	(c)			Add indicator to sodium hydroxide solution / solution in cup (1) Add acid slowly (from burette) (1) Indicator changes colour sharply at point of neutralisation (1)	3			3		3
				Question 7 total	**3**	**1**	**2**	**6**	**2**	**3**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8	(a)			'No sunscreen' and 'zinc oxide' are both reference substances ✓			1	1		
	(b)			How does the protection for each sunscreen compare with the others? ✓			1	1		
	(c)			To make the samples the same thickness ✓			1	1		1
	(d)			Result set 2 (1) The zinc oxide spot has stayed white because it blocks sunlight (1) The no sunscreen spot has gone black because sunlight has been absorbed by the paper (1)			3	3		3
				Question 8 total	**0**	**0**	**6**	**6**	**0**	**4**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
9				***Indicative content*** • Examples of objects made from plastic which were previously made from traditional materials e.g. drain pipes made of iron, bottles made of glass, window frames made of wood • Key properties required for these uses • Additional properties of plastics which make them a better choice than traditional materials for these uses e.g. plastic drain pipes do not rust and don't need to be painted, plastic bottles do not break easily, plastic window frames don't rot and don't need to be painted **5–6 marks** A comprehensive list of objects previously made from three different traditional materials; key properties identified and a range of additional advantageous properties given *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3–4 marks** A minimum of two objects previously made from two different traditional materials; key properties identified and an additional advantageous property given in at least one case *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.*	4	2		6		

				1–2 marks One or two objects previously made from a traditional material; advantage of plastic over traditional material stated *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks** *No attempt made or no response worthy of credit.*						
				Question 9 total	**4**	**2**	**0**	**6**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
10	(a)	(i)		$2SO_2 + O_2 \rightleftharpoons 2SO_3$ (3) If equation not correct award (1) for each of following SO_2 and O_2 on reactant side SO_3 on product side		3		3	1	
		(ii)		30 % (2) If answer is incorrect award (1) for 86 or 56 read from graph		2		2	2	
		(iii)		$SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$ (2) If equation not correct award (1) for either of following SO_3 and H_2SO_4 oleum formula based on incorrect reactant hydrogen, sulfur and oxygen atoms only e.g. $H_2S_2O_6$ if sulfuric acid given as H_2SO_3		2		2	1	
	(b)			Copper(II) sulfate turns from <u>blue to white</u> (1) Any one of the following for (1) Crystals become powdery / crumbly Loses its crystalline appearance Dehydrating agent (1)	3			3		3
				Question 10 total	**3**	**7**	**0**	**10**	**4**	**3**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
11	(a)	(i)		Correct transfer of both outer shell potassium electrons to the oxygen atom (1)		1		1		
		(ii)		All four electronic configurations and charges correct (2) Any two correct (1) potassium ions (2,8,8) K^+ oxide ions (2,8) O^{2-}		2		2		
	(b)			 Diagram shows shared pair of electrons between oxygen and both hydrogen atoms (1) Octet of electrons around oxygen atom and only two around both hydrogen atoms (1)		2		2		
	(c)			**C** (1) Conducts electricity in its solid form (1)			2	2		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
11	(d)			Award (1) each for up to three of following properties **with explanation** Conducts electricity – **free electrons carrying the charge** Malleable / can be hammered into shape / bent into shape – **layers of ions can slide over each other** Ductile / can be drawn into a wire – **layers of ions can slide over each other** High density – **ions are tightly packed** High melting / boiling point – **ions are tightly packed** If no creditworthy explanations given award (1) for two correct properties	3			3		
				Question 11 total	**3**	**5**	**2**	**10**	**0**	**0**

FOUNDATION TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	2	2	1	5	2	1
2	5	1	0	6	2	1
3	3	4	1	8	2	1
4	3	3	2	8	0	6
5	2	5	2	9	4	1
6	4	2	0	6	1	0
7	3	1	2	6	2	3
8	0	0	6	6	0	4
9	4	2	0	6	0	0
10	3	7	0	10	4	3
11	3	5	2	10	0	0
TOTAL	32	32	16	80	17	20

Surname	Centre Number	Candidate Number
Other Names		

GCSE

CHEMISTRY

UNIT 2: CHEMICAL BONDING, APPLICATION OF CHEMICAL REACTIONS AND ORGANIC CHEMISTRY
HIGHER TIER

SAMPLE ASSESSMENT MATERIALS

(1 hour 45 minutes)

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**10**	
3.	**7**	
4.	**12**	
5.	**11**	
6.	**8**	
7.	**8**	
8.	**6**	
9.	**8**	
Total	**80**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer all questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The number of marks is given in brackets at the end of each question or part-question.
Question **8** is a quality of extended response (QER) question where your writing skills will be assessed.

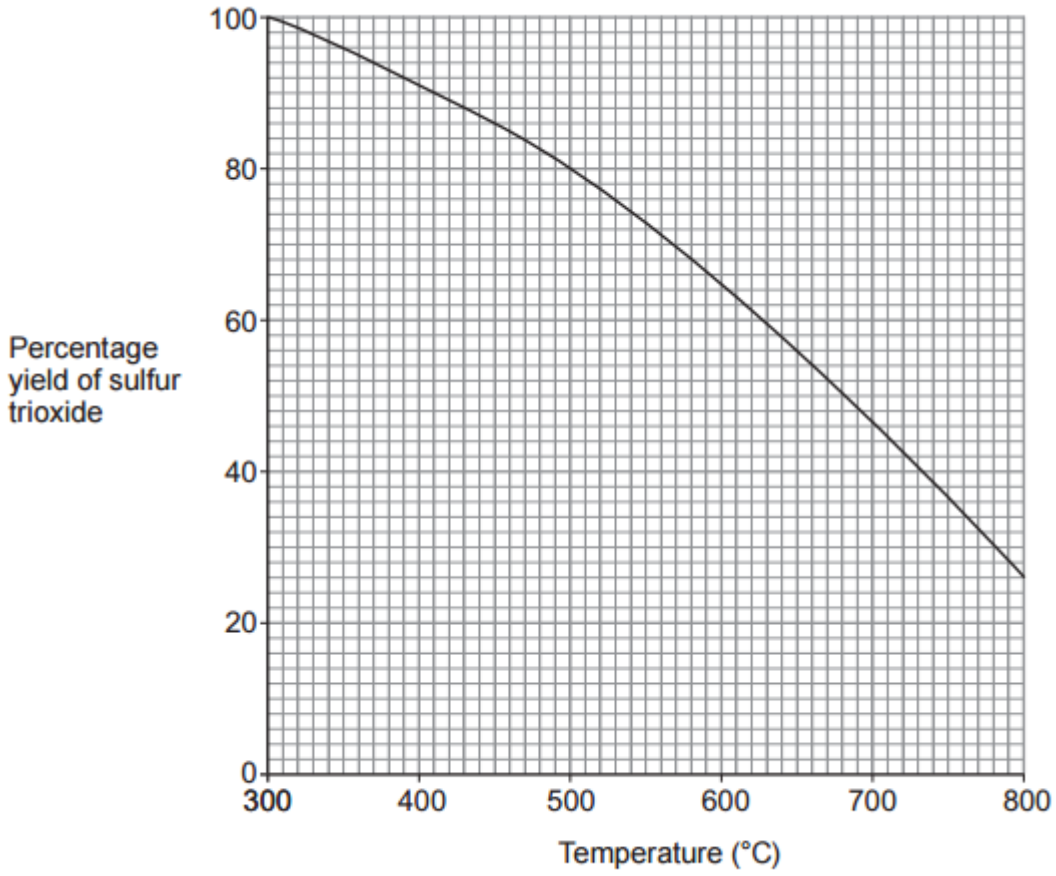
Answer **all** *questions.*

1. (a) One of the main stages in the manufacture of sulfuric acid is the reaction between sulfur dioxide and oxygen to form sulfur trioxide.

(i) Write the balanced **symbol** equation which represents this reaction.[3]

..... + ... ⇋ .....

(ii) The graph below shows how the percentage yield of sulfur trioxide changes with temperature between 300°C and 800°C.



Use the graph to find the increase in percentage yield if the temperature is reduced from 650 °C to 450 °C. [2]

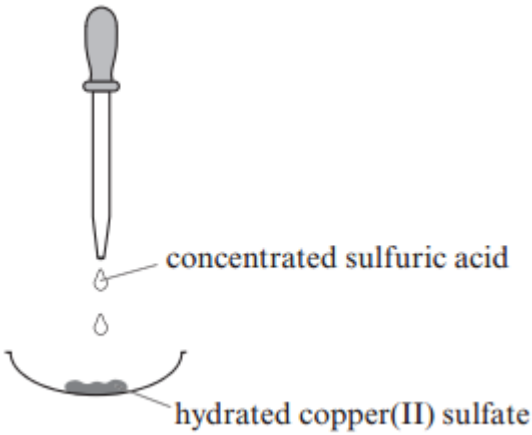
increase in percentage yield =..... %

(iii) One molecule of sulfur trioxide reacts with one molecule of sulfuric acid to form one molecule of oleum as the **only** product.

Write a balanced **symbol** equation for this reaction. [2]

..... + ... → .....

(b) A few drops of concentrated sulfuric acid were added to some crystals of hydrated copper(II) sulfate, $CuSO_4.5H_2O$



Describe **two** changes that would be seen in the appearance of the copper(II) sulfate and state the property that the concentrated sulfuric acid displaying.

[3]

……..

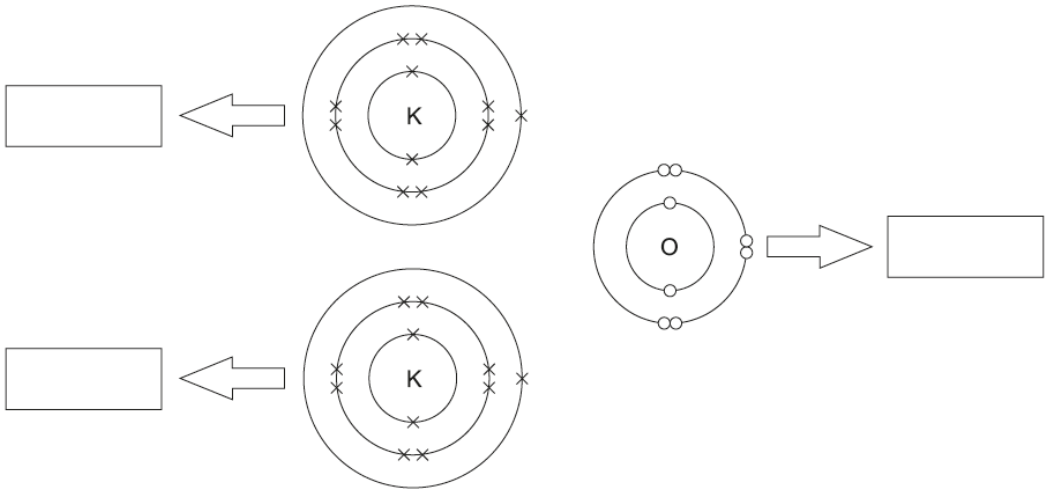
……..

……..

……..

10

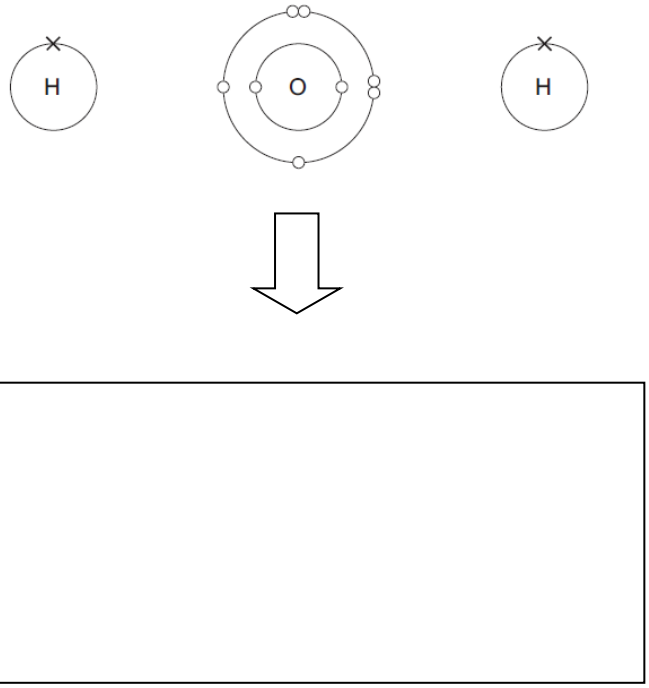
2. (a) Potassium reacts with oxygen to form potassium oxide. The diagram below can be used to show the electronic changes that take place as potassium oxide is formed.



(i) **Draw arrows on the diagram** to show the movement of electrons that leads to the formation of ions. [1]

(ii) **Write in the boxes**, the electronic configurations of the potassium and oxide **ions** formed. Include the charges on these ions. [2]

(b) Using the electronic structures shown, complete the diagram to show the covalent bonding in a molecule of water, H_2O. [2]



(c) **Table 1** shows some properties associated with three different types of structure.

Structure	Particle model	Melting point and boiling point	Electrical conductivity
giant ionic	consists of charged ions	high	only when molten or in solution
giant covalent	single molecules consisting of very many atoms	high	poor
simple covalent	small molecules, each consisting of a few atoms	low	poor

Table 1

Table 2 lists some properties of four substances, **A**, **B**, **C** and **D**.

Substance	Melting point (°C)	Boiling point (°C)	Electrical conductivity
A	–182	–161	poor
B	3550	4827	poor
C	1085	2562	good
D	801	1413	good when dissolved

Table 2

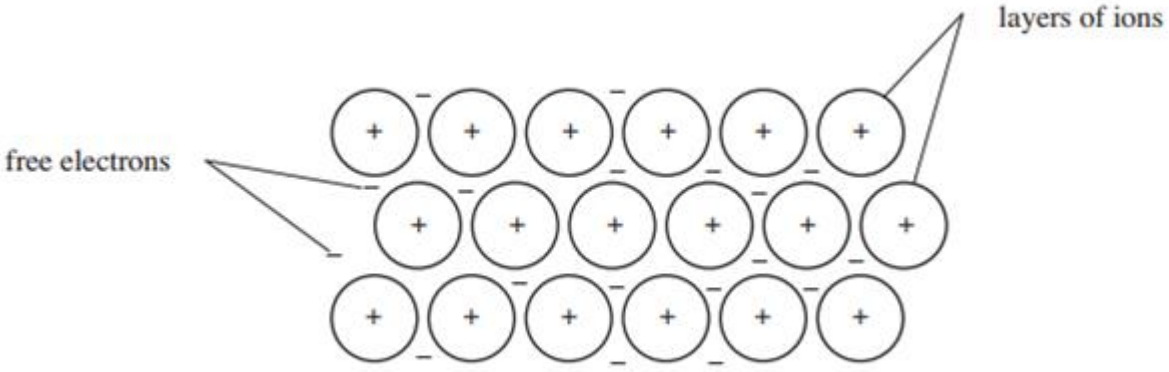
Give the letter of the substance, **A**, **B**, **C** or **D** that does not have a structure listed in **Table 1**. Give the reason for your answer. [2]

Substance .....

Reason .....

.....

(d) The diagram shows a model that can be used to represent the structure of a metal.



Use this model to explain **three** properties that are typical of metals. [3]

……..

……..

……..

……..

10

3. The following passage gives some information about how wine makers convert grapes into wine:

"Grapes contain sugar. When picked at the right time, the grapes are crushed and the juices are collected. They are covered with a layer of yeast solution and a chemical reaction takes place. During the reaction, the yeast transforms the sugars from the grapes into carbon dioxide and alcohol. This way of making alcohol has been used for thousands of years and is known as fermentation."

(a) During the fermentation reaction, frothy bubbles form. Why does this happen? Tick (✓) the correct answer. [1]

bubbles form because alcohol is produced and turns into a gas ☐

bubbles form because of the yeast reproducing ☐

bubbles form because a gas, carbon dioxide, is produced ☐

bubbles form because the grape juice turns into a vapour ☐

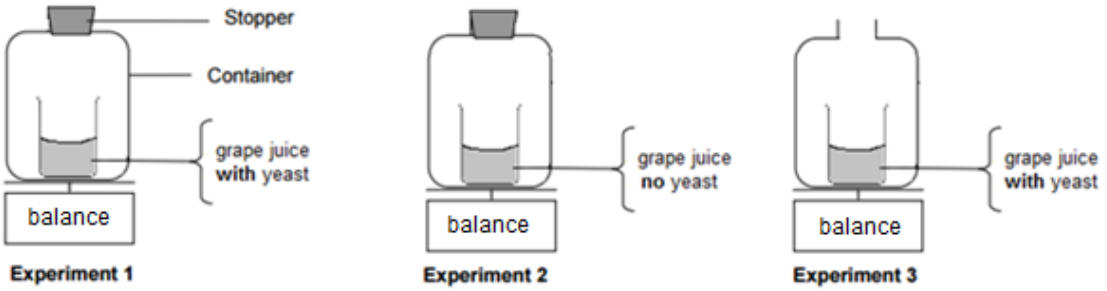
(b) During the reaction, the yeast transforms the sugar in the grapes into carbon dioxide and alcohol.

Where do the carbon atoms that are present in the carbon dioxide and alcohol come from? Complete the following table. [3]

Suggested explanation of where the carbon atoms come from	Is this correct? Yes/No
some carbon atoms come from the sugars	.....
some carbon atoms come from the yeast	.....
some carbon atoms come from the solution	.....

(c) During the fermentation process, carbon dioxide gas is produced.

Three separate fermentation experiments were set up as shown below and left for 1 hour. State and explain what you would expect to happen to the mass of each experiment after one hour. [3]



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7

4. (a) On Anglesey, there is a large copper mine called Parys Mountain. Unwanted rock from the mining process has been dumped forming waste tips. As rainwater passes through the waste tips it dissolves copper salts. One of the salts is copper(II) sulfate.

During the 18th century, large shallow pits were dug all over the mountain. These filled with rainwater. Scrap iron was placed into the water and after a few months the pits were drained and copper-rich sludge was collected.

Explain the reaction taking place in the pits. Give the names of the products formed. [3]

……..

……..

…….....……

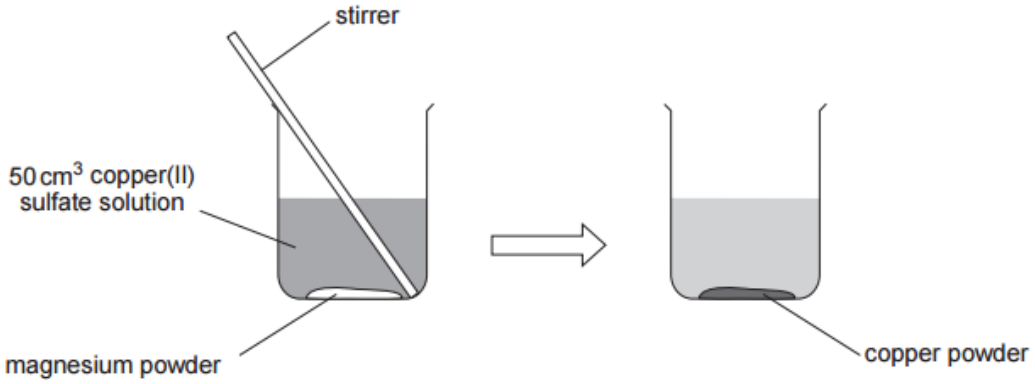
…….....

(b) A similar reaction takes place between copper and silver nitrate. One of the products formed is copper(II) nitrate, $Cu(NO_3)_2$.

Write the balanced **symbol** equation for this reaction. [2]

…… + …… → …… + ……

(c) Three students individually investigated the mass of copper formed when increasing amounts of magnesium powder were added to 50 cm^3 of copper(II) sulfate solution.



- Each pupil added 0.1 g of magnesium to 50 cm^3 of copper(II) sulfate solution and stirred the mixture until no more magnesium remained.
- They filtered, dried and weighed the copper formed.
- They repeated the experiment using 0.15, 0.20 and 0.25 g of magnesium powder and a new 50 cm^3 of copper(II) sulfate solution each time.

The results they obtained, as well as the theoretical results are shown in the following table.

Mass of magnesium added (g)	**Mass of copper formed (g)**				
	Student 1	**Student 2**	**Student 3**	**Mean result**	**Theoretical result**
0.10	0.15	0.13	0.14	0.14	0.26
0.15	0.25	0.21	0.23	0.23	0.40
0.20	0.35	0.37	0.28	0.36	0.54
0.25	0.41	0.45	0.39	0.40	0.68

(i) **Circle** the anomalous results **not** used in calculating the mean masses of copper. [1]

(ii) Using the information in the table, describe the relationship between the mass of magnesium added and the mass of copper formed. [1]

……

……

(iii) Using the information in the table, state whether the evidence supporting your conclusion in part (ii) is strong or weak. Give a reason for your answer. [1]

……

……

(iv) The mean values calculated are lower than the theoretical values. Suggest **two** possible reasons for this difference. [2]

……

……

……

……

(v) Use the results to predict the **theoretical** mass of copper that would be deposited when a mass of 0.35 g of magnesium is added. Give a reason for your answer. [2]

Theoretical mass deposited = ... g

Reason ……...

……

12

5. (a) Crude oil is a mixture of hydrocarbons.

(i) Describe briefly how crude oil was formed. [2]

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.....

(ii) Explain how crude oil is separated into different fractions. [4]

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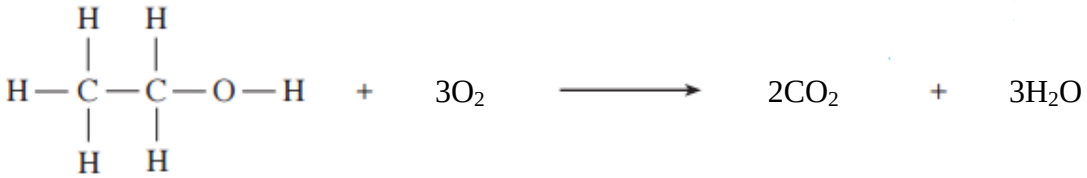
(b) Some countries use ethanol as a fuel for their cars instead of petrol. The following diagram shows the chemical changes that occur as ethanol burns.



Remember that CO_2 contains double bonds **only**

The bond energies relating to the bonds in the above diagram are shown in the table.

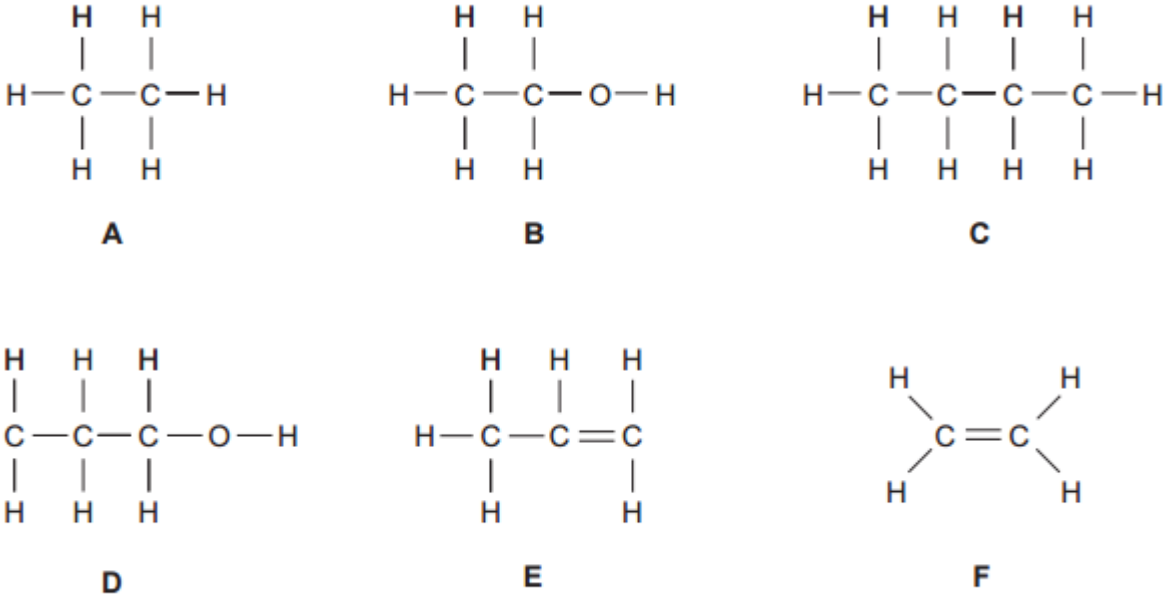
Bond	Bond energy (kJ)
O = O	496
C—H	413
C—C	347
C—O	358
O—H	464
C = O	743

Use this information to show that the reaction is exothermic and that the overall energy change is –1034 kJ. [5]

……..

……..

6. The following diagram shows the structures of six organic compounds.



(a) Complete the table below by giving the name of the family to which each pair of compounds belongs and the general molecular formula for that family. [2]

Pair of compounds	Family to which the pair of compounds belong	General molecular formula for the family
A and **C**		
B and **D**		

(b) Describe a chemical test that could be carried out to distinguish between compounds **C** and **E** compounds. [2]

……..

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……..

(c) Compound **C** is one of two isomers that have the molecular formula C_4H_{10}.

(i) Give the meaning of the term *isomer.* [1]

……

……

(ii) Draw the structure of the other isomer of C_4H_{10}. [1]

(d) Identify from compounds **A**-**F**, **one** compound other than **C** that has an isomer. Draw the structure of its isomer and give its systematic name. [2]

Compound .....

Structure

Name .....

8

7. (a) A student carries out a series of chemical tests on three unknown solutions, **A**, **B** and **C**. Her results are recorded in the table below.

Use all the information to identify reagents **X** and **Y** and solutions **A** and **B**. [4]

	Add dilute HCl	**Add $BaCl_2$(aq)**	**Add reagent X**	**Add reagent Y**
A	no reaction	white precipitate forms	pale green precipitate forms	no reaction
B	fizzes	no reaction	pungent smell given off	white precipitate forms
C	no reaction	no reaction	no reaction	yellow precipitate forms

Reagent **X** .....

Reagent **Y** .....

Solution **A** .....

Solution **B** .....

(b) Give the balanced **symbol** equation for the reaction that takes place between sodium carbonate and dilute nitric acid. [2]

Na_2CO_3 + ☐ HNO_3 → ☐ ..... + ... + ...

(c) The equation below represents the reaction occurring between copper(II) chloride solution and sodium hydroxide solution.

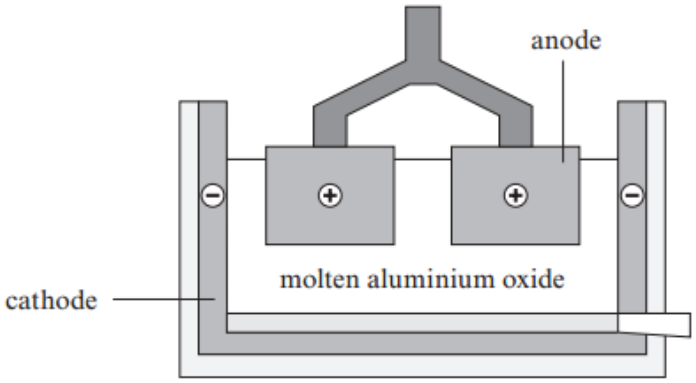
$$CuCl_2 + 2NaOH \rightarrow Cu(OH)_2 + 2NaCl$$

Write the **ionic** equation for this reaction. Include state symbols. [2]

..... + ... → .....

8

8. The diagram below shows an electrolysis cell used in the extraction of aluminium from aluminium oxide.



Describe and explain how this process works, including relevant equations. [6 QER]

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6

9. (a) Richard prepared a solution of sodium hydroxide, NaOH, by dissolving 2.40 g of sodium hydroxide pellets in 250 cm^3 of water.

Calculate the concentration of the sodium hydroxide solution in mol/dm^3. [2]

M_r(NaOH) = 40

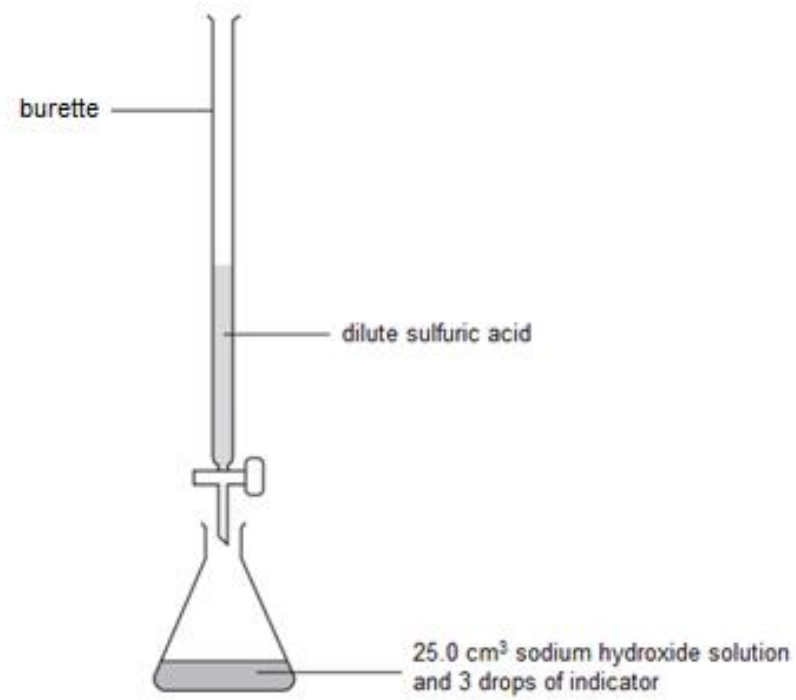
concentration = ... mol/dm^3

(b) Sulfuric acid reacts with sodium hydroxide according to the following equation.

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

Richard used his sodium hydroxide solution to determine the concentration of a sample of dilute sulfuric acid.

He measured exactly 25.0 cm^3 of the sodium hydroxide solution and titrated it against the sulfuric acid using the following apparatus.



(i) Explain why a burette is used to add the sulfuric acid. [2]

……

……

(ii) The results of the titration are shown in the following table.

Titration	1	2	3	4
Volume of sulfuric acid used (cm^3)	17.3	15.9	16.1	16.0

Use the results of the titrations to calculate the concentration of the dilute sulfuric acid in mol/dm^3. [4]

concentration = ... mol/dm^3

8

END OF PAPER

FORMULAE FOR SOME COMMON IONS

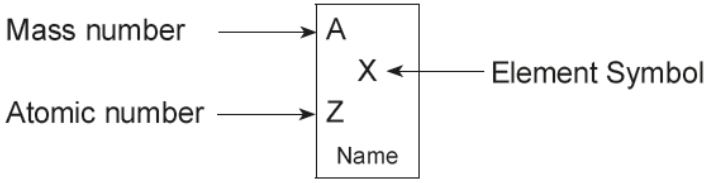
POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

Avogadro's number, $L = 6 \times 10^{23}$

PERIODIC TABLE OF ELEMENTS

1	2											3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:



UNIT 2: CHEMICAL BONDING, APPLICATION OF CHEMICAL REACTIONS AND ORGANIC CHEMISTRY
HIGHER TIER

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Extended response question

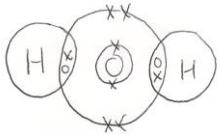
A level of response mark scheme is used. Before applying the mark scheme please read through the whole answer from start to finish. Firstly, decide which level descriptor matches best with the candidate's response: remember that you should be considering the overall quality of the response. Then decide which mark to award within the level. Award the higher mark in the level if there is a good match with both the content statements and the communication statements.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

Question				Marking details	Marks Available					
					AO1	**AO2**	**AO3**	**Total**	**Maths**	**Prac**
1	(a)	(i)		$2SO_2 + O_2 \leftrightharpoons 2SO_3$ (3) If equation not correct award (1) for each of following SO_2 and O_2 on reactant side SO_3 on product side		3		3	1	
		(ii)		30 % (2) If answer is incorrect award (1) for 86 or 56 read from graph		2		2	2	
		(iii)		$SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$ (2) If equation not correct award (1) for either of following SO_3 and H_2SO_4 oleum formula based on incorrect reactant hydrogen, sulfur and oxygen atoms only e.g. $H_2S_2O_6$ if sulfuric acid given as H_2SO_3		2		2	1	
	(b)			Copper(II) sulfate turns from <u>blue to white</u> (1) Any one of the following for (1) Crystals become powdery / crumbly Loses its crystalline appearance Dehydrating agent (1)	3			3		3
				Question 1 total	**3**	**7**	**0**	**10**	**4**	**3**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		Correct transfer of both outer shell potassium electrons to the oxygen atom (1)		1		1		
		(ii)		All four electronic configurations and charges correct (2) Any two correct (1) potassium ions (2,8,8) K^+ oxide ions (2,8) O^{2-}		2		2		
	(b)			 Diagram shows shared pair of electrons between oxygen and both hydrogen atoms (1) Octet of electrons around oxygen atom and only two around both hydrogen atoms (1)		2		2		
	(c)			**C** (1) Conducts electricity in its solid form (1)			2	2		

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(d)			Award (1) each for up to three of following properties **with explanation** Conducts electricity – **free electrons carrying the charge** Malleable / can be hammered into shape / bent into shape – **layers of ions can slide over each other** Ductile / can be drawn into a wire – **layers of ions can slide over each other** High density – **ions are tightly packed** High melting / boiling point – **ions are tightly packed** If no creditworthy explanations given award (1) for two correct properties	3			3		
				Question 2 total	**3**	**5**	**2**	**10**	**0**	**0**

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks Available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>3</td><td>(a)</td><td></td><td></td><td>Bubbles form because a gas, carbon dioxide, is produced ✓</td><td>1</td><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td></td><td>
<table>
<tr><th>Suggested explanation of where the carbon atoms come from</th><th>Is this correct? Yes/No</th></tr>
<tr><td>some carbon atoms come from the sugars</td><td>Yes</td></tr>
<tr><td>some carbon atoms come from the yeast</td><td>No</td></tr>
<tr><td>some carbon atoms come from the solution</td><td>No</td></tr>
</table>
Award (1) for all correct answers</td><td></td><td></td><td>3</td><td>3</td><td></td><td></td></tr>
<tr><td></td><td>(c)</td><td></td><td></td><td>Award (1) for each of following

Experiment 2 – no change; no yeast therefore no reaction

Experiment 1 – no change; reaction takes place but gas cannot escape as container is sealed

Experiment 3 – mass decreases; reaction takes place and gas escapes from container</td><td></td><td></td><td>3</td><td>3</td><td></td><td>3</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 3 total</td><td>1</td><td>0</td><td>6</td><td>7</td><td>0</td><td>3</td></tr>
</table>

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks Available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>4</td><td>(a)</td><td></td><td></td><td>Iron is more reactive than copper (1)

Displacement reaction occurs / iron displaces the copper (1)

Products – iron(III) oxide and copper (1)
Accept iron oxide</td><td>1

1</td><td>

1</td><td></td><td>

3</td><td></td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td></td><td>$Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$ (2)

If equation not correct award (1) for $AgNO_3$ and Ag included on appropriate sides</td><td></td><td>2</td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td></td><td><table><tr><td rowspan="2">Mass of magnesium added (g)</td><td colspan="5">Mass of copper formed (g)</td></tr><tr><td>Student 1</td><td>Student 2</td><td>Student 3</td><td>Mean result</td><td>Theoretical result</td></tr><tr><td>0.10</td><td>0.15</td><td>0.13</td><td>0.14</td><td>0.14</td><td>0.26</td></tr><tr><td>0.15</td><td>0.25</td><td>0.21</td><td>0.23</td><td>0.23</td><td>0.40</td></tr><tr><td>0.20</td><td>0.35</td><td>0.37</td><td>0.28</td><td>0.35</td><td>0.54</td></tr><tr><td>0.25</td><td>0.41</td><td>0.45</td><td>0.39</td><td>0.39</td><td>0.68</td></tr></table>
Both identified</td><td></td><td></td><td>1</td><td>1</td><td></td><td>1</td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>The greater the mass of magnesium added, the more copper deposited
Accept more magnesium gives more copper</td><td></td><td>1</td><td></td><td>1</td><td></td><td>1</td></tr>
<tr><td></td><td></td><td>(iii)</td><td></td><td>The evidence for this conclusion is strong because:

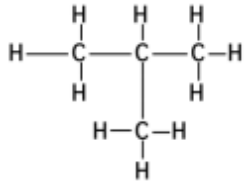
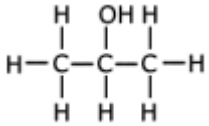
Each student has similar results / results are reproducible
Each student has same pattern in results

Credit for reason</td><td></td><td></td><td>1</td><td>1</td><td></td><td>1</td></tr>
</table>

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(c)	(iv)		Award (1) each for up to two possible issues that would lead to a reduction in the mass of copper Not all magnesium reacted / insufficient stirring / reaction time Magnesium not clean / had reacted before experiment / turned to oxide Not all copper retrieved / copper left behind in beaker / filter			2	2		2
		(v)		0.96 g (1) increase of 0.14 g per 0.05 g magnesium added (1)			2	2	2	
				Question 4 total	**2**	**4**	**6**	**12**	**2**	**5**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
5	(a)	(i)		Award (2) for any four of following points Award (1) for any two Formed from the remains of marine life / remains sea animals and plants Buried / compacted under sediment (over time) No oxygen Change chemically / turn to oil under heat and pressure Over millions of years	2			2		
		(ii)		Crude oil is heated until it boils / evaporates (1) Compounds with longer chain lengths have higher boiling points / shorter chain lengths have lower boiling points (1) Higher the boiling point the lower down the column the compounds condense (1) Compounds with similar chain lengths condense at similar temperatures and are collected as part of the same fraction (1)	4			4		
	(b)			Energy required (in breaking bonds) = 4722 (2) If incorrect award (1) for identification of bonds broken Energy released (in forming bonds) = 5756 (2) If incorrect award (1) for identification of bonds formed Difference between energy required and energy released is 1034 kJ and more energy given out than taken in therefore the reaction is exothermic and has negative value (1) or Overall energy change = energy required – energy released = 4722 – 5756 = –1034 kJ (1)		5		5	5	
				Question 5 total	**6**	**5**	**0**	**11**	**5**	**0**

<table>
<tr><th colspan="4" rowspan="2">Question</th><th rowspan="2">Marking details</th><th colspan="6">Marks Available</th></tr>
<tr><th>AO1</th><th>AO2</th><th>AO3</th><th>Total</th><th>Maths</th><th>Prac</th></tr>
<tr><td>6</td><td>(a)</td><td></td><td></td><td>All four names and formulae correct (2)
Any two correct (1)
<table><tr><th>Pair of Compounds</th><th>Family to which the pair of compounds belong</th><th>General molecular formula for the family</th></tr><tr><td>A and C</td><td>Alkanes</td><td>C_nH_{2n+2}</td></tr><tr><td>E and F</td><td>Alkenes</td><td>C_2H_{2n}</td></tr></table></td><td>2</td><td></td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td>(b)</td><td></td><td></td><td>Add bromine water (1)

Stays brown/orange/red/no reaction with C and E turns from brown/orange to colourless (1)</td><td>1</td><td>1</td><td></td><td>2</td><td></td><td>2</td></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td></td><td>Same molecular formula but different structure</td><td>1</td><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td></td><td>  </td><td>1</td><td></td><td></td><td>1</td><td></td><td></td></tr>
<tr><td></td><td>(d)</td><td></td><td></td><td>D has an isomer – no credit for identification alone
  (1) propan-2-ol (1)</td><td></td><td>2</td><td></td><td>2</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Question 6 total</td><td>5</td><td>3</td><td>0</td><td>8</td><td>0</td><td>0</td></tr>
</table>

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
7	(a)	(i)		Reagent **X** – sodium hydroxide (solution) / NaOH (1) Reagent **Y** – silver nitrate (solution) / $AgNO_3$ (1) Solution **A** – iron(II) sulfate / $FeSO_4$ (1) Solution **B** – ammonium carbonate / $(NH_4)_2CO_3$ (1)	1 1		1 1	4		4
		(ii)		$Na_2CO_3 + 2HNO_3 \rightarrow 2NaNO_3 + H_2O + CO_2$ (2) If equation is not correct award (1) for $NaNO_3$ and H_2O and CO_2 on product side		2		2	1	
	(b)			$Cu^{2+}(aq) + 2OH^-(aq) \rightarrow Cu(OH)_2(s)$ (2) If state symbols missing or incorrect award (1) for correct reactants **and** product	1	1		2	2	
				Question 7 total	**3**	**3**	**2**	**8**	**3**	**4**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
8				***Indicative content*** Aluminium oxide heated until molten (cryolite added to lower melting point) Al^{3+} and O^{2-} ions free to move in molten state Al^{3+} ions attracted to cathode where they gain electrons and form atoms $Al^{3+} + 3e^- \rightarrow Al$ Molten aluminium falls to bottom of cell O^{2-} ions attracted to anodes O^{2-} ions lose electrons forming oxygen molecules $2O^{2-} \rightarrow O_2 + 2e^-$ Overall reaction is $2Al_2O_3 \rightarrow 4Al + 3O_2$ **5–6 marks** All key points included, explanation in terms of electron gain/loss, electrode equations and overall equation *There is a sustained line of reasoning which is coherent, relevant, substantiated and logically structured. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.* **3–4 marks** Reference to aluminium oxide being molten, movement of ions and good attempt at electrode equation(s) or overall equation *There is a line of reasoning which is partially coherent, largely relevant, supported by some evidence and with some structure. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.*	6			6		

				1–2 marks Minimum of three points including two linked points e.g. molten **therefore** ions free to move *There is a basic line of reasoning which is not coherent, largely irrelevant, supported by limited evidence and with very little structure. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.* **0 marks** *No attempt made or no response worthy of credit.*						
				Question 8 total	**6**	**0**	**0**	**6**	**0**	**0**

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
9	(a)			0.24 (2) If answer is incorrect award (1) for 0.06 mol **or** Calculated number of mol divided by 0.25		2		2	2	2
	(b)	(i)		Allows more precision in adding acid / acid to be added in smaller quantities (1) End point is identified more accurately identifies / less error in recorded end point (1)	2			2		2
		(ii)		Allow error carried forward from part (a) Mean volume acid = 16.0 (1) n(NaOH) = 0.006 (1) n(H_2SO_4) = 0.003 (1) Concentration = 0.1875 (1) Award (4) for correct answer only Error carried forward throughout	1	1 1 1		4	4	
				Question 9 total	**3**	**5**	**0**	**8**	**6**	**4**

HIGHER TIER

SUMMARY OF MARKS ALLOCATED TO ASSESSMENT OBJECTIVES

Question	AO1	AO2	AO3	TOTAL MARK	MATHS	PRAC
1	3	7	0	10	4	3
2	3	5	2	10	0	0
3	1	0	6	7	0	3
4	2	4	6	12	2	5
5	6	5	0	11	5	0
6	5	3	0	8	0	0
7	3	3	2	8	3	4
8	6	0	0	6	0	0
9	3	5	0	8	6	4
TOTAL	32	32	16	80	20	19

GCSE

CHEMISTRY

UNIT 3: PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INSTRUCTIONS TO TEACHERS / EXAMS OFFICERS

Confidential

To be opened on receipt for immediate use by

TEACHERS / EXAMS OFFICERS

This document should be stored securely by the exams officer when not in use by the teacher. Its contents should not be divulged except to those concerned with the preparation of the assessment.

A. General Instructions

1. Each candidate will have to submit the number of tasks indicated in the table below.

Qualification	Number of tasks to be submitted
Biology	1
Chemistry	1
Physics	1
Science (Double Award)	2
Applied Science (Double Award)	2
Applied Science (Single Award)	1

The assessment will need to be completed in the first half of the spring term (i.e. January-February). Each task will be completed in two sessions each of 60 minutes duration.

Each task will have a section A and a section B. Section A and section B will be two separate question papers.

Section A will be completed in session 1 and will involve obtaining results. This will be collected from the candidates at the end of session 1. Section B will be completed in session 2 and will involve the analysis and evaluation of the results. Candidates should be given access to their section A question paper in session 2. **Section B should not be given to candidates until the second session. Both sections should be collected in at the end of session 2.**

2. The assessment should be supervised at all times by a member of staff responsible for teaching GCSE Science. Centres may use additional laboratories, provided that a subject teacher is available to supervise all groups at all times.

3. Teachers may open the **"Setting up Instructions"** document at the start of January. **This is for the purpose of ensuring that the apparatus functions well enough for the candidates to complete the task fully. Teachers are encouraged to try out the task, whilst preserving the confidentiality of the assessment.**

4. The question papers for all tasks will be made available to the examinations officer in each centre at the start of January.

5. **Section A**: It is permissible for candidates to work in small groups, of no more than three candidates. Teachers should ensure that each group has adequate working space and that the groups are set a reasonable distance apart. Each group requires uninterrupted access to the allocated apparatus – one set of apparatus per group. This is carried out under a limited level of control, i.e. learners may work with others to obtain results but they must provide their own responses to the questions set. Teacher assistance should not normally be required, but may be given if equipment failure occurs.

6. Once section A is completed, the question paper should be securely stored by the teacher until section B takes place.

7. **Section B**: This is carried out under a high level of control, i.e. learners must work individually. This section is to be completed with no teacher feedback or assistance allowed and under formal supervision. Candidates should have access to their section A question paper, as they need the results obtained in the first session to answer the questions in section B.

8. Candidates should write their answers in the spaces provided on the question paper. Should there be a need for additional space then a standard extension/answer booklet should be provided.

9. If candidates fail to obtain results for section A, it is acceptable for them to be given unformatted teacher results.

10. As soon as both section A and section B have taken place, the question papers for each candidate should be attached to each other and then securely stored by the exams officer before they are sent to the examiner by …… at the latest. Teachers should not be given access to the completed question papers after the actual assessments have taken place.

11. The assessment will be externally marked by a WJEC examiner. The name and address of the examiner will be issued to centres by the end of April.

12. Monitoring visits will take place on a random sample of centres to ensure the practical assessment is being administered correctly.

B. Specific Instructions

Details of the apparatus and materials required for the tasks follow.

If any difficulty is experienced in providing the apparatus, WJEC should be informed as soon as possible.

Contacts:

Subject Officer Helen Francis, 029 2026 5081, helen.francis@wjec.co.uk

Support Officer Lowri Evans, 029 2026 5140, lowri.evans@wjec.co.uk

INVESTIGATING THE REACTION BETWEEN ZINC AND COPPER SULFATE

Apparatus Required

The following apparatus is required for each group:
(each group should consist of no more than three candidates)

- 1 × standard size polystyrene cup to fit in 250 cm^3 beaker
- 1 × 100 cm^3 measuring cylinder
- 1 × 250 cm^3 beaker
- 100 cm^3 0.5M copper sulfate
- 10 g zinc powder
- 1 × microspatula
- 1 × thermometer (-10 °C to 110 °C and resolution ± 1 °C)
- safety goggles
- CLEAPSS student safety sheet 49 - zinc and its compounds

GCSE

CHEMISTRY

UNIT 3: PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE REACTION BETWEEN ZINC AND COPPER SULFATE

SETTING UP INSTRUCTIONS

Confidential

To be opened on …… (date) by TEACHERS

This document should be stored securely by the exams officer when not in use by the teacher. Its contents should not be divulged except to those concerned with the preparation of the assessment.

SECTION A

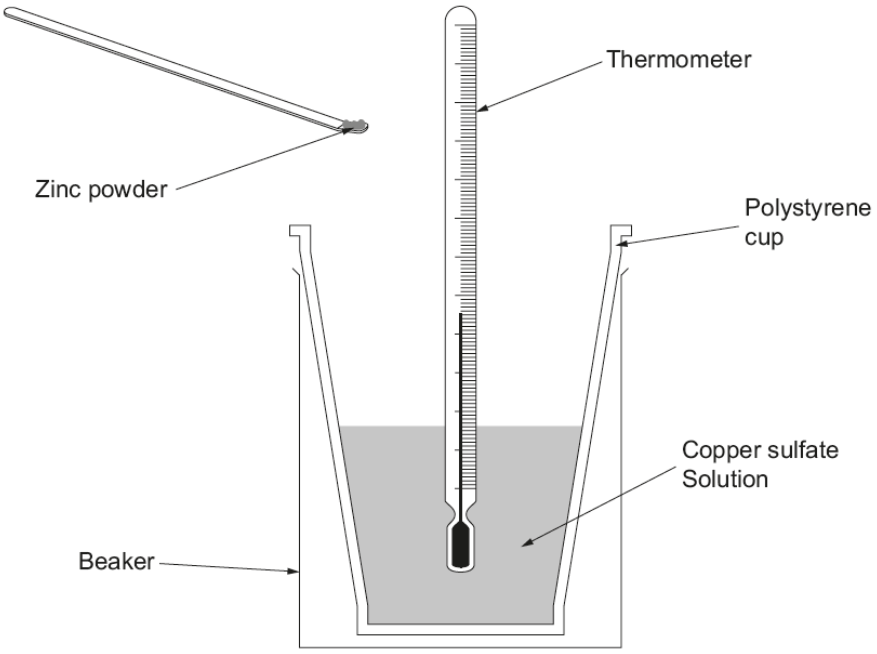
Introduction

Your task is to investigate the reaction between zinc and copper sulfate solution.

Apparatus

The following apparatus is required for each group:
(each group should consist of no more than three candidates)

- Polystyrene cup
- 100 cm^3 measuring cylinder
- 250 cm^3 beaker
- Safety goggles
- 50 cm^3 0.5M copper sulfate
- Zinc powder
- Microspatula



Method:

1. Measure 50 cm^3 of copper sulfate into the polystyrene cup.
2. Stand the cup in a beaker to keep it stable.
3. Measure the initial temperature of the copper sulfate solution.
4. Add 1 microspatula of zinc powder to the copper sulfate solution and stir.
5. Measure and record the highest temperature reached by the mixture.
6. Calculate the temperature rise compared to the original temperature.
7. Repeat steps 4 - 6 until a total of 8 microspatulas of zinc powder have been added to the copper sulfate solution.
8. Repeat steps 1 to 7 to gain two sets of results in total.

The remainder of the examination paper is not required for the purpose of checking the setting up of the task.

In order that the work of each candidate may be correctly assessed, information is required about the materials used in the task. Please ensure that the "**Information required from centres**" sheet on page 158 is completed and given to the exams officer to be sent to the examiner with the completed examination papers.

GCSE

CHEMISTRY

UNIT 3: PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE REACTION BETWEEN ZINC AND COPPER SULFATE

INFORMATION REQUIRED FROM CENTRES

Centre Number .....

(Please detach and send with the completed examination papers to the **examiner.**)

SPECIFIC DATA REQUIRED:

Concentration of copper sulfate solution

.....

Volume of copper sulfate used

.....

Candidate Name	Centre Number					Candidate Number				
						0				

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CHEMISTRY

UNIT 3: PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE REACTION BETWEEN ZINC AND COPPER SULFATE SOLUTION

SECTION A

(1 hour)

For Examiner's use only		
	Maximum Mark	**Mark Awarded**
Section A	**6**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The total number of marks available for this section of the task is 6.
The number of marks is given in brackets at the end of each question or part question.
This task is in 2 sections, **A** and **B**. You will complete section **A** in one session and section **B** in the next session.

SECTION A

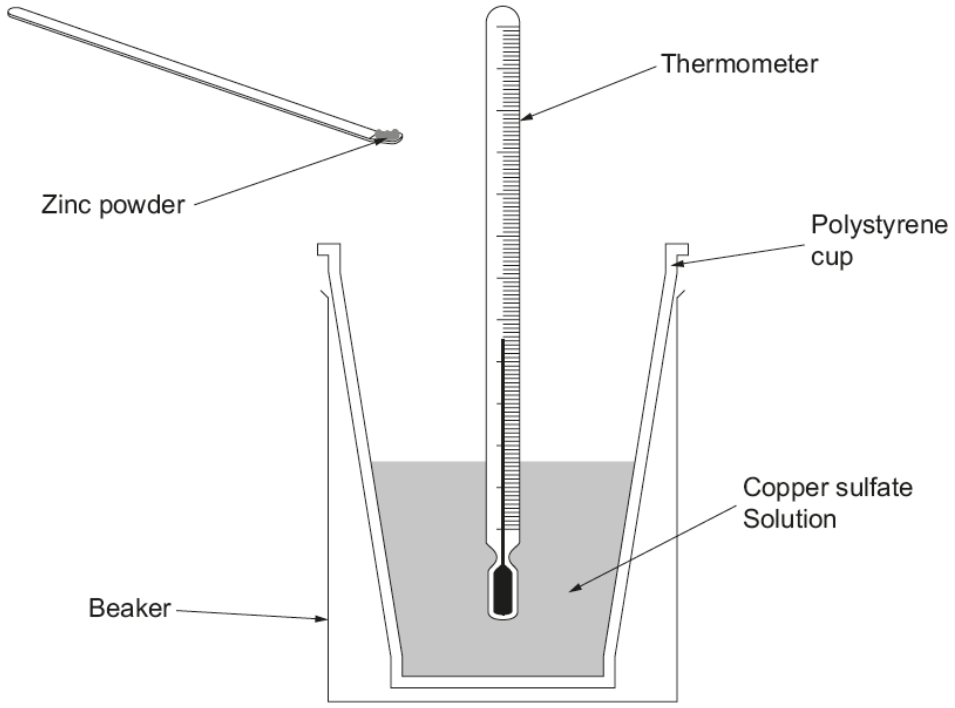
Introduction

Your task is to investigate the reaction between zinc and copper sulfate solution.

Apparatus

The following apparatus is required for each group:
(each group should consist of no more than three candidates)

- Polystyrene cup
- 100 cm^3 measuring cylinder
- 250 cm^3 beaker
- Safety goggles
- 50 cm^3 0.5M copper sulfate
- Zinc powder
- Microspatula



Read the method and answer question 1(a) before carrying out the experiment and recording your results.

Method:

1. Measure 50 cm^3 of copper sulfate into the polystyrene cup.
2. Stand the cup in a beaker to keep it stable.
3. Measure the initial temperature of the copper sulfate solution.
4. Add 1 microspatula of zinc powder to the copper sulfate solution and stir.
5. Measure and record the highest temperature reached by the mixture.
6. Calculate the temperature rise compared to the original temperature.
7. Repeat steps 4 - 6 until a total of 8 microspatulas of zinc powder have been added to the copper sulfate solution.
8. Repeat steps 1 to 7 to gain two sets of results in total.

Answer **all** *questions*

1. (a) Copper sulfate and zinc powder are irritants. Complete the risk assessment for copper sulfate using the template set out below. [1]

HAZARD	RISK	CONTROL MEASURE
Copper sulfate is an irritant/ harmful		

You may record raw results in the space below.

(b) Present your results in a table, including all of your results and the mean temperature rise for each spatula added. [5]

6

END OF PAPER

Candidate Name	Centre Number					Candidate Number				
						0				

GCSE

CHEMISTRY

UNIT 3: PRACTICAL ASSESSMENT

SAMPLE ASSESSMENT MATERIALS

INVESTIGATING THE REACTION BETWEEN ZINC AND COPPER SULFATE

SECTION B

(1 hour)

For Examiner's use only		
	Maximum Mark	**Mark Awarded**
Section B	**24**	

ADDITIONAL MATERIALS
In addition to this paper you will require a calculator and your section **A** exam paper.

INSTRUCTIONS TO CANDIDATES
Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES
The total number of marks available for this section of the task is 24.
The number of marks is given in brackets at the end of each question or part question.
This task is in 2 sections, **A** and **B**. You will have completed section **A** in a previous session.

SECTION B

Answer **all** *questions*

2. (a) (i) Identify the independent and dependent variables in the experiment completed in section A. [2]

independent variable: ……

dependent variable: ……

(ii) State **two** controlled variables from the method used in section A and give the value for each. [2]

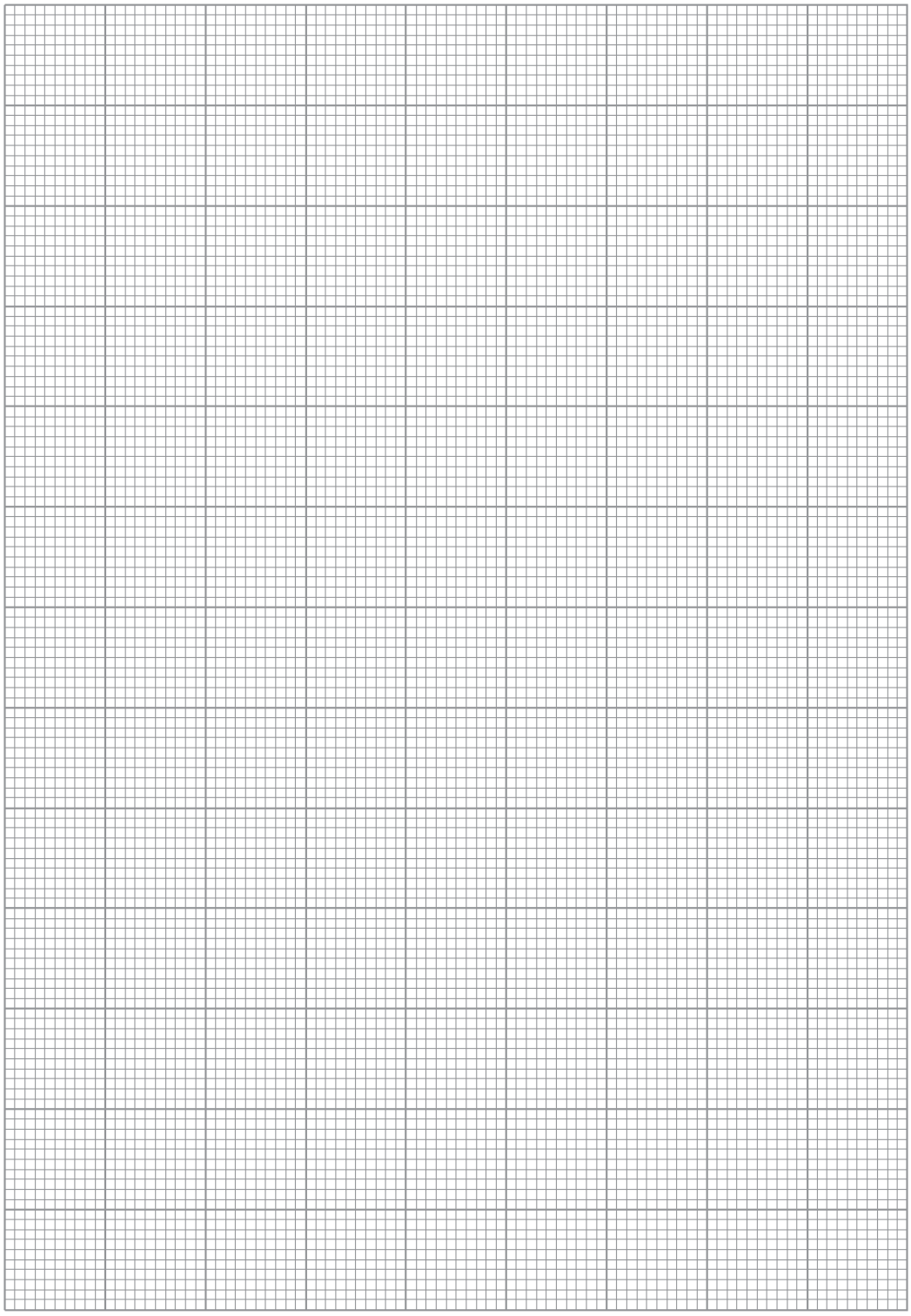
Controlled variable 1 ……..

value ……..

Controlled variable 2 ……..

value ……..

(b) Use your results from section A to draw a graph on the grid below. [5]



(c) Use your graph to describe the relationship between the quantity of zinc added and the temperature change. [2]

……

……

……

……

(d) Why is a polystyrene cup used to carry out the experiment? [1]

……

(e) (i) How could you change the apparatus/method used to ensure that the maximum temperature change was achieved? [2]

……

……

……

……

……

(ii) Identify **two** inaccuracies in the method and suggest an improvement for each. [4]

……

……

……

……

……

……

(f) What is the name given to a reaction in which heat energy is given out? [1]

……

(g) What happens in terms of energy changes during the reaction that causes the temperature to rise? [2]

……

……

……

……

……

(h) Using the formula given below, calculate the maximum energy released during your experiment. [3]

$E = mc\Delta T$

where:

E = Energy released (J)

m = mass of solution used ($1\,cm^3 = 1\,g$)

c = specific heat capacity = $4.18\,J/g\,^oC$

ΔT = temperature change ($T_{maximum}$ - $T_{initial}$)

energy released = ...J

24

END OF PAPER

UNIT 3: PRACTICAL ASSESSMENT

INVESTIGATING THE REACTION BETWEEN ZINC AND COPPER SULFATE SOLUTION

MARK SCHEME

GENERAL INSTRUCTIONS

Recording of marks

Examiners must mark in red ink.

One tick must equate to one mark (apart from the questions where a level of response mark scheme is applied).

Question totals should be written in the box at the end of the question.

Question totals should be entered onto the grid on the front cover and these should be added to give the script total for each candidate.

Marking rules

All work should be seen to have been marked.

Marking schemes will indicate when explicit working is deemed to be a necessary part of a correct answer.

Crossed out responses not replaced should be marked.

Credit will be given for correct and relevant alternative responses which are not recorded in the mark scheme.

Marking abbreviations

The following may be used in marking schemes or in the marking of scripts to indicate reasons for the marks awarded.

cao = correct answer only
ecf = error carried forward
bod = benefit of doubt

SECTION A

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			Copper sulfate risk: copper sulfate could get onto skin when being added to cup **and** Copper sulfate control measure: wash hands immediately if any copper sulfate gets on to them/ wear laboratory gloves **OR** Copper sulfate risk: copper sulfate could get transferred from hands to eyes **and** Copper sulfate control measure: wear eye protection (1)	1			1		1
	(b)			All data recorded and logically organised (1) Headings – number of spatulas/ temperature/ temperature increase (1) Units – ^{o}C (1) Temperature rise calculated correctly (1) Temperature rise means calculated correctly (1)	1 1 1	1 1		5	2	5
				Section A total	**4**	**2**	**0**	**6**	**2**	**6**

SECTION B

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		Independent variable - Number of spatulas (1) Dependent variable - Temperature rise (1)	2			2		2
		(ii)		**Any 2 x (1) from:** • Zinc + 1 microspatula • Copper sulfate volume + 50 cm^3 • Copper sulfate concentration + 0.5 M	2			2		2
	(b)			Axes labelled correctly with units (1) Scales & use of at least ½ of graph paper (1) All plots correctly plotted with ± ½ small square tolerance (2) 1 error (1) >1 error (0) Smooth curve of best fit within ± ½ small square division of all points (1) Don't accept thick, double, whispy line	1 1	2 1		5	5	5
	(c)			As more zinc is added there is an increase in temperature (1) To a given value (corresponding to graph) (1)		2		2		2
	(d)			To reduce heat losses to the surroundings		1		1		1
	(e)	(i)		Put a lid on the polystyrene cup/increase the insulation (1) Stirring (1)			2	2		2
		(ii)		Any 2 suitable inaccuracies (1) + improvement (1) masses of zinc on spatula vary (1) weigh out equal amounts of the zinc (1) **OR** thermometer only accurate to nearest °C (1) thermometer/ digital thermometer with higher resolution/ smaller divisions (1) **OR** measuring cylinder only accurate to nearest cm^3 (1) measuring cylinder with higher resolution/ smaller divisions (1)			4	4		4
	(f)			Exothermic	1			1		1

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
	(g)			Energy is needed to break bonds and energy is released when bonds are made (1) In this reaction **more** energy is released when bonds are made than is needed to break bonds (1)		2		2		2
	(h)			Correct calculation of ΔT (1) Correct substitution of figures (1) Correct calculation of E (1)	1	1 1		3	3	3
				Section B total	**8**	**10**	**6**	**24**	**8**	**24**