CCEA GCSE CHEMISTRY

CHEMISTRY



EXAM QUESTION PACK

UNIT C2 FOUNDATION TIER GCH21 PAPERS

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2016

GCSE Chemistry

Unit 2

Foundation Tier

GCH21

[GCH21]

WEDNESDAY 22 JUNE, MORNING

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in blue or black ink only. **Do not write with a gel pen.**
Answer **all six** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 90.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **4(b)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

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1 **(a)** The first national report examining the impact of water fluoridation on children was published in 2014. The dental health of five year olds and twelve year olds living in fluoridated water and non-fluoridated water areas was measured.

Data from this report is shown in the table below.

	In fluoridated water areas	In non-fluoridated water areas
% of twelve year olds with tooth decay	22	37
% of five year olds with tooth decay	13	42
% of hospital admissions for children aged 1–4 for tooth decay	2	20

(i) **Use the data** in the table to deduce the effect, if any, of the presence of fluoride in water on the dental health of children.

_____

_____

_____

_____

_____ [2]

(ii) State one reason why some people are against the fluoridation of drinking water.

_____

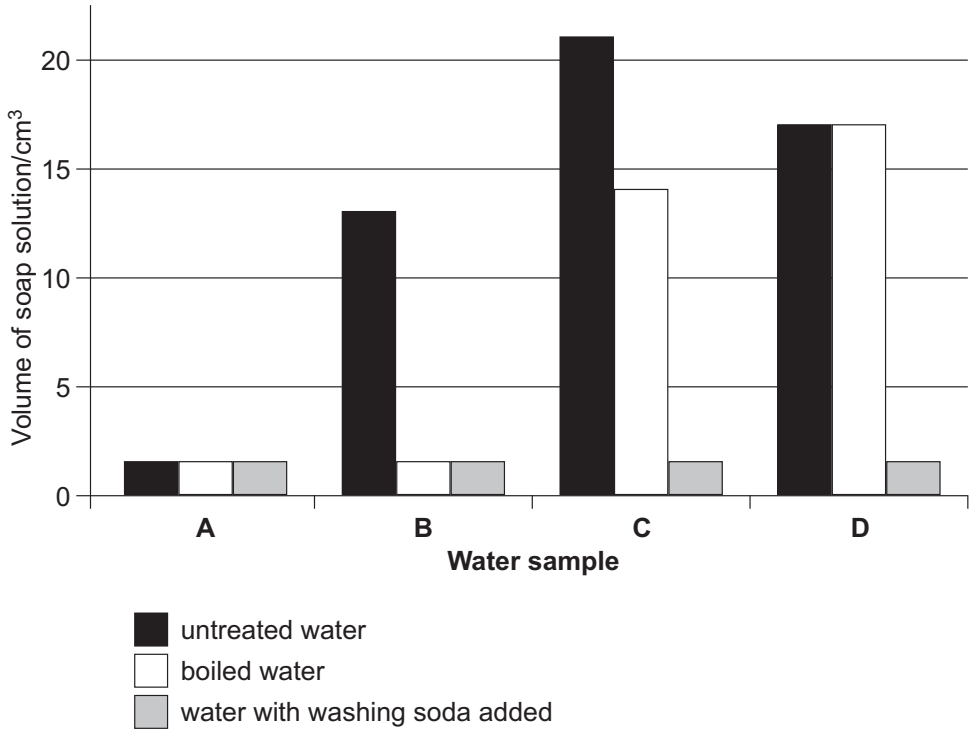
_____ [1]

[Turn over

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(b) Four samples of water, A, B, C and D, were tested for hardness. Soap solution was added, with shaking, to each of the four 20.0 cm^3 samples of water. The volume of soap solution required to produce 1 cm height of lather was recorded.

The experiment was repeated, with fresh boiled samples of water and then again with fresh samples of water which had been treated with washing soda. The results of the experiment are shown below.



(i) What is meant by the term hard water?

_____

_____ [1]

(ii) Which one of the samples, A, B, C or D is the hardest water? Explain your answer.

Sample: _____

_____

_____

_____ [2]

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(iii) What type of hardness is present in the following samples?

Sample B _____

Sample D _____ [2]

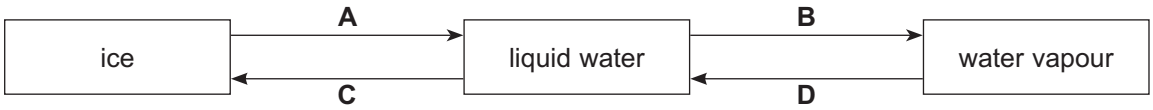
(iv) Explain why hard water is considered to be good for your health.

_____

_____ [1]

(c) Water can exist in three different states of matter.

(i) The changes of state are represented by the letters A, B, C and D, in the diagram below.



Complete the table below giving the name of the change of state represented by each letter.

Change of state	Name of the change of state
A	
B	
C	
D	

[4]

(ii) Name a chemical which could be used to test for the presence of water.

_____ [1]

[Turn over

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2 Cyclohexane, cyclohexene, ethanol and ethanoic acid are colourless liquids at room temperature. Each one belongs to a different homologous series.

(a) What is meant by the term homologous series?

_____

_____

_____

_____ [3]

(b) Cyclohexane is a colourless liquid alkane.

(i) What is the general formula for the alkanes?

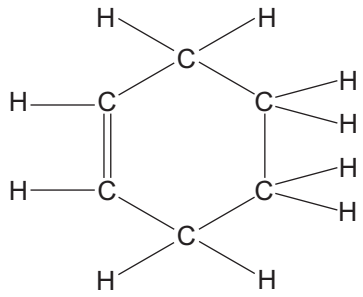
_____ [1]

(ii) Draw the structural formula of ethane.

[1]

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(c) The colourless liquid cyclohexene is a hydrocarbon with the molecular formula C_6H_{10}. The structural formula of cyclohexene is shown below.



(i) What is the functional group in cyclohexene?

_____ [1]

(ii) Why is cyclohexene described as a hydrocarbon?

_____

_____ [1]

(iii) Name the two products formed when cyclohexene is burned in excess oxygen.

1. _____

2. _____ [2]

(iv) Name the two **compounds** formed when cyclohexene is burned in a limited supply of oxygen.

1. _____

2. _____ [2]

[Turn over

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(d) Ethanol is a colourless liquid which can be made by fermentation.

(i) Describe the process of fermentation.

_____

_____

_____

_____

_____ [4]

(ii) State one use of ethanol.

_____ [1]

(e) Ethanoic acid is a colourless liquid with a sharp smell.

(i) State one use of ethanoic acid.

_____ [1]

(ii) Complete the word equation below.

ethanoic acid + sodium carbonate → [1]

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3 Hydrogen peroxide decomposes rapidly into water and oxygen in the presence of a catalyst.

(a) (i) Write a balanced symbol equation for the decomposition of hydrogen peroxide.

_____ [3]

(ii) Name the catalyst used for this reaction in the laboratory.

_____ [1]

(iii) What is meant by the term catalyst?

_____

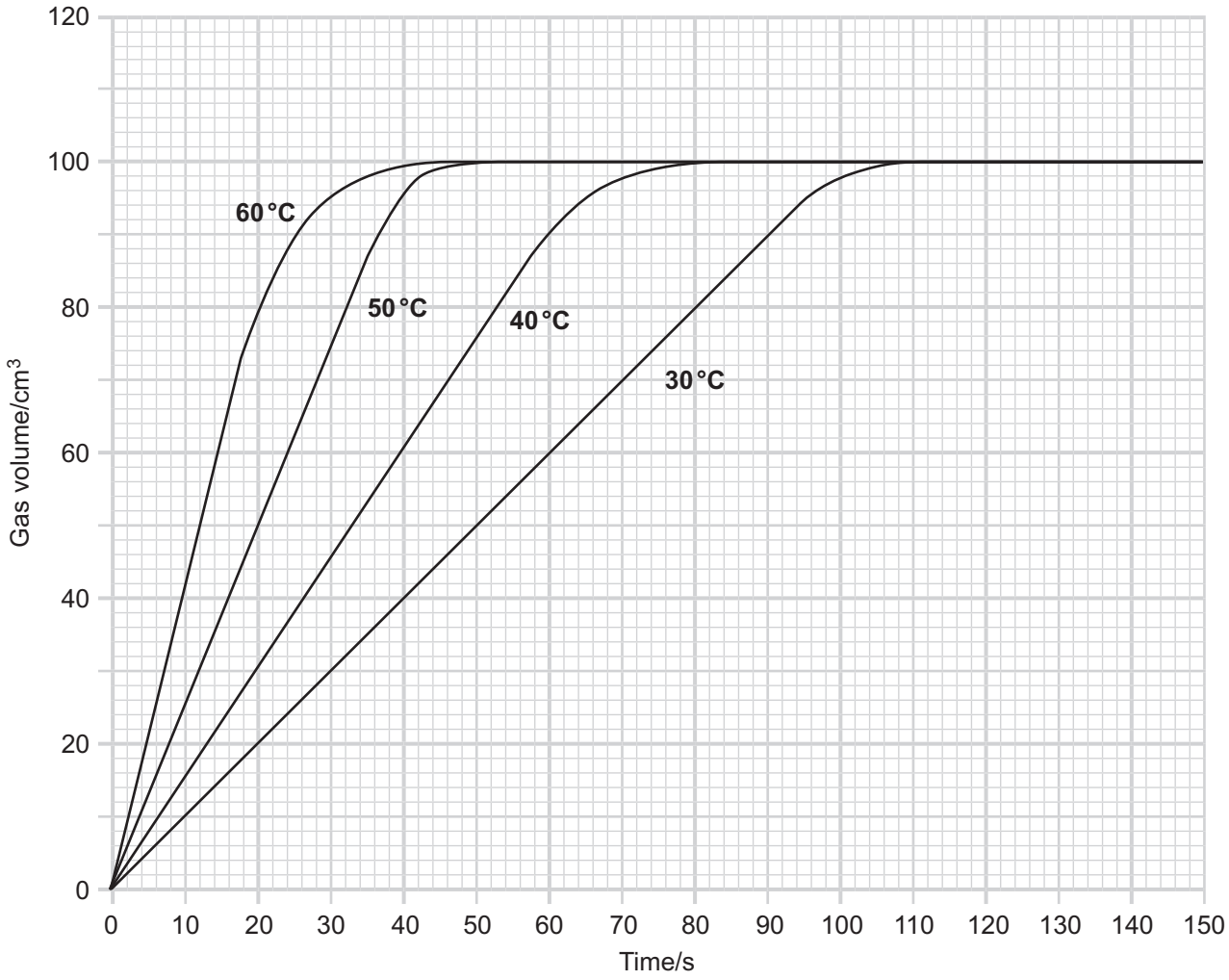
_____

_____ [3]

[Turn over

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(b) The volume of gas produced by the catalytic decomposition of hydrogen peroxide was measured at four different temperatures. The results were plotted on the graph below.



9999

(i) What was the gas volume at 40 seconds when the temperature was 30 °C? State the units.

_____ [2]

(ii) Complete the table below giving the time taken for the reaction to finish at 60 °C. Calculate the rate based on this time.

Temperature (°C)	Time taken for reaction to finish (s)	Rate = $\frac{1}{\text{time}}$ (s^{-1})
30	108	0.00926
40	79	0.01266
50	48	0.02083
60		

[2]

(iii) Using the data from the table above, state how rate changes as temperature increases.

_____ [1]

[Turn over

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4 **(a)** The element carbon is found in all living things.

(i) Write a balanced symbol equation for carbon burning in air to form carbon dioxide gas.

_____ [2]

(ii) Describe a chemical test for carbon dioxide gas and state the result for a positive test.

_____

_____

_____

_____ [3]

(b) Acid rain has been a major environmental problem for decades. Sulfur impurities in fossil fuels contribute to acid rain.

Describe in detail how these sulfur impurities lead to the formation of acid rain. Describe the effects of acid rain and methods used to prevent it.

Your answer should include:

- A description of how sulfur impurities lead to acid rain. (Include balanced symbol equations)
- At least two detrimental effects of acid rain on the environment
- At least two methods used to prevent acid rain.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

_____

_____

_____

_____

_____

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[9]

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5 Chemical reactions involve reactants being converted into products.

(a) Some signs of a chemical reaction occurring are given in the box below.

colour change	gas produced	formation of a precipitate

For each of the chemical reactions in the table below, choose a sign from the box above which would indicate that a chemical reaction is occurring.

Chemical reaction	Sign
magnesium + hydrochloric acid	
copper(II) oxide + hydrochloric acid	

[2]

(b) Chemical reactions may be classified as exothermic or endothermic reactions.

(i) Explain the meaning of the term endothermic.

_____

_____ [1]

(ii) Complete the following table by placing a tick (✔) in the appropriate column.

Chemical Reaction	Exothermic	Endothermic
Neutralisation		
Thermal decomposition		

[2]

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(iii) Fill in the missing words to complete the passage below.

During a chemical reaction, bonds in the reactants are broken and this process _____ energy. New bonds are formed in the products and this process _____ energy. [2]

(c) Rusting of iron is a major problem costing millions of pounds every year.

(i) Name the two substances that react with iron to form rust.

1. _____

2. _____ [2]

(ii) Describe the appearance of rust.

_____

_____ [2]

(iii) State a method used to prevent iron from rusting and explain how it works.

Method _____

Explanation _____

_____

_____ [2]

[Turn over

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(d) Iron is extracted from its ore, haematite, in a Blast Furnace. Haematite is mainly iron(III) oxide which is reduced by carbon monoxide to produce iron and carbon dioxide.

(i) Write a balanced symbol equation for the reaction between iron(III) oxide and carbon monoxide.

_____ [3]

(ii) Explain why iron(III) oxide is said to be reduced in this reaction.

_____

_____

_____

_____ [2]

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(Questions continue overleaf)

[Turn over

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6 **(a)** The reactivity of metals can be studied using displacement reactions. If a displacement reaction occurs there is a temperature rise.

In an experiment the following method was used:

- Pour some copper(II) sulfate solution into a polystyrene cup and record the temperature of the solution.
- Add a known mass of metal and stir.
- Record the maximum temperature of the mixture.
- Repeat the experiment.

The results of this experiment are shown in the table below.

Metal	Temperature increase (°C)		Average temperature rise (°C)
	Experiment 1	Experiment 2	
magnesium	11.5	16.5	14.0
silver	0.0	0.0	0.0
iron	3.0	4.0	3.5
gold	0.0	0.0	0.0
zinc	7.0	8.0	7.5

(i) State two factors which should be kept the same in this experiment to make it a fair test.

1. _____

2. _____ [2]

(ii) State and explain which of the metals gave the least reliable temperature rise.

_____

_____ [1]

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(iii) State and explain which of the metals used in the experiment is the most reactive.

_____

_____ [2]

(iv) Explain why there is no temperature rise when silver is added to copper(II) sulfate solution.

_____ [1]

(v) Why do the results make it impossible to decide which of the metals is the least reactive?

_____

_____ [1]

(vi) Write a balanced symbol equation for the displacement reaction between zinc and copper(II) sulfate solution.

_____ [2]

[Turn over

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(b) Aluminium is extracted from its ore by electrolysis.

(i) Explain what is meant by the term electrolysis.

_____

_____

_____ [2]

(ii) Name the ore from which aluminium is extracted.

_____ [1]

(iii) The ore of aluminium contains aluminium ions and oxide ions. State the formulae of these ions.

aluminium ion _____

oxide ion _____ [2]

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Question Number	Marks
1	
2	
3	
4	
5	
6	
Total Marks	

Examiner Number

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SYMBOLS OF SELECTED IONS

Positive ions

Name	Symbol
Ammonium	NH_4^+
Chromium(III)	Cr^{3+}
Copper(II)	Cu^{2+}
Iron(II)	Fe^{2+}
Iron(III)	Fe^{3+}
Lead(II)	Pb^{2+}
Silver	Ag^+
Zinc	Zn^{2+}

Negative ions

Name	Symbol
Carbonate	CO_3^{2-}
Dichromate	$Cr_2O_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogen carbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	$HCOO^-$
Nitrate	NO_3^-
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}

SOLUBILITY IN COLD WATER OF COMMON SALTS, HYDROXIDES AND OXIDES

Soluble
All sodium, potassium and ammonium salts
All nitrates
Most chlorides, bromides and iodides EXCEPT silver and lead chlorides, bromides and iodides
Most sulfates EXCEPT lead and barium sulfates Calcium sulfate is slightly soluble

Insoluble
Most carbonates EXCEPT sodium, potassium and ammonium carbonates
Most hydroxides EXCEPT sodium, potassium and ammonium hydroxides
Most oxides EXCEPT sodium, potassium and calcium oxides which react with water

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29 Clarendon Road, Clarendon Dock, Belfast BT1 3BG
✆ +44 (0)28 9026 1200 🖷 +44 (0)28 9026 1234 ☎ +44 (0)28 9024 2063 ✉ info@ccea.org.uk 🌐 www.ccea.org.uk
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DATA LEAFLET

For the use of candidates taking
Science: Chemistry,
Science: Double Award
or Science: Single Award

Copies must be free from notes or additions of any kind. No other type of data booklet or information sheet is authorised for use in the examinations.

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Symbols of Selected Ions 4
Solubility of Common Salts 4

gcse
science
chemistry
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single award

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THE PERIODIC TABLE OF ELEMENTS

Group

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1	2											3	4	5	6	7	0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La* Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac† Actinium 89	261 Rf Rutherfordium 104	262 Db Dubnium 105	263 Sg Seaborgium 106	262 Bh Bohrium 107	265 Hs Hassium 108	266 Mt Meitnerium 109	269 Ds Darmstadtium 110	272 Rg Roentgenium 111	285 Cn Copernicium 112						

* 58 – 71 Lanthanum series																	
† 90 – 103 Actinium series																	
a / b x = relative atomic mass (approx), x = atomic symbol, b = atomic number																	
	140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	147 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71			
	232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	242 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	245 Bk Berkelium 97	251 Cf Californium 98	254 Es Einsteinium 99	253 Fm Fermium 100	256 Md Mendelevium 101	254 No Nobelium 102	257 Lr Lawrencium 103			

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General Certificate of Secondary Education
2016

GCSE Chemistry

Unit 2

Foundation Tier

[GCH21]

WEDNESDAY 22 JUNE, MORNING

MARK SCHEME

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General Marking Instructions and Mark Grids

Introduction
Mark schemes are intended to ensure that the GCSE examination is marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses likely to be worthy of credit. They also set out the criteria that they should apply in allocating marks to candidates' responses. The mark schemes should be read in conjunction with these marking instructions.

Quality of candidates' responses
In marking the examination papers, examiners should be looking for a quality response reflecting the level of maturity which may reasonably be expected of a 16-year-old which is the age at which the majority of candidates sit their GCSE examinations.

Flexibility in marking
Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, the examiners should seek the guidance of the Supervising Examiner.

Positive marking
Examiners must be positive in their marking, giving appropriate credit for description, explanation and analysis, using knowledge and understanding and for the appropriate use of evidence and reasoned argument to express and evaluate personal responses, informed insights and differing viewpoints. Examiners should make use of the whole of the available mark range of any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected of a 16-year-old GCSE candidate.

Awarding zero marks
Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Types of mark scheme
Mark Schemes for questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

AVAILABLE MARKS

1 **(a)** **(i)** fluoride reduces tooth decay/less tooth decay in fluoridated areas [1]
use of any data to compare [1] [2]

(ii) any **one** from:
no freedom of choice
mass medication
other effects of fluoride in drinking water unknown [1]

(b) **(i)** water which does not lather **readily** with **soap** [1]

(ii) Sample C [1]
requires the greatest volume of soap to obtain a lather [1] [2]

(iii) Sample B – temporary (hardness) [1]
Sample D – permanent (hardness) [1] [2]

(iv) contains calcium (ions) so good for teeth/bones/prevent heart disease [1]

(c) **(i)**

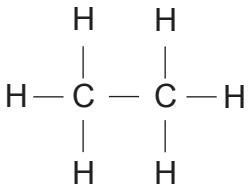
Change in state	Name of the change in state
A	melting [1]
B	boiling/evaporation [1]
C	freezing [1]
D	condensation [1]

[4]

(ii) anhydrous copper(II) sulfate/anhydrous cobalt(II) chloride/cobalt chloride paper [1]

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			AVAILABLE MARKS
2	**(a)**	same general formula [1] similar chemical properties [1] gradation in physical properties [1] differ by a 'CH_2' unit [1] max [3]	
	(b)	**(i)** C_nH_{2n+2} [1]	
		(ii)  [1]	
	(c)	**(i)** C═C/carbon-carbon double bond/allow circled C═C on diagram [1]	
		(ii) it only contains carbon and hydrogen [1]	
		(iii) carbon dioxide [1] water [1] [2]	
		(iv) carbon monoxide [1] water [1] [2]	
	(d)	**(i)** yeast [1] sugar/glucose/source of sugar [1] warm [1] in solution [1] absence of air/anaerobic [1] max [4]	
		(ii) fuel/solvent/alcoholic drinks [1]	
	(e)	**(i)** vinegar/food flavouring [1]	
		(ii) sodium ethanoate + water + carbon dioxide [1]	18

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AVAILABLE MARKS

3 **(a)** **(i)** $2H_2O_2 \rightarrow 2H_2O + O_2$
correct formula of reactant [1]
correct formulae of products [1]
correct balancing [1] [3]

(ii) manganese(IV) oxide/manganese dioxide [1]

(iii) substance which speeds up (or increases the rate of) [1]
a (chemical) reaction [1]
without being used up/remains chemically unchanged at the end [1] [3]

(b) **(i)** 40 [1] cm^3 [1] [2]

(ii)

Temperature (°C)	Time for reaction to finish (s)	Rate = $\frac{1}{\text{time}}$ (s^{-1})
30	108	0.00926
40	79	0.01266
50	48	0.02083
60	42 [1]	0.0238 [1]

allow 42–46 [2]

(iii) (rate) increases [1] 12

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AVAILABLE MARKS

4 (a) (i) $C + O_2 \rightarrow CO_2$
correct formulae of reactants [1]
correct formula of product [1] [2]

(ii) limewater [1]
changes from colourless [1] to milky [1] [3]

(b) Indicative content

Formation
- sulfur (present in fossil fuels) reacts with oxygen in the air/undergoes combustion to form sulfur dioxide [1]
- $S + O_2 \rightarrow SO_2$ [2]
- sulfur dioxide reacts with water **in the air** to form sulfurous acid [1]
- $SO_2 + H_2O \rightarrow H_2SO_3$ [2]

Environmental effects
- corrosion of limestone buildings and statues [1]
- kills fish in rivers and lakes [1]
- defoliates trees [1]

Prevention
- remove sulfur from fossil fuels before combustion [1]
- burn less fossil fuels/use renewable energy sources [1]
- remove sulfur dioxide from industrial waste gases [1]

Response	Mark
Candidates must use appropriate specialist terms to explain fully the formation of acid rain (using 10–12 points of indicative content) including two balanced symbol equations. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[7]–[9]
Candidates must use appropriate specialist terms to explain fully the formation of acid rain (using 6–9 points of indicative content) including one balanced symbol equation. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[4]–[6]
Candidates describe briefly and partially the formation of acid rain (using 2–5 points of indicative content). They use limited spelling, punctuation and grammar and they make little use of specialist terms. The form and style are of a limited standard.	[1]–[3]
Response not worthy of credit	[0]

[9] 14

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AVAILABLE MARKS

5 **(a)**

Chemical reaction	Sign
magnesium + hydrochloric acid	gas produced [1]
copper(II) oxide + hydrochloric acid	colour change [1]

[2]

(b) **(i)** heat is taken in

[1]

(ii)

Chemical Reaction	Exothermic	Endothermic
Neutralisation	✓ [1]	
Thermal decomposition		✓ [1]

[2]

(iii) takes in/requires [1]
gives out/releases [1] [2]

(c) **(i)** water [1]
oxygen [1] [2]

(ii) brown [1] flaky [1] solid [1] max [2]

(iii) any one method of prevention [1] and explanation [1] from: [2]

Method of prevention: [1]
painting/oiling/plastic coating/metal coating/galvanising

Explanation: [1]
acts as a barrier/prevents air and water from coming into contact with iron metal

Or

Method of prevention [1]
galvanising/sacrificial protection

Explanation [1]
idea that more reactive metal reacts first

(d) **(i)** $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
correct formulae of reactants [1]
correct formulae of products [1]
correct balancing [1] [3]

(ii) iron/iron(III) oxide has lost oxygen [1]
loss of oxygen is reduction [1] [2]

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				AVAILABLE MARKS
6	(a)	(i)	same **volume** of copper(II) sulfate [1] same **concentration** of copper(II) sulfate [1] same mass of metal/same number of moles of metal [1] max [2]	
		(ii)	magnesium the repeat result was not similar/far apart [1]	
		(iii)	magnesium [1] temperature rise was greatest [1] [2]	
		(iv)	no reaction/silver cannot displace copper/silver below copper in the reactivity series [1]	
		(v)	two metals/gold and silver give the same result [1]	
		(vi)	$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$ correct formulae of reactants [1] correct formulae of products [1] [2]	
	(b)	(i)	decomposition [1] of a substance/electrolyte/compound by (the passage of) electricity [1] [2]	
		(ii)	bauxite [1]	
		(iii)	Al^{3+} [1] O^{2-} [1] [2]	14
			Total	**90**

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General Certificate of Secondary Education
2015

GCSE Chemistry

Unit 2

Foundation Tier

[GCH21]

WEDNESDAY 17 JUNE, MORNING

MARK SCHEME

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General Marking Instructions and Mark Grids

Introduction
Mark schemes are intended to ensure that the GCSE examination is marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses likely to be worthy of credit. They also set out the criteria that they should apply in allocating marks to candidates' responses. The mark schemes should be read in conjunction with these marking instructions.

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Awarding zero marks
Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

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Mark Schemes for questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

						AVAILABLE MARKS
1	(a)	(i)	H_2O		[1]	
		(ii)	2 H/hydrogen (atoms) 1 O/oxygen (atom)	[1] [1]	[2]	
		(iii)	anhydrous copper(II) sulfate/cobalt chloride paper Accept anhydrous copper sulfate correct colour change for anhydrous copper(II) sulfate = white [1] to blue [1] for cobalt chloride paper = (pale) blue [1] to pink [1] correct colours wrong way round allow [1]	[1] [2]	[3]	
		(iv)	ice		[1]	
	(b)	(i)	water which does not lather readily with soap water which does not lather with soap = [1]		[2]	
		(ii)	temporary hardness is removed by boiling permanent hardness is not removed by boiling	[1] [1]	[2]	
		(iii)	tastes better/better for specified health benefit, e.g. teeth, bones		[1]	12

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AVAILABLE MARKS

2 (a) Indicative content

- sugar/glucose (or source of sugar such as fruit)
- in solution
- yeast (or zymase)
- absence of air/anaerobic conditions
- warm conditions
- carbon dioxide also produced

Response	Mark
Candidates must use appropriate specialist terms to explain fully the process of fermentation (5–6 points of indicative content). They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates must use appropriate specialist terms to explain fully the process of fermentation (using 3–4 points of indicative content). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates explain briefly and partially the process of fermentation (using 2 points of indicative content). They use limited spelling, punctuation and grammar and they have made little use of specialist terms. The form and style are of limited standard.	[1]–[2]
Response not worthy of credit	[0]

[6]

(b) (i) compound containing **only** carbon and hydrogen atoms [1]

(ii) C_8H_{18} [1]

(iii) carbon dioxide [1]
water [1] [2]

(c) (i) $\frac{24}{46}$ [1] × 100 = 52.17 [1] % [2]

(ii) carbon monoxide produced [1] is toxic [1] [2] 14

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						AVAILABLE MARKS
3	**(a)**	**(i)**	hydrogen		[1]	
		(ii)	gas syringe		[1]	
	(b)	**(i)**	80 (s) (allow 78–82)		[1]	
		(ii)	$\frac{1}{80}$ [1] = 0.0125 [1] allow consequential marking from **(b)(i)**		[2]	
		(iii)	30		[1]	
	(c)	**(i)**	D		[1]	
			faster reaction/steeper slope finishes at same gas volume	[1] [1]	[2]	
		(ii)	B		[1]	
		(iii)	A	[1]		
			half mass used so half volume produced/less gas produced less mass used so less volume produced	[1]	[2]	
	(d)	**(i)**	cobalt nitrate	[1]		
			shortest time/fastest reaction	[1]	[2]	
		(ii)	KNO_3		[1]	15

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			AVAILABLE MARKS
4	**(a)**		

Property \ Gas	Sulfur dioxide	Nitrogen
Formula	SO_2 [1]	N_2 [1]
Colour	colourless [1]	colourless [1]
Acidic, basic or neutral	acidic [1]	neutral

[5]

(b) to manufacture fertilisers/to manufacture HNO_3 [1]

(c) **(i)** nitrogen [1]

(ii) hydrogen [1]

(iii) a pressure in range 200–1000 atm, e.g. 200 atm [1]

(iv) $N_2 + 3H_2 \rightarrow 2NH_3$
correct formulae of reactants [1]
correct formula of product [1]
correct balancing [1] [3]

(v) iron [1]

(vi) a temperature in range 350 °C–550 °C, e.g. 450 °C [1]

(vii) cooled [1] 15

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						AVAILABLE MARKS
5	(a)	(i)	continental drift		[1]	
		(ii)	Idea that Wegener could not explain how it happened		[1]	
	(b)	(i)	oxygen/air moisture/water	[1] [1]	[2]	
		(ii)	any **two** from: painting coating in a suitable metal, e.g. chromium galvanising oiling/greasing coating in rubber or plastic sacrificial protection		[2]	
		(iii)	red-brown [1] flaky [1] solid [1]		**max** [2]	
	(c)	(i)	$FeSO_4$		[1]	
		(ii)	$Fe + 2HCl \rightarrow FeCl_2 + H_2$ correct formulae of reactants correct formulae of products correct balancing	 [1] [1] [1]	 [3]	
		(iii)	iron gains oxygen gain of oxygen is oxidation	[1] [1]	[2]	
		(iv)	apply lit splint [1] pop [1]		[2]	
		(v)	displacement		[1]	17

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AVAILABLE MARKS

6 **(a)**

Item	Natural	Synthetic
Glass bottle		✓ [1]
Woollen rug	✓ [1]	
Plastic bucket		✓ [1]
Iron nail		✓ [1]

[4]

(b) **(i)** any **two** from the following:
- reduces landfill
- conserves raw materials
- cheaper than extraction
- saves energy

[2]

(ii) plastics/glass/paper/cardboard/food cans [1]

(c) **(i)** decomposition (of an ionic compound) [1]
using (a direct current of) electricity [1] [2]

(ii) bauxite [1]

(iii) cathode [1]

(d) **(i)** $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
correct formulae of reactants [1]
correct formulae of products [1]
correct balancing [1] [3]

(ii) loss of oxygen/gain of electrons/gain of hydrogen [1]

(iii) haematite [1]

(e) iron [1]

17

Total **90**

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2014

GCSE Chemistry

Unit 2

Foundation Tier

[GCH21]

GCH21

THURSDAY 19 JUNE, AFTERNOON

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided. Do not write outside the box, around each page or on blank pages.
Complete in blue or black ink only. **Do not write with a gel pen.**
Answer **all six** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 90.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **4(c)(iii)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

8566

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Examiner Only	
Marks	Remark

1 Many multivitamin supplements are produced as tablets which effervesce when added to water. The label of a multivitamin supplement is shown below.

Multivitamin Supplement

Niacin
Calcium carbonate
Vitamin B12
Sweeteners
Salt
Orange flavouring
Citric acid

In an experiment one multivitamin tablet was added to 50 cm^3 of water in a conical flask at a temperature of 20 °C. The flask was loosely stoppered with a cotton wool plug and placed on an electronic balance. A stopclock was started as soon as the tablet made contact with the water. The mass was recorded every 20 seconds.

(a) (i) Draw a labelled diagram of the assembled apparatus used to carry out this experiment. **Include all apparatus**.

[4]

(ii) Explain the purpose of the cotton wool plug.

_____

_____ [1]

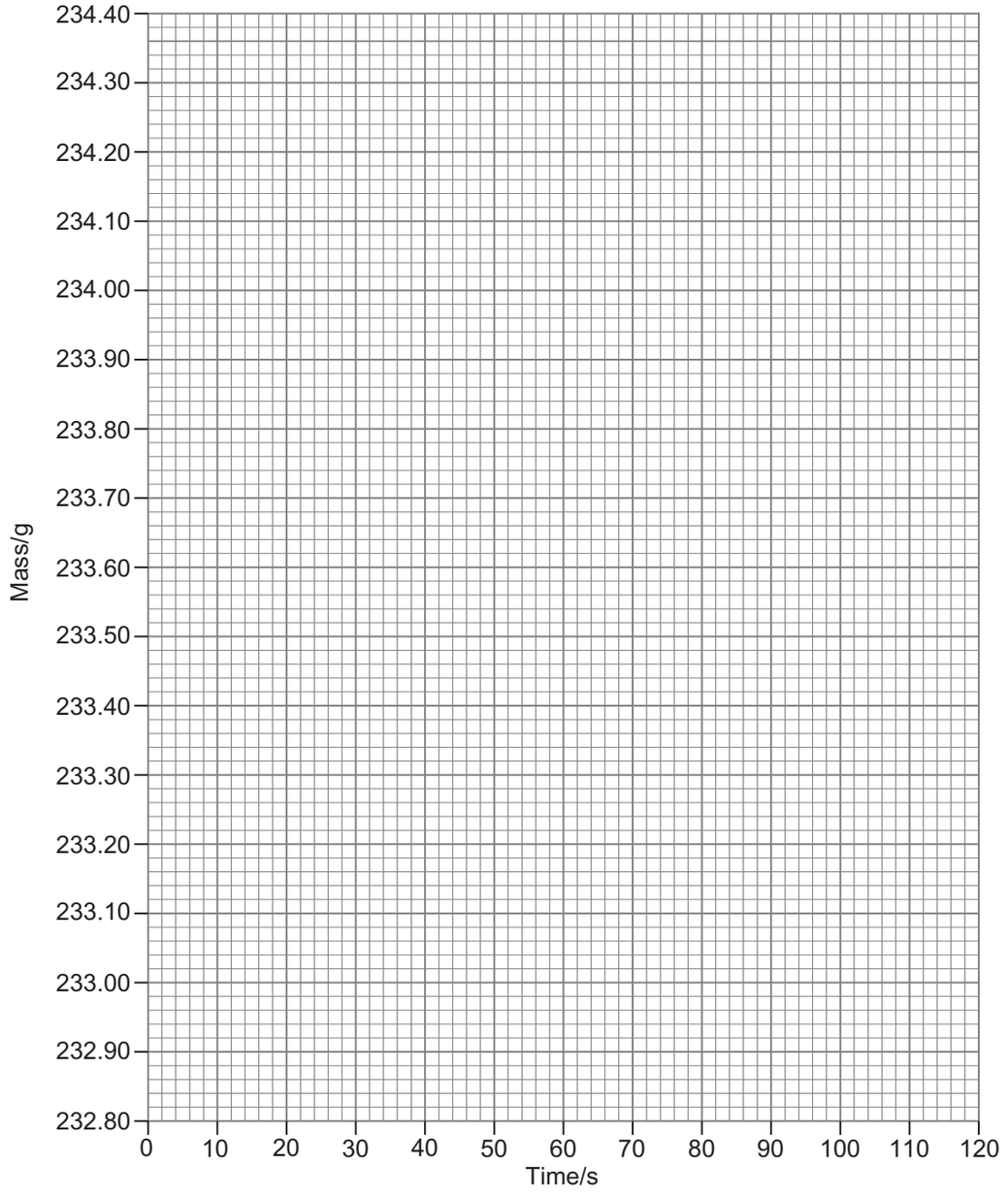
[Turn over

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(b) The results obtained from the experiment are shown below.

Time/s	0	20	40	60	80	100	120
Mass/g	234.10	233.70	233.40	233.20	233.05	233.00	233.00

(i) Plot these results on the graph below. [4]



Examiner Only	
Marks	Remark

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Using the graph answer the following questions.

(ii) At what time does the reaction stop?

_____ [1]

(iii) Calculate the total loss in mass.

_____ [1]

(iv) The experiment was repeated using one tablet and 50 cm^3 of water at 40 °C. On the same axes, sketch the graph for this experiment and label it B. [3]

(v) Apart from temperature, state one other factor which affects the rate of a chemical reaction.

_____ [1]

Examiner Only	
Marks	Remark
Total Question 1	

[Turn over

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Examiner Only	
Marks	Remark

2 **(a)** When food decays many different gases are produced, including ammonia, carbon dioxide, carbon monoxide, hydrogen, hydrogen sulfide, sulfur dioxide and methane.



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(i) Name **one** of the gases produced during decay which has a pungent smell.

_____ [1]

(ii) Complete the table below which gives details of some of the gases produced during decay.

Gas	Formula	Colour
	NH_3	
carbon dioxide	CO_2	
hydrogen		colourless
carbon monoxide	CO	colourless

[4]

(iii) Carbon monoxide burns in oxygen forming carbon dioxide. Write a balanced symbol equation for this reaction.

_____ [3]

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(iv) A glass rod is dipped into concentrated hydrochloric acid and placed into a sample of ammonia gas. Describe what is observed.

_____

_____ [2]

(b) Hydrogen sulfide gas is toxic and flammable. It reacts with oxygen according to the equation:

hydrogen sulfide + oxygen → sulfur dioxide + water

(i) Write a balanced symbol equation for this reaction.

_____ [3]

(ii) Name the substance being oxidised in this reaction.

_____ [1]

(iii) State one safety precaution you would take in a laboratory when using hydrogen sulfide.

_____ [1]

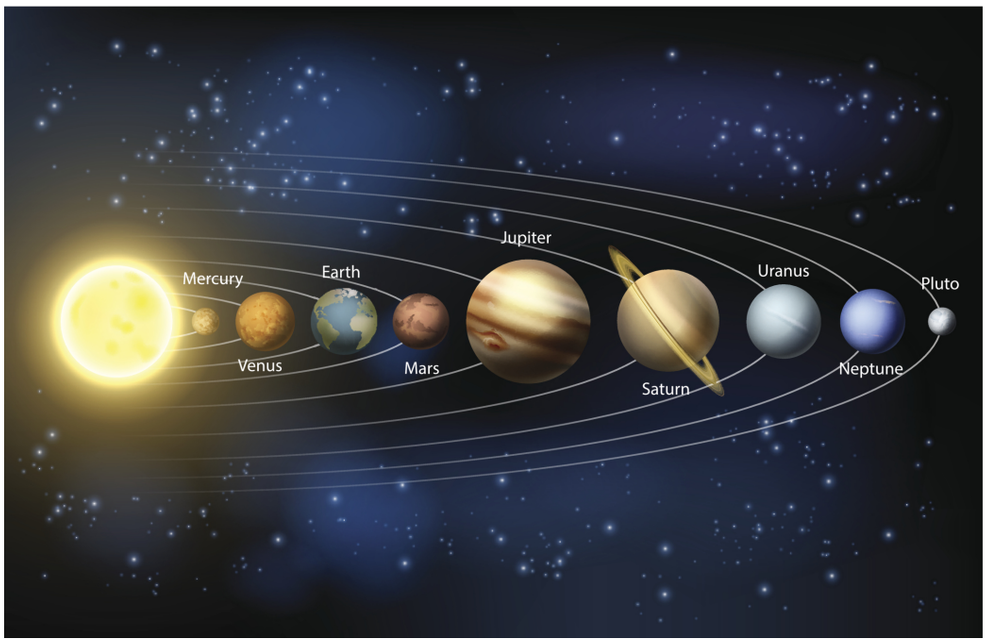
Examiner Only	
Marks	Remark
Total Question 2	

[Turn over

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3 The diagram below shows the Earth's solar system.

Examiner Only	
Marks	Remark



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(a) Mars is often called the red planet due to the presence of haematite on its surface. A recent study of the Huygens Crater on Mars has also shown the presence of iron(III) hydroxide and calcium carbonate.

(i) Calcium carbonate and iron(III) hydroxide undergo thermal decomposition. What is meant by the term thermal decomposition?

_____

_____ [2]

(ii) Complete the word equation for the thermal decomposition of calcium carbonate.

calcium carbonate → _____ + _____

[2]

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Examiner Only	
Marks	Remark

(b) Mars does not have tectonic plates but Earth does. What may occur at the boundaries between tectonic plates?

_____

_____ [2]

(c) Atmosphere is the term used to describe the collection of gases that surround a planet. The composition of the atmosphere of Mars is shown in the table below.

Gas	Composition
Carbon dioxide	95.0%
Nitrogen	3.0%
Noble gases	1.6%
Oxygen	trace
Methane	trace

Compare the composition of nitrogen and oxygen in the Earth's atmosphere today, with that of the planet Mars.

_____

_____

_____

_____

_____

_____

_____

_____ [3]

[Turn over

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(d) Dione is a moon of the planet Saturn. In March 2012 scientists verified that Dione has an atmosphere which is made up of mainly oxygen. The discovery was made using instruments on board the unmanned Cassini spacecraft.

(i) Describe a chemical test which proves the presence of oxygen gas.

_____

_____ [2]

(ii) State two physical properties of oxygen gas.

1. _____

2. _____ [2]

(e) Changes in the atmosphere of the Earth occurred slowly over millions of years due to photosynthesis and other processes.

(i) An unbalanced symbol equation for photosynthesis is shown below. Balance this equation.

CO_2 + H_2O → $C_6H_{12}O_6$ + O_2 [1]

(ii) The composition of the Earth's atmosphere is still changing today. This could be due to the burning of fossil fuels.

displacement	endothermic	exothermic
neutralisation	oxidation	reduction

Choose two words from the box above which describe the burning of fossil fuels.

1. _____

2. _____ [2]

Examiner Only	
Marks	Remark
Total Question 3	

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(Questions continue overleaf)

[Turn over

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Examiner Only	
Marks	Remark

4 Water is essential for life and it makes up approximately 60 percent of the human body.

(a) Complete the table below to show the physical properties of water.

State at room temperature	Boiling point (°C)	Melting point (°C)	Colour

[4]

(b) The physical properties of water alone are not enough to positively identify it. A chemical test must be used. Complete the following table to show two chemical tests for water.

Chemical Test	Colour before adding water	Colour after adding water
	white	blue
cobalt chloride paper		

[4]

(c) The water supply in some parts of Northern Ireland is described as hard water.

(i) Explain what you understand by the term hard water.

_____

_____

_____ [2]

(ii) Which one of the four compounds below causes permanent hardness in water? Circle the correct answer.

calcium hydrogen carbonate **magnesium sulfate**

sodium carbonate **sodium chloride**

[1]

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(iii) Describe in detail how a sample of water may be tested for hardness.

Your answer should include:

- how to determine that hardness is present in the water
- how to determine if the hardness present is temporary or permanent
- all practical details

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

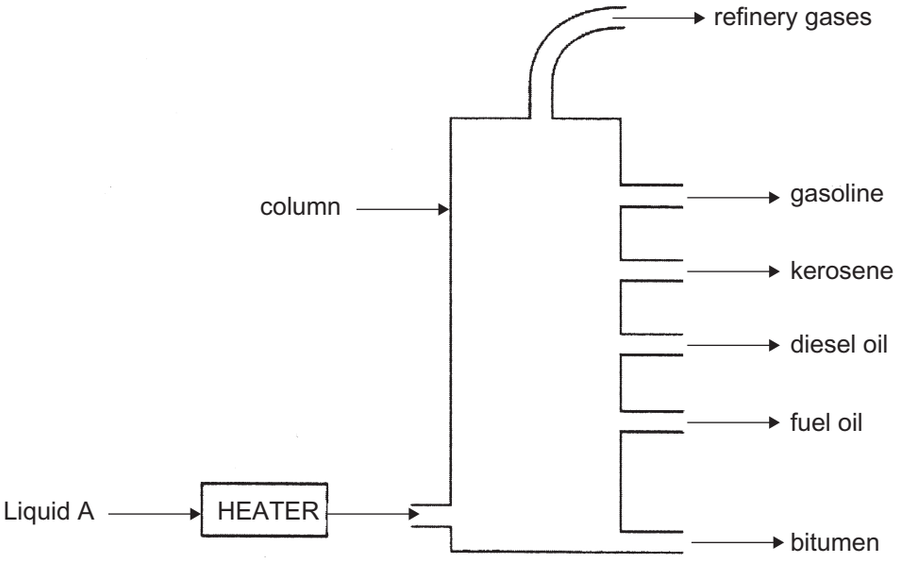
Examiner Only	
Marks	Remark
Total Question 4	

[Turn over

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Examiner Only	
Marks	Remark

5 **(a)** The diagram below shows how Liquid A is separated into useful products.



(i) Name Liquid A.

_____ [1]

(ii) Fill in the missing words to complete the passage below.

Liquid A is separated by the process of _____ _____.

In this process Liquid A is heated until it _____.

As the gaseous mixture rises up the column the temperature _____ and the different parts of the mixture are collected separately. [4]

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Examiner Only	
Marks	Remark

(iii) The chemicals obtained from Liquid A are hydrocarbons. A hydrocarbon is a molecule made from only two elements. Name the two elements.

1. _____

2. _____ [2]

(iv) State one use for the kerosene obtained in this separating process.

_____ [1]

(b) A homologous series is a family of organic compounds that have the same general formula and show a gradation in physical properties.

(i) State one other feature of a homologous series.

_____

_____ [1]

(ii) Alkanes and alkenes are examples of homologous series. Complete the following table.

Name of homologous series	General formula	Molecular formula of compound with three carbon atoms
Alkanes		C_3H_8
Alkenes	C_nH_{2n}	

[2]

(iii) Name the alkane with the molecular formula C_3H_8.

_____ [1]

[Turn over

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(iv) Calculate the percentage of carbon by mass in C_3H_8.

$$\frac{\text{total mass of carbon}}{\text{RFM}} \times 100 = \% \text{ carbon}$$

Percentage of carbon by mass _____ % [3]

(v) Draw the structural formula of C_3H_8.

[1]

Examiner Only	
Marks	Remark
Total Question 5	

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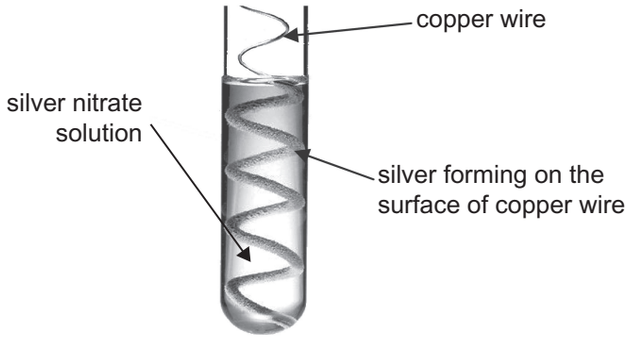
6 A reactivity series of some metals is shown below:

potassium
sodium
calcium
magnesium
aluminium
iron
copper

reactivity increases

Examiner Only	
Marks	Remark

(a) Silver metal does not appear on the above reactivity series. Copper metal will react with silver nitrate solution to form silver as shown below.



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(i) Indicate the position of silver on the reactivity series shown above. [1]

(ii) Silver nitrate solution is colourless. What is the colour of the solution at the end of this reaction?

_____ [1]

[Turn over

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(iii) Explain why copper displaces silver from a solution of silver nitrate.

_____

_____ [2]

(b) Silver particles of size 1 to 100 nanometres (nm) are used to kill bacteria in wound dressings.

(i) Explain what you understand by a nanometre.

_____ [1]

(ii) Describe one risk which has been associated with the use of silver particles of this size.

_____

_____ [1]

(c) Aluminium is a very useful metal due to its high electrical conductivity, relatively low density and lack of reactivity.

(i) Explain why aluminium shows a lack of reactivity even though the reactivity series would suggest it is a moderately reactive metal.

_____

_____

_____

_____ [3]

Examiner Only	
Marks	Remark

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(ii) A balanced symbol equation for a reaction of aluminium is shown below:

$$2Al + 3CuO \rightarrow Al_2O_3 + 3Cu$$

Write a word equation for this reaction.

_____ [2]

Examiner Only	
Marks	Remark
Total Question 6	

THIS IS THE END OF THE QUESTION PAPER

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Question Number	**Marks**
1	
2	
3	
4	
5	
6	
Total Marks	

Examiner Number

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Rewarding Learning

General Certificate of Secondary Education
2014

GCSE Chemistry

Unit 2

Foundation Tier

[GCH21]

THURSDAY 19 JUNE, AFTERNOON

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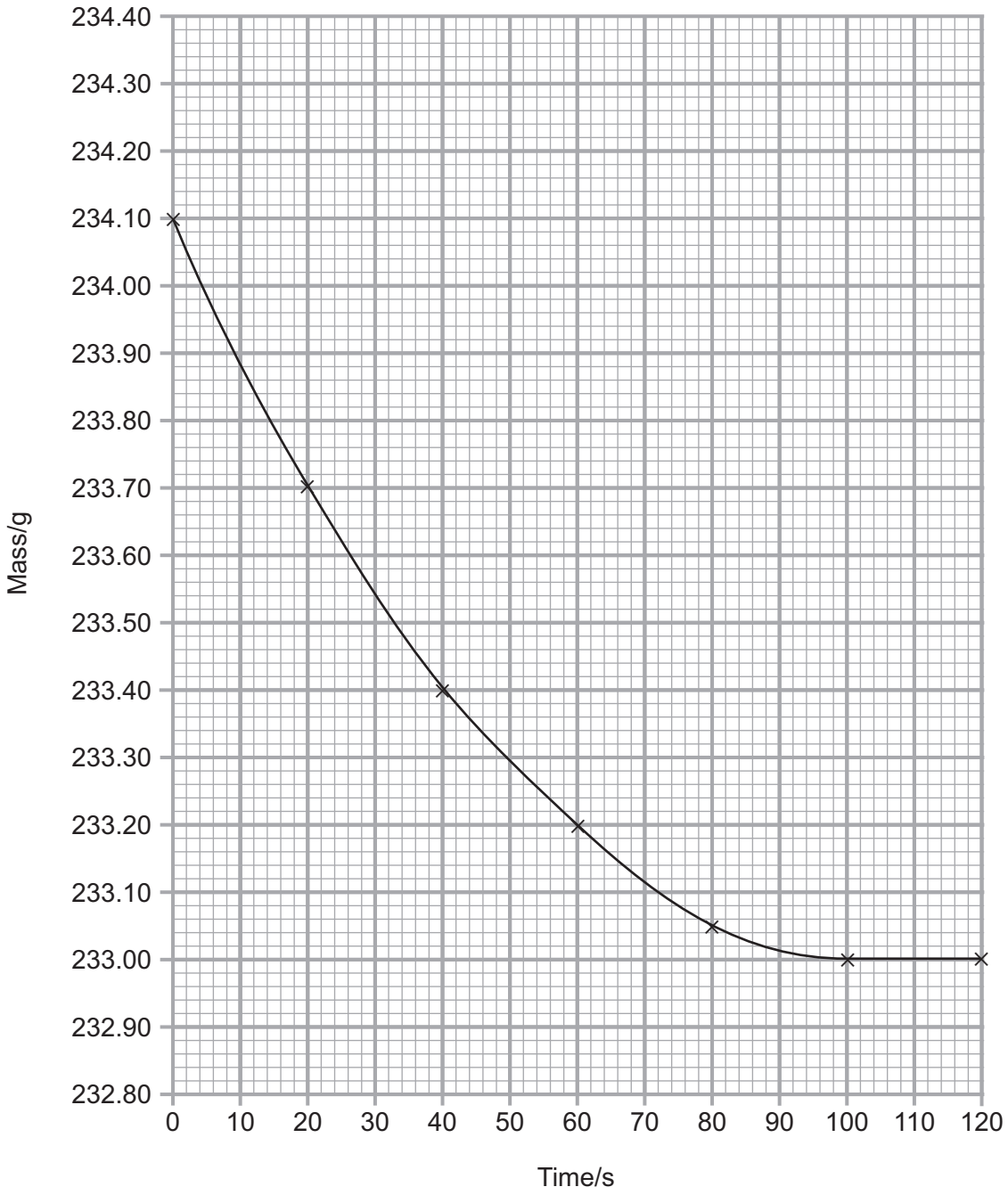
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						AVAILABLE MARKS
1	(a)	(i)	conical flask with cotton wool plug	[1]		
			placed on electronic balance	[1]		
			tablet in contact with water	[1]		
			timer/stopclock/stopwatch	[1]	[4]	
			no labels = [0]			
		(ii)	to prevent the loss of any liquid/spray		[1]	
	(b)	(i)	5–7 points plotted correctly	[3]		
			2–4 points plotted correctly	[2]		
			1 point plotted correctly	[1]		
			smooth **curve**	[1]	[4]	
		(ii)	95–100 **seconds** units essential		[1]	
		(iii)	1.10 g units essential allow 1.1 g		[1]	
		(iv)	graph starts at (0, 234.1) **and** remains lower	[1]		
			levels off earlier	[1]		
			levels off at same mass reading as initial graph	[1]	[3]	
		(v)	concentration/surface area/catalyst/pressure/light		[1]	15

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AVAILABLE MARKS

2 **(a)** **(i)** ammonia/sulfur dioxide
accept hydrogen sulfide [1]

(ii)

Gas	Formula	Colour
ammonia [1]	NH_3	**colourless** [1]
carbon dioxide	CO_2	**colourless** [1]
hydrogen	**H_2** [1]	colourless
carbon monoxide	CO	colourless

[4]

(iii) $2CO + O_2 \rightarrow 2CO_2$
[1] for correct formulae of reactants
[1] for correct formula of product
[1] for correct balancing [3]

(iv) white [1] smoke/solid [1] allow cloud/fumes [2]

(b) **(i)** $2H_2S + 3O_2 \rightarrow 2SO_2 + 2H_2O$
[1] for correct formulae of reactants
[1] for correct formulae of products
[1] for correct balancing [3]

(ii) hydrogen sulfide/sulfide/allow sulfur [1]

(iii) no naked flames/fume cupboard [1] 15

AVAILABLE MARKS

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					AVAILABLE MARKS
3	**(a)**	**(i)**	breaking down (a substance) [1] using heat [1]	[2]	
		(ii)	calcium oxide [1] carbon dioxide [1]	[2]	
	(b)		Any **two** from: volcanoes/earthquakes/mountain **formation**	[2]	
	(c)		comparison of oxygen composition [1] comparison of nitrogen composition [1] one correct % of either oxygen or nitrogen in Earth's atmosphere [1]	[3]	
	(d)	**(i)**	a glowing splint [1] relights [1] second mark dependent on first	[2]	
		(ii)	Any **two** from: colourless/odourless/neutral pH-7/**low solubility** (in water)/same density as air	[2]	
	(e)	**(i)**	**6**CO_2 + **6**$H_2O \rightarrow C_6H_{12}O_6$ + **6**O_2 [1] for correct balancing	[1]	
		(ii)	exothermic [1] oxidation [1]	[2]	16

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AVAILABLE MARKS

4 **(a)**

State at room temperature	Boiling point °C	Melting point °C	Colour
liquid [1]	100 [1]	0 [1]	colourless [1]

[4]

(b)

Test	Colour before adding water	Colour after adding water
anhydrous copper sulfate [2] copper sulfate [1]	white	blue
cobalt chloride paper	(pale) blue [1]	pink [1]

[4]

(c) **(i)** does not form a lather **readily** with soap [2]
does not form a lather with soap [1] [2]

(ii) magnesium sulfate [1]

(iii) **Indicative content**

- Add soap (solution) to sample of water **and shake**
- If scum forms/there is no immediate lather, the water is hard
- Take another sample of the water
- Boil it
- Add soap solution and shake
- If a lather forms – temporary hardness
- If no lather – permanent hardness

Response	Mark
Candidates must use appropriate specialist terms throughout to describe fully how a sample of water is tested for hardness and how to determine if the hardness is temporary or permanent (6–7 points from the indicative content above) in a logical sequence. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use some appropriate specialist terms to describe how a sample of water is tested for hardness and/or how to determine if the hardness is temporary or permanent (3–5 points from the indicative content above) in a logical sequence. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates describe how to test a sample of water for hardness and/or how to determine if the hardness is temporary or permanent (1–2 points from the indicative content above) which may not be in a logical sequence. They use limited spelling, punctuation and grammar and they have made little use of specialist terms. The form and style are of a limited standard.	[1]–[2]
Response not worthy of credit	[0]

[6]

17

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5 **(a)** **(i)** crude oil [1]

(ii) fractional distillation [2] distillation [1]
boils [1]
decrease [1] [4]

(iii) carbon [1] hydrogen [1] [2]

(iv) aircraft fuel [1]

(b) **(i)** show **similar** chemical properties/differ by a CH_2 (unit/group) [1]

(ii)

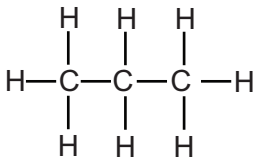
Name of homologous series	General formula	Molecular formula of compound with three carbon atoms
Alkanes	C_nH_{2n+2} [1]	C_3H_8
Alkenes	C_nH_{2n}	C_3H_6 [1]

[2]

(iii) propane [1]

(iv) $\frac{36\ [1]}{44\ [1]} \times 100 = 81.82\ [1]\ \%$ [3]

(v)



[1]

AVAILABLE MARKS

16

					AVAILABLE MARKS
6	(a)	(i)	silver indicated below copper	[1]	
		(ii)	blue	[1]	
		(iii)	copper is more reactive/higher in reactivity series [1] than silver [1] **or** converse second mark dependent on first	[2]	
	(b)	(i)	1×10^{-9} **m or** other suitable idea of length, e.g. 1×10^{-6} **mm**	[1]	
		(ii)	unknown effects/absorbed through skin/discolour skin/allergic reaction/damage organs	[1]	
	(c)	(i)	a layer [1] of (aluminium) oxide [1] forms on surface of aluminium which prevents aluminium reacting [1]	[3]	
		(ii)	aluminium + copper(II) oxide → aluminium oxide + copper [1] for reactants and [1] for products allow copper oxide for copper(II) oxide	[2]	11
				Total	**90**

Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2013

Science: Chemistry

Unit C2

Foundation Tier

[GCH21]

GCH21

THURSDAY 20 JUNE, AFTERNOON

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided. Do not write outside the box, around each page or on blank pages.
Complete in blue or black ink only. **Do not write with a gel pen**.
Answer **all** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is **90**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in question **3(c)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

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Examiner Only	
Marks	Remark

1 Fireworks contain the three ingredients shown in the box below.

colouring agent
fuel
oxidiser

(a) Magnesium is often used in fireworks as the colouring agent.

(i) What is the colour of the flame observed when magnesium burns?

_____ [1]

(ii) Write a balanced symbol equation for magnesium burning in air.

_____ [3]

(iii) What is the percentage of oxygen in air?

_____ [1]

(b) Carbon in the form of charcoal is often used as the fuel in fireworks.

(i) What is observed when a sample of carbon burns?

_____

_____

_____ [2]

(ii) Name the product formed when carbon burns in a limited supply of oxygen.

_____ [1]

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Examiner Only	
Marks	Remark

(c) Oxidisers provide the oxygen needed to allow fireworks to burn effectively. A common oxidiser is potassium nitrate.

Write the formula for potassium nitrate.

_____ [1]

(d) Sparklers are hand held fireworks which contain a fuel, an oxidiser and iron powder. Often the iron powder is mixed with linseed oil to prevent it rusting.

(i) What conditions are required for iron to rust?

_____

_____ [2]

(ii) Explain why rusting is an oxidation reaction.

_____

_____ [2]

(iii) State one observation you would make which would indicate that rusting is a chemical reaction.

_____

_____ [1]

[Turn over

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(e) In industry, iron is manufactured in the Blast Furnace. Two of the reactions which occur in the Blast Furnace are shown in the table below. Choose a word or phrase from the box which is most suitable to describe each type of reaction.

thermal decomposition	**redox**	**displacement**
neutralisation	**combustion**	

Reaction in the Blast Furnace	Type of Reaction
$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$	
$CaCO_3 \rightarrow CaO + CO_2$	

[2]

Examiner Only	
Marks	Remark
Total Question 1	

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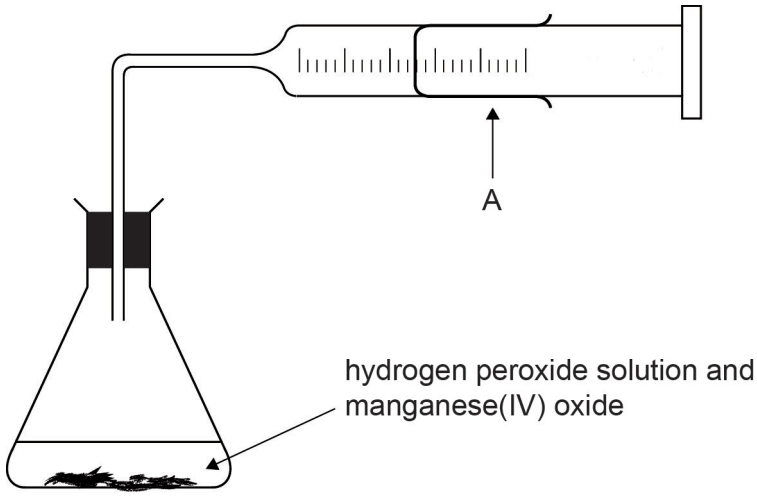
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(Questions continue overleaf)

[Turn over

Examiner Only	
Marks	Remark

2 **(a)** The rate of decomposition of hydrogen peroxide using a catalyst can be measured using the apparatus shown below.



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(i) Name the pieces of apparatus labelled A and B.

A _____

B _____ [2]

(ii) Name the catalyst used in the decomposition of hydrogen peroxide.

_____ [1]

(iii) What is meant by the term catalyst?

_____

_____

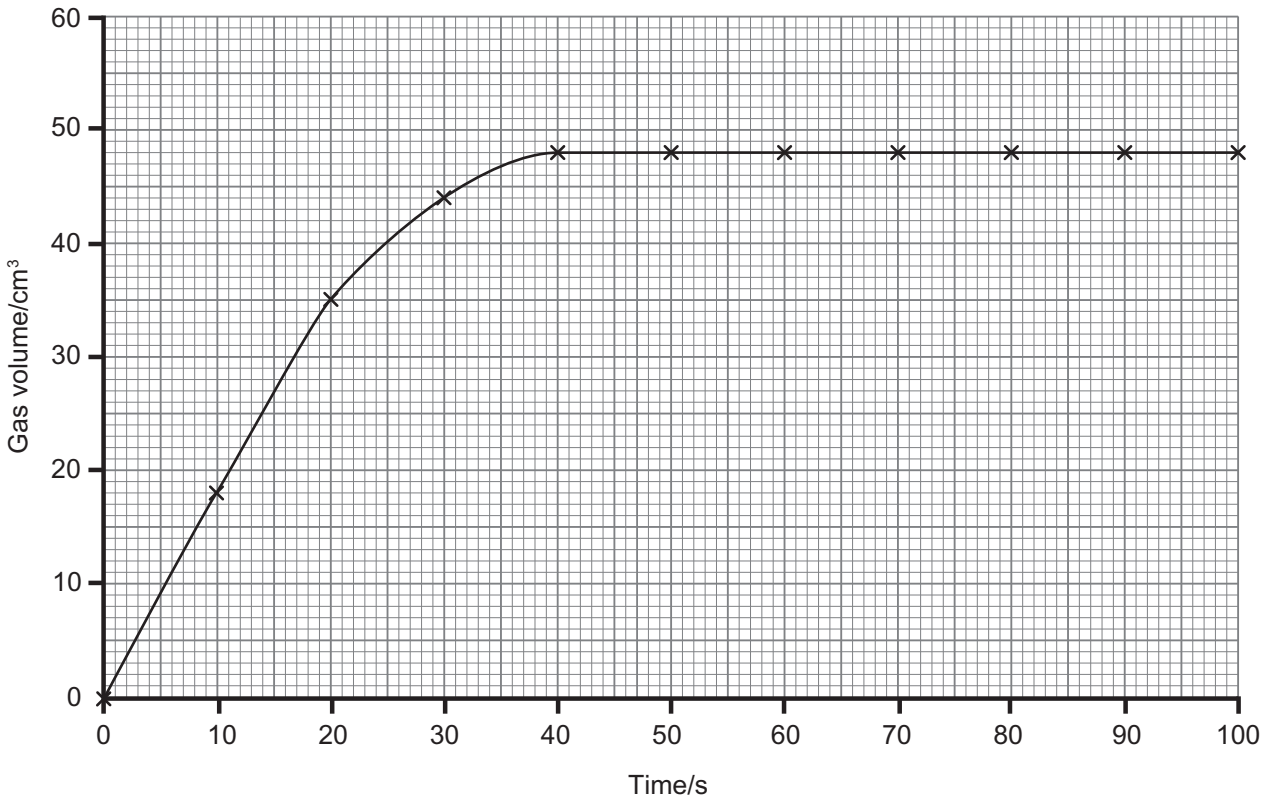
_____ [3]

(iv) Write a balanced symbol equation for the decomposition of hydrogen peroxide.

_____ [3]

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(b) The graph below shows a set of data obtained.



(i) Apart from the apparatus shown in the diagram in part **(a)**, name one other piece of equipment which would be required to collect the results used to draw the graph.

_____ [1]

(ii) What volume of gas was collected at 25 seconds?

_____ [1]

(iii) What was the total volume of gas collected?

_____ [1]

(iv) At what time did the reaction finish?

_____ [1]

Examiner Only	
Marks	Remark
Total Question 2	

[Turn over

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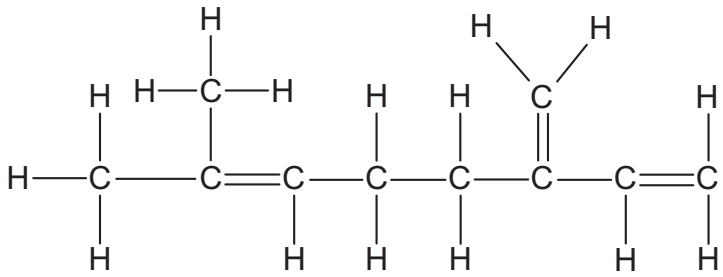
Examiner Only	
Marks	Remark

3 Perfume is a mixture of essential oils dissolved in a solvent. One of the essential oils used in making perfume is called myrcene.



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(a) The structural formula of a molecule of myrcene is shown below.



(i) Explain why a molecule of myrcene can be classified as a hydrocarbon.

_____

_____ [1]

(ii) Identify the functional group present in myrcene.

_____ [1]

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Examiner Only	
Marks	Remark

(iii) Like all hydrocarbons, myrcene ($C_{10}H_{16}$) undergoes combustion. Complete the balanced symbol equation for the **complete** combustion of myrcene.

$C_{10}H_{16} + \quad O_2 \longrightarrow$ [2]

(iv) Calculate the relative molecular mass (RMM) of myrcene ($C_{10}H_{16}$).

_____ [1]

(v) Calculate the percentage of carbon present in myrcene ($C_{10}H_{16}$).

_____% [2]

(b) Ethene can be used to manufacture the solvent used in perfumes. Complete the table below to give information about ethene.

Name	Molecular formula	Structural formula	State at room temperature and pressure
Ethene			

[3]

[Turn over

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(c) Ethene can also be used to make polymers. Polymers may be disposed of by landfill and incineration.

Explain what you understand by the term polymer and state the advantages and disadvantages associated with each method of disposal.

In this question, you will be assessed on using your written communication skills including the use of specialist scientific terms.

[6]

Examiner Only	
Marks	Remark
Total Question 3	

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(Questions continue overleaf)

Examiner Only	
Marks	Remark

4 Bauxite is an ore of aluminium, named after the village La Baux in France where it was first discovered.

(a) Aluminium is obtained from purified bauxite by electrolysis.

(i) What is meant by the term electrolysis?

_____

_____ [2]

(ii) Bauxite contains aluminium oxide. Write the formula for aluminium oxide.

_____ [1]

(iii) During the electrolysis of purified bauxite the ions present are attracted to the electrodes. Complete the table below.

Name of ion	Formula of ion (including charge)	Name of electrode to which ion is attracted
aluminium		
	O^{2-}	

[4]

(iv) Explain why the carbon anodes need to be replaced periodically during this electrolysis.

_____

_____

_____

_____ [2]

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(b) Aluminium cans are the world's most recycled packaging container. Over 50% of aluminium cans are recycled worldwide.



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State **two** reasons why it is important to recycle aluminium.

1. _____

_____

2. _____

_____ [2]

Examiner Only	
Marks	Remark
Total Question 4	

[Turn over

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Examiner Only	
Marks	Remark

5 Metals may be placed in a reactivity series by observing their reactions with air, water, steam and dilute acid.

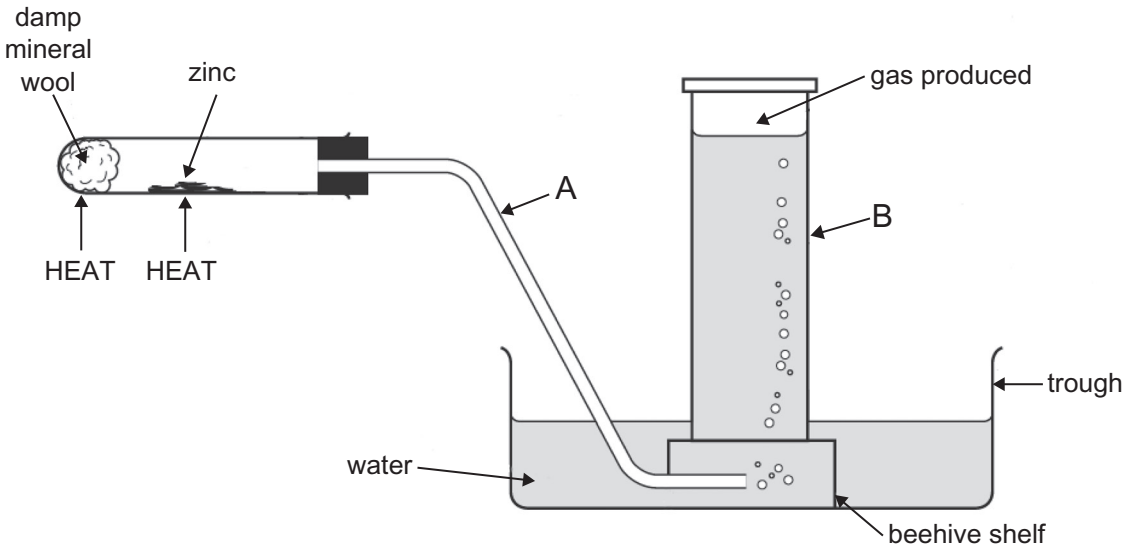
(a) Describe what would be observed when a piece of calcium metal is heated in air.

_____

_____

_____ [2]

(b) The apparatus below may be used to react zinc metal with steam.



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(i) What labels should be placed at A and B on the diagram?

A _____

B _____ [2]

(ii) Explain why the damp mineral wool is heated.

_____ [1]

(iii) Name the gas produced in this experiment.

_____ [1]

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(iv) Name a metal which does not react when heated with steam.

_____ [1]

(c) X is an unknown metal. The table below gives details of some reactions of the three metals X, sodium and zinc.

Metal	Reaction when heated in oxygen	Reaction with cold water	Reaction with dilute hydrochloric acid
X	Black coating forms on metal without burning	No reaction	No reaction
Sodium	Burns very vigorously with a yellow flame		Dangerous reaction not carried out in school laboratory
Zinc	Burns forming a yellow solid which changes to white on cooling	No reaction	Reacts steadily

(i) Suggest the name of metal X.

_____ [1]

(ii) Describe what you would observe when sodium reacts with cold water.

_____

_____

_____

_____

_____ [3]

(iii) Write a balanced symbol equation for the reaction of sodium with water.

_____ [3]

Examiner Only	
Marks	Remark
Total Question 5	

[Turn over

Examiner Only	
Marks	Remark

6 **(a)** Fill in the blanks in the following sentences about water.

Water is a colourless liquid at room temperature and pressure and has a melting point of 0 °C and a boiling point of _____ °C.

One test for water is to use cobalt(II) chloride paper which changes colour from _____ to _____ if water is present. [3]

(b) An investigation was carried out to compare the hardness of water samples from three towns A, B and C.

25 cm^3 of each water sample were placed into three separate conical flasks and labelled A, B and C. A sample of deionised water was also tested.

Soap solution was added 1 cm^3 at a time to each conical flask with shaking until a lasting lather formed. The total volume of soap solution added to each flask was recorded.

The experiment was repeated with fresh samples of A, B and C which had been boiled and allowed to cool, before adding the soap solution.

The results are shown in the table below.

Water sample	**Volume of soap solution required to form a lather**	
	before boiling (cm^3)	**after boiling (cm^3)**
Deionised water	2	2
A	6	6
B	8	2
C	11	7

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(i) Name a piece of apparatus which could be used to measure the 25 cm^3 samples of water.

_____ [1]

(ii) Which of the three water samples (A, B or C) is the hardest water?

_____ [1]

(iii) Which of the three water samples (A, B or C) contains **only** temporary hardness?

_____ [1]

(iv) Which of the three water samples (A, B or C) contains both temporary and permanent hardness?

_____ [1]

(c) State two disadvantages of hard water.

1. _____

_____

2. _____

_____ [2]

Examiner Only	
Marks	Remark
Total Question 6	

Examiner Only	
Marks	Remark

7 **(a)** Nitrogen can be used to manufacture ammonia gas.

(i) Complete the table below giving some physical properties of nitrogen.

	Nitrogen
State at room temperature and pressure	
Colour	
Odour	

[3]

(ii) State one other use of nitrogen.

_____ [1]

(b) Describe how you would carry out a chemical test for the presence of ammonia gas, stating the observations you would make for a positive test.

_____

_____

_____

_____

_____ [4]

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(c) Nitrogenous fertilisers contain ammonium compounds such as ammonium nitrate which is produced when ammonia reacts with nitric acid.

(i) Write a balanced symbol equation for the reaction of ammonia with nitric acid.

_____ [2]

(ii) State one disadvantage of using nitrogenous fertilisers.

_____ [1]

Examiner Only	
Marks	Remark
Total Question 7	

THIS IS THE END OF THE QUESTION PAPER

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For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
6	
7	
QWC	
Total Marks	

Examiner Number

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Rewarding Learning

General Certificate of Secondary Education
2013

Science: Chemistry

Unit C2

Foundation Tier

[GCH21]

THURSDAY 20 JUNE, AFTERNOON

MARK SCHEME

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General Marking Instructions

Introduction

Mark schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of students in schools and colleges.

The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes, therefore, are regarded as part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

AVAILABLE MARKS

1 **(a)** **(i)** white [1]

(ii) $2Mg + O_2 \rightarrow 2MgO$
[1] for correct formulae of reactants
[1] for correct formula of product
[1] for correct balancing [3]

(iii) one fifth/20% (allow 19–21%) [1]

(b) **(i)** black solid [1] burns with an orange/yellow [1] flame [1]
sooty/smoky [1]
white/grey ash [1] formed
heat released [1] **max** [2]

(ii) carbon monoxide [1]

(c) KNO_3 [1]

(d) **(i)** water/moisture [1]
air/oxygen [1] [2]

(ii) iron gains oxygen [1]
gain of oxygen is oxidation [1] [2]

(iii) red-brown/colour change [1]

(e)

Reaction in the Blast Furnace	Type of Reaction
$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$	redox [1]
$CaCO_3 \rightarrow CaO + CO_2$	thermal decomposition [1]

[2]

16

					AVAILABLE MARKS
2	(a)	(i)	A = conical flask [1] B = gas syringe [1]	[2]	
		(ii)	manganese(IV) oxide/manganese dioxide	[1]	
		(iii)	substance which increases [1] the **rate of a (chemical) reaction** [1] without being used up/without being chemically changed at the end [1]	[3]	
		(iv)	$2H_2O_2 \rightarrow 2H_2O + O_2$ [1] for correct formula of reactant [1] for correct formulae of products [1] for correct balancing	[3]	
	(b)	(i)	any second accurate timing device, e.g. stopclock/stopwatch	[1]	
		(ii)	40 (cm^3)	[1]	
		(iii)	48 (cm^3)	[1]	
		(iv)	38–40 (s)	[1]	13

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AVAILABLE MARKS

3 (a) (i) **only** contains carbon and hydrogen [1]

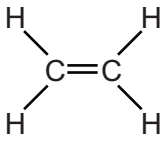
(ii) C═C [1]

(iii) $C_{10}H_{16} + 14\ O_2 \rightarrow 10\ CO_2 + 8\ H_2O$
[1] for correct formulae of products
[1] for balancing [2]

(iv) 136 [1]

(v) $\frac{120}{136} \times 100$ [1] = 88.2 [1] [2]

(b)

Name	Molecular formula	Structural formula	State at room temperature
Ethene	C_2H_4 [1]	 [1]	gas [1]

[3]

(c) Indicative content
- polymer is a long chain molecule
- chain made up of repeating units or monomers bonded together

Advantages and disadvantages in context of disposal of **polymers**

Advantages of landfill:
- using local land/small transport costs
- cheapest option available

Disadvantages of landfill:
- (addition) polymers are nonbiodegradable
- wastes land
- eyesore
- creates litter

Advantages of incineration:
- prevents landfill
- idea that heat produced may be usefully employed, e.g. in production of electricity

Disadvantages of incineration:
- releases greenhouse gases
- releases toxic gases
- causes air pollution
- ash residue is toxic

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Response	Mark
Candidates must use appropriate specialist terms to describe fully what is meant by a polymer and to discuss an advantage and disadvantage of landfill and an advantage and disadvantage of incineration (**using 5–6 points** of indicative content). They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use some appropriate specialist terms to explain what is meant by a polymer and to discuss an advantage and disadvantage of landfill and/or an advantage and disadvantage of incineration (**using 3–4 points** of indicative content). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates explain briefly what is meant by a polymer or discuss some of the advantages and disadvantages of landfill or incineration (**using at least 2 points** of indicative content). They use limited spelling, punctuation and grammar and they have made little use of specialist terms. The form and style are of a limited standard.	[1]–[2]
Response not worthy of credit	[0]

[6]

AVAILABLE MARKS

16

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AVAILABLE MARKS

4 **(a)** **(i)** decomposition [1]
using a current of electricity [1] [2]

(ii) Al_2O_3 [1]

(iii)

Name of ion	Formula of ion (including charge)	Name of electrode to which ion is attracted
aluminium	Al^{3+} [1]	cathode [1]
oxide [1]	O^{2-}	anode [1]

[4]

(iv) anode/carbon reacts with oxygen [1]
forming carbon dioxide [1] [2]

(b) any **two** from:
- there is less mining (of aluminium ore)/saves resources
- there is less use of electricity/less energy used
- there is less noise/dust pollution
- there is less destruction of natural habitat/eyesore
- it provides more employment [2]

11

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				AVAILABLE MARKS
5	**(a)**	grey/white metal [1] red flame [1] small explosion [1] white solid formed [1] Any **two**	[2]	
	(b)	**(i)** A delivery tube [1] B gas jar [1]	[2]	
		(ii) to generate steam	[1]	
		(iii) hydrogen	[1]	
		(iv) copper/silver/gold/platinum	[1]	
	(c)	**(i)** copper	[1]	
		(ii) any **three** from: floats/on surface moves about melts to form a silvery ball fizzing/gas produced colourless solution formed metal disappears heat released	[3]	
		(iii) $2Na + 2H_2O \rightarrow 2NaOH + H_2$ [1] for correct formulae of reactants [1] for correct formulae of products [1] for correct balancing	[3]	14
6	**(a)**	100 [1] (pale) blue [1] pink [1]	[3]	
	(b)	**(i)** measuring cylinder/burette/pipette	[1]	
		(ii) C	[1]	
		(iii) B	[1]	
		(iv) C	[1]	
	(c)	disadvantages associated with: • wastes soap • produces limescale in kettles/hot water pipes/iron etc. • qualified cost (more electricity used, purchase of ion exchange, dishwasher salt) • forms scum with soap	**max** [2]	9

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7 **(a)** **(i)**

	Nitrogen
State at room temperature and pressure	gas [1]
Colour	colourless [1]
Odour	odourless [1]

[3]

(ii) coolant/food packaging [1]

(b) dip glass rod [1]
into concentrated hydrochloric acid [1] apply to gas
white [1] smoke/solid [1] [4]

(c) **(i)** $NH_3 + HNO_3 \rightarrow NH_4NO_3$ [2]

(ii) blue baby syndrome/stomach cancer/eutrophication [1]

Total

AVAILABLE MARKS

11

90

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