CCEA GCSE DOUBLE AWARD SCIENCE

SCIENCE



EXAM QUESTION PACK

CHEMISTRY UNIT C2 HIGHER TIER GSD52 PAPERS

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2016

Double Award Science: Chemistry

Unit C2

Higher Tier

[GSD52]

GSD52

WEDNESDAY 15 JUNE 2016, AFTERNOON

TIME

1 hour 15 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 eight** 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 Questions **3** and **6(c)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

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1 This question is about the rate of reaction of zinc metal with acid.

(a) In the reaction of zinc granules with hydrochloric acid, a little copper sulfate is sometimes added as a catalyst.

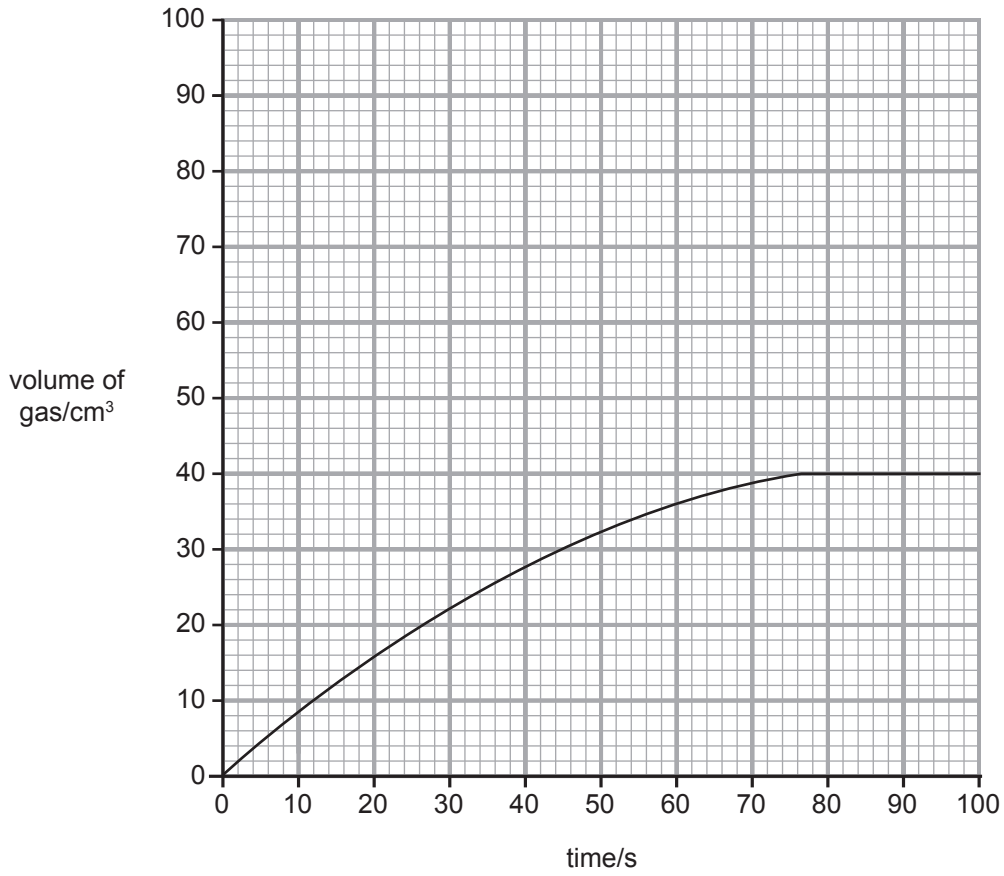
Why is the copper sulfate described as a catalyst and not a reactant?

_____

_____

_____ [2]

(b) A group of students investigated how dilute hydrochloric acid reacted with zinc granules. The volume of hydrogen gas given off was measured every 20 seconds and a graph drawn as shown below. Excess zinc was used to make sure that all the acid reacted.



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(i) How much gas is given off after 40 seconds?

_____ [1]

(ii) After how many seconds did the reaction stop?

_____ [1]

(iii) What happens to the reaction rate as the time increases?

_____

_____ [1]

(c) **On the graph** draw the curve you would expect to get if the acid concentration was doubled, and the zinc granules were still in excess. You should assume that the volume of acid used was the same as in the earlier investigation. [2]

2 This question is about the combustion of carbon and the properties of the products formed.

(a) (i) What compound is formed on the **complete** combustion of carbon?

_____ [1]

(ii) Write a balanced symbol equation for the **incomplete** combustion of carbon.

_____ [3]

(iii) Explain why the compound formed in the incomplete combustion of carbon is so dangerous.

_____

_____ [2]

(b) (i) Complete the symbol equation below to show what happens when carbon dioxide reacts with water.

$CO_2 + H_2O \rightarrow$ [1]

(ii) Name the product formed in this reaction.

_____ [1]

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(c) When carbon dioxide is bubbled through limewater ($Ca(OH)_2$) solution a white precipitate is formed. If more carbon dioxide is bubbled through, the precipitate will disappear.

(i) What is the chemical name of the precipitate?

_____ [1]

(ii) Why does the precipitate disappear when excess carbon dioxide is added?

_____

_____

_____ [3]

[Turn over

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3 Sulfur dioxide reacts with water in the air to form acid rain.

Describe environmental and economic effects of acid rain and outline measures which are used to help prevent acid rain.

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

[6]

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(Questions continue overleaf)

4 This question is about relative formula masses and using and understanding the term mole.

(a) Calculate the relative formula mass of each of the following substances.

(relative atomic masses: H = 1, C = 12, O = 16, N = 14, Na = 23, Mg = 24)

(i) ammonia NH_3

_____ [1]

(ii) sodium carbonate Na_2CO_3

_____ [1]

(iii) magnesium hydroxide $Mg(OH)_2$

_____ [1]

(b) What do you understand by the term "a mole of a substance"?

_____

_____

_____ [2]

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(c) **(i)** The relative formula mass of sulfur dioxide is 64. What is the mass of 0.6 moles of sulfur dioxide?

_____ g [1]

(ii) How many moles are in 320 grams of sulfur dioxide?

_____ [1]

(d) Solid silver chloride can be formed by mixing silver nitrate solution with magnesium chloride solution.

$$2AgNO_3 + MgCl_2 \rightarrow 2AgCl + Mg(NO_3)_2$$

Relative formula masses:
silver nitrate = 170, magnesium chloride = 95, silver chloride = 143.5

(i) How many moles of magnesium chloride would be needed to react with 8.5 g of silver nitrate?

_____ moles [2]

(ii) Use the equation:

$$2AgNO_3 + MgCl_2 \rightarrow 2AgCl + Mg(NO_3)_2$$

to calculate the mass of silver nitrate needed to produce 14.35 g of silver chloride.

_____ g [2]

[Turn over

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5 **(a)** Adding water to anhydrous copper sulfate can be used as a test for water.

(i) Describe the colour change when water is added drop by drop to anhydrous copper sulfate.

from _____ to _____ [2]

(ii) Is this an exothermic or endothermic reaction?

_____ [1]

(b) When copper carbonate is heated it undergoes thermal decomposition.

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

_____ [2]

(ii) Describe the colour change when copper carbonate is heated.

from _____ to _____ [2]

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(c) Propane can be used as a fuel. It burns to form carbon dioxide and water.

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

Describe in terms of bond breaking and bond making why **this** reaction is exothermic.

[5]

[Turn over

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6 This question is about hard and soft water.

(a) Give three disadvantages of hard water.

1. _____

2. _____

3. _____ [3]

(b) Temporary hardness in water occurs in limestone regions. Explain what happens chemically to produce temporary hardness in water.

_____

_____

_____

_____

_____ [3]

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(c) Temporary hardness in water can be softened by boiling. All hard water can be softened by ion exchange. Explain how both these methods work by setting out clearly what happens and why the water ends up being soft.

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

Boiling:

Ion exchange:

[6]

[Turn over

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7 **(a)** Explain how fractional distillation separates the compounds found in crude oil.

[3]

(b) Complete the table below by giving the molecular and structural formulae of the named compounds.

Name	Molecular Formula	Structural Formula
Ethanol		
Ethene		

[4]

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(c) Ethene and ethane are both gaseous hydrocarbons.

(i) To which homologous series does ethene belong?

_____ [1]

(ii) Describe a test to distinguish between the two gases ethane and ethene.

_____

_____

_____

_____ [4]

(d) Polychloroethene is a useful plastic made from chloroethene molecules.

(i) Write a balanced symbol equation for the reaction of chloroethene molecules to form polychloroethene.

[4]

(ii) Give one use of polychloroethene and explain what property or properties make it suitable for this use.

Use: _____

Property: _____ [2]

[Turn over

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8 **(a)** In the manufacture of iron, haematite (impure iron(III) oxide), limestone (calcium carbonate), coke (carbon) and hot air are used.

(i) What happens to the limestone in the Blast Furnace?

_____

_____

_____

_____ [3]

(ii) Describe the main way in which the reducing agent, carbon monoxide, is produced in the Blast Furnace.

_____

_____

_____ [2]

(b) Write a balanced symbol equation for the reduction of iron(III) oxide in the Blast Furnace.

_____ [3]

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(c) In the manufacture of aluminium the reaction at the cathode can be represented as:

$$Al^{3+} + 3e^- \rightarrow Al$$

Is this type of reaction an oxidation, a reduction, redox or none of these? Explain your answer.

_____

_____ [2]

(d) The Haber process involves the following reaction:

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

(i) Which substance undergoes reduction in the reaction above?

_____ [1]

(ii) What is the meaning of the symbol $\rightleftharpoons$ that is used in the reaction above?

_____ [1]

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For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
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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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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Solubility of Common Salts 4

gcse
science
chemistry
double award
single award

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THE PERIODIC TABLE OF ELEMENTS

Group

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						

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

* 58 – 71 Lanthanum series
† 90 – 103 Actinium series

a
b x

a = relative atomic mass (approx)
x = atomic symbol
b = atomic number

Rewarding Learning

General Certificate of Secondary Education
2016

Double Award Science: Chemistry

Unit C2

Higher Tier

[GSD52]

WEDNESDAY 15 JUNE 2016, 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)	It speeds up the reaction/lowers the activation energy [1] Idea that it is not used up/does not react/does not take part in the reaction [1]	[2]	
	(b) (i)	Accept answers in range 27–28 cm^3 But not, e.g. 28 or 28 gas/cm^3 correct units needed	[1]	
	(ii)	76 ± 1 s units not needed	[1]	
	(iii)	Rate slows down/decreases	[1]	
	(c)	Steeper slope [1] double volume of gas [1]	[2]	7
2	(a) (i)	carbon dioxide	[1]	
	(ii)	$2C + O_2 \rightarrow 2CO$ LHS [1] RHS [1] balancing (if all formulae correct) [1]	[3]	
	(iii)	toxic/poisonous/silent killer [1] **not** just 'kills' no colour/smell/taste **or** idea of it combining with haemoglobin/red blood cells [1] **or** (alternative answer) idea of it combining with haemoglobin/red blood cells [1] idea of this (combining) being in place of oxygen/reducing oxygen/being irreversible [1]	[2]	
	(b) (i)	$CO_2 + H_2O \rightarrow H_2CO_3$	[1]	
	(ii)	Carbonic acid	[1]	
	(c) (i)	calcium carbonate	[1]	
	(ii)	Explicit idea that calcium carbonate/the precipitate reacts [1] to give calcium hydrogen carbonate [1] i.e. temporary hardness is caused by calcium hydrogen carbonate Explicit that calcium hydrogen carbonate/the **product** from the reaction is soluble/has dissolved [1] **Do not credit** idea that "the precipitate"/"calcium carbonate" dissolves, i.e. the final marking point is dependent on recognising that the precipitate has reacted.	[3]	12

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3 Indicative points:

Effects of acid rain

- corrosion of (limestone) buildings/statues/metal (e.g. bridges/cars) **not** "destroys", or "dissolves" **not** rocks
- kills fish/aquatic life (ignore ref. to animal habitats or animals)
- idea of defoliation/damages trees or plants/or crops/deforestation
- specific economic reason 1
- specific economic reason (2) – or idea of causing respiratory problems/asthma – not just health

Not any answer relating to increasing global warming

Preventing acid rain

- burn less fossil fuels/use alternative fuel/energy sources/limiting transportation
- idea of removing sulfur dioxide from industrial/vehicle emissions **NB not** removing sulfur
- idea of desulfurization i.e. removing sulfur from fuels
- idea of government legislation (clean air act)

Response	Marks
Candidates must use specialist terms throughout. (6–9 indicative points required). They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use some specialist terms throughout (4–5 indicative points required). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates give 1–3 of the indicative points but not necessarily in a logical sequence. They use limited spelling, punctuation and grammar and they have made little use of specialist terms.	[1]–[2]
Response not worthy of credit. Candidates make no reference to the points above and offer no other suitable response.	[0]

[6]

AVAILABLE MARKS

6

					AVAILABLE MARKS
4	**(a)**	**(i)**	17	[1]	
		(ii)	106	[1]	
		(iii)	58	[1]	
	(b)		The relative formula mass (RFM) [1] of the substance in grams [1] second mark dependant on first Alternative answer 1: The mass of a substance which contains the same number of particles as there are in 12 g of the carbon-12 isotope [2]		
			Alternative answer 2: Idea that a mole contains 6×10^{23} particles [2]	[2]	
	(c)	**(i)**	38.4 (g)	[1]	
		(ii)	5	[1]	
	(d)	**(i)**	0.025 (moles) [2] If answer incorrect then 1 method mark can be awarded for either a method that shows that 8.5 g is 0.05 moles (of silver nitrate) or that the reactants are needed in a 2 : 1 ratio	[2]	
		(ii)	17 (g) [2] If answer incorrect then 1 method mark can be awarded for either a method that shows that 0.1 mole (of silver nitrate) is needed or that a 1 : 1 ratio is needed	[2]	11
5	**(a)**	**(i)**	white [1] to blue [1]	[2]	
		(ii)	exothermic	[1]	
	(b)	**(i)**	$CuCO_3 \rightarrow CuO + CO_2$ LHS [1] RHS [1	[2]	
		(ii)	colour change from green [1] to black [1]	[2]	
	(c)		Bonds are broken in named reactants (propane and oxygen) [1] idea that energy is needed to break bonds/bond breaking is endothermic [1] bonds are made in named products (carbon dioxide and water) [1] idea that energy is given out when bonds are made/bond making is exothermic [1] **Clear** idea that the reaction is exothermic because **more** energy is released in bond making than is needed for bond breaking – **No** credit for simply stating that reaction is exothermic because heat/energy is given out [1] MAX = (5 × [1])	[5]	
			The first and third marking points require named reactants and products to be given. *if answer is a generic one then maximum mark is* [3] *if only 2 of the 4 chemicals are appropriately referred to i.e. either both reactants or both products* ***or*** *only 1 of each then award* ***either*** *marking point 1 or marking point 3 but not both.* *i.e. maximum mark for a non generic answer which only names 2 of the 4 chemicals is* [4] *for all* [5] *marks at least 3 of the 4 chemicals must be explicitly referred to.*		12

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AVAILABLE MARKS

6 **(a)** Any **three** of:
wastes soap (**not** doesn't lather with soap)
produces (lime)scale (or fur) in pipes/boilers/kettles (allow "blocks **hot** water pipes" but **not** "blocks pipes") **not** scale on its own
produces scum **with soap**
one clear, explicit economic disadvantage, e.g. the need to buy dishwasher salt **or** need to replace kettles or other correct, e.g. idea of not being good for washing clothes/hair or "stains clothes"
any 3 × [1] [3]

(b) Any **three** of:
idea of water, limestone (calcium carbonate) and carbon dioxide all being needed [1]
water reacts with carbon dioxide to from carbonic acid [1]
carbonic acid (or water and carbon dioxide react with limestone to form a **soluble** calcium compound [1]
calcium hydrogen carbonate (is the chemical present in temporary hard water) [1] [3]
max 3 × [1] a correct equation can gain all three marks

$$CaCO_3 + CO_2 + H_2O \rightarrow Ca(HCO_3)_{2(aq)}$$

If role of carbon dioxide is completely missed but candidate has idea of calcium carbonate and water forming a soluble calcium compound/calcium hydrogen carbonate award [1]

(c) **Indicative points:**
Boiling
- clear idea of thermal decomposition
- calcium hydrogen carbonate is decomposed
- calcium carbonate is produced
- the product (calcium carbonate) is insoluble (in water)
- clear idea that calcium ions are removed from solution (making the water soft)

NB: indicative points can be credited through an equation

$$Ca(HCO_3)_{2(aq)} \rightarrow CaCO_{3(s)} + CO_2 + H_2O$$

Ion exchange
- idea that there are sodium ions present (accept hydrogen ions) in the resin/ion exchanger
- the sodium/hydrogen ions replace the calcium ions
- calcium ions are removed from solution making the water soft/ sodium ions do not cause hardness

Response	Marks
Candidates must use specialist terms throughout. (6–8 indicative points required). They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use some specialist terms throughout (4–5 indicative points required). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates give 2–3 of the indicative points but not necessarily in a logical sequence. They use limited spelling, punctuation and grammar and they have made little use of specialist terms.	[1]–[2]
Response not worthy of credit. Candidates make reference to less than 2 of the points above and offer no other suitable response.	[0]

[6]

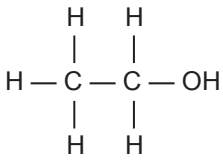
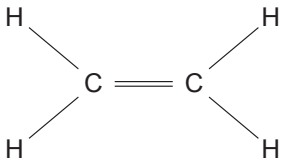
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AVAILABLE MARKS

7 **(a)** Clear idea that crude oil is heated (to 400 °C) [1]
idea that it undergoes a series of evaporations and condensations/vapours condense at different temperatures/idea that fractions condense/or collected at different levels in the column [1]
fractions are separated due to differences in boiling point [1] [3]

(b)

Name	Molecular Formula	Structural Formula
Ethanol	*1 C_2H_5OH [1]	 [1]
Ethene	*2 C_2H_4 [1]	 [1]

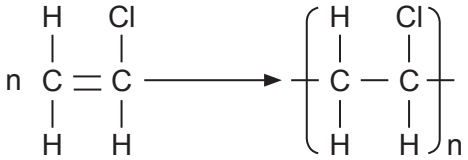
[4]

*1 C_2H_6O and CH_3CH_2OH as alternatives to the C_2H_5OH molecular formula for ethanol

*2 $CH_2 = CH_2$ and $CH_2 – CH_2$ as alternatives to the C_2H_4 molecular formula for ethene

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

(ii) Bubble each gas into bromine **water/solution** [1]
idea that bromine water is orange [1]
ethene decolorises (bromine water) [1]
there is no decolorisation with ethane [1] [4]

(d) **(i)** 

correct monomer structure [1]
correct polymer repeating unit [1]
n before chloroethene [1]
indicating repeating unit
(repeat can be brackets and n after or a min of 3 repeating units) [1]
must be equation if not 3 mark max. [4]

(ii) Suitable use [1] and linked property [1]
e.g. electric cable [1] good (electrical insulator) [1]
guttering/drainpipes [1] waterproof/tough/durable/can be coloured [1] [2]

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					AVAILABLE MARKS
8	**(a)**	**(i)**	Idea that the calcium carbonate (thermally) decomposes [1] forming calcium oxide [1] and carbon dioxide [1]	[3]	
		(ii)	Carbon/coke reacts with carbon dioxide [2] Carbon/coke reacts with oxygen [1]	[2]	
	(b)		$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ LHS [1] RHS [1] balancing, if all formulae correct [1]	[3]	
	(c)		It is a reduction [1] aluminium **ions** are gaining electrons [1]	[2]	
	(d)	**(i)**	nitrogen	[1]	
		(ii)	the reaction is reversible	[1]	12
				Total	**90**

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2015

Double Award Science: Chemistry

Unit C2

Higher Tier

[GSD52]

GSD52

TUESDAY 9 JUNE 2015, AFTERNOON

TIME

1 hour 15 minutes.

INSTRUCTIONS TO CANDIDATES

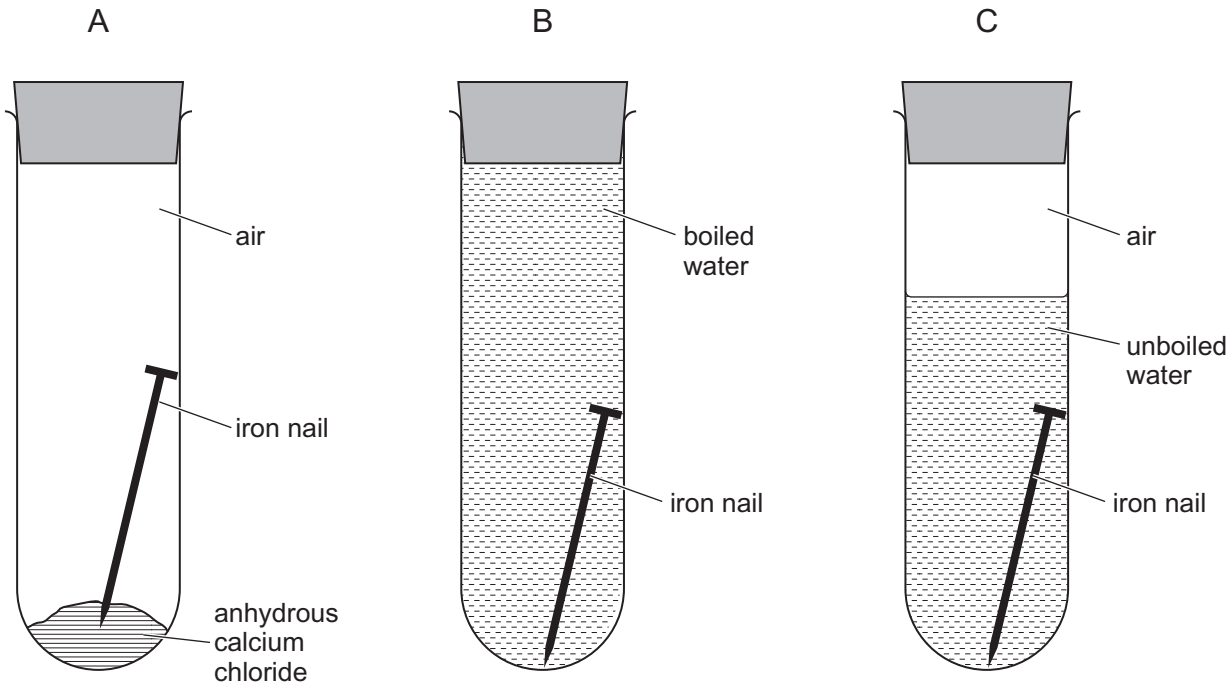
Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in blue or black ink only. **Do not write with a gel pen.**
Answer **all eight** 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 Questions **3(a)** and **6(c)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

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1 **(a)** A student set up 3 test tubes as shown below to investigate the conditions needed for the rusting of iron.



(i) After a week, which was the only test tube, A, B or C to have a rusty nail?

_____ [1]

(ii) How did the student make the test fair?

_____

_____ [1]

(iii) Why had the water in test tube B been boiled?

_____ [1]

(iv) What **two** conditions are necessary for the rusting of iron to occur?

_____ and _____ [1]

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(b) Iron can be protected from rusting by sacrificial protection.

(i) Which **one** of the metals listed below could protect an iron nail from rusting by sacrificial protection?

Circle the correct answer.

copper **zinc** **lead**

[1]

(ii) Use your understanding of sacrificial protection to explain your answer to part **(i)**.

_____

_____

_____

_____ [2]

(c) This part of the question is about the reaction of iron with sulfur.

When a mixture of sulfur powder and iron filings is placed in a boiling tube and then heated a chemical reaction takes place.

(i) When the mixture is heated an orange-red glow is seen in the boiling tube. What is observed when the heating is stopped?

_____

_____ [2]

(ii) Write a balanced symbol equation for the reaction between iron and sulfur.

_____ [2]

[Turn over

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2 **(a)** Magnesium reacts with steam to give two products.

(i) Complete the word equation for the reaction of magnesium with steam.

magnesium + steam → + [2]

(ii) Describe **one** observation you would make during this reaction.

_____ [1]

(b) Magnesium powder reacts quickly with copper(II) sulfate solution.

(i) Describe two things you would expect to **see** happening in this reaction.

1. _____

2. _____ [2]

(ii) What does this reaction tell you about the reactivity of magnesium compared to that of copper?

_____ [1]

(c) The reaction of magnesium powder with copper sulfate solution can be represented by the two half equations shown below.

$$Mg \rightarrow Mg^{2+} + 2e^-$$

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

Explain, in terms of electron transfer, why this is a **redox** reaction.

_____

_____

_____

_____ [3]

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[Turn over

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20GSD5205

3 A student is given three gas jars labelled A, B and C and told that one contains nitrogen, one contains carbon dioxide and one contains oxygen. The student does not know which gas jar contains which gas.

(a) Give two similarities between the three gases and describe how, using tests for gases, you would work out which gas jar contains nitrogen.
Additional gas jars containing gases A, B and C are available as needed.

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

[6]

(b) The atmosphere contains a mixture of gases. How was the early atmosphere formed?

_____

_____ [2]

(c) The two main gases in the atmosphere make up about 99%.

(i) Just under 80% of the atmosphere is made up of nitrogen. Which is the second most abundant gas in our atmosphere?

_____ [1]

(ii) Which **one** of the gases below is considered to be an atmospheric gas? Circle the correct answer.

argon **hydrogen** **chlorine**

[1]

(d) In the Haber process ammonia is manufactured from nitrogen and hydrogen.

(i) Write a balanced symbol equation for the formation of ammonia in the Haber process.

_____ [3]

(ii) Explain why the manufacture of ammonia is described as a reduction reaction.

_____ [1]

[Turn over

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20GSD5207

4 This question is about relative atomic mass, relative formula masses and using mole calculations.

(a) What do you understand by the **relative atomic mass** of an element?

_____

_____

_____ [3]

(b) Calculate the relative formula mass of each of the substances given below.
(Relative atomic masses: H = 1, O = 16, Na = 23, Al = 27, S = 32)

(i) Sodium sulfate Na_2SO_4

_____ [1]

(ii) Aluminium hydroxide $Al(OH)_3$

_____ [1]

(c) Lead iodide can be produced by reacting lead nitrate with potassium iodide. This reaction is carried out by mixing a solution of lead nitrate with a solution of potassium iodide. Solid lead iodide is formed.

$$Pb(NO_3)_2 + 2KI \rightarrow PbI_2 + 2KNO_3$$

Relative formulae masses:		
	lead nitrate	331
	potassium iodide	166
	lead iodide	461

(i) How many moles of potassium iodide would be needed to react with 33.1 g of lead nitrate?

Answer _____ moles [2]

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(ii) Use the equation:

$$Pb(NO_3)_2 + 2KI \rightarrow PbI_2 + 2KNO_3$$

to calculate the maximum mass of lead iodide that could be obtained from 33.1 g of lead nitrate.

Answer _____ g [2]

(iii) If a student used 0.2 moles of lead nitrate and 0.2 moles of potassium iodide, how many moles of lead iodide would be produced?

Answer _____ moles [1]

[Turn over

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5 **(a)** In some parts of Northern Ireland the water is described as hard water. Hardness in water can be temporary or permanent.

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

_____

_____ [1]

(ii) What causes hardness in water?

_____ [1]

(iii) How could you easily distinguish between temporary and permanent hardness in water?

_____

_____ [1]

(b) When sodium carbonate (Na_2CO_3) is added to hard water, the water is softened by precipitation. Explain what happens to the ions involved in this process.

_____

_____

_____

_____

_____

_____ [4]

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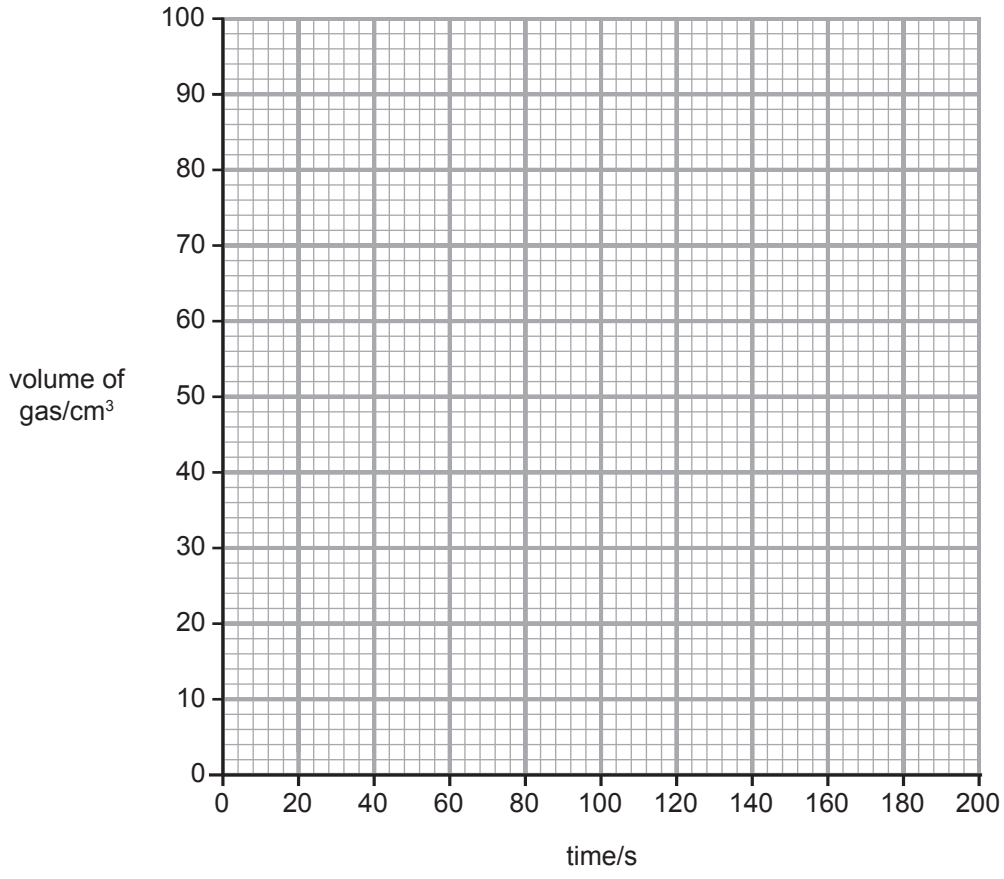
6 Calcium carbonate reacts with excess dilute hydrochloric acid to form carbon dioxide, water and calcium chloride solution.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

A student investigated the rate of this reaction by measuring the volume of carbon dioxide gas produced over a period of time. The total volume of gas measured at 20 second intervals is recorded in the table below.

Time/s	0	20	40	60	80	100	120	140	160
Volume/cm^3	0	32	50	66	76	83	87	90	90

(a) On the grid below, plot the results given in the table. Draw a curve of best fit. [3]



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(b) (i) At what time did the reaction stop?

_____ [1]

(ii) Using your answer from **(b)(i)** and the equation

$$\textbf{rate} = \frac{\textbf{total volume of gas produced}}{\textbf{reaction time}}$$

calculate the average rate of this reaction and state the units.

Answer _____ [2]

[Turn over

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(c) After further investigation the student found that the rate of this reaction can be increased by using a more concentrated solution of hydrochloric acid, by increasing the temperature and by using smaller particles of calcium carbonate.

Use the collision theory to explain how the rate of reaction is increased by:

- using a more **concentrated** solution of hydrochloric acid
- increasing the **temperature**
- using smaller particles of calcium carbonate

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

Concentration:

Temperature:

Particle size:

[6]

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7 This question is about the quarrying of limestone near a town and its use in the blast furnace.

(a) (i) Describe two ways, other than giving uses of limestone, in which a limestone quarry could be an advantage to the local community.

1. _____

_____

2. _____

_____ [2]

(ii) Give two reasons why quarrying limestone could be a problem for the community living close to the quarry.

1. _____

_____

2. _____

_____ [2]

(b) Limestone is added as a raw material to the blast furnace in the reduction of iron ore.

(i) At the temperature of the furnace the limestone (calcium carbonate) decomposes. Write a balanced symbol equation for the thermal decomposition of limestone.

_____ [2]

(ii) Explain how the compound produced from the thermal decomposition of limestone removes the silicon dioxide impurity from the iron ore and is taken from the furnace.

_____

_____

_____

_____ [3]

[Turn over

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8 **(a)** A recent spillage of crude oil onto the shores of the USA caused serious environmental problems. It is important that oil spillages are dealt with quickly.

(i) Give three examples of environmental problems caused by oil spillage.

1. _____

_____

2. _____

_____

3. _____

_____ [3]

(ii) How are oil spillages cleaned up?

_____

_____ [1]

(b) The hydrocarbon propane is a major source of energy.

(i) Name the homologous series which includes propane.

_____ [1]

(ii) Give the general formula of this homologous series.

_____ [1]

(iii) Write a balanced symbol equation for the combustion of propane in a plentiful supply of air.

_____ [3]

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(c) Members of the carboxylic acid homologous series include ethanoic acid.

(i) Name the first member of this homologous series.

_____ [1]

(ii) Draw the structural formula of ethanoic acid showing all the bonds present.

[2]

(d) **(i)** What pH would you expect ethanoic acid to have?

_____ [1]

(ii) Give one use of ethanoic acid.

_____ [1]

[Turn over

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20GSD5217

(e) Ethanoic acid shows typical reactions of an acid.

(i) Describe three observations you could make when ethanoic acid is added to solid copper carbonate.

1. _____

_____

2. _____

_____

3. _____

_____ [3]

(ii) Name a metal that you could react safely with ethanoic acid to form hydrogen gas.

_____ [1]

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For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
Total Marks	

Examiner Number

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Rewarding Learning

General Certificate of Secondary Education
2015

Double Award Science: Chemistry

Unit C2

Higher Tier

[GSD52]

TUESDAY 9 JUNE 2015, 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)	C	[1]	
		(ii)	Let 3 nails remain for same time/same size of nail/same temperature/ same type of nail/same size of test tube **Ignore** 'bung' **or** idea of control	[1]	
		(iii)	To remove air or oxygen	[1]	
		(iv)	Air/oxygen and water/moisture (allow dampness, wetness)	[1]	
	(b)	(i)	Zinc	[1]	
		(ii)	Zinc is more reactive (than iron) [1] Zinc reacts first/reacts in preference to iron (so iron does not rust) [1] **Not** zinc reacts quicker; **not** zinc rusts	[2]	
	(c)	(i)	It continues to glow [1] Idea that a grey/black solid (**not** powder) is formed [1] **Allow** idea of turning grey or black unless wrongly qualified, e.g. **not** soot; **not** pungent smell; **not** powder	[2]	
		(ii)	Fe + S = FeS LHS [1] RHS [1] If balancing wrong but formulae (all) correct award [1]	[2]	11
2	(a)	(i)	Magnesium oxide [1] Hydrogen [1]	[2]	
		(ii)	Solid goes (from grey) to white or solid glows brightly **Allow** white light **not** white flame	[1]	
	(b)	(i)	Any **two** of: (Blue) solution goes colourless or fades Magnesium dissolves/disappears Reddish-brown/pink/brown/orange/copper coloured **Not** red; **not** copper; **not** heat produced Or other correct – 2 × [1]	[2]	
		(ii)	Magnesium is more reactive (than copper) or vice-versa **Not** faster	[1]	
	(c)		Idea that both oxidation & reduction are happening together (i.e. redox definitions) [1] Oxidation is loss of electrons **and** reduction is gain of electrons [1] Magnesium (only) loses electrons [1] Copper ions (only) gain electrons [1] Any 3 × [1]	[3]	9

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AVAILABLE MARKS

3 (a) Indicative Points

Similarities

All three gases are:

- colourless
- odourless
- not toxic
- tasteless
- all found in air

any other correct (for all three gases)

maximum 2 indicative points for similarities

Testing

- idea of testing in logical order, e.g. take **a** jar (not **the** gas jar) and test all three
- use a glowing splint/lit splint
- result: it relights/burns more brightly with oxygen
- add limewater
- result: it turns milky with carbon dioxide
- nitrogen identified by elimination

N.B. indicative points for results are dependent on correct tests

Response	Marks
Candidates must use specialist terms throughout to plan the experiment (7–8 indicative points required including the idea of testing in order). They use good spelling, punctuation and grammar and the form and style are of a high standard.	5–6
Candidates use some specialist terms to plan the experiment (4 to 6 indicative points required). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	3–4
Candidates give 1–3 of the indicative points but not necessarily in a logical sequence. They use limited spelling, punctuation and grammar and they have made little use of specialist terms.	1–2
Response not worthy of credit.	0

[6]

(b) idea of (intense) volcanic activity [1]
which released gases into the atmosphere [1]
N.B. For any credit volcanoes must be mentioned
Credit release of gases unless wrongly qualified, e.g. not toxic, dangerous, SO_2 [2]

(c) (i) oxygen [1]

(ii) argon [1]

(d) (i) $N_2 + 3H_2 \rightleftharpoons 2NH_3$
LHS [1] RHS [1] balancing (if LHS & RHS correct) [1]
N.B. **equilibrium** sign **not** essential [3]

(ii) clear idea of addition/gain of hydrogen **to nitrogen** [1]

14

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					AVAILABLE MARKS
4	**(a)**		Average mass of an **atom** (of an element) [1] compared with that of a carbon-12 isotope [1] which has mass of exactly (clearly implied) 12 [1]	[3]	
	(b)	**(i)**	sodium sulfate 142	[1]	
		(ii)	aluminium hydroxide 78	[1]	
	(c)	**(i)**	0.2 moles allow **one** method mark for either 33.1 g = 0.1 moles (lead nitrate) **or** recognition of 1:2 lead nitrate : potassium iodide ratio. For 33.1/166 method give no credit	[2]	
		(ii)	46.1 g allow one method mark for explicit recognition of 1:1 ratio	[2]	
		(iii)	0.1 moles	[1]	10
5	**(a)**	**(i)**	water which does not lather (easily) **with soap**	[1]	
		(ii)	(Dissolved) Ca^{2+} or Mg^{2+} **ions**	[1]	
		(iii)	Idea that temporary hardness can be removed by boiling or idea that permanent hardness cannot be removed by boiling	[1]	
	(b)		dissolved Ca^{2+} ions react [1] with CO_3^{2-} ions (from Na_2CO_3) [1] form $CaCO_3$ [1] clear idea that product is insoluble [1] unless wrongly qualified this removes the Ca^{2+} ions and (therefore) softens the water [1] Any 4 × [1]	[4]	7

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6 **(a)** 8–9 points [2] 5–7 points [1] appropriate hand drawn curve [1] [3]

(b) **(i)** 140s **or** 140 seconds – units needed [1]

(ii) 0.64 [1] cm^3/s [1] apply CM [2]

(c) **Indicative Points**

Concentration

- Explicit idea of more particles/H+ ions (in the same volume) (**not** molecules or atoms)
- Idea of more collisions/more successful collisions

Temperature

- idea that particles H+ ions have more energy
- move faster
- Idea of **more energetic** collisions/more successful collisions

Accept more **kinetic energy** as first 2 indicative points

Particle size

- Idea of larger surface area
- More (chance of) collisions

Response	**Marks**
Candidates must use specialist terms throughout. (6–7 indicative points covering **all three** areas required). They use good spelling, punctuation and grammar and the form and style are of a high standard.	5–6
Candidates use some specialist terms throughout. (4–5 indicative points required). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	3–4
Candidates give 1–3 of the indicative points but not necessarily in a logical sequence. They use limited spelling, punctuation and grammar and they have made little use of specialist terms.	1–2
Response not worthy of credit.	0

[6]

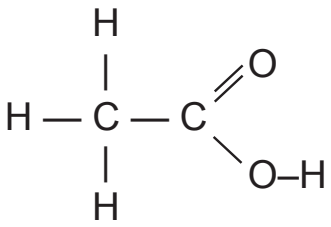
AVAILABLE MARKS

12

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					AVAILABLE MARKS
7	(a)	(i)	provides jobs (for local people) helps local economy/idea of financial benefits improvement in roads infrastructure quarries can be used for landfill **or** other correct Any 2 × [1]	[2]	
		(ii)	Noise pollution disturbing animal habitats idea of poor air quality (due to dust and lorry fumes) increased traffic eyesore qualified danger **or** other correct Any 2 × [1]	[2]	
	(b)	(i)	$CaCO_3 \rightarrow CaO + CO_2$ LHS [1] RHS [1] if incorrect balancing max is [1]	[2]	
		(ii)	Idea that (alkaline) CaO **reacts** with (acidic) SiO_2 [1] Producing calcium silicate $CaSiO_3$ /slag [1] Idea of tapped off at the bottom of the furnace (as slag) [1]	[3]	9

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					AVAILABLE MARKS
8	(a)	(i)	Any **three** of: water pollution damages beaches kills or damages birds kills or damages sea life destroys habitats/breeding grounds destroys marine plant life idea of effect of light on sea life can stay a long time **Ignore** eyesore **Not** defoliates trees; **not** animals except reference to habitats; **not** cost of cleaning or other correct Any 3 × [1]	[3]	
		(ii)	Oil spillages are cleaned up by spraying them with detergents/ idea of physical removal/dispersants/bacteria or other correct **Not** burning; **not** filtering; **not** neutralising	[1]	
	(b)	(i)	alkane	[1]	
		(ii)	C_nH_{2n+2}	[1]	
		(iii)	$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ LHS [1] RHS [1] balancing (if LHS & RHS correct) [1]	[3]	
	(c)	(i)	Methanoic acid	[1]	
		(ii)	 If one error allow [1]; don't differentiate between -OH and –O-H, e.g. for propanoic acid drawn out award [1]	[2]	
	(d)	(i)	Any answer in range pH 3 – pH 6	[1]	
		(ii)	food flavouring/vinegar/food preservation or other correct, e.g. cleaning; **not** industrial; **not** disinfectant **allow** used for **wasp** stings, not **bee** stings	[1]	
	(e)	(i)	Any **three** of: effervescence/bubbles/fizzing/gas given off idea that gas is colourless solid dissolves/disappears blue solution formed heat evolved or other correct Any 3 × [1]	[3]	
		(ii)	Magnesium/zinc/aluminium/iron or other correct **Not** potassium, sodium, lithium, calcium, copper, gold etc.	[1]	18
				Total	**90**

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Rewarding Learning

Centre Number	
71	

Candidate Number

General Certificate of Secondary Education
2014

Double Award Science: Chemistry

Unit C2

Higher Tier

[GSD52]

GSD52

TUESDAY 10 JUNE 2014, AFTERNOON

TIME

1 hour 15 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all eight** 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 Questions **1(a)** and **8(a)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
Total Marks	

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Examiner Only	
Marks	Remark

1 **(a)** The reaction between dilute hydrochloric acid and marble chips is given in the equation below:

$$CaCO_{3(s)} + 2HCl_{(aq)} \rightarrow CaCl_{2\,(aq)} + CO_{2(g)} + H_2O_{(l)}$$

Plan a method to measure the rate of reaction between dilute hydrochloric acid and marble chips.

You should give clear details of how you would carry out your investigation, including a description of what results you will need to record. Explain how you would use your results.

You will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

(b) Use the idea of collisions to explain the effect of increasing the concentration of the hydrochloric acid on the rate of reaction.

[3]

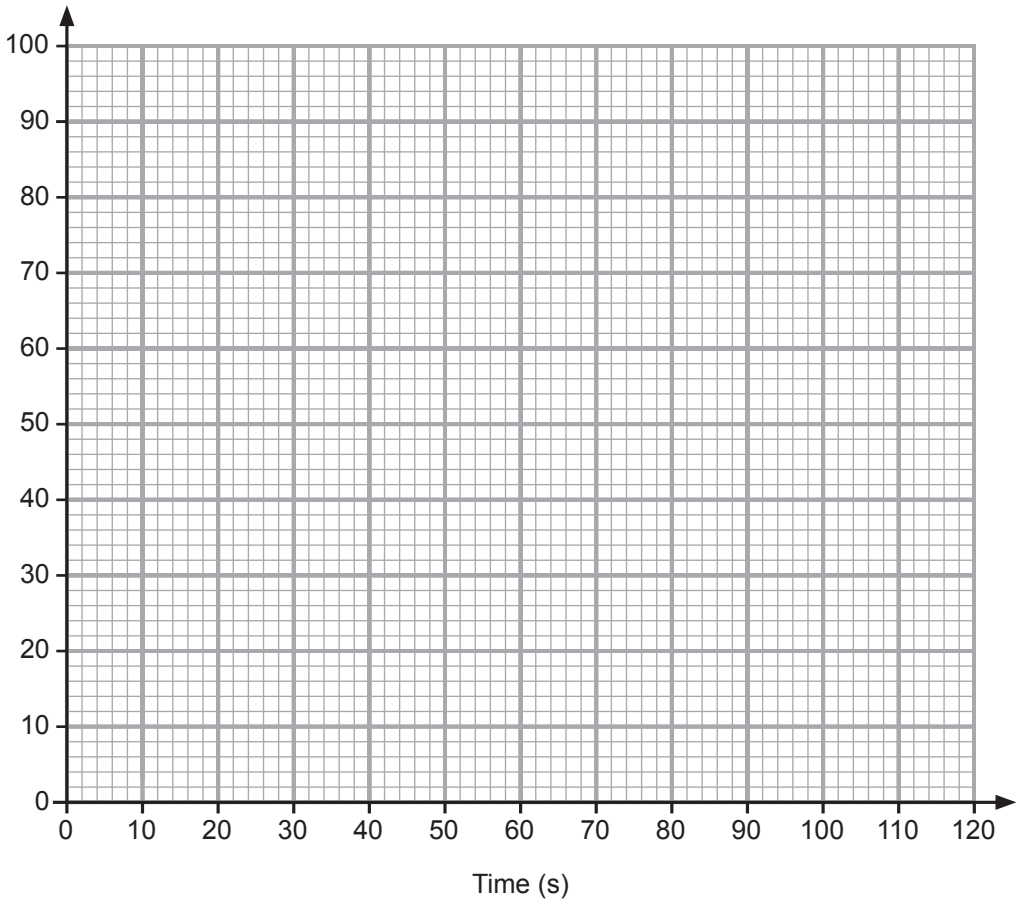
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(c) Magnesium ribbon reacts with dilute hydrochloric acid to produce hydrogen gas. A student measured the volume of gas produced over a period of time. The results are shown in the table below.

Volume of H_2 gas (cm^3)	0	23	40	58	71	75	78	80	80
Time (s)	0	10	20	40	60	70	80	90	100

(i) Label the y-axis on the grid below. [1]

(ii) Use the grid to plot a curve showing the results of the experiment. [3]



(iii) At what time did the reaction stop?

_____ [1]

(iv) From your graph, how long did it take for 50 cm^3 of hydrogen to be formed?

_____ [1]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

2 **(a)** Calculate the relative formula mass of each of the following substances.

(Relative atomic masses: H=1, N=14, O=16, Na=23, S=32, Ca=40)

(i) sodium nitrate $NaNO_3$

_____ [1]

(ii) sulfuric acid H_2SO_4

_____ [1]

(iii) calcium hydroxide $Ca(OH)_2$

_____ [1]

(b) What is meant by one mole of a substance?

_____

_____

_____ [2]

(c) This part of the question is about the amount of iron that can be produced from a certain amount of iron(III) oxide. The equation for the reaction is given below:

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

The relative formula mass of Fe_2O_3 is 160.

(i) How many moles of Fe_2O_3 are in 80 g of the substance?

Answer _____ moles [1]

(ii) How many moles of iron could be produced from 80 g of Fe_2O_3?

Answer _____ moles [1]

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(iii) Calculate the maximum mass of iron that could be produced from 80 g of Fe_2O_3. You may find your Data Leaflet useful when answering this question.

Answer _____ g [1]

(iv) Calculate the maximum mass of iron that could be produced from 8 tonnes of Fe_2O_3. (1 tonne = 1000 kg)

Answer _____ tonnes [1]

(d) The final part of this question is about the effect that dilution has on the concentration of a solution and the number of moles in the solution.

(i) If 800 cm^3 of water is added to 200 cm^3 of a 1 mol/dm^3 solution of hydrochloric acid, to make a 1 dm^3 solution, what happens to the **concentration** of the acid? Tick (✓) the correct answer.

It stays the same ☐

It becomes 0.25 mol/dm^3 ☐

It becomes 0.20 mol/dm^3 ☐ [1]

(ii) If 800 cm^3 of water is added to 200 cm^3 of a 1 mol/dm^3 solution of hydrochloric acid, what happens to the **number of moles** of acid in the solution? Tick (✓) the correct answer.

It stays the same ☐

It becomes 25% of its original value ☐

It becomes 20% of its original value ☐ [1]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

3 **(a)** This part of the question is about the heating of solid calcium carbonate.

(i) Complete the word equation for this reaction.

calcium carbonate $\xrightarrow{\text{heat}}$ + [2]

(ii) The reaction in part **(i)** is an example of an endothermic change. Which one of the following statements describes an endothermic reaction? Tick (✓) the correct statement.

Gives out heat energy to the surroundings ☐

Takes in heat energy from the surroundings ☐

No change in energy during reaction ☐

[1]

(iii) Circle the term below which best describes the type of reaction which occurs when calcium carbonate is heated.

thermal cracking **displacement** **neutralisation**

thermal decomposition **photosynthesis**

[1]

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(b) Methane burns in oxygen. The reaction is described by the equation below:

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

Explain, in terms of the bonds that are broken and made **in this reaction**, why the burning of methane is exothermic.

[5]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

4 **(a)** Temperary hard water is found in limestone regions.

(i) Name the compound that causes temporary hardness in water.

_____ [1]

(ii) Explain how water in limestone regions becomes hard.

_____

_____

_____

_____

_____

_____ [4]

(b) Hard water can be softened by addition of washing soda Na_2CO_3.

Explain, in terms of the ions involved, why the addition of washing soda can be used to soften hard water.

_____

_____

_____

_____

_____

_____ [3]

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Examiner Only	
Marks	Remark

5 **(a)** During the first billion years of the Earth's existence, there was intense volcanic activity which released gases that formed the early atmosphere. The early atmosphere contained over 90% carbon dioxide, 5% nitrogen, 3% sulfur dioxide and traces of hydrogen sulfide, ammonia and methane, but no oxygen. It was hot, smelly and deadly poisonous.

(i) What is the **difference** in percentage composition of nitrogen gas found in the atmosphere today compared to its composition in the early atmosphere?

_____ [1]

(ii) One theory suggests that the early atmosphere changed as living organisms evolved. State two ways that the carbon dioxide could have been removed from the early atmosphere.

1. _____

2. _____ [2]

(b) This part is about the Group 2 metal strontium and some of its compounds.

- You may find your understanding of the properties of magnesium and calcium and their compounds to be helpful.
- You may find your Data Leaflet useful.

(i) What is the formula of strontium sulfate?

_____ [1]

(ii) What would you expect to happen if some strontium carbonate was placed in a beaker of water?

_____ [1]

(iii) What would you expect to observe if a small piece of strontium metal was placed in a beaker of water?

_____

_____

_____

_____

_____ [3]

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Examiner Only	
Marks	Remark

6 **(a)** This part of the question is about the physical properties and uses of nitrogen gas.

(i) From the list below tick (✓) **two** physical properties of nitrogen gas.

very soluble in water ☐

pale green coloured ☐

colourless ☐

odourless ☐

sweet smelling ☐

[2]

(ii) Nitrogen is used in the manufacture of ammonia. Give one other use of nitrogen.

_____ [1]

(b) Ammonia gas is manufactured in the Haber Process by reacting hydrogen with nitrogen:

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

(i) What do the arrows ($\rightleftharpoons$) mean in the above equation?

_____ [1]

(ii) Complete the table below to give the conditions needed for this reaction to occur. Include units where appropriate.

temperature	
catalyst	
pressure	

[3]

(iii) Give two uses of ammonia.

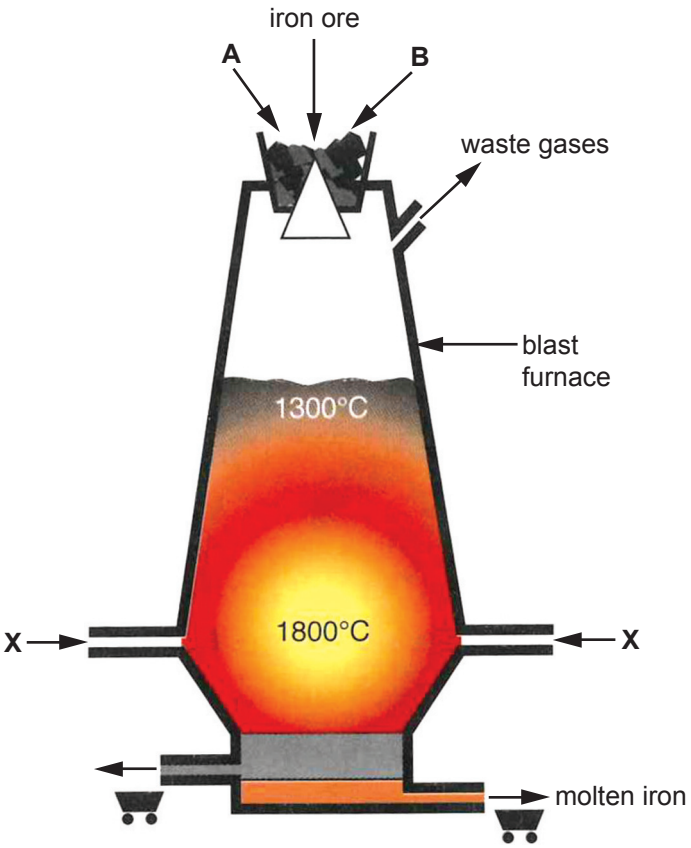
1. _____

2. _____ [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

7 **(a)** The diagram below shows a Blast Furnace, used in the manufacture of iron.



© Barking Dog Art

(i) What is the common name for the iron ore used in the Blast Furnace?

_____ [1]

(ii) Name the substances **A** and **B** that go into the top of the Blast Furnace.

A _____

B _____ [2]

(iii) Name substance **X**, which goes into the bottom of the Blast Furnace.

_____ [1]

(iv) How is the iron removed from the Blast Furnace?

_____ [1]

(v) Describe how the acidic impurities are removed from the Blast Furnace.

_____

_____

_____

_____ [2]

(b) Carbon monoxide is produced from carbon dioxide in the Blast Furnace. Write a balanced symbol equation to show how carbon monoxide is formed.

_____ [3]

(c) The extraction of iron in the Blast Furnace is an example of a redox reaction.

(i) What is meant by the term **redox**?

_____

_____

_____ [2]

(ii) The extraction of iron from iron ore can be represented by the half equation:

$$Fe^{3+} + 3e^{-} \rightarrow Fe$$

Explain, in terms of electrons, why this is a reduction reaction.

_____

_____ [2]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

8 **(a)** Methanol and ethanol are both members of the alcohol homologous series. Define the term homologous series and outline the similarities between methanol and ethanol.

You will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

(b) **(i)** Ethanol is used as a clean fuel. Give two other uses of ethanol.

1. _____

2. _____ [2]

(ii) Write a balanced symbol equation for the production of ethanol from ethene.

_____ [2]

(c) Polythene is a useful polymer made from ethene molecules.

(i) Write a balanced equation, using **structural formulae**, for the polymerisation of ethene.

[4]

(ii) Polythene can be used to make plastic buckets.

State two properties of polythene that make it suitable for this use.

1. _____

2. _____ [2]

Examiner Only

Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

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113177

Rewarding Learning

General Certificate of Secondary Education
2014

Double Award Science: Chemistry

Unit C2

Higher Tier

[GSD52]

TUESDAY 10 JUNE 2014, 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) Planning a method to study or measure the rate of the reaction between dilute hydrochloric acid and marble chips.

Feasible methods enable either the (loss in) mass to be measured/recorded or the volume of gas produced to be measured/recorded.

Indicative Points:

- Placing the dilute acid and the marble chips in a suitable reaction container
- Using a (top pan) balance **or** using a gas syringe – in a correct context
- Clear idea of timing the reaction – in the context of a sensible suggestion
- At the start weigh the contents of the beaker/flask **or** at the start take an initial syringe reading/zero the syringe
- Look for Loss in mass **or** Gain in (gas) volume **or** marble chip to disappear/reaction to stop.
- Measure/record the change in mass **or** the gain in volume.
- Either idea of measuring/recording the change at different times **or** (in a case where one result is being taken) at an appropriate time, e.g. when "it" stops fizzing/when "it" has been reacting for x seconds.
- Idea of plotting a graph (using the results) **or** idea of calculating the rate.
- Idea that the graph should be mass **or** volume against time **or** that the rate calculation is mass or volume/time.

Response	Mark
Candidates must use specialist terms throughout to plan the experiment in a logical sequence (6 or more indicative points required). They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use some specialist terms to plan the experiment in a logical sequence (4 to 5 indicative points required). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates give 1 to 3 of the indicative points tested but not necessarily in a logical sequence. They use limited spelling, punctuation and grammar and they have made little use of specialist terms.	[1]–[2]
Response not worthy of credit.	[0]

[6]

(b) Increased concentration means more particles/more collisions [1]
(thus) more high energy/more successful collisions [1]
and faster reaction [1] [3]

(c) (i) Volume of H_2 gas (cm^3) Unit needed [1]

(ii) 8–9 correct points (within $\frac{1}{2}$ square) [2]
7 correct points [1]
Smooth curve [1] [3]

(iii) 90(s) **or** 90 seconds Units needed [1]

(iv) 30 ± (s) 30 ±1 (s) seconds [1]

Apply c.m. if units absent in **(iii)** and **(iv)**
If answer outside 29–31 second range check graph again – if answer/error due to poor curve penalise curve in **1(c)(ii)** but allow answer in **1(c)(iv)**.

15

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					AVAILABLE MARKS
2	**(a)**	**(i)**	85	[1]	
		(ii)	98	[1]	
		(iii)	74	[1]	
	(b)		The relative formula mass [1] in grams [1] of a substance second mark depends on first **or** 6×10^{23} [1] atoms/molecules/ions/particles [1] second mark depends on first **or** The amount of a substance that contains the same number of atoms/ molecules/ions/particles as [1] there are in 12 g of carbon-12 [1]	[2]	
	(c)	**(i)**	0.5 mole	[1]	
		(ii)	1 mole **or** c.m. answer i.e. **(c)(i)** × 2	[1]	
		(iii)	56 g Apply c.m.	[1]	
		(iv)	5.6 (tonnes) Apply c.m. i.e. **(c)(iv)** answer numerically is 0.1 × **(c)(iii)** answer	[1]	
	(d)	**(i)**	It becomes 0.20 mol/dm^3	[1]	
		(ii)	It stays the same	[1]	11
3	**(a)**	**(i)**	Calcium oxide [1] Carbon dioxide [1] either order	[2]	
		(ii)	Takes in heat energy from the surroundings	[1]	
		(iii)	Thermal decomposition	[1]	
	(b)		Bonds are broken in named reactants (methane and oxygen) [1] Ideas that energy is needed to break bonds/bond breaking is endothermic [1] Bonds are made in named products (carbon dioxide and water) [1] Idea that energy is given out when bonds are made/bond making is exothermic [1] **Clear** idea that the reaction is exothermic because **more** energy is released in bond making than is needed for bond breaking – No credit for simply stating that reaction is exothermic because heat/energy is given out [1] **max** (5 × [1])	[5]	
			The first and third marking points require named reactants and products to be given – if answer is a generic one then maximum mark is [3]; if 2 of the 4 chemicals are appropriately referred to, i.e either both reactants or both products or 1 of each, then maximum mark is [4]; for all 5 marks at least 3 of the 4 chemicals must be explicitly referred to; if 0 or 1 reactants/products given maximum is [3] for a generic answer.		9

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					AVAILABLE MARKS
4	(a)	(i)	Calcium or magnesium hydrogencarbonate	[1]	
		(ii)	Carbon dioxide dissolves in rainwater [1] to form (carbonic) acid/an acid solution. [1] This **reacts** with (insoluble) calcium carbonate/limestone [1] to form **a soluble** calcium compound/soluble calcium hydrogencarbonate/ calcium ions in solution [1]	[4]	
	(b)		Carbonate ions (from the washing soda) [1] combine with calcium ions [1] from the hard water to form insoluble calcium carbonate/limestone [1] removing calcium ions from solution [1] Any 3 from 4	[3]	
			or $Ca^{2+}(aq) + CO_3^{2-}(aq) \rightarrow CaCO_3(s)$ [1] [1] [1]		8
5	(a)	(i)	73–75%	[1]	
		(ii)	Idea of being "locked/trapped" in fossil fuels Idea of being "locked/trapped" in carbonates/limestone Idea of being absorbed/used by plants/trees in photosynthesis Idea of being dissolved in oceans Any 2 × [1]	[2]	
	(b)	(i)	$SrSO_4$	[1]	
		(ii)	Idea that it would not dissolve/no reaction/go milky **Not** "nothing"	[1]	
		(iii)	Any of the following ideas: It reacts (fairly) vigorously/speeds up (**Not** violent **Not** slow) It sinks **or** sinks and floats (**Not** floats alone) Fizzing/effervescence/bubbles Solution formed/strontium dissolves/disappears Idea that solution is **colourless** Accept idea that water goes cloudy An exothermic reaction happens Or other correct, i.e. linked to reaction of calcium but a bit quicker **Not** linked to sodium reaction. **max** (3 × [1])	[3]	8

						AVAILABLE MARKS
6	**(a)**	**(i)**	colourless [1] odourless [1] (if 3 ticks – 2 correct award [1]		[2]	
		(ii)	Food packaging/coolant or other correct		[1]	
	(b)	**(i)**	Reversible reaction		[1]	
		(ii)	Temperature: 250–450 °C [1] Catalyst: Iron [1] Pressure: 200–500 atm [1]		[3]	
		(iii)	Manufacture of fertilisers Production of nitric acid Manufacture of nylon Or other correct **max** (2 × [1])		[2]	9
7	**(a)**	**(i)**	Haematite **not** iron oxide		[1]	
		(ii)	Limestone/calcium carbonate [1]/coke/carbon [1] ANY order		[2]	
		(iii)	(Blast) of hot air		[1]	
		(iv)	Idea that (molten) iron is tapped off/run off		[1]	
		(v)	Name: idea of reacting with calcium oxide [1] slag produced/ calcium silicate **or** product is tapped off [1]		[2]	
	(b)		$CO_2 + C \rightarrow 2CO$ [1] for reactants [1] for products and [1] for balancing		[3]	
	(c)	**(i)**	Oxidation and reduction occur [1] in the same reaction/ simultaneously		[2]	
		(ii)	Electron gain [1] by the iron **ion** [1]		[2]	14

AVAILABLE MARKS

8 **(a)** Definition of homologous series
Family of organic molecules with:
- Same general formula $C_nH_{(2n+1)}OH$
- Similar chemical properties/similar reactions
- differ by CH_2
- gradation in physical properties

Similarities between methanol and ethanol
- Both liquids/low BP **not** "not hydrocarbons"
- Both colourless
- Both water soluble
- Both contain an –OH group
- Burn to give CO_2 and H_2O/burn/flammable
- Idea that both can be fuels
- Idea that both are solvents

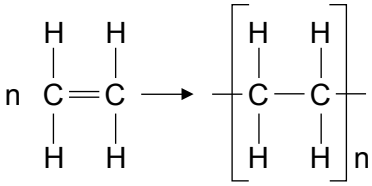
Response	**Mark**
Candidates must use specialist terms throughout. Definition of homologous series must be included (at least 7 indicative points required including at least 2 definition points). They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use some specialist terms throughout. Definition of homologous series must be included (4–6 indicative points including at least 1 definition point). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates include 1–3 of the indicative points. They use limited spelling, punctuation and grammar and they have made little use of specialist terms.	[1]–[2]
Response not worthy of credit. Candidates do not make reference to any of the indicative points above and offer no other suitable response.	[0]

[6]

(b) **(i)** In alcoholic drinks [1]
As a solvent [1]
or other correct
max (2 × [1]) [2]

(ii) $C_2H_4 + H_2O \rightarrow C_2H_5OH$
[1] for reactants and [1] for products [2]

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			AVAILABLE MARKS
(c)	**(i)**		
		[1] for correct monomer structure [1] for correct polymer structure in brackets [1] for n before **ethene** [1] for indicating repeat (repeat can be brackets* and n after or a mininum of 3 repeating units) *bonds must extend beyond brackets No arrow, maximum [3] [4]	
	(ii)	Chemically inert/unreactive/lightweight/flexible or can be easily moulded into shape/can be coloured/durable/waterproof [1] for each property correctly related to named use to a maximum of [2] [2] **not** hard, **not** strong, **not** cheap	16
		Total	**90**

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Rewarding Learning

Centre Number	
71	

Candidate Number

General Certificate of Secondary Education
2013

Double Award Science: Chemistry

Unit C2

Higher Tier

[GSD52]

GSD52

MONDAY 10 JUNE 2013, AFTERNOON

TIME

1 hour 15 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all nine** 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 Questions **2** and **5(a)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

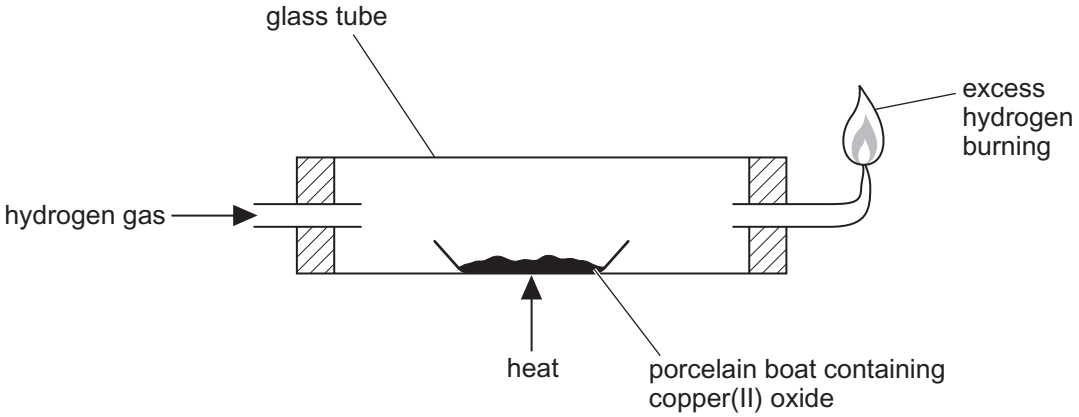
For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
Total Marks	

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Examiner Only	
Marks	Remark

1 The reaction between hydrogen gas and copper(II) oxide can be carried out using the apparatus shown below.



(i) What colour change takes place during this reaction?

from _____ to _____ [2]

(ii) Complete the word equation for the reaction.

copper(II) oxide + hydrogen → + [2]

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2 Limestone is mined from a quarry near Larne, Co. Antrim. The limestone is blasted from the quarry rock and it is then taken by dumper truck and fed into a crushing plant. Heavy lorries then carry the crushed limestone to the port of Larne and various parts of Northern Ireland.

Describe the advantages and disadvantages to the people of Larne of having a limestone quarry near their town.

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

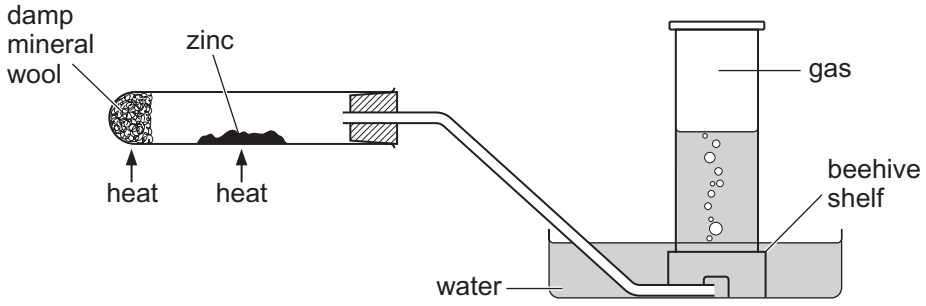
[6]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

3 **(a)** Zinc does not react with cold water, but does react with steam.

The diagram below shows the apparatus used to react zinc with steam and to collect the gas produced.



(i) What gas is produced when zinc reacts with steam?

_____ [1]

(ii) Why is the damp mineral wool heated?

_____ [1]

(iii) What colour is the solid product formed from zinc in this reaction?

_____ [1]

(iv) Name a metal, other than zinc, which will react with steam but not with cold water.

_____ [1]

(b) Magnesium is a Group 2 metal.

(i) Give two observations made when magnesium is burned in air.

1. _____

2. _____ [2]

(ii) Complete and balance the symbol equation for the reaction of magnesium with air.

$$Mg + \quad O_2 \longrightarrow$$

[2]

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Examiner Only	
Marks	Remark

4 This question is about carbon dioxide and the gases in the Earth's atmosphere.

(a) The atmosphere contains about 0.04% carbon dioxide gas. Complete the table below by adding the two most abundant gases in the atmosphere and their approximate proportions.

Gas	Approximate proportion in the atmosphere
carbon dioxide	about 0.04%

[4]

(b) The table below shows how the level of carbon dioxide in the Earth's atmosphere has changed over the last 150 years. The table also shows the change in average global temperature in the same time span.

Year	1750	1800	1850	1900	1950	2000
concentration of CO_2 in atmosphere/% by volume	0.027	0.028	0.029	0.030	0.032	0.037
average global temperature/°C	13.3	13.4	13.5	13.6	13.8	14.4

(i) Use the information in the table to describe the pattern of change in carbon dioxide levels in the atmosphere between 1750 and 2000.

_____

_____

_____

_____ [2]

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(ii) What is the relationship between the level of carbon dioxide in the atmosphere and average global temperature?

_____

_____ [1]

(iii) Give one reason for the changing amounts of carbon dioxide in the atmosphere.

_____

_____ [1]

(iv) Give one way in which our planet is affected by global warming.

_____

_____ [1]

(c) Carbon dioxide is used to make fizzy drinks and can be tested for in the laboratory using limewater solution.

(i) Give one physical property which makes carbon dioxide suitable for use in fizzy drinks.

_____ [1]

(ii) What is the name of the substance formed when carbon dioxide dissolves in water?

_____ [1]

(iii) What would be observed when carbon dioxide gas is bubbled through limewater solution?

_____

_____ [2]

(iv) What would be observed if you continued to bubble carbon dioxide gas through limewater solution?

_____

_____ [1]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

5 Town A has a hard water supply and town B has a soft water supply. You are provided with two samples of water, one from town A and the other from town B.

(a) Explain what is meant by hard water and describe a **fair** test you could carry out to find which is the hard water sample.

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

[6]

(b) The water in town A is hard water.

(i) Name an ion which causes water to be hard.

[1]

(ii) Why is hard water thought to be good for your health?

[1]

(iii) Name one industry which benefits from hard water.

_____ [1]

(iv) Why could it be less expensive to live in town B, where the water is soft, rather than town A?

_____

_____

_____

_____

_____ [2]

(c) The water in town C is temporary hard water

(i) Name a compound that causes temporary hard water.

_____ [1]

(ii) Explain, **in terms of ions present**, how temporary hard water can be softened by boiling.

_____

_____

_____

_____

_____

_____

_____ [4]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

6 The Haber Process is used in the manufacture of ammonia and it involves a reversible reaction.

(a) What do you understand by the term **reversible reaction**?

_____

_____ [2]

(b) Write a balanced symbol equation to show the important reversible reaction in the Haber Process.

_____ [4]

(c) Name the catalyst used in the Haber Process.

_____ [1]

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Examiner Only	
Marks	Remark

7 When zinc metal reacts with hydrochloric acid the mixture fizzes as hydrogen gas is given off. The reaction can be speeded up by increasing the concentration of the hydrochloric acid or by heating the reaction mixture.

(a) Use the collision theory to explain how increasing the concentration of the hydrochloric acid increases the rate of the reaction.

[2]

(b) Use the collision theory to explain how increasing the temperature of the reaction mixture increases the rate of reaction.

[3]

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Examiner Only	
Marks	Remark

8 This question is about relative atomic mass, relative formula masses and using mole calculations.

(a) What do you understand by the relative atomic mass of an atom?

_____

_____

_____ [3]

(b) Barium sulfate can be produced by reacting barium nitrate with excess sodium sulfate.

$$Ba(NO_3)_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaNO_3$$

(i) Calculate the relative formula mass of barium sulfate.
(Ba = 137; S = 32; O = 16)

Answer _____ [1]

(ii) Calculate the relative formula mass of barium nitrate.
(Ba = 137; N = 14; O = 16)

Answer _____ [1]

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(iii) Calculate the number of moles of barium nitrate in 13.05 g of the compound.

Answer _____ mole [1]

(iv) Use your answer to **(b)(i)** and **(b)(iii)** and the equation:

$$Ba(NO_3)_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaNO_3$$

to calculate the maximum mass of barium sulfate that can be obtained from 13.05 g of barium nitrate.

Answer _____ g [1]

(c) A solution of dilute sodium hydroxide is described as 2.0 mol/dm^3.

(i) What does 2.0 mol/dm^3 mean?

_____

_____ [2]

(ii) How much water must be added to 100 cm^3 of 2.0 mol/dm^3 sodium hydroxide to make a 1.0 mol/dm^3 solution?

_____ [1]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

9 **(a)** Natural gas is an important fossil fuel that is found in refinery gases. It is described as a non-renewable fuel.

(i) What is a **fossil fuel**?

_____

_____ [1]

(ii) What element is present in all fossil fuels?

_____ [1]

(iii) Natural gas is described as **non-renewable**. What does this mean?

_____

_____ [1]

(b) Ethanol is a renewable fuel. It is produced from food crops. Distillation is needed in the manufacture of ethanol. Burning ethanol produces less carbon dioxide than burning natural gas but ethanol is more expensive to produce than natural gas.

(i) Suggest one reason why ethanol is used as a fuel.

_____

_____ [1]

(ii) Suggest one reason why there could be concerns about replacing natural gas with ethanol as a fuel.

_____

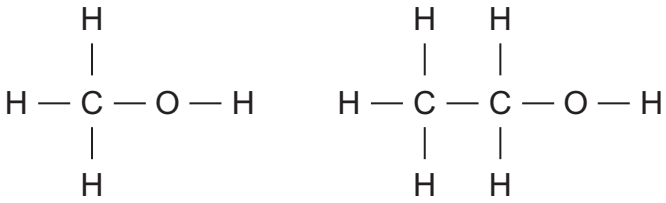
_____ [1]

(iii) Why is hydrogen considered to be a “cleaner” fuel than either ethanol or natural gas?

_____

_____ [1]

(c) The structural formula for the first two members of the alcohol homologous series are given below:



(i) Give the general formula of the alcohol homologous series.

_____ [1]

(ii) What is the functional group of the alcohol homologous series?

_____ [1]

(iii) Write out the molecular formula of ethanol.

_____ [1]

(d) Ethanol can be prepared from the reaction of ethene with steam. Write a balanced symbol equation for this reaction.

_____ [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

(e) **(i)** Methanol and ethanol can be used as fuels.
Write a balanced symbol equation for the combustion of methanol in a plentiful supply of air.

_____ [3]

(ii) When alcohols are burned in a limited supply of air another product is formed. Name this product.

_____ [1]

(f) The alkane hexane and the alkene hexene are both colourless liquids. Describe a chemical test you could carry out on each of these liquids to determine which one is the alkene.

Test _____

_____

_____ [2]

Expected result with hexene: _____

_____

_____ [2]

Expected result with hexane: _____

_____ [1]

THIS IS THE END OF THE QUESTION PAPER

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113178

Rewarding Learning

General Certificate of Secondary Education
2013

Double Award Science: Chemistry

Unit C2

Higher Tier

[GSD52]

MONDAY 10 JUNE 2013, 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 **(i)** Black [1] to pink/reddish orange/red-brown/orange-brown [1] [2]

(ii) Copper [1] Water [1] either order [2] — 4

2 **Indicative Content**

Advantages

- Use of limestone building industry/liming of soil
- Provides jobs (for locals)
- Good for local economy
- Disused quarry can be used for landfill
- Helps road infrastructure for transporting limestone

or other correct

Allow maximum of 4 indicative points for advantages

Disadvantages

- Noisy machinery
- Unsightly
- Destruction of habitats
- Fumes, pollution from machinery and heavy lorries
- Idea of traffic congestion

or other correct, e.g. danger if qualified

Allow maximum of 4 indicative points for disadvantages

When annotating apply indicative point ticks for advantages on LHS of answer at appropriate line(s) of answer; apply indicative point ticks for disadvantages on RHS of answer at appropriate line(s) of answer;

Response	**Mark**
Candidates make correct reference to 6–8 of the indicative points shown. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates make correct reference to 4–5 of the indicative points shown. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates make correct reference to 1–3 of the indicative points shown. The form and style are of a limited standard.	[1]–[2]
Candidates make no correct reference to any of the indicative points	[0]

[6] — 6

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					AVAILABLE MARKS
3	**(a)**	**(i)**	Hydrogen	[1]	
		(ii)	Idea of producing the steam	[1]	
		(iii)	White (allow yellow)	[1]	
		(iv)	Magnesium/aluminium/iron	[1]	
	(b)	**(i)**	Any **two** of (burns with) a bright/white light/flame [1] to form a white powder/ash/solid allow white smoke heat given out/exothermic reaction [1] idea of very vigorous reaction [1] (max 2 × [1])	[2]	
		(ii)	$2Mg + O_2 \rightarrow 2MgO$ [1] for MgO and [1] for balancing if formula is correct	[2]	8
4	**(a)**	Nitrogen [1]	79% ± 1% [1]		
		Oxygen [1]	20% ± 1% [1]	[4]	
	(b)	**(i)**	Idea that between 1750 and 1900 there was a gradual increase [1] Idea that 1900–2000 greater increase in CO_2 production [1] Idea of increase over time gains [1] NB Answer which links CO_2 with temperature gains no credit	[2]	
		(ii)	Idea that as carbon dioxide level increases global temperature increases **not** idea that as temperature rises so do CO_2 levels	[1]	
		(iii)	Burning of (more) fossil fuels/deforestation **or** other correct, e.g. idea of more vehicles **not** population increase	[1]	
		(iv)	Idea of melting of polar ice caps/sea levels rising/flooding in low lying areas/droughts in some areas/ecosystems will change **or** other correct	[1]	
	(c)	**(i)**	Soluble in water/accept idea of non-toxic/no smell/colourless/ tasteless	[1]	
		(ii)	Carbonic acid	[1]	
		(iii)	Limewater is colourless [1] **not** clear Turns milky or cloudy [1] **not** just turns white	[2]	
		(iv)	Then turns colourless/idea that cloudiness disappears/precipitate dissolves	[1]	14

AVAILABLE MARKS

5 (a) Indicative content

- Water containing calcium and/or magnesium ions
  or Does not form a lather easily with soap

Description of test

- Same volume of two water samples unless wrongly qualified
- Addition of soap (solution)
- Idea of 1 cm^3 at a time/idea of one fixed volume of soap
- Shaken/stirred
- Addition repeated until a (permanent) lather is formed
  or Idea of measuring height/amount of lather
- Correct statement of results: The sample needing most soap to lather is hard **or** converse **or** sample with least lather is hard **or** converse

Response	Mark
Candidates must use specialist terms throughout to fully explain definition of hard water and describe a fair test which you could carry out to find which is a hard water sample in a logical sequence (6 or 7 indicative points required). They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use some specialist terms to explain the definition of hard water and describe a fair test which you could carry out to find which is the hard water sample in a logical sequence (4 or 5 indicative points required). They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates explain the definition of hard water or describe a fair test which could be carried out to find which is a hard water sample (1–3 indicative points required). They use limited spelling, punctuation and grammar and they have made little use of specialist terms.	[1]–[2]
Response not worthy of credit	[0]

[6]

(b) (i) Calcium/magnesium ion or Ca^{2+}/Mg^{2+} [1]

(ii) Good for teeth and bones/tastes better/reduces heart disease [1]

(iii) Brewing or other correct, e.g. bottled water, water softening, soap making Allow plumbing [1]

(iv) An advantage of soft water [1] related to less cost [1]
e.g. less soap is needed to form lather [1]
idea that householder spends less money on soap [1]
or
e.g. In hard water town limescale builds up on pipes [1]
pipes may have to be replaced [1]
or
fur in kettles [1]
more electricity used to heat water [1]
or other correct, e.g. having to replace/use more energy with an electrical device which uses hot water gets the expense mark.
Problem caused by the water needed for second mark. [2]

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					AVAILABLE MARKS
	(c)	**(i)**	Calcium hydrogencarbonate	[1]	
		(ii)	Temporary hard water contains calcium ions and hydrogencarbonate ions (in solution) [1] when heated the hydrogencarbonate ions (thermally decompose to) form carbonate ions [1] The carbonate ions react with calcium ions in the water to form calcium carbonate [1] which precipitates out removing calcium ions/removing hardness [1]	[4]	16
6	**(a)**		Idea that products form reactants **and** reactants form products For partially correct reaction idea, not using the term reversed [1]	[2]	
	(b)		$N_2 + 3H_2 \rightleftharpoons 2NH_3$ LHS [1], reversible sign [1], RHS [1], balancing if LHS and RHS correct [1]	[4]	
	(c)		Iron	[1]	7
7	**(a)**		Explicit idea of more particles (in same volume) [1] Idea of more collisions (faster reaction) [1] Reference to more energy negates collision mark	[2]	
	(b)		Idea that particles have more energy [1] move faster/more particles possess activation energy [1] Idea of more collisions [1] Max [2] points out of [3] Idea of harder/more energetic collisions/more successful collisions [1]	[3]	5
8	**(a)**		Mass of an atom [1] compared with that of a carbon-12 isotope [1] which has mass of exactly (clearly implied) 12 [1]	[3]	
	(b)	**(i)**	233	[1]	
		(ii)	261	[1]	
		(iii)	13.05/261 = 0.05 Allow CM	[1]	
		(iv)	11.65 Allow CM	[1]	
	(c)	**(i)**	Two moles of solute/sodium hydroxide/allow solid/substance in 1l/dm^3/1000 cm^3 **of solution** [1] **not** 'of water'	[2]	
		(ii)	100 cm^3	[1]	10

					AVAILABLE MARKS
9	(a)	(i)	Idea that fossil fuels have been formed from living organism	[1]	
		(ii)	Carbon	[1]	
		(iii)	Clear idea that the resource is finite **not** idea that it can only be used once	[1]	
	(b)	(i)	It burns to give out energy/burning ethanol produces less carbon dioxide than natural gas/other fuels/it can be obtained from crops/it can be used in cars/**or** other correct, e.g. idea that it is renewable **or** that it saves fossil fuels	[1]	
		(ii)	Idea of cost of production/idea that using food crops could mean that people could go hungry/**or** other correct	[1]	
		(iii)	Idea that burning hydrogen does not produce any carbon dioxide/ greenhouse gases **or** product is water only – clearly implied	[1]	
	(c)	(i)	$C_nH_{2n+1}OH$	[1]	
		(ii)	OH (group) or O–H (group)	[1]	
		(iii)	C_2H_5OH or CH_3CH_2OH	[1]	
	(d)		$C_2H_4 + H_2O \rightarrow C_2H_5OH$ LHS [1] RHS [1] Apply CM for C_2H_6O	[2]	
	(e)	(i)	$2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O$ (**or** double this) LHS [1] RHS [1] [1] for balancing if all formulae correct	[3]	
		(ii)	Carbon monoxide	[1]	
	(f)		Test: idea of using bromine water/solution [1] idea of shaking the mixture [1] **not** bubbling Result with hexene – goes from brown/orange/yellow or combination or red-brown [1] to colourless [1] Award [1] for bromine water decolourised Result with hexane – idea of colour not disappearing [1] or no reaction **not** nothing	[5]	20
				Total	**90**

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