Mark Scheme (Results)

Summer 2017

Pearson Edexcel International GCSE
in Chemistry (4CH0) Paper 1CR

Pearson Edexcel International
in Science (Double Award) (4SC0) Paper 1CR

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Summer 2017
Publications Code 4CH0_1CR_1706_MS

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question number	Answer	Notes	Marks
1 (a)	**D** (Br_2) **The only correct answer is D** A is not correct because Br is the symbol for bromine B is not correct because the 2 is a superscript not a subscript C is not correct because the 2 is not a subscript		1
(b) (i)	**B** (diffusion) **The only correct answer is B** A is not correct because condensation is the change of state from a gas to liquid C is not correct because evaporation is change of state from a liquid to gas D is not correct because the change of state from sublimation is solid to gas		1
(ii)		**ALLOW** particles evaporate	2

	M1 the bromine/liquid evaporates / the particles escape (from the liquid) **M2** (bromine fills the gas jar because) the (gas) particles move freely/randomly/constantly	**ALLOW** (gas) particles spread **ALLOW** particles move from a high concentration to low (concentration) **IGNORE** references to diffusion **ACCEPT** molecules for particles **REJECT** atoms once only	
(c)	**C** **The only correct answer is C** A is not correct because NH_3 gas diffuses faster HCl gas B is not correct because NH_3 gas diffuses faster HCl gas D is not correct because the position indicated is too close to the right hand end of the tube		1
		Total	**5**

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>2 (a)</td><td>M1 oxygen

M2 water (vapour)</td><td>ACCEPT O_2
IGNORE O
IGNORE air

ACCEPT moisture
ACCEPT H_2O

If both name and formula given, mark name only</td><td>2</td></tr>
<tr><td>(b)

(c)</td><td><table><tr><th>Item</th><th>Method</th></tr><tr><td>bicycle chain</td><td>oiling</td></tr><tr><td>bridge</td><td>painting / galvanising</td></tr><tr><td>car body</td><td>painting / galvanising</td></tr></table>D (zinc)

The only correct answer is D

A is not correct because zinc is the only metal used to galvanise iron

B is not correct because zinc is the only metal used to galvanise iron

C is not correct because zinc is the only metal used to galvanise iron</td><td></td><td>3

1</td></tr>
<tr><td></td><td></td><td>Total</td><td>6</td></tr>
</table>

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>3 (a)</td><td>
<table>
<tr><th>Separation</th><th>Method</th></tr>
<tr><td>to obtain sand from a mixture of sand and water</td><td>filtration</td></tr>
<tr><td>to separate crude oil into its components</td><td>fractional distillation</td></tr>
<tr><td>to obtain pure water from salt water</td><td>simple distillation</td></tr>
<tr><td>to obtain ethanol from a mixture of ethanol and water</td><td>fractional distillation</td></tr>
</table>
</td><td></td><td>4</td></tr>
<tr><td>(b) (i)</td><td>M1 (add to) <u>anhydrous/white</u> copper(II) sulfate

M2 turns blue

OR

M1 add to cobalt(II) chloride paper / cobalt chloride paper

M2 turns pink</td><td>

ACCEPT turns copper(II) sulfate from white to blue for 2 marks

ACCEPT blue cobalt(II) chloride
ALLOW anhydrous cobalt(II) chloride

ACCEPT turns cobalt(II) chloride from blue to pink for 2 marks

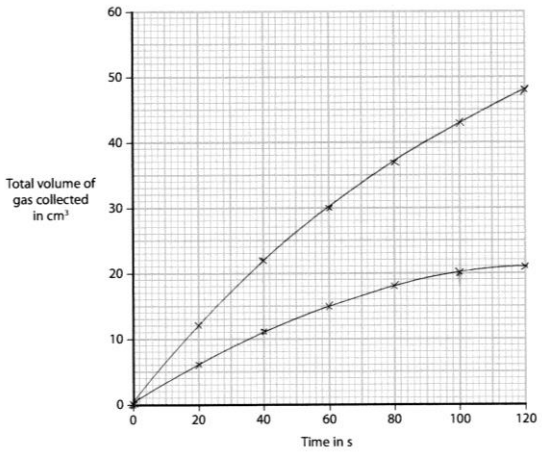
M2 DEP on M1 or near miss
e.g. just copper(II) sulfate
IGNORE any reference to testing with indicators</td><td>2</td></tr>
</table>

Question number	Answer	Notes	Marks
3 (b) (ii)	**M1** measure/determine/test its boiling point **M2** $100\,^{0}C$ **OR** **M1** measure/determine/test its freezing point **M2** $0\,^{0}C$ **OR** **M1** measure/determine/test its density **M2** $1\,g/cm^3$	**ACCEPT** boil it / heat until it boils it boils at 100 ºC **ALLOW** its boiling point is 100 ºC for 1 mark **ALLOW** heat it and it boils at 100 ºC for 2 marks **ACCEPT** freeze it / cool until it freezes it freezes at 0 ºC **ALLOW** its freezing point is 0 ºC for 1 mark **ALLOW** cool it and it freezes at 0 ºC for 2 marks **ALLOW** its density is $1\,g/cm^3$ for 1 mark **M2** DEP on **M1** throughout	2
		Total	**8**

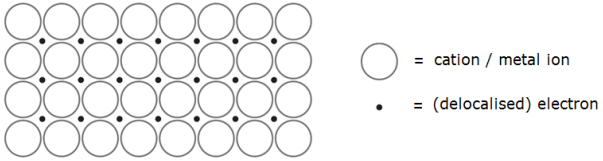
Question number	Answer	Notes	Marks
4 (a) (i)	**B** (the number of protons in an atom) **The only correct answer is B** A is not correct because atomic number is not the number of neutrons in an atom C is not correct because atomic number is not the number of protons plus the number of electrons in an atom D is not correct because atomic number is not the number of protons plus the number of neutrons in an atom		1
(ii)	**C** (electrons in the outer shell) **The only correct answer is C** A is not correct because the number of protons does not determine chemical properties B is not correct because the number of neutrons does not determine chemical properties D is not correct because the number of protons and neutrons does not determine chemical properties		1

(b)		One mark for each correct row	3
		Total	**5**

	Li	Be	B	C	N	F
melting point				high	low	low
structure	giant			giant	molecular	
acid-base character of the oxide	basic			acidic	acidic	acidic

Question number	Answer	Notes	Marks
5 (a) (i)	add acid before magnesium	ORA	1
(ii)	a burette has a better resolution (than a measuring cylinder)	**ALLOW** greater accuracy (of data) **ALLOW** greater precision (of data)	1
(b)	 **M1** and **M2** all points plotted correctly to the nearest gridline for both experiments **M3** suitable curve of best fit drawn for acid X **M4** suitable curve of best fit drawn for acid Y	Deduct one mark for each incorrectly plotted point Missing (0,0) loses 1 mark only	4

Question number	Answer	Notes	Marks
5 (c)	**M1 Y** (has the greater concentration) **M2** (because) the curve (for acid Y) has a steeper slope/greater gradient (showing that the reaction is faster) **OR** (because) it produces the larger volume of gas/more gas in the same time	 **M1** DEP **M2** OWTTE Mark CSQ on candidate's labelling of their curves If no labelling assume steeper curve is acid Y	2
(d)	**M1** vertical line drawn to touch curve at t = 70 s **OR** horizontal line drawn to touch curve at t = 70 s **M2** value read correctly from candidate's graph to nearest gridline	 Expected value in range 16-17 (cm^3)	2
(e)	**M1** 17 (cm^3) **M2** (17 ÷30) = 0.57 (cm^3/s)	**ACCEPT** value read correctly from candidate's graph to nearest gridline **ACCEPT** any number of sig figs e.g. 0.6, 0.567, 0.56 recurring Mark **M2** CSQ on **M1**	2
		Total	**12**

Question number	Answer	Notes	Marks
6 (a) (i)			3
	M1 minimum of 5 circles in regular pattern in at least two rows	**IGNORE** different numbers of ions and electrons	
	M2 circle(s) labelled cation(s)/metal ion(s)/positive ion(s)/atom(s)	+ drawn in circle is sufficient **IGNORE** particle	
	M3 spread of electrons in between circles **AND** labelled	e or e^- is sufficient	
(ii)	**M1** delocalised electrons	**ACCEPT** sea of electrons **IGNORE** free electrons	2
	M2 are able to flow (in an electric field)	**ACCEPT** are able to move / are mobile **IGNORE** references to carrying a charge/current **M2** DEP on mention of electrons Any mention of ions/atoms/nuclei/protons moving scores 0/2	

Question number	Answer	Notes	Marks
6 (a) (iii)	**M1** strong (electrostatic) forces (of attraction) between cations/metal ions and (delocalised) electrons **M2** large amount of (thermal/heat) energy needed to overcome the forces	**ACCEPT** strong forces (of attraction) between nuclei of atoms and (delocalised) electrons **ACCEPT** strong metallic bonding / metallic bonds Not just strong bonds Not just heat Not just more energy **M2** DEP on **M1** or near miss, e.g. strong bonds Any mention of ionic bonds or covalent bonds or intermolecular forces being broken or overcome scores 0/2	2

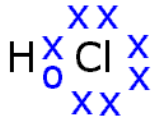
Question number	Answer	Notes	Marks
6 (b)	**M1** (Cu^{2+}) blue precipitate **M2** (Fe^{2+}) green precipitate	**IGNORE** shades **IGNORE** names of precipitates or formulae **REJECT** any other colours Both colours correct but no mention of precipitates score 1/2	2
(c) (i)	it is unreactive / it is not very reactive / it is low in the reactivity series	**ACCEPT** it is not as reactive as iron/it is below iron in the reactivity series **IGNORE** inert	1
(ii)	$CO_2 + C \rightarrow 2CO$ / $2C + O_2 \rightarrow 2CO$	**ACCEPT** multiples and halves	1
(iii)	**M1** iron / Fe **M2** (because) it loses oxygen / because oxygen has been removed **M2** DEP on **M1**	 **ALLOW** it loses O **IGNORE** gains electrons **ALLOW** the iron(III) <u>ion</u> / Fe^{3+} (is reduced because it) has gained electrons for 1 mark **ALLOW** Iron(III) oxide/Fe_2O_3/Fe^{3+} (is reduced because it) has lost oxygen for 1 mark	2
(iv)	**M1** calcium carbonate decomposes/forms/ changes into calcium oxide **M2** calcium oxide reacts with silicon dioxide/silica	**ACCEPT** limestone for calcium carbonate **ACCEPT** correct chemical equations **IGNORE** sand **ALLOW** calcium carbonate reacts with silicon dioxide for 1 mark **IGNORE** reacts with impurities	2
		Total	**15**

Question number	Answer	Notes	Marks
7 (a) (i)	silver does not react with (dilute sulfuric) acid	**ACCEPT** silver is below hydrogen in the reactivity series **IGNORE** silver is unreactive / silver has a low reactivity / silver is inert	1
(ii)	**D** (zinc and sulfuric acid) **The only correct answer is D** A is not correct because copper does not react with dilute sulfuric acid B is not correct because gold does not react with dilute hydrochloric acid C is not correct because the reaction between potassium and dilute hydrochloric acid is explosive and therefore not safe		1
(b) (i)	Experiment 3 because the volume collected is much lower than / very different to the other three	**ACCEPT** any answer that suggests the result/value in experiment 3 is much lower/much different to the other three e.g. it is much lower than the other three or there is a large difference between it and the other three	1

(ii)	**M1** chooses 64, 67 and 63 **M2** 65 (cm^3)	**ACCEPT** 194 **ACCEPT** any number of sig figs except 1 eg 64.7 / 64.67 / 64.667 / 64.6 recurring Correct answer with no working scores 2 **ALLOW** 1 mark for correct calculation using all four volumes (58.5 / 59)	2
(iii)	to increase the validity/reliability (of the measurements/data)	**ACCEPT** to check for anomalous results **IGNORE** references to increased accuracy	1
		Total	**6**

Question number	Answer	Notes	Marks
8 (a)	**M1** (54.4 ÷ 127) = 0.428 AND (45.6 ÷ 35.5) = 1.28 **M2** Divide by the smaller number to obtain 1:3 ratio **OR** 0.428:1.28 = 1:3	**ACCEPT** any number of sig figs except 1, but allow use of 0.4 in calculation of ratio in **M2** **ALLOW** answers to **M1** given as fractions **only** if it is clear that division by smaller has taken place to obtain a ratio	2
(b) (i)	**M1** rate of forward reaction = rate of backward reaction **M2** amounts/concentrations/masses of reactants (and products) remain constant / constant macroscopic properties	**IGNORE** forward reaction = backward reaction **IGNORE** amounts/concentrations of reactants and products are equal	2
(ii)	**M1** (liquid) (contains) ions that can flow/move/are mobile **M2** (solid) (does not contain any) charged particles that can flow/move/are mobile	**IGNORE** references to carry charge **REJECT** any reference to electrons moving **ACCEPT** molecules are not charged/are neutral **ACCEPT** no electrons that can flow/move/are mobile **ACCEPT** no delocalised electrons **ACCEPT** no sea of electrons **IGNORE** free electrons **REJECT** any suggestion that the solid is ionic or contains ions	2
		Total	**6**

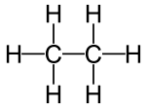
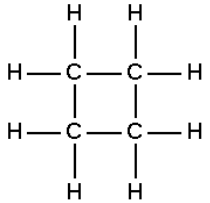
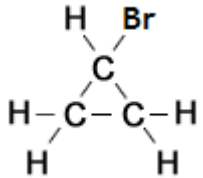
Question number	Answer	Notes	Marks
9 (a) (i)	halogens are poisonous/toxic	**ACCEPT** any named halogen **IGNORE** harmful/dangerous/irritant **IGNORE** (named) products are toxic	1
(ii)	**M1** chlorine most reactive AND iodine least reactive **OR** chlorine > bromine > iodine	**IGNORE** reactivity of the halogens decreases down the group	2
	M2 chlorine glows most brightly / glows very brightly **AND** iodine glows least brightly / glows dimly	**IGNORE** references to heat given out	
(iii)	**M1** the statement/student is incorrect	**ACCEPT** the reactivity can be found	2
	M2 because vapours/gases were used (so the physical states at room temperature are irrelevant)	**M1** DEP on **M2**	

Question number	Answer	Notes	Marks
9 (b) (i)	$H_2 + Br_2 \rightarrow 2HBr$	**ACCEPT** multiples and halves	1
(ii)	 **M1** bonding pair of electrons **M2** non-bonding pairs correct	**M2** DEP on **M1** **ALLOW** any combination of dots and crosses If overlapping/touching circles used both electrons must be within the overlapping/touching area **IGNORE** inner electrons on chlorine even if incorrect	2
(iii)	hydrochloric acid		1
		Total	**9**

Question number	Answer	Notes	Marks
10 (a) (i)	**M1** (magnesium ribbon) shiny / silvery **M2** (magnesium oxide) white (powder/solid/smoke/ash)	**IGNORE** grey **IGNORE** grey	2
(ii)	(lift the lid) to allow oxygen into the crucible (replaces the lid) minimise the loss of magnesium oxide/product	**ACCEPT** air **ACCEPT** to allow magnesium to react with <u>oxygen</u> **ACCEPT** smoke for magnesium oxide **ALLOW** prevent the loss of magnesium oxide, etc	2
(b)	**M1** n[Mg] = 0.6 ÷ 24 **OR** 0.025 (mol) **M2** mass of O_2 = 0.4 (g) **OR** (**M1 ÷** 2) × 32 evaluated correctly **Alternative method** **M1** 48 (g) require 32 (g) **M2** 0.6 (g) require 0.4 (g)		2
(c)	$3Mg + N_2 \rightarrow Mg_3N_2$	**ACCEPT** multiples and halves	1
		Total	**7**

Question number	Answer	Notes	Marks
11 (a) (i)	**D** (C_nH_{2n+2}) **The only correct answer is D** A is not correct because C_nH_n is not the general formula for the alkanes B is not correct because C_nH_{2n-2} is not the general formula for the alkanes C is not correct because C_nH_{2n} is not the general formula for the alkanes		1
(ii)	**C** (C_nH_{2n}) **The only correct answer is C** A is not correct because C_nH_n is not the general formula for the cycloalkanes B is not correct because C_nH_{2n-2} is not the general formula for the cycloalkanes D is not correct because C_nH_{2n} is not the general formula for the cycloalkanes		1

(iii)	**Any two from:** **M1** similar/same chemical properties **M2** graded physical properties / trend in physical properties **M3** same functional group **M4** each member differs (from the previous member) by CH_2	 **ALLOW** they all react in the same way/in a similar way **ACCEPT** description of a graded physical property e.g. boiling increases as number of carbon atoms increases **IGNORE** different physical properties	2

Question number	Answer	Notes	Marks
11 (b) (i)	(the molecule) contains only single bonds	**ACCEPT** contains no (carbon-carbon) double bonds/multiple bonds **IGNORE** references to no more atoms can be added, or contains the maximum number of hydrogen atoms	1
(ii)		**IGNORE** bond angles	1
(iii)		**IGNORE** bond angles	1
(c) (i)	ultraviolet/uv (light/radiation)	**ALLOW** sunlight **IGNORE** references to temperature or catalyst	1
(ii)		**ACCEPT** any number of bromine atoms substituted	1
		Total	**9**

Question number	Answer	Notes	Marks
12 (a)	**M1** add water (and stir) **M2** filter	**ALLOW** dissolve in water **ACCEPT** description of filtration **ACCEPT** decant **M2** DEP on **M1** **M2** not scored if any mention of evaporating the solution	2
(b) (i)	**M1** (cation) ammonium / NH_4^+ **M2** (anion) chloride / Cl^-	If both name and formula given, both must be correct One mark if both correct but given in wrong order	2
(ii)	ammonia / NH_3	If both name and formula given, both must be correct	1
(c) (i)	**M1** (anion) carbonate / CO_3^{2-} **M2** (because) carbon dioxide/CO_2 is given off (when hydrochloric acid/HCl is added)	**ACCEPT** hydrogencarbonate / HCO_3^- If both name and formula given, both must be correct **ALLOW** the gas is carbon dioxide	2
(ii)	**M1** (test) flame test **M2** (result) brick-red (colour)	**ACCEPT** description of flame test **ACCEPT** red / orange-red **REJECT** all other colours **M2** DEP on **M1** or near miss e.g. heat the solid but **REJECT** if solid is heated in a test tube, etc	2
		Total	**9**

Question number	Answer	Notes	Marks
13 (a)	**M1** use the burette to add the (sulfuric) acid (to the sodium hydroxide)		4
	M2 until there is a change in colour (of the indicator/methyl orange/solution)	If both initial and final colours are given both must be correct **ACCEPT** orange/pink/red as the final colour **ACCEPT** correct colours of any alternative indicator chosen e.g. (pink) to colourless for phenolphthalein (blue) to purple/red/pink for litmus **REJECT** Universal Indicator	
	M3 take initial and final readings of acid (and subtract to calculate the volume added) Plus any one from: **M4** add acid dropwise (when near to the end point) **M5** swirl the solution (when near to the end point)		
	M6 repeat to obtain concordant results	**ALLOW** repeat to obtain accurate/reliable results	

Question number	Answer	Notes	Marks
13 (b) (i)	20(.0) ºC		1
(ii)	17.5 cm^3		1
(iii)	10 (cm^3) AND 25 (cm^3)		1
		Total	**7**

Question number	Answer	Notes	Marks
14 (a)	**B** (changes from shiny to dull) **The only correct answer is B** A is not correct because a freshly exposed surface of lithium does not bubble and fizz when in contact with air C is not correct because a freshly exposed surface of lithium does not burst into flame when in contact with air D is not correct because a freshly exposed surface of does change when in contact with air		1
(b) (i)	burns with a pop/squeak **OR** use burning/lit spill to see if pops/squeaks **OR** use flame to see if pops/squeaks	Must be reference to test and result Reference to spill/match with no indication of flame is not enough **REJECT** reference to glowing spill/splint **IGNORE** flame extinguished 'Squeaky pop test' alone is not sufficient	1

(ii)	**M1** lithium hydroxide/LiOH/hydroxide ion(s)/OH^- (formed) **M2** (therefore) the solution is alkaline	If both name and formula given both must be correct **ACCEPT** pH is of the solution greater than 7 **ALLOW** solution is basic	2

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>14 (c)</td><td>
<table>
<tr><th>Name of compound</th><th>Formula of compound</th><th>Formula of cation in compound</th><th>Formula of anion in compound</th></tr>
<tr><td></td><td>Li_2O</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>CO_3^{2-}</td></tr>
</table>
</td><td></td><td>2</td></tr>
<tr><td>14 (d) (i)</td><td>
<table>
<tr><td>the reaction with caesium is more vigorous</td><td>✓</td></tr>
<tr><td>the reaction with caesium produces a different gas</td><td></td></tr>
<tr><td>the reaction with caesium produces an acidic solution</td><td></td></tr>
<tr><td>the reaction with caesium produces a different compound</td><td>✓</td></tr>
<tr><td>the reaction of caesium is endothermic</td><td></td></tr>
</table>
</td><td></td><td>2</td></tr>
<tr><td>(d) (ii)</td><td>$2Cs + 2H_2O \rightarrow 2CsOH + H_2$

M1 all formulae correct

M2 correctly balanced</td><td>ACCEPT multiples and halves

M2 DEP on M1</td><td>2</td></tr>
</table>

Question number	Answer	Notes	Marks
15 (a)	**M1** 0.02(00) x 0.2(00) **M2** 0.004(00) (mol)	 **ACCEPT** 4 for 1 mark Correct answer with no working scores 2	2
(b)	**M1** 0.004(00) ÷ 0.1(00) **OR** **M2** from (a) ÷ 0.1(00) **M2** 0.04(00) dm^3 / 40(.0) cm^3 **OR** **M2** from (a) ÷ 0.1(00) correctly evaluated	 Unit required Correct answer, using **M2** from part (a), with no working scores 2	2
(c)	**M1** *n*(NaOH) = 0.03(00) x 0.2(00) **OR** 0.006(00) (mol) **M2** mass of NaOH = 0.24 g **OR** **M1** × 40 correctly evaluated	 Correct answer with no working scores 2	2
		Total	**6**

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