

Mark Scheme (Results)

Summer 2016

Pearson Edexcel International GCSE
Chemistry (4CH0) Paper 1C
Science Double Award (4SC0) Paper 1C

Pearson Edexcel Level 1/Level 2 Certificate
Biology (KCH0) Paper 1C
Science (Double Award) (KSC0) Paper 1C

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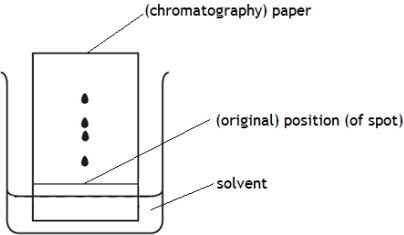
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General Marking Guidance

- 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)	B (condensation)		1
(b)	<p>M1 (the particles/they) lose (kinetic) energy / have less energy</p> <p>M2 (the particles/they) move closer together / pack more closely</p> <p>M3 (the particles/they) do not move as freely / move more slowly / move less randomly</p> <p>NB M1, M2 and M3 can be scored anywhere across the whole answer</p>	<p>ACCEPT lose potential/heat energy</p> <p>ACCEPT not as many gaps / smaller gaps REJECT refs to density</p> <p>ACCEPT molecules for particles</p> <p>REJECT atoms once only.</p>	3

Question number	Answer	Notes	Marks
2 (a)	A (argon)		1
(b)	CO ₂ / H ₂ O do not allow as part of an equation	IGNORE names even if correct	1
(c) (i)	M1 (the copper) <u>reacts/combines</u> with oxygen / oxidised M2 to form copper(II) oxide	IGNORE bonds with oxygen IGNORE burns / combusts REJECT refs to rust ACCEPT copper oxide REJECT any other oxidation state	2
(ii)	the volume of a gas changes with temperature / gas expands when hot/heated	ACCEPT reverse argument IGNORE refs to density	1
(iii)	<u>all</u> the oxygen has reacted / the oxygen has been used up / no oxygen (left to react)	DO NOT ACCEPT refs to 'not enough oxygen'	1
(d)	M1 (150 - 125) or 25 (cm ³) M2 (25/150) x 100 = 16.7 (%) OR M1 100 x (125/150) = 83.3 (cm ³) M2 100 - 83.3 = 16.7 (%) M2 is cq on M1	ACCEPT 17 / 16.67 / 16.6̇ ACCEPT 83 / 83.33/ 83.3̇ REJECT 16.6 for M2 correct answer (with no working) scores 2	2

Question number	Answer	Notes	Marks
3 (a)	D (filtration)		1
(b) (i)		<p>award one mark for each correct label</p> <p>solvent: ALLOW label line to any point under the solvent level</p> <p>paper: ALLOW label line to paper, including under solvent level</p> <p>original spot: has to be in the centre of the baseline i.e. below the visible spots</p>	3
(ii)	Four because there are <u>four</u> spots/dots (above the baseline in the chromatogram)	ALLOW blobs / marks / colours IGNORE refs to different heights	1

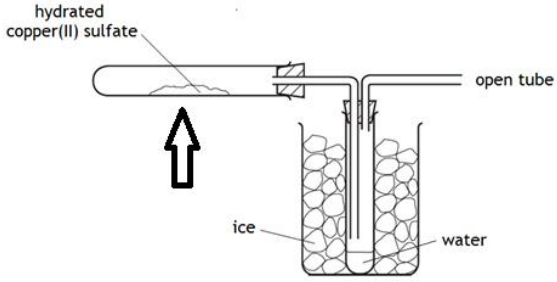
Question number	Answer	Notes	Marks
4 (a) (i)	E		6
	(ii) B		
	(iii) F		
	(iv) C		
	(v) F		
	(vi) E		
(b) (i)	M1 (bonding/shared) electrons M2 nuclei OR M1 nuclei M2 bonding/shared electrons	ACCEPT protons / nucleus(es) ACCEPT nucleus(es)	2
(ii)	A ₂ D / DA ₂	ACCEPT H ₂ O REJECT if charges shown	1

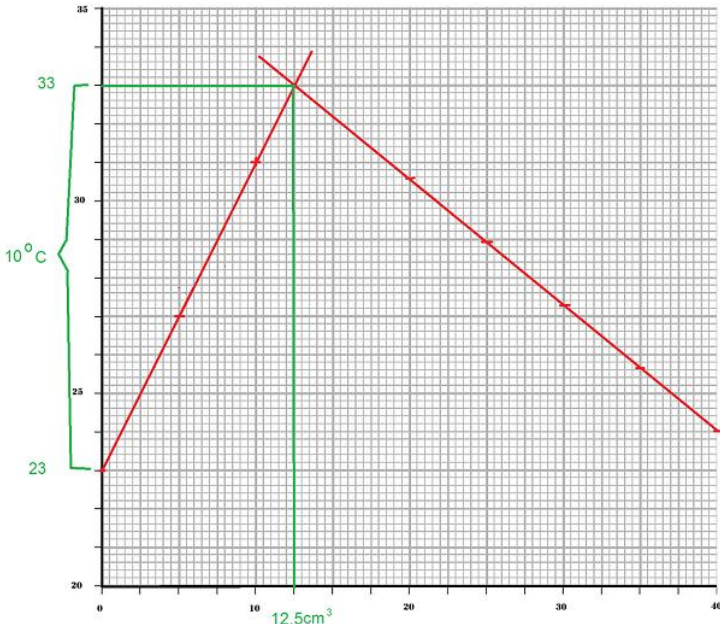
Question number	Answer		Notes	Marks												
5 (a)	<table border="1"> <thead> <tr> <th data-bbox="344 271 663 331">Metal</th> <th data-bbox="668 271 983 331">Highest temperature</th> </tr> </thead> <tbody> <tr> <td data-bbox="344 338 663 376">aluminium</td> <td data-bbox="668 338 983 376">42.0</td> </tr> <tr> <td data-bbox="344 383 663 421">copper</td> <td data-bbox="668 383 983 421">25.0</td> </tr> <tr> <td data-bbox="344 427 663 465">iron</td> <td data-bbox="668 427 983 465">29.0</td> </tr> <tr> <td data-bbox="344 472 663 510">magnesium</td> <td data-bbox="668 472 983 510">46.5</td> </tr> <tr> <td data-bbox="344 517 663 555">zinc</td> <td data-bbox="668 517 983 555">31.5</td> </tr> </tbody> </table>		Metal	Highest temperature	aluminium	42.0	copper	25.0	iron	29.0	magnesium	46.5	zinc	31.5	<p>M1 for magnesium and zinc M2 and M3 for other 3 metals – 1 mark for 2 correct, 2 marks for all 3 correct</p> <p>Penalise missing trailing 0 once only</p>	3
Metal	Highest temperature															
aluminium	42.0															
copper	25.0															
iron	29.0															
magnesium	46.5															
zinc	31.5															
(b) (i)	magnesium		mark csq on table in (a)	1												
(ii)	it/copper does not react (with sulfuric acid)		ACCEPT there is no reaction / the (sulfuric) acid does not react (with copper) IGNORE copper is unreactive	1												
(c)	<p>M1 (change/rise in temperature would be) less</p> <p>M2 because there is a larger volume/mass of solution/liquid (to be heated)</p> <p>OR</p> <p>same (amount of) energy distributed to a larger number of particles</p>		<p>ACCEPT halved IGNORE any quoted temperatures</p> <p>ACCEPT there is more/twice as much solution/liquid to be heated</p> <p>ALLOW acid for solution/liquid</p> <p>REJECT the magnesium has to react with more acid</p> <p>M2 dep on M1</p>	2												

Question number	Answer	Notes	Marks																
6 (a) (i)	<p>H × H •</p> <p>NB H does not need to be shown if touching / overlapping circles are shown</p>	<p>ACCEPT any combination of dots and crosses</p> <p>if overlapping / touching circles used both electrons must be within the overlapping/touching area</p>	1																
(ii)	<p>M1 weak forces (of attraction) between molecules / weak intermolecular forces</p> <p>M2 (therefore) little (thermal/heat) energy required to overcome these forces / separate the molecules (into the gaseous state)</p>	<p>ACCEPT particles</p> <p>ACCEPT bonds for forces for both M1 and M2</p> <p>ACCEPT correctly named IMF</p> <p>IGNORE more easily separated / easier to break</p> <p>REJECT atoms for both M1 and M2</p> <p>NB any mention of breaking covalent or ionic bonds scores 0</p>	2																
(b) (i)	<p>M1 <u>atoms</u> of the same element</p> <p>M2 with different masses</p>	<p><u>atoms</u> with same atomic number / <u>atoms</u> same number of protons</p> <p>different mass numbers / different numbers of neutrons</p> <p>IGNORE references to electrons unless incorrect</p>	2																
(ii)	<table border="1" data-bbox="359 1760 930 1908"> <thead> <tr> <th></th> <th>¹H</th> <th>²H</th> <th>³H</th> </tr> </thead> <tbody> <tr> <td>protons</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>neutrons</td> <td>0</td> <td>1</td> <td>2</td> </tr> <tr> <td>electrons</td> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table>		¹ H	² H	³ H	protons	1	1	1	neutrons	0	1	2	electrons	1	1	1	<p>one mark for each correct row</p>	3
	¹ H	² H	³ H																
protons	1	1	1																
neutrons	0	1	2																
electrons	1	1	1																

Question number	Answer	Notes	Marks
(c) (i)	exothermic		1
(ii)	$2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ M1 all formulae correct M2 balanced	ACCEPT multiples and halves IGNORE state symbols even if incorrect	2
(iii)	M1 (add to) <u>anhydrous/white</u> copper(II) sulfate M2 turns blue M2 dep on M1 or near miss	turns copper(II) sulfate from white to blue scores 2 ACCEPT equivalent description of test with anhydrous cobalt(II) chloride (blue to pink) IGNORE any references to testing with indicators	2
(iv)	M1 <u>measure/determine</u> the boiling point M2 100 °C OR M1 <u>measure/determine</u> the melting/freezing point M2 0 °C OR M1 <u>measure/determine</u> the density M2 1 g/cm ³	ACCEPT boil the water / heat until it boils it boils at 100 °C ALLOW "heat it and it boils at 100 °C " for 2 ACCEPT freeze the water / cool until it freezes it freezes at 0 °C ALLOW "cool it and it freezes at 0 °C " for 2	2

Question number	Answer	Notes	Marks
7 (a) (i)	<p>Any two from:</p> <p>M1 calcium/solid/it disappears</p> <p>M2 bubbles (of gas) / fizzing / effervescence</p> <p>M3 <u>white</u> solid (forms) / <u>white</u> suspension (forms) / (liquid) turns milky / (liquid) turns cloudy / <u>white</u> trails forms</p> <p>M4 calcium moves (up and down)</p> <p>M5 water/solution/liquid gets warm</p>	<p>ACCEPT dissolves / gets smaller IGNORE mass decreases</p> <p>ACCEPT gas given off IGNORE hydrogen given off IGNORE incorrect gas / colour</p> <p>ACCEPT <u>white</u> precipitate forms</p> <p>IGNORE floats REJECT refs to moving <u>on the surface</u></p> <p>ACCEPT temperature of water/solution/liquid rises IGNORE refs to heat released</p>	2
(ii)	<p>M1 any value greater than 7</p> <p>M2 hydroxide <u>ions</u>/OH⁻ are present / calcium hydroxide/Ca(OH)₂ is an alkali / calcium hydroxide/Ca(OH)₂ is a base</p> <p>M2 dep on correct or missing M1</p>	<p>ACCEPT "greater than 7"</p> <p>ACCEPT metal hydroxides are alkalis/bases IGNORE hydroxides are alkalis/bases IGNORE calcium is an alkali metal</p>	2
(b)	<p>M1 (Solid X) – CaO / calcium oxide</p> <p>M2 (Solution Y) – CaCl₂ / calcium chloride</p> <p>M3 (Solid Z) – CaCO₃ / calcium carbonate</p>	<p>if both formula and name given both must be correct</p> <p>REJECT Ca(HCO₃)₂ / calcium hydrogencarbonate</p>	3

Question number	Answer	Notes	Marks
8 (a)	 <p>NB the arrow must point to the solid</p>	ACCEPT a flame if >1 arrow drawn, all must be correct	1
(b)	to condense the (water) vapour / steam	ACCEPT to cool the water vapour ACCEPT to cool/condense the gas (given off) IGNORE to condense the water IGNORE to stop the water escaping as water vapour IGNORE to condense the product	1
(c)	<p>M1 $n(\text{CuSO}_4 \cdot 5\text{H}_2\text{O}) = 2.50 \div 250$ OR 0.01 (mol)</p> <p>M2 $n(\text{H}_2\text{O}) = 0.01 \times 5$ OR 0.05 (mol)</p> <p>M3 mass of water = $(0.05 \times 18) = 0.9(0)$ (g)</p> <p>OR</p> <p>M1 5×18 OR 90</p> <p>M2 $250 \text{ (g)} \rightarrow 90 \text{ (g)}$</p> <p>M3 $2.50 \text{ (g)} \rightarrow 0.9(0) \text{ (g)}$</p> <p>OR</p> <p>M1 5×18 OR 90</p> <p>M2 $90 \div 250 \times 100 \text{ (\%)} \rightarrow 36 \text{ (\%)}$</p> <p>M3 $36 \text{ (\%)} \times 2.50 \text{ (g)} \rightarrow 0.9(0) \text{ (g)}$</p>	<p>mark csq throughout</p> <p>correct final answer (with no working) scores 3</p> <p>ACCEPT calculations that use A_r of Cu as 63.5 (giving 0.9(05) (g) as a final answer)</p> <p>M2 subsumes M1 for all methods</p>	3

Question number	Answer	Notes	Marks
9 (a)	 <p>M1 & M2 all points plotted correctly, to the nearest gridline</p> <p>M3 best fit straight line through first 3 points drawn with the aid of a ruler</p> <p>M4 best fit straight line through last 6 points drawn with the aid of a ruler</p>	<p>deduct one mark for each incorrectly plotted point</p> <p>ALLOW M3 and M4 even if lines do not intersect</p>	4
(b) (i)	value correctly read ($\pm 0.25 \text{ cm}^3$) to nearest gridline from candidate's graph (12.5 cm^3 if correctly drawn)	Do not award these marks if lines do not cross	1
(ii)	value correctly read ($\pm 0.1^\circ\text{C}$) to nearest gridline from candidate's graph (10 $^\circ\text{C}$ if correctly drawn)		1

Question number	Answer	Notes	Marks
9 (c)	<p>M1 (water) – to remove/flush out solution (X)</p> <p>M2 (solution Y) – to remove the water / avoid diluting solution Y</p>	<p>ACCEPT so that the only liquid in the burette is solution Y</p> <p>IGNORE to remove impurities for both M1 and M2</p>	2
(d)	<p>solution Y is less concentrated (than solution X)</p> <p>OR</p> <p>solution (in Experiment 2) is less concentrated</p>	<p>IGNORE references to reactivity</p> <p>ALLOW weaker / less strong instead of less concentrated</p> <p>IGNORE refs to more/less acidic</p> <p>ACCEPT reverse argument</p>	1

Question number	Answer	Notes	Marks
10 (a) (i)	Q R S P M1 Q and P correct M2 R and S correct		2
(ii)	M1 magnesium chloride M2 hydrogen M1 and M2 can be in either order	ACCEPT correct formulae IGNORE incorrect formulae	2
(b)	M1 (add) (aqueous) silver nitrate / AgNO_3 M2 white precipitate (forms)	IGNORE refs to nitric acid do not award M1 if hydrochloric acid also added M2 dep on mention of silver nitrate in M1	2

Question number	Answer	Notes	Marks
11 (a)	propane		1
(b)	C ₄ H ₁₀	ACCEPT H ₁₀ C ₄ penalise incorrect use of symbols and subscripts REJECT structural and displayed formulae	1
(c)	W X Y	all three required	1
(d)	CH ₂	ACCEPT H ₂ C REJECT C _n H _{2n}	1
(e)	<p>M1 (unsaturated) contains a (carbon to carbon) double bond</p> <p>M2 (hydrocarbon) (compound/molecule/substance) contains (the elements/atoms) hydrogen and carbon...</p> <p>M3 ...only</p>	<p>ACCEPT multiple bonds IGNORE refs to single bonds</p> <p>REJECT element/atom/mixture for compound/molecule/substance REJECT ions/molecules for elements/atoms</p> <p>M3 dep on mention of hydrogen & carbon in M2 ACCEPT other equivalents e.g. solely, just, exclusively</p>	3
(f) (i)	$ \begin{array}{cccc} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} - \text{Br} \\ & & & \\ & \text{H} & \text{H} & \text{H} \end{array} $	<p>ACCEPT bromine in any position</p> <p>ACCEPT multiple substitutions</p> <p>ACCEPT correct displayed formula given as a product of an equation</p> <p>IGNORE any structural formula eg CH₃CH₂CH₂Br or molecular formula</p> <p>IGNORE H-Br</p>	1
(ii)	UV / ultraviolet light/radiation	IGNORE references to heat / (high) temperature / (high) pressure	1

Question number	Answer	Notes	Marks
12 (a)	<p>M1 (Fe) (Ti) (O) <u>36.8</u> <u>31.6</u> <u>31.6</u> 56 48 16</p> <p>M2 0.66 0.66 1.98</p> <p>M3 1 1 3</p> <p>OR</p> <p>M1 calculation of M_r of $\text{FeTiO}_3=152$</p> <p>M2 expression for % of <u>each</u> element e.g. Fe: $56 \div 152 \times 100\%$</p> <p>M3 evaluation to show these equal 36.8% Fe, 31.6% Ti, 31.6% O</p>	<p>Division by atomic number scores 0</p> <p>ACCEPT any number of sig figs except one ALLOW 0.65, 0.65, 1.97</p>	3
(b)	<p>M1 (element oxidised) – carbon / C</p> <p>M2 (reason) – (it has) gained/combined with oxygen / forms carbon dioxide</p> <p>M2 dep on M1</p>	<p>IGNORE refs to electron loss ACCEPT oxidation state/number increases ACCEPT oxidation state/number changes from 0 to (+)4</p>	2
(c) (i)	<p>$\text{TiCl}_4 + 2\text{Mg} \rightarrow \text{Ti} + 2\text{MgCl}_2$</p> <p>M1 all formulae correct</p> <p>M2 balanced</p>	<p>ACCEPT multiples and halves IGNORE state symbols even if incorrect</p>	2 1
(ii)	<p>titanium / Ti / magnesium / Mg reacts with oxygen</p> <p>OR titanium / Ti / magnesium / Mg reacts with nitrogen</p>	<p>IGNORE refs to oxidation ACCEPT forms an oxide</p> <p>ACCEPT forms a nitride</p>	
(iii)	<p><u>magnesium chloride</u> will dissolve more quickly / to help the <u>magnesium chloride</u> to dissolve / more of the <u>magnesium chloride</u> is in contact with the water</p>	<p>IGNORE to speed up the reaction IGNORE refs to increasing surface area</p>	1

(d) (i)	M1 positive ions/cations/nuclei and delocalised electrons M2 attract (one another) M2 dep on M1	IGNORE metal ions ALLOW sea of electrons IGNORE free electrons any refs to ionic bonding, covalent bonding or IMFs scores zero	2
(ii)	(delocalised) electrons can flow/move (through structure)/are mobile (when voltage/pd is applied)	IGNORE carry charge	1

Question number	Answer	Notes	Marks
13 (a)	$I_2 + Cl_2 \rightarrow 2ICl$	ACCEPT halves and multiples	1
(b) (i)	<p>M1 rate of forward reaction = rate of backwards reaction</p> <p>M2 concentrations of reactants/ products remain constant</p>	<p>ACCEPT both reactions occur at the same rate IGNORE forward reaction = backwards reaction</p> <p>ACCEPT amounts/masses for concentrations ACCEPT don't change/stay for remain IGNORE concentrations/ amounts of reactants and products are the same/are equal ALLOW colour remains constant</p>	2
(ii)	<p>M1 equilibrium has shifted to the left / equilibrium has shifted to the ICl side / equilibrium has shifted to the reactants side OR more ICl has been produced / more reactants have been produced</p> <p>M2 an increase in temperature shifts the equilibrium in the endothermic direction</p>	<p>IGNORE references to Le Chatelier's principle e.g. an increase in temperature favours the endothermic reaction</p> <p>ACCEPT 'therefore the (backward) reaction is endothermic' for M2 if M1 has been awarded</p>	2

Question number	Answer		Notes	Marks										
14 (a)	<table border="1" data-bbox="416 264 1007 450"> <thead> <tr> <th data-bbox="416 264 710 300">Solid</th> <th data-bbox="710 264 1007 300">Amount</th> </tr> </thead> <tbody> <tr> <td data-bbox="416 300 710 336">KHCO₃</td> <td data-bbox="710 300 1007 336">0.080</td> </tr> <tr> <td data-bbox="416 336 710 371">K₂O</td> <td data-bbox="710 336 1007 371">0.059</td> </tr> <tr> <td data-bbox="416 371 710 407">KOH</td> <td data-bbox="710 371 1007 407">0.099</td> </tr> <tr> <td data-bbox="416 407 710 443">K₂CO₃</td> <td data-bbox="710 407 1007 443">0.040</td> </tr> </tbody> </table> <p data-bbox="416 488 842 555">all four correct = 2 marks three correct = 1 mark</p>		Solid	Amount	KHCO ₃	0.080	K ₂ O	0.059	KOH	0.099	K ₂ CO ₃	0.040	ALLOW values (corrected rounded) from 1 sf up to calculator value	2
Solid	Amount													
KHCO ₃	0.080													
K ₂ O	0.059													
KOH	0.099													
K ₂ CO ₃	0.040													
(b)	<p data-bbox="416 593 644 629">M1 equation 3</p> <p data-bbox="416 667 1007 734">M2 the (mole) ratio of KHCO₃ to K₂CO₃ /reactant to product is 2:1</p>		mark csq on amounts given in part (a)	2										

Question number	Answer	Notes	Marks
15 (a)	Enthalpy change (of reaction)	ACCEPT heat (energy) change	1
(b)	<p>M1 temperature rise = 23.5 (°C)</p> <p>M2 heat produced = 200 x 4.2 x 23.5</p> <p>M3 = 20 000(J) OR 20 kJ unit must be given <u>if answer in kJ</u></p>	<p>Penalise use of 0.725 / 200.725 / 199.275 g in M2 only</p> <p>ACCEPT 19 740 / 19 700 (J) ACCEPT 19.74(0) / 19.7(00) kJ IGNORE sign</p> <p>mark consequentially throughout</p> <p>correct answer (with no working) scores 3</p>	3
(c) (i)	<p>(the reaction is) exothermic</p> <p>OR</p> <p>transfers heat/thermal energy to the surroundings / gives out heat/thermal energy</p> <p>OR</p> <p>gives out heat</p>	<p>ACCEPT loses for gives out</p> <p>DO NOT ACCEPT just energy</p> <p>ACCEPT loses for gives out</p>	1
(ii)	<p><u>incomplete</u> combustion/burning (of the butane)</p> <p>OR</p> <p>(burns in a) limited supply of oxygen/air</p>		1
(iii)	<p>less heat (energy) / thermal energy produced</p> <p>OR</p> <p>temperature rise less (than expected)</p>	<p>ACCEPT less heat (energy) / thermal energy transferred to the water</p> <p>ALLOW soot has absorbed some of the heat (energy) / soot has acted as an insulator</p>	1
(iv)	heat/energy is lost to the air/ beaker/surroundings / water evaporates	<p>ALLOW beaker is not insulated/has no lid</p> <p>ALLOW water is not stirred</p>	1

Question number	Answer	Notes	Marks
16 (a)	to avoid loss of acid (spray) / solution / liquid OR <u>only</u> gas/carbon dioxide can escape	REJECT to avoid CaCO ₃ /solid escaping	1
(b)	carbon dioxide / gas AND escapes / given off / released	REJECT incorrectly named gas	1
(c) (i)		M2 dep on M1	2
(ii)		ACCEPT ions REJECT atoms / molecules ACCEPT per unit time / per minute ACCEPT collision frequency increases IGNORE any refs to chance of collisions	3

