



Mark Scheme (Results)

Summer 2017

Pearson Edexcel International GCSE
in 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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Summer 2017

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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	Marks
1	atomic number of the atom	3
	number of shells shown	2
	mass number of the atom	7
	number of protons in an isotope of this element	3
	group where element is found in the Periodic Table	1
		5

(Total for Question 1 = 5 marks)

Question number	Answer	Notes	Marks
2 (a)	<p>B (H₂)</p> <p>The only correct answer is B</p> <p>A is not correct because H is the symbol of an atom of hydrogen not a molecule of hydrogen</p> <p>C is not correct because H₂O is the formula of water which is a compound</p> <p>D is not correct because H₂O₂ is the formula of hydrogen peroxide which is a compound</p>		1
(b)	<p>D (sodium chloride solution)</p> <p>The only correct answer is D</p> <p>A is not correct because sodium is an element not a mixture</p> <p>B is not correct because chlorine is an element not a mixture</p> <p>C is not correct because sodium chloride is a pure compound not a mixture</p>		1

Question number	Answer	Notes	Marks
(c)	<p>A (chromatography)</p> <p>The only correct answer is A</p> <p>B is not correct because crystallisation would not separate the dyes in food colouring</p> <p>C is not correct because evaporation would not separate the dyes in food colouring</p> <p>D is not correct because filtration would not separate the dyes in food colouring</p>		1
(d) (i)	<p>M1 add (dilute) nitric acid</p> <p>M2 add silver nitrate (solution)</p> <p>M3 white precipitate</p> <p style="writing-mode: vertical-rl; transform: rotate(180deg); font-size: small;">4CH0 2017 May/June Paper 1 GradeMax</p>	<p>Accept HNO₃</p> <p>If no acid then M2 M3 can be scored</p> <p>If incorrect acid then M2 M3 can be scored</p> <p>Ignore references to testing for chlorine/electrolysis</p> <p>Accept AgNO₃</p> <p>Do not award mark if additional reagent added</p> <p>Ignore litmus</p> <p>Accept usual alternatives to precipitate</p> <p>Ignore cloudy/milky</p> <p>Ignore qualifiers such as pale</p> <p>Reject all other colours</p> <p>Reject other observations e.g. fizzing</p> <p>M3 DEP on mention of silver nitrate/AgNO₃</p>	3

Question number	Answer	Notes	Marks
(d) (ii)	diffusion	Ignore identity of precipitate	1
(e) (i)	M1 flask M2 column M3 condenser		3
(ii)	<p>C (g) → (l)</p> <p>The only correct answer is C</p> <p>A is not correct because change of state from solid to aqueous does not occur in fractional distillation</p> <p>B is not correct because change of state from liquid to solid does not occur in fractional distillation</p> <p>D is not correct because change of state from aqueous to solid does not occur in fractional distillation</p>		1

(Total for Question 2 = 11 marks)

Question number	Answer	Notes	Marks
3 (a)	galvanising/galvanisation	Ignore sacrificial protection	1
3 (b)	(i) rust (ii) M1 oxygen M2 water	Accept air / O ₂ Ignore O Accept H ₂ O Allow moisture Ignore vapour Accept answers in either order If name and formulae given both must be correct	1 2

Question number	Answer	Notes	Marks
(iii)	<p>M1 Zn/zinc is more reactive than Fe/iron</p> <p>M2 Zn loses (two) electrons / Zn forms Zn²⁺</p> <p>M3 prevents Fe from losing electrons / prevents Fe forming Fe²⁺</p>	<p>Accept Zn higher in reactivity series Accept zinc reacts in preference to/instead of iron Allow zinc is oxidised in preference to iron Ignore references to sacrificial protection Reject zinc rusts Reject use of Zn²⁺ and Fe²⁺ in place of Zn / Fe</p> <p>Accept reverse argument for iron</p> <p>Accept Zn → Zn²⁺ (+ 2e⁻) Reject Fe loses (two) electrons/Fe forms Fe²⁺</p> <p>Accept (so) Fe → Fe²⁺ (+ 2e⁻) does not take place</p> <p>Accept (so) Fe²⁺ (+ 2e⁻) → Fe (does take place) IF mentioned in correct context of reaction with zinc/displacement</p> <p>Accept Fe²⁺ (ions) gain (two) electrons and converted into Fe (atoms) IF mentioned in context of reaction with zinc/displacement</p>	3

(Total for Question 3 = 7 marks)

Question number	Answer	Notes	Marks
4 (a)	M1 (top row) CuCl_2 M2 (middle row) $(\text{NH}_4)_2\text{SO}_4$ M3 (bottom row) $\text{Fe}_2(\text{CO}_3)_3$		3
(b)	C (copper(II) sulfate) The only correct answer is C A is not correct because the name of CuSO_4 is not copper(I) sulfate B is not correct because the name of CuSO_4 is not copper(I) sulfite D is not correct because the name of CuSO_4 is not copper(II) sulphite		1
(c)	C (white Al colourless) The only correct answer is C A is not correct because $\text{NH}_4\text{Cl}(s)$ is not colourless B is not correct because $\text{NH}_4\text{Cl}(s)$ is not colourless D is not correct because $\text{NH}_4\text{Cl}(aq)$ is not white		1

Question number	Answer	Notes	Marks
(d) (i)	<p>A (brown precipitate)</p> <p>The only correct answer is A</p> <p>B is not correct because the product of the test, iron(III) hydroxide is not a brown solution</p> <p>C is not correct because the product of the test, iron(III) hydroxide is not a green precipitate</p> <p>D is not correct because the product of the test, iron(III) hydroxide is not a green solution</p>		1
(ii)	<p>M1 iron(III) hydroxide</p> <p>M2 sodium sulfite</p>	<p>Ignore iron hydroxide Accept ferric hydroxide Ignore formulae whether correct or incorrect</p> <p>Accept sulphate</p> <p>Accept answers in either order</p>	2
(iii)	<p>to prevent the formation of other precipitates OR to react with/remove carbonate (ions)</p>	<p>Ignore references to impurities</p> <p>Accept so only sulfate (ions) react with barium chloride/barium ions</p> <p>Accept to remove sulfite ions Reject if to remove an incorrect ion</p>	1

Question number	Answer	Notes	Marks
(d) (iv)	white precipitate	Reject other colours Accept usual alternatives for precipitate Reject incorrect extra observations	1
(e)	M1 add (dilute) acid /H ⁺ OR heat M2 bubble/pass gas/carbon dioxide into limewater/OWTTE M3 (limewater) turns milky	Accept any named acid Accept correct formulae Reject if limewater added to CuCO ₃ Accept cloudy / white precipitate M3 indep	3

(Total for Question 4 = 13 marks)

Question number	Answer	Notes	Marks
5 (a) (i)	to (produce) heat (energy)	Ignore exothermic reaction Accept to reach/maintain a high temperature Allow to make the furnace/it hot Ignore to increase the temperature Ignore for energy alone Ignore to make carbon dioxide	1
(ii)	to produce the reducing agent	Accept to produce substance needed to reduce iron ore/iron oxide/haematite Ignore to make carbon monoxide Allow to make carbon monoxide/CO/substance which reacts with iron ore to produce iron	1
(b)	M1 $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$ M2 $\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$	Award 1 mark for two correct equations in wrong order Ignore state symbols	2

Question number	Answer	Notes	Marks
(c)	<p>M1 iron/iron oxide is reduced AND carbon is oxidised</p> <p>M2 (because) iron/iron oxide loses oxygen AND carbon gains oxygen</p>	<p>In M1 and M2 Accept Fe/Fe₂O₃/Fe³⁺ and C</p> <p>Allow use of O</p> <p>Ignore references to electrons</p> <p>Allow reference to oxidation number of iron has decreased and oxidation number of carbon has increased (if oxidation numbers stated must be correct)</p>	2

(Total for Question 5 = 6 marks)

Question number	Answer	Notes	Marks												
6 (a)	M1 vapourisation M2 temperature M3 condensation M4 boiling point		4												
(b)	<table border="1"> <tr> <td data-bbox="443 560 994 660">the molecules that are cracked are hydrocarbons</td> <td data-bbox="994 560 1167 660">✓</td> </tr> <tr> <td data-bbox="443 660 994 761">catalytic cracking uses iron as the catalyst</td> <td data-bbox="994 660 1167 761"></td> </tr> <tr> <td data-bbox="443 761 994 861">cracking is used because of different requirements for hydrocarbons</td> <td data-bbox="994 761 1167 861">✓</td> </tr> <tr> <td data-bbox="443 861 994 995">cracking reactions are examples of addition reactions</td> <td data-bbox="994 861 1167 995"></td> </tr> <tr> <td data-bbox="443 995 994 1129">cracking produces molecules with shorter chains</td> <td data-bbox="994 995 1167 1129">✓</td> </tr> <tr> <td data-bbox="443 1129 994 1264"> $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$ is an equation for cracking reaction </td> <td data-bbox="994 1129 1167 1264"></td> </tr> </table>	the molecules that are cracked are hydrocarbons	✓	catalytic cracking uses iron as the catalyst		cracking is used because of different requirements for hydrocarbons	✓	cracking reactions are examples of addition reactions		cracking produces molecules with shorter chains	✓	$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$ is an equation for cracking reaction		Award 1 mark for each correct tick If more than 3 ticks then subtract 1 mark for each extra tick	3
the molecules that are cracked are hydrocarbons	✓														
catalytic cracking uses iron as the catalyst															
cracking is used because of different requirements for hydrocarbons	✓														
cracking reactions are examples of addition reactions															
cracking produces molecules with shorter chains	✓														
$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$ is an equation for cracking reaction															

Question number	Answer	Notes	Marks
6 (c) (i)	C_nH_{2n}	Accept other letters, such as x, in place of n	1
(ii)	M1 propene M2 methane	Accept propylene Accept answers in either order	2
(iii)	$ \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array} $	Must show all atoms and all bonds	1
(iv)	$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \quad \\ \text{H}-\text{C}=\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \quad \quad \quad \\ \quad \quad \quad \text{H} \quad \text{H} \end{array} $ $ \begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \quad \\ \text{H}-\text{C}-\text{C}=\text{C}-\text{C}-\text{H} \\ \quad \quad \quad \\ \text{H} \quad \quad \quad \text{H} \end{array} $	Award 1 mark for each structure Accept answers in either order Must show all atoms and all bonds Allow cis/trans isomers Allow cyclobutane	2

Question number	Answer	Notes	Marks
(d)	M1 product has longer (carbon) chain	Must have a comparative statement / a statement about both reactant and product Accept reactant has shorter (carbon) chain	3
	M2 only product has (all) single (C—C) bonds	Ignore reactant is a monomer and product is a polymer Accept only the reactant has a double bond Allow only the reactant is unsaturated Allow only the product is saturated Ignore references to alkanes/alkene	
	M3 only the product is a solid / only the reactant is a gas	Reject if an incorrect state also given	

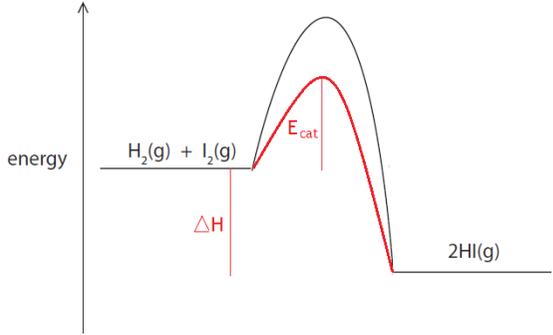
(Total for Question 6 = 16 marks)

Question number	Answer	Notes	Marks
7 (a)	reaction faster / takes less time	Ignore references to larger surface area Reject references to dissolving	1
(b)	reaction very slow/too slow without water	Accept rusting needs water/moisture Allow so that iron can rust Accept reference to increasing rate of reaction/rusting	1
(c)	M1 (at start) 71 M2 (at end) 16 M3 (change) (-)55	Ignore trailing .0(0) in all answers Ignore units M3 CQ M1 -M2	3

Question number	Answer	Marks
(d)	<p>D (he uses a smaller mass of iron filings) The only correct answer is D</p> <p>A is not correct because the change in volume is governed by the mass of iron so to produce a smaller change in volume the mass of iron present needs to be smaller – increasing the volume of water would not produce a smaller volume</p> <p>B is not correct because the change in volume is governed by the mass of iron so to produce a smaller change in volume the mass of iron present needs to be smaller – leaving the apparatus for longer would not produce a smaller change in volume</p> <p>C is not correct because the change in volume is governed by the mass of iron so to produce a smaller change in volume the mass of iron present needs to be smaller – having the apparatus in a warmer place would change the rate of reaction – and would not affect the change in volume</p>	1

Question number	Answer		Marks
(e) (i)	identifies the error e.g. has divided by the syringe reading at the start OR corrects the error e.g. should divide by the total volume	Accept has divided by 90 / has divided by the wrong number/has not included the volume of air in the flask and glass tube/has not included the 250 Accept should divide by 340 / should include the volume of air in the flask and glass tube	1
(ii)	M1 $\frac{70 \times 100}{340}$ (= 20.5882.....) M2 21	Allow any number of sig. fig. but reject 20	2
		Allow $\frac{70 \times 100}{250} = 28$ for (1) Correct final answer with or without working scores 2 marks	

(Total for Question 7 = 9 marks)

Question number	Answer	Notes	Marks
8 (a) (i) (ii)		<p>curve from reactant level to product level with peak below that of original (1)</p> <p>M1 for approximately vertical line/arrow between reactant level and product level labelled ΔH/enthalpy change/-9 kJ/mol</p> <p>M2 for approximately vertical line/arrow between reactant level and peak of <u>candidate</u> curve labelled E_{cat} /activation energy</p> <p>M1 and M2 CQ candidate curve</p>	1 2
(b) (i)	rate decreases / OWTTE	<p>Allow (reaction is) slower</p> <p>Allow reaction takes longer</p> <p>Ignore references to yield / position of equilibrium</p>	1
(ii)	<p>M1 (at lower temperature equilibrium position shifts to right / yield of hydrogen iodide) increases</p> <p>M2 because (forward) reaction is exothermic</p>	<p>Ignore ΔH is negative</p> <p>Accept backward reaction is endothermic</p> <p>Ignore because reaction moves in exothermic direction</p> <p>Ignore references to Le Chatelier's principle e.g. decrease in temperature favours exothermic reaction</p> <p>M2 DEP M1</p>	2

Question number	Answer	Notes	Marks
(c) (i)	(rate) decreases / OWTTE	Allow (reaction is) slower Allow reaction takes longer (to reach equilibrium) Ignore references to yield / position of equilibrium	1
(ii)	M1 (decrease in pressure has) no effect (on yield of hydrogen iodide) M2 because equal numbers of (gas) moles/molecules on both sides	Allow no change Ignore has no effect on other factors e.g. equilibrium (position) Ignore references to rate Allow (gas) particles for moles/molecules M2 DEP M1	2

(Total for Question 8 = 9 marks)

Question number	Answer	Notes	Marks												
9 (a)	<table border="1"> <tr> <td data-bbox="481 272 1155 384">the elements can be obtained by electrolysing molten metal halides</td> <td data-bbox="1160 272 1265 384">✓</td> </tr> <tr> <td data-bbox="481 387 1155 499">the elements with paler colours are lower down the group</td> <td data-bbox="1160 387 1265 499"></td> </tr> <tr> <td data-bbox="481 502 1155 614">the boiling points decrease down the group</td> <td data-bbox="1160 502 1265 614"></td> </tr> <tr> <td data-bbox="481 617 1155 729">the elements form covalent compounds with other non-metals</td> <td data-bbox="1160 617 1265 729">✓</td> </tr> <tr> <td data-bbox="481 732 1155 844">their molecules contain two atoms</td> <td data-bbox="1160 732 1265 844">✓</td> </tr> <tr> <td data-bbox="481 847 1155 959">all are gases at room temperature</td> <td data-bbox="1160 847 1265 959"></td> </tr> </table>	the elements can be obtained by electrolysing molten metal halides	✓	the elements with paler colours are lower down the group		the boiling points decrease down the group		the elements form covalent compounds with other non-metals	✓	their molecules contain two atoms	✓	all are gases at room temperature		Award 1 mark for each correct tick If more than 3 ticks then subtract 1 mark for each extra tick	3
the elements can be obtained by electrolysing molten metal halides	✓														
the elements with paler colours are lower down the group															
the boiling points decrease down the group															
the elements form covalent compounds with other non-metals	✓														
their molecules contain two atoms	✓														
all are gases at room temperature															
(b)	$2K + I_2 \rightarrow 2KI$	Accept fractions/multiples Ignore state symbols	1												
(c)	(hydrogen chloride) g (hydrochloric acid) aq		2												

Question number	Answer	Notes	Marks
(d)	M1 effervescence / bubbles / fizzing	Accept gas formed / evolved / given off Ignore hydrogen Reject extra incorrect observations	3
	M2 (in water hydrogen chloride forms) H ⁺ ions / forms (hydrochloric) acid	Ignore dissociates/ionises if no reference to H ⁺ / acid	
	M3 magnesium reacts to form hydrogen/H ₂	Accept chemical/word equation M3 DEP M2	
	OR		
	M1 magnesium disappears/gets smaller	Allow dissolves Reject extra incorrect observations Ignore magnesium moving	
	M2 (in water hydrogen chloride forms) H ⁺ ions / forms (hydrochloric) acid	Ignore dissociates/ionises if no reference to H ⁺ / acid	
M3 magnesium reacts to form magnesium chloride/MgCl ₂ /magnesium ions/Mg ²⁺	Accept chemical/word equation M3 DEP M2 Ignore references to solution with HCl dissolved in methylbenzene before water added		

Question number	Answer	Notes	Marks
9 (e) (i)	M1 test 2 M2 chlorine does not react with chloride (ions)	Allow description of test Accept chlorine does not displace itself Allow chlorine does not react with itself Accept reference to halogen/halide in place of chlorine/chloride Ignore chlorine does not displace chloride M2 DEP on correct M1 or missing M1	2
(ii)	C (solution becomes darker) The only correct answer is C A is not correct because original sodium iodide solution is colourless but in Test 1 iodine is formed in the solution so the solution becomes darker (red/brown)- no effervescence is seen as no gas being formed B is not correct because original sodium iodide solution is colourless but in Test 1 iodine is formed in the solution so the solution becomes darker (red/brown)- no iodine vapour produced so no purple fumes produced D is not correct because original sodium iodide solution is colourless but in Test 1 iodine is formed in the solution so the solution becomes darker (red/brown)- no white precipitate formed		1

Question number	Answer	Notes	Marks
(f) (i)	$\text{Cl}_2 + 2\text{At}^- \rightarrow \text{At}_2 + 2\text{Cl}^-$	Accept fractions/multiples Ignore 2e on both sides of equation Reject other extra species	1
(ii)	M1 chlorine/ Cl_2 is reduced AND astatide (ion)/ At^- is oxidised M2 chlorine/ Cl_2 gains electron(s) AND astatide (ion)/ At^- loses electron(s)	Allow Cl Reject chloride (ions) reduced Allow Cl Ignore references to oxidation numbers Reject use of astatine in place of astatide ions once only in (ii)	2

(Total for Question 9 = 15 marks)

Question number	Answer	Notes	Marks
(c) (i)	M1 bright / white flame M2 white solid / powder / ash / smoke	Allow bright / white light Ignore sparks Ignore grey Reject precipitate	2
(ii)	<p>A (it makes a squeaky pop with a lighted splint)</p> <p>The only correct answer is A</p> <p>B is not correct because hydrogen gas does not relight a glowing splint</p> <p>C is not correct because hydrogen gas does not turn damp blue litmus red</p> <p>D is not correct because hydrogen gas does not turn limewater milky</p>		1

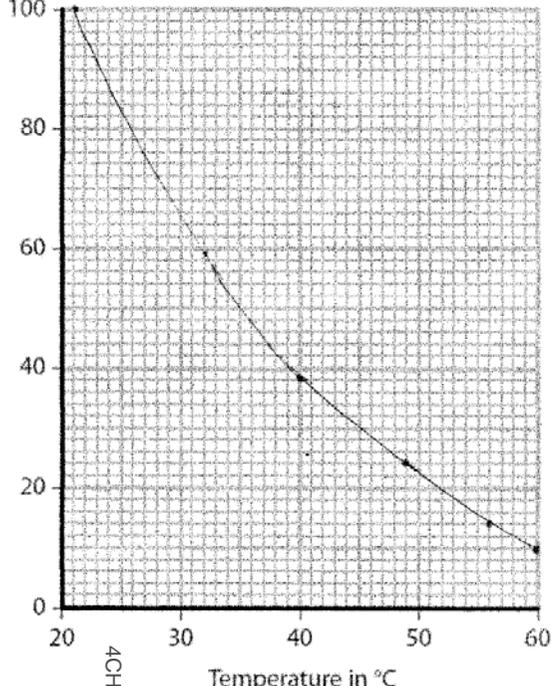
Question number	Answer	Notes	Marks
(d)	to evaporate/remove/boil off some of the water	Reject to remove (all) the water (stated or implied) Accept to increase the concentration (of the solution) Accept to produce a (hot) saturated solution Accept to reach crystallisation point Allow to reduce the volume (of the solution) Allow to evaporate/remove some of the solution Ignore references to rate of reaction Reject to evaporate acid	1
	M1 to see if/when crystals form	Allow solid for crystals	2
	M2 indicates the crystallisation point/when solution is saturated/OWTE	Accept indicates when to stop heating/if need to continue heating	2
	Any two from M1 MgO ₄ M2 H ₂ M3 H ₂ O ₄	Ignore names even if incorrect	

Question number	Answer	Notes	Marks
10 (e)	M1 calculation of mass of water M2 calculation of amounts of MgSO ₄ AND H ₂ O M3 calculation of MgSO ₄ : H ₂ O ratio M4 x=7	$m(\text{H}_2\text{O}) = (17.2 - 8.3) = 8.9 \text{ (g)}$ $n(\text{MgSO}_4) = 8.3 \div 120 \text{ OR } 0.069 \text{ (mol)}$ Allow any sig. fig e.g. 0.07 AND $n(\text{H}_2\text{O}) = 8.9 \div 18 \text{ OR } 0.49 \text{ (mol)}$ Allow any sig. fig e.g. 0.5 0.069 : 0.49 OR 1 : 7.101449275.. allow any sig. fig. OR 0.49/0.069 OR 7.101449275.. allow any sig. fig. accept MgSO ₄ .7H ₂ O Correct final answer with or without working scores 4 marks Check for incorrect working e.g. $120 \div 18 = 6.66 = 7$ Mark CQ throughout	4

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(Total for Question 10 = 18 marks)

Question number	Answer	Notes	Marks
11 (a) (i)	<p>(moles route)</p> <p>M1 $n(\text{CaO}) = 28000 \div 56$ OR 500 (mol)</p> <p>M2 $n(\text{H}_2\text{O}) = 500$ (mol)</p> <p>M3 $m(\text{H}_2\text{O}) = 500 \times 18 = 9000$ g / 9 kg</p> <p>OR (mass ratios route)</p> <p>M1 $M_r(\text{CaO}) = 56$ AND $M_r(\text{H}_2\text{O}) = 18$</p> <p>M2 $m(\text{H}_2\text{O}) = \frac{18}{56} \times 28000$</p> <p>M3 = 9 kg / 9000 g</p>	<p>Allow 0.5 if final answer given in kg</p> <p>For M2 need to use or state mol H₂O</p> <p>Units not needed for intermediate answers</p> <p>Do not award M3 if unit missing or incorrect</p> <p>Correct final answer with or without working scores 3 marks</p> <p>Mark M2 and M3 CQ on M1</p> <p>Do not award M3 if unit missing or incorrect</p> <p>Correct final answer with or without working scores 3 marks</p> <p>Mark M2 and M3 CQ on M1</p>	3
(ii)	<p>M1 carbon dioxide is (an) acidic (oxide)</p> <p>M2 calcium hydroxide is a base / an alkali</p>	<p>Ignore contains hydroxide/OH⁻ ions</p>	2

Question number	Answer	Notes	Marks
11 (b)	 <p data-bbox="414 502 571 590">Time to collect 100 cm³ of gas in seconds</p> <p data-bbox="772 925 974 949">Temperature in °C</p>	<p data-bbox="1265 279 1859 414">M1 + M2 all five points plotted to nearest gridline Deduct 1 mark for each error up to max 2</p> <p data-bbox="1265 454 1814 630">M3 curve of best fit Curve CQ on points plotted Penalise repeated straight line(s) joining points Penalise more than one curve visible</p>	3
(c)	<p data-bbox="414 997 907 1029">M1 particles have more energy</p> <p data-bbox="414 1069 1164 1141">M2 more collisions have energy equal to/greater than the activation energy</p> <p data-bbox="414 1181 1052 1212">M3 more successful collisions per second</p>		3

(Total for Question 11 = 11 marks)

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