

## IGCSE CHEMISTRY 4335-2H MARK SCHEME

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Question Number	Correct Answer	Acceptable Answers	Reject	Mark
1 (a)(i)	electrolysis			(1)
1 (a)(ii)	graphite / carbon			(1)
1 (a)(iii)	- on left and + on right			(1)
1 (a)(iv)	aluminium oxide / alumina cryolite	accept correct formulae ignore bauxite		1 1 (2)
1 (a)(v)	electricity (ignore qualifications) / electrical energy (not energy alone)	anode/positive electrode replacement	cathode /electrode replacement	(1)
1 (b)(i)	oxygen			(1)
1 (b)(ii)	<ul style="list-style-type: none"> <li>•carbon dioxide / carbon monoxide</li> <li>•graphite/carbon/electrode oxidised/burned/reacts with oxygen</li> </ul>	accept correct formulae (ignore lower case)	lists equation	1 1 (2)
				9
2 (a)(i)	Any two from: <ul style="list-style-type: none"> <li>•same or similar chemical properties / same functional group</li> <li>• gradation in physical properties</li> <li>•neighbouring/successive members differ by CH<sub>2</sub></li> </ul>	gradation of specified physical property (eg: boiling point/bp(t), melting point/mp(t), viscosity)	NOT a specified chemical property  different/same physical properties	(2)
2 (a)(ii)	alkene			(1)
2 (a)(iii)	C <sub>n</sub> H <sub>2n</sub>	any other letter in place of "n"		(1)
2 (b)(i)	<ul style="list-style-type: none"> <li>•(H) one electron shown</li> <li>•(C) two electrons in first shell and four in second shell</li> </ul>	aAccept any symbol for electrons.	electrons on nucleus	1 1 (2)
2 (b)(ii)	<ul style="list-style-type: none"> <li>•all five atoms and four shared pairs of electrons</li> <li>•no extra outer electrons.</li> </ul>	IGNORE inner electrons		1  1 (2)
2 (b)(iii)	tetrahedral			(1)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
2 (c)(i)	<ul style="list-style-type: none"> <li>•(compounds with) same molecular formula</li> <li>•(but) different structural formulae /displayed formula/structure / atoms arranged differently (same) elements = 0 marks</li> </ul>	mark independently	same chemical formula. Reject substances.	1 1 (2)
2 (c)(ii)	<p>Correct structures of butane and methylpropane. ALL bonds shown</p> <p>Penalise sticks with missing H once only</p>			1 1 (2)
				13
3 (a)(i)	2			(1)
3 (a)(ii)	2.8.2			(1)
3 (b)(i)	<p>any two from</p> <ul style="list-style-type: none"> <li>•effervescence / fizzing / bubbles</li> <li>• cloudiness / white precipitate /milky / white suspension</li> <li>•Ca get smaller / disappears (ignore dissolves).</li> <li>•Ca moves up and down</li> </ul>	<p>ignore gas made</p> <p>ignore floats/moves</p>	List	(2)
3 (b)(ii)	Ca(OH) <sub>2</sub>			(1)
3 (b)(iii)	<ul style="list-style-type: none"> <li>•blue</li> <li>•alkali / OH<sup>-</sup> / hydroxide / pH &gt;7 (ignore base)</li> <li>•stated pH value in range 8-14</li> </ul>		purple	1 1 (2)
3 (c)(i)	<ul style="list-style-type: none"> <li>•grey / silver(y)</li> <li>•white</li> </ul>			1 1 (2)
3 (c)(ii)	<p>any two from</p> <ul style="list-style-type: none"> <li>•over/through water / downward displacement of water</li> <li>• (gas) syringe</li> <li>•upward delivery / downward displacement of air</li> </ul>	<p>a description of this</p> <p>suitable diagrams</p>	gas cylinder	(2)
3 (c)(iii)	hydrogen + oxygen → water / steam	ignore heat	formulae	(1)
				12
4 (a)(i)	ammonia / NH <sub>3</sub>		ammonium NH <sub>4</sub>	(1)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
4 (a)(ii)	chloride / Cl <sup>-</sup>		chlorine Cl Cl <sub>2</sub>	(1)
4 (a)(iii)	copper(II) / Cu <sup>2+</sup> / copper / cupric	cupper	copper(I) cuprous Cu <sup>+</sup>	(1)
4 (a)(iv)	iron(II) / Fe <sup>2+</sup> / ferrous		Fe <sup>3+</sup> ferric iron	(1)
4 (b)(i)	CuSO <sub>4</sub> / copper((II)) sulphate			(1)
4 (b)(ii)	<ul style="list-style-type: none"> <li>•KNO<sub>3</sub> / potassium nitrate</li> <li>•lilac (dependent on correct compound)</li> </ul> OR <ul style="list-style-type: none"> <li>•CuSO<sub>4</sub> / copper((II)) sulphate</li> <li>•green / blue-green (dependent on correct compound)</li> </ul>	potassium/C pink  copper/B	purple  blue	(2)
4 (c)(i)	yellow precipitate/ppt/ppte	suspension		(1)
4 (c)(ii)	AgNO <sub>3</sub> (aq) + LiI(aq) → AgI(s) + LiNO <sub>3</sub> (aq) LiI(aq) + AgNO <sub>3</sub> (aq) formulae of products state symbols of products (dependent on correct product formulae)	if all correct but balanced wrongly, award 2 marks		(3)
				11
5 (a)(i)	diffusion			(1)
5 (a)(ii)	<ul style="list-style-type: none"> <li>•mention of particles (if particles named, must be correct) in correct context</li> <li>•moving (randomly)</li> </ul>	(accept molecules/ ions) move (from high to low concentration)		1 1 (2)
5 (b)(i)	<ul style="list-style-type: none"> <li>•(blue) ppt - colour not needed but penalise ppt if colour is wrong</li> <li>•deep/dark/royal blue</li> <li>•solution / dissolves</li> </ul>	ignore changes to colour of solution	dark/royal/ deep blue ppt	1  1 1 (3)
5 (b)(ii)	$[\text{Cu}(\text{H}_2\text{O})_2(\text{NH}_3)_4]^{2+}$ / $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{2+}$	formulae without []		(1)
				7

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
6 (a)(i)	Any three from <ul style="list-style-type: none"> <li>•float/on surface</li> <li>•fizz/bubble (ignore gas)</li> <li>•move/dart about</li> <li>•melt/form sphere/ball</li> <li>•Na gets smaller / disappears (ignore dissolves)</li> </ul>	ignore references to flames / igniting		(3)
6 (a)(ii)	$2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$ <ul style="list-style-type: none"> <li>•correct formulae</li> <li>•balancing (dependent on first mark being awarded)</li> </ul>	Na(OH) any multiple		(2)
6 (a)(iii)	Moves/bubbles faster/(more) violent/more vigorous/catches fire/flame/ explodes		reaction faster/ it is faster	(1)
6 (b)(i)	<ul style="list-style-type: none"> <li>•sodium loses electron(s)</li> <li>• oxygen gains electrons</li> <li>•correct number of electrons for each atom</li> </ul> <p>marks could be gained by suitable additions to printed diagram</p>	indication of 2 Na and 1 O	any reference to sharing /covalent gives 0	(3)
6 (b)(ii)	<ul style="list-style-type: none"> <li>•strong attractive forces / bonds (regardless of what these are between)</li> <li>•between <u>ions</u></li> <li>•require a lot of energy to overcome / difficult to break (regardless of what these are between)</li> </ul>		second mark not given if atoms / molecules / intermolecular	1 1 1 (3)
6 (b)(iii)	<ul style="list-style-type: none"> <li>•stronger attractive forces / bonding</li> <li>•magnesium ion 2+, sodium ion 1+ / magnesium loses 2 electrons, sodium loses 1 electron/magnesium ions are smaller or have bigger charge or are more highly charged (must state or imply comparison between Mg and Na)</li> </ul>	ignore more bonds/ intermolecular forces	MgO Covalent = 0 delocalised electrons = 0	1 1 (2)
				14

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
7 (a)	any five from: <ul style="list-style-type: none"> <li>•add magnesium carbonate to acid</li> <li>•stir/mix</li> <li>•excess magnesium carbonate</li> <li>• filter / centrifuge and decant</li> <li>•heat or evaporate filtrate and stop evaporation at a suitable point / heat filtrate and leave to cool / leave filtrate to evaporate or to crystallise or for suitable time / place in oven below 100 °C</li> <li>•dry crystals with (filter) paper /desiccator</li> </ul>	Ignore indicators <ul style="list-style-type: none"> <li>•If use sodium carbonate (or other soluble carbonate)only points 2,5,6</li> <li>•If use other insoluble carbonate, all bar first point.</li> <li>•Wrong method of prep. Then get 5 and 6 only.</li> </ul>	heat to dryness, can not get 5 or 6	(5)
7 (b)(i)	<ul style="list-style-type: none"> <li>•colourless</li> <li>•to pink</li> </ul>	if just state "pink" with no start colour, then score 1	purple / red	1 1 (2)
7 (b)(ii)	<ul style="list-style-type: none"> <li>•0.150 x 0.00870</li> <li>•=0.00131 correct answer scores 2 (moles)</li> </ul>	incorrect or failure to convert volume to dm <sup>3</sup> gives max 1 accept 2 to 4 sig figs (0.001305)	wrong numbers used = 0	1 1 (2)
7 (b)(iii)	(ii) ÷ 2 = 0.000653 (moles)	cq on b(ii) accept 2 to 4 sig figs (0.006525)		(1)
7 (b)(iv)	(iii) ÷ 0.025 = 0.0261 (mol dm <sup>-3</sup> )	cq on b(iii) accept 2 to 4 sig figs (0.02612)		(1)
				11
8 (a)(i)	<ul style="list-style-type: none"> <li>•add (named) acid</li> <li>•bubbles/effervescence/fizzing</li> </ul> OR gas produced turns limewater milky	2 <sup>nd</sup> mark possible only if acid added		1 1 (2)
8 (a)(ii)	2NaOH + CO <sub>2</sub> → Na <sub>2</sub> CO <sub>3</sub> + H <sub>2</sub> O formulae = 1 balancing = 1 (only if formulae correct)	accept any multiple		(2)
8 (b)	<ul style="list-style-type: none"> <li>•no change / remains clear</li> <li>•carbon dioxide reacted /removed(by sodium hydroxide) / formed sodium carbonate /</li> </ul>			1 1 (2)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
8 (c)(i)	<ul style="list-style-type: none"> <li>•Mr NaHCO<sub>3</sub> = 84</li> <li>•moles = 4.2 ÷ 84</li> <li>•= 0.05(0) ignore any units</li> </ul> Correct answer scores 3 If M <sub>r</sub> incorrect, max 2 (107 gives 0.039; 168 gives 0.025)			1 1 1 (3)
8 (c)(ii)	(i) ÷ 2 = 0.025 ignore any units	cq		(1)
8 (c)(iii)	(ii) x 24 (dm <sup>3</sup> ) = 0.6 unit not required but penalise incorrect units.	cq	answer in cm <sup>3</sup>	(1)
				11
9 (a)	any in range 40 to 100			(1)
9 (b)(i)	H <sub>2</sub> + Cl <sub>2</sub> → 2HCl formulae = 1 balancing = 1 (only if formulae correct) accept any multiples		CL	(2)
9 (b)(ii)	water: <ul style="list-style-type: none"> <li>• paper becomes red (NOT orange)</li> <li>• acidic / H<sup>+</sup> ions produced</li> </ul> methylbenzene: <ul style="list-style-type: none"> <li>• no change / orange</li> <li>• no H<sup>+</sup> ions formed / not acidic / does not ionise (indep. of colour)</li> </ul>	red/orange  ignore refs to being neutral	orange ionizes alone  green references to acidity of methyl benzene	1 1  1 1 (4)
				7
10 (a)(i)	galvanising / sacrificial protection			(1)
10 (a)(ii)	railings / cars / bridges / buckets / watering cans / lamp posts etc.	accept ships/boats even though zinc blocks and not a continuous layer used	bikes	(1)
10 (a)(iii)	<ul style="list-style-type: none"> <li>•zinc more reactive (than iron)</li> <li>• zinc reacts/corrodes/oxidises in preference to /before /instead of iron</li> </ul>	It is more reactive than iron	It is more reactive zinc rusts protective coating of zinc oxide	1 1 (2)

Question Number	Correct Answer	Acceptable Answers	Reject	Mark
10 (b)	<ul style="list-style-type: none"> <li>• make solution of nickel nitrate</li> <li>• add metal</li> <li>• if reaction occurs then metal is more reactive than nickel</li> </ul> OR <ul style="list-style-type: none"> <li>• work down from top of list until no reaction occurs / work up from bottom of list until reaction does occur.</li> </ul>	displacement reaction without making a solution is max 2	reaction with anything else (such as HCl(aq)) is zero react with metal (for 2 <sup>nd</sup> mark)	1 1 1 (3)
10 (c)(i)	Reduced because gain of electrons	reduced because oxidation state decreases		(1)
10 (c)(ii)	<ul style="list-style-type: none"> <li>• <math>Q = 1.5 \times 160 = 240</math> (coulombs)</li> <li>• Faradays = <math>240 \div 96000 = 0.0025</math> (cq)</li> <li>• Moles Ni = <math>0.0025 \div 2 = 0.00125</math> (cq)</li> <li>• mass Ni = <math>0.00125 \times 59 = 0.074</math> (g) (0.0737 or 0.07375) (cq). (0.0025 x 59 is max 3) units not required</li> </ul> Final answer correct = 4 marks	Accept 2 or more sig figs (1 sig fig max 3) Accept use of 96500  0.00249  0.001245 0.07337	incorrect use of kg or mg	1 1 1 1 (4)
				12
11 (a)(i)	<ul style="list-style-type: none"> <li>• appropriate catalyst alumina/aluminium oxide/porous pot/(conc) phosphoric acid / conc sulphuric acid.)</li> <li>• heat / high temperature</li> </ul>	ignore references to pressure  150 - 1000°C	aluminium	1 1 (2)
11 (a)(ii)	<ul style="list-style-type: none"> <li>• correct energy level for endothermic (higher) and one from</li> <li>• products marked with correct names/formulae</li> </ul> Mark independently	Ignore any activation energies shown		1 1 (2)
11 (a)(iii)	<ul style="list-style-type: none"> <li>• Increased</li> <li>• endothermic (left to right) or description of endothermic / <math>\Delta H</math> is positive</li> </ul>	ignore references to rate	if decreased or stays the same = zero	1 1 (2)

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11 (b)	<ul style="list-style-type: none"> <li>•correct structure with minimum 4 carbons</li> <li>•continuation bonds shown (not just dots) (brackets not required)</li> </ul>	Ignore "n" subscripts	any structure with C=C or based on wrong repeat unit = 0	1 1 (2)																												
11 (c)	<p>If calculate empirical first:</p> <ul style="list-style-type: none"> <li>•Correct empirical formula with some correct working = 3</li> </ul> <table border="1"> <tr> <td>division by A<sub>r</sub></td> <td>38.7/12 = 3.23</td> <td>9.70/1 = 9.70</td> <td>51.6/16 = 3.23</td> </tr> <tr> <td>division by smallest</td> <td>3.23 / 3.23 = 1</td> <td>9.70 / 3.23 = 3</td> <td>3.23 / 3.23 = 1</td> </tr> <tr> <td>empirical</td> <td colspan="3">CH<sub>3</sub>O</td> </tr> </table> <ul style="list-style-type: none"> <li>•Correct molecular formula (with any correct working)= 2</li> </ul> <table border="1"> <tr> <td>mass of empirical</td> <td>31</td> </tr> <tr> <td>molecular</td> <td>C<sub>2</sub>H<sub>6</sub>O<sub>2</sub></td> </tr> </table> <p>If calculate molecular first</p> <table border="1"> <tr> <td>mass of each element</td> <td>38.7 x .62 = 24</td> <td>9.70 x 62 = 6</td> <td>51.6 x .62 = 32</td> </tr> <tr> <td>division by A<sub>r</sub></td> <td>24 / 12 = 2</td> <td>6 / 1 = 6</td> <td>32 / 16 = 2</td> </tr> <tr> <td></td> <td colspan="3">C<sub>2</sub>H<sub>6</sub>O<sub>2</sub></td> </tr> </table> <p>correct molecular with some working = 3</p> <p>Correct empirical = 2</p>	division by A <sub>r</sub>	38.7/12 = 3.23	9.70/1 = 9.70	51.6/16 = 3.23	division by smallest	3.23 / 3.23 = 1	9.70 / 3.23 = 3	3.23 / 3.23 = 1	empirical	CH <sub>3</sub> O			mass of empirical	31	molecular	C <sub>2</sub> H <sub>6</sub> O <sub>2</sub>	mass of each element	38.7 x .62 = 24	9.70 x 62 = 6	51.6 x .62 = 32	division by A <sub>r</sub>	24 / 12 = 2	6 / 1 = 6	32 / 16 = 2		C <sub>2</sub> H <sub>6</sub> O <sub>2</sub>			<p>If A<sub>r</sub> incorrect/ use Z in place of A<sub>r</sub> then lose first mark</p> <p>If NO working shown, then max 2 each for the two answers regardless of order of answers</p>	<p>If first step totally wrong, zero.</p>	1 1 1 2  1 1 1  2 (5)
division by A <sub>r</sub>	38.7/12 = 3.23	9.70/1 = 9.70	51.6/16 = 3.23																													
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PAPER TOTAL 120 MARKS