



Mark Scheme (Results)

Summer 2018

Pearson Edexcel International GCSE
In Chemistry (4CH0) Paper 1C



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Summer 2018

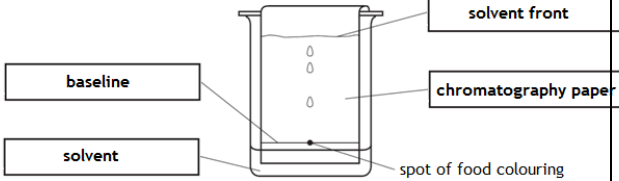
Publications Code 4CH0_1C_1806_MS

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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)		<p>Four correct scores 3</p> <p>Two correct scores 2</p> <p>One correct scores 1</p>	3
(b) (i)	<p>C (R)</p> <p>The only correct answer is C because food colouring R produces one spot so contains only one dye</p> <p>A is not correct because food colouring P produces four spots so does not contain only one dye</p> <p>B is not correct because food colouring Q produces three spots so does not contain only one dye</p> <p>D is not correct because food colouring S produces two spots so does not contain only one dye</p>		1
(ii)	<p>C (Q, R and S)</p> <p>The only correct answer is C because food colourings Q, R and S have one dye in common as they all produce one spot which has travelled the same distance</p> <p>A is not correct because P, Q and R do not all produce one spot which has travelled the same distance</p> <p>B is not correct because P, R and S do not all produce one spot which has travelled the same distance</p> <p>D is not correct because P, Q, R and S do not all produce one spot which has travelled the same distance</p>		1

Question number	Answer	Notes	Marks
1 (b) (iii)	<p>M1 P</p> <p>M2 largest number of/four spots (in the chromatogram)</p>	<p>ALLOW "four dyes"</p> <p>ALLOW blobs / dots / marks / points for spots</p> <p>M2 DEP on M1</p>	2

Total for Question 1 = 7 marks

Question number	Answer	Notes	Marks
2 (a)	<p>C (tap funnel)</p> <p>The only correct answer is C because the apparatus containing the dilute hydrochloric acid is called a tap funnel</p> <p><i>A is not correct because the apparatus containing the dilute hydrochloric acid is not called a burette</i></p> <p><i>B is not correct because the apparatus containing the dilute hydrochloric acid is not called a pipette</i></p> <p><i>D is not correct because the apparatus containing the dilute hydrochloric acid is not called a thistle funnel</i></p>		1
(b)	<p>$\text{CaCO}_3 + 2 \text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$</p> <p>M1 H_2O</p> <p>M2 correct balancing</p>	<p>ACCEPT multiples</p> <p>M2 DEP on M1</p> <p>Use of lower case letters, incorrect subscript / superscript, penalise M1, but can score M2</p>	2
(c)	<p>B (it turns limewater milky)</p> <p>The only correct answer is B because carbon dioxide turns limewater milky</p> <p><i>A is not correct because carbon dioxide does not turn red litmus blue</i></p> <p><i>C is not correct because carbon dioxide does not relight a glowing spill</i></p> <p><i>D is not correct because carbon dioxide does not burn with a squeaky pop</i></p>		1

Question number	Answer	Notes	Marks
2 (d)	(i) it is more dense than air	IGNORE heavier than air IGNORE more dense than oxygen	1
	(ii) (gas) syringe / over water	ACCEPT description of collecting over water	1
(e)	any value between 4(.0) and 6.9		1
(f)	M1 (from) green M2 (to) black	ACCEPT shades of green e.g. dark Award (1) for both colours correct but in wrong order	2
(g)	any two from: M1 does not support combustion M2 more dense than air M3 can be compressed (into a fire extinguisher cylinder) M4 does not conduct electricity	ALLOW does not burn / not flammable ALLOW more dense than oxygen IGNORE heavier than air IGNORE references to reactivity / cost / not harmful	2

Total for Question 2 = 11 marks

Question number	Answer	Notes	Marks
3 (a) (i)	Any two from: M1 sodium gets smaller /disappears M2 sodium moves/darts around M3 white trail M4 melts/forms a ball M5 litmus/solution/liquid turns blue	ALLOW dissolves IGNORE floats fizzing/bubbles/ effervescence IGNORE references to flames / sparks / heat produced / explodes	2
(ii)	2 Na(s) + 2 H₂O(l) → 2 NaOH(aq) + (1) H₂(g) M1 correct balancing M2 correct state symbols	ALLOW multiples and fractions	2
(b) (i)	(both) contain one electron in the outer(most)/valence shell	ALLOW same number of electrons in the outer(most) shell	1
(ii)	(most reactive) potassium/K sodium/Na (least reactive) lithium/Li		1

Total for Question 3 = 6 marks

Question number	Answer	Notes	Marks
4 (a)	<p>C (elements)</p> <p>The only correct answer is C because the substances found in the Periodic Table are elements</p> <p><i>A is not correct because the substances found in the Periodic Table are not alloys</i></p> <p><i>B is not correct because the substances found in the Periodic Table are not compounds</i></p> <p><i>D is not correct because the substances found in the Periodic Table are not mixtures</i></p>		1
(b)	<p>A (atomic number)</p> <p>The only correct answer is A because the substances found in the Periodic Table (elements) are arranged in order of increasing atomic number</p> <p><i>B is not correct because the substances found in the Periodic Table (elements) are not arranged in order of increasing mass number</i></p> <p><i>C is not correct because the substances found in the Periodic Table (elements) are not arranged in order of increasing nucleon number</i></p> <p><i>D is not correct because the substances found in the Periodic Table (elements) are not arranged in order of increasing relative atomic mass</i></p>		1

Question number	Answer	Notes	Marks																								
4 (c)	<table border="1"> <thead> <tr> <th>Gas</th> <th>Symbol</th> <th>Boiling point</th> <th>Reaction</th> </tr> </thead> <tbody> <tr> <td>helium</td> <td></td> <td></td> <td></td> </tr> <tr> <td>neon</td> <td>Ne</td> <td></td> <td></td> </tr> <tr> <td>argon</td> <td></td> <td>40 to 100</td> <td></td> </tr> <tr> <td>krypton</td> <td></td> <td></td> <td></td> </tr> <tr> <td>xenon</td> <td></td> <td></td> <td>no reaction</td> </tr> </tbody> </table>	Gas	Symbol	Boiling point	Reaction	helium				neon	Ne			argon		40 to 100		krypton				xenon			no reaction	<p>REJECT NE/ne/nE</p> <p>IGNORE units</p>	3
Gas	Symbol	Boiling point	Reaction																								
helium																											
neon	Ne																										
argon		40 to 100																									
krypton																											
xenon			no reaction																								
(d)	<p>M1 argon does not react with tungsten/filament</p> <p>M2 (because) argon has full outer shell of <u>electrons</u> / does not (easily) gain or lose or share <u>electrons</u></p> <p>OR</p> <p>tungsten/filament reacts with oxygen</p>	<p>ALLOW metal ALLOW argon is inert / unreactive</p> <p>ALLOW metal ALLOW tungsten combusts in oxygen /is oxidised in oxygen</p>	2																								

Total for Question 4 = 7 marks

Question number	Answer	Notes	Marks
5 (a) (i)	(because) all of the acid/HCl is reacted/used up OR (because) the cobalt(II) oxide is in excess	Assume "it" refers to the acid ACCEPT (because) cobalt(II) oxide is added until no more of it can react ALLOW (because) cobalt(II) oxide is added until no more of it can dissolve	1
(b)	to increase the rate of reaction	ACCEPT to make reaction faster IGNORE references to dissolving the cobalt(II) oxide IGNORE references to increases (kinetic) energy / particles move more/faster	1
(c)	glass does not react with acid/solution OR metal may/does react with acid/solution	IGNORE glass is unreactive ALLOW so no other/unwanted metal ions form ALLOW glass is not a good (thermal) conductor <u>and</u> so less likely to burn yourself (or reverse argument for metal)	1

Question number	Answer	Notes	Marks
5 (d)	solid stops disappearing / solid settles/left over	ALLOW cobalt(II) oxide/it for solid ALLOW dissolving for disappearing IGNORE references to fizzing/effervescence/gas given off	1
(e)	the (soluble) impurity will also be present with the (cobalt chloride) crystals	ALLOW the (soluble) impurity remains / won't be removed by filtration/in Step 5	1
(f)	<p>IGNORE any initial steps that try to remove impurities e.g. filter / wash</p> <p>M1 heat/boil (the filtrate / evaporating basin)</p> <p>M2 until reach crystallisation point / until solution is concentrated/ saturated / until crystals form on the end of a glass rod</p> <p>M3 leave the solution (to cool) and filter (to remove the crystals)</p> <p>M4 wash the crystals (with a small amount of deionised water)</p> <p>M5 dry the crystals on filter/tissue paper / in a (warm) oven</p>	<p>ALLOW evaporate</p> <p>ALLOW until most/some of the water has evaporated</p> <p>If solution is <u>heated to evaporate all water</u> at this stage see METHOD 2 below.</p> <p>If M2 is scored but the saturated solution is then <u>left to evaporate the remaining water</u> then M3 cannot be awarded, but M4 & M5 can be awarded</p> <p>IGNORE just "dry it" ALLOW leave (the crystals) to dry REJECT hot oven or any method of direct heating (eg Bunsen burner)</p>	5

5 (f)	<p>METHOD 2</p> <p>If the filtrate is <u>heated to evaporate all water</u>:</p> <p>M1 heat/boil (the filtrate / evaporating basin)</p> <p>M4 wash the crystals (with a small amount of deionised water)</p> <p>M5 dry the crystals on filter/tissue paper / in a (warm) oven</p>	<p>ALLOW evaporate</p> <p>IGNORE just "dry it" ALLOW leave to dry REJECT hot oven or any method of direct heating (eg Bunsen burner)</p> <p>M5 DEP on M4 in <u>METHOD 2 only</u></p>	
(g) (i)	$\text{CoCl}_2 \cdot 2\text{H}_2\text{O} + 4 \text{H}_2\text{O} \rightarrow \text{CoCl}_2 \cdot 6\text{H}_2\text{O}$		1
(ii)	<p>B (dehydration)</p> <p>The only correct answer is B because when the pink solid $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ is heated to from the blue solid CoCl_2 it is losing water which is dehydration</p> <p>A is not correct because when the pink solid $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ is heated to from the blue solid CoCl_2 it is losing water which is not crystallisation</p> <p>C is not correct because when the pink solid $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ is heated to from the blue solid CoCl_2 it is losing water which is not hydration</p> <p>D is not correct because when the pink solid $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$ is heated to from the blue solid CoCl_2 it is losing water which is not a redox reaction</p>	1	

Total for Question 5 = 12 marks

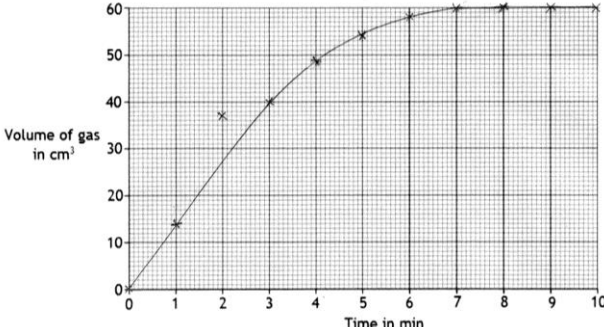
Question number	Answer	Notes	Marks
6 (a)	ammonia / NH ₃	If name and formula given, both must be correct	1
(b)	K ⁺		1
(c) (i)	M1 (test 3A) no carbonate (ion) present M2 (test 3B) no halide (ion) present	ACCEPT CO ₃ ²⁻ ALLOW hydrogencarbonate/ HCO ₃ ⁻ ACCEPT no chloride, bromide or iodide (ion) present (all three halides must be mentioned) ALLOW one halide if result is given e.g. no chloride ions present because a white precipitate would form	2
(ii)	sulfate / SO ₄ ²⁻	If name and formula given both must be correct	1

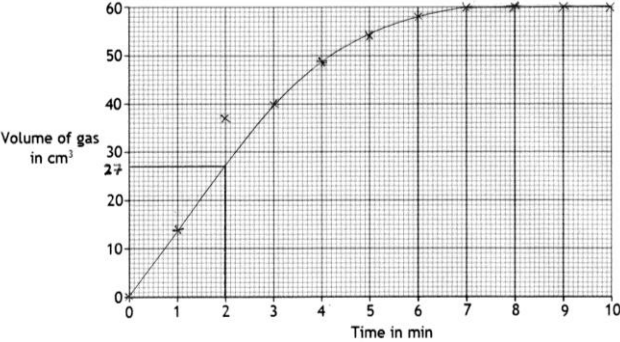
Total for Question 6 = 5 marks

Question number	Answer	Notes	Marks
7 (a) (i)	(it has) gained oxygen / oxygen has been added (to it)	ACCEPT oxidation number has increased / changed from -2 to $+4$ ALLOW gained O / O has been added IGNORE references to electrons	1
(ii)	$\text{Sb}_2\text{O}_4 + 2 \text{C} \rightarrow 2 \text{Sb} + 2 \text{CO}_2$		1

Question number	Answer	Notes	Marks
7 (b) (i)	Bi ³⁺		1
(ii)	<p>M1 strong electrostatic forces/attractions between the (oppositely-charged) ions</p> <p>M2 large amount of (thermal / heat) <u>energy</u> required to overcome these forces/attractions</p>	<p>ACCEPT strong ionic bonding/bonds / many ionic bonds</p> <p>IGNORE giant ionic structure / lattice</p> <p>ACCEPT large amount of (thermal/heat) <u>energy</u> required to break the bonds</p> <p>IGNORE more energy required</p> <p>M2 DEP on M1 or near miss e.g. "strong bonds"</p> <p>If reference to intermolecular forces /metallic/covalent bonding, then score 0 out of 2</p>	2
(iii)	<p>Bi₂O₃ + 6 HCl → 2 BiCl₃ + 3 H₂O</p> <p>M1 H₂O as only product not containing Bi</p> <p>M2 equation fully correct i.e. formula of BiCl₃ and balanced</p>	<p>ACCEPT multiples and halves</p> <p>M2 DEP on M1</p>	2

Total for Question 7 = 7 marks

Question number	Answer	Notes	Marks
8 (a) (i)	 <p data-bbox="295 660 925 728">M1 and M2 all points plotted correctly (\pm half a square)</p>	<p data-bbox="970 660 1181 761">IGNORE plotting of (0, 0).</p> <p data-bbox="970 795 1181 940">Deduct one mark for each point plotted incorrectly.</p>	2
(ii)	suitable curve drawn, avoiding the anomalous point	ALLOW curve drawn \pm half a square through other points	1

Question number	Answer	Notes	Marks
8 (b) (i)	measured volume of gas later (than 2 minutes)	ALLOW misread the syringe / syringe not read at eye level	1
(ii)	 <p data-bbox="295 976 895 1084">M1 value read correctly ($\pm 1\text{cm}^3$) from candidate's graph</p> <p data-bbox="295 1120 783 1189">M2 vertical line drawn at 2 min intersecting curve</p> <p data-bbox="295 1227 879 1368">OR horizontal line drawn from vertical axis intersecting curve at 2 min</p>	ALLOW a cross on the curve at 2 mins	2

Question number	Answer	Notes	Marks
8 (c)	<p>M1 the reaction has finished</p> <p>M2 because <u>all</u> the acid has reacted / the acid has been used up</p>	<p>ALLOW references to no more gas given off</p> <p>IGNORE the reactants have been used up</p> <p>IGNORE the zinc has reacted</p> <p>IGNORE the zinc is in excess</p> <p>REJECT <u>all</u> of the zinc has reacted / the zinc has been used up</p>	2
(d) (i)	the gradient/slope of the curve decreases	<p>ACCEPT the curve becomes less steep</p> <p>ALLOW the curve levels off</p>	1
(ii)	<p>M1 fewer particles (of acid/zinc to react)</p> <p>M2 fewer (successful) collisions (between particles) per second</p>	<p>ALLOW concentration of <u>acid</u> decreases</p> <p>ACCEPT less frequent (successful) collisions</p> <p>IGNORE references to less chance of collision</p> <p>IGNORE references to wrong type of particles eg molecules</p> <p>Any reference to particles losing energy / moving more slowly scores 0 out of 2.</p>	2

Total for Question 8 = 11 marks

Question number	Answer	Notes	Marks
9	<p>(magnesium):</p> <p>M1 delocalised electrons</p> <p>M2 are able to flow/move (through the structure)</p> <p>(solid MgCl₂):</p> <p>M3 (positive and negative) ions</p> <p>M4 are in fixed positions /can only vibrate / cannot move</p> <p>(aqueous MgCl₂):</p> <p>M5 (positive and negative) ions</p> <p>M6 can move/flow (to electrodes of opposite charge)</p>	<p>IGNORE any references to carrying charge throughout the question</p> <p>ALLOW sea of electrons IGNORE free electrons</p> <p>ALLOW are mobile</p> <p>M2 DEP on mention of electrons in M1</p> <p>Any mention of <u>moving</u> ions / atoms /nuclei / protons loses M1 & M2</p> <p>IGNORE refs to electrons</p> <p>M4 DEP on M3</p> <p>REJECT refs to electrons</p> <p>M6 DEP on M5</p>	6

Total for Question 9 = 6 marks

Question number	Answer	Notes	Marks
10 (a)	<p>M1 the (mean/average) energy of the molecules/particles increases</p> <p>M2 molecules/particles/they escape (from the liquid)</p> <p>OR</p> <p>intermolecular forces are broken AND the molecules/particles move further apart</p>	<p>ACCEPT molecules/particles gain energy</p> <p>ACCEPT the (mean/average) speed/velocity of the molecules increases</p> <p>ACCEPT molecules move faster</p> <p>IGNORE evaporate</p>	2
(b)	$\text{Br}_2 + \text{H}_2\text{O} \rightarrow \text{HBr} + \text{HBrO}$	<p>ALLOW reactants in either order</p> <p>ALLOW products in either order</p>	1

Question number	Answer	Notes	Marks
10 (c) (i)	<p>M1 $n[\text{MgBr}_2 \cdot 6\text{H}_2\text{O}] = 0.125 \text{ (mol)}$</p> <p>M2 mass of $\text{MgBr}_2 \cdot 6\text{H}_2\text{O} = 0.125 \times 292$</p> <p>M3 = 36.5 (g)</p> <p>OR</p> <p>M1 mass of $\text{MgCO}_3 = 0.125 \times 84$ OR 10.5 (g)</p> <p>M2 84 (g) of MgCO_3 give 292 (g) of $\text{MgBr}_2 \cdot 6\text{H}_2\text{O}$</p> <p>OR mass of $\text{MgBr}_2 \cdot 6\text{H}_2\text{O} = (292 \div 84) \times 10.5 \text{ (g)}$</p> <p>M3 mass of $\text{MgBr}_2 \cdot 6\text{H}_2\text{O} = 36.5 \text{ (g)}$</p> <p>OR</p> <p>M1 mass of $\text{MgBr}_2 = 0.125 \times 184$ OR 23 (g)</p> <p>M2 mass of $6\text{H}_2\text{O} = 0.125 \times 6 \times 18$ OR 13.5 (g)</p> <p>M3 $23 + 13.5 = 36.5 \text{ (g)}$</p> <p>OR</p> <p>$36.5 \div 292 = 0.125$ scores (3)</p>	<p>M3 DEP on valid working in M2</p> <p>M3 DEP on valid working in M2</p>	3

Question number	Answer	Notes	Marks
10 (c) (ii)	<p>any two from:</p> <p>M1 solution not left for long enough</p> <p>M2 magnesium carbonate is impure</p> <p>M3 some magnesium carbonate did not react</p> <p>M4 some of the product was lost during Transfer between pieces of apparatus</p> <p>M5 (hydrated magnesium bromide) loses some water of crystallisation</p> <p>M6 some of the product dissolves when the crystals are washed</p>	<p>ALLOW crystallisation was incomplete / some crystals remain in solution</p> <p>ALLOW reaction (between carbonate and acid) did not go to completion</p> <p>IGNORE references to spillage</p> <p>ALLOW magnesium bromide is not fully hydrated</p>	2

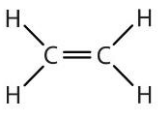
Total for Question 10 = 8 marks

Question number	Answer	Notes	Marks
11	<p>M1 powder/crush the malachite (using the pestle and mortar)</p> <p>M2 add the malachite/powder to dilute sulfuric acid (in a beaker) OR add dilute sulfuric acid to the malachite (in a beaker)</p> <p>M3 filter (using filter funnel and paper)</p> <p>M4 add magnesium powder to the filtrate/solution/copper sulfate</p> <p>M5 method to collect/obtain/ remove the residue/copper (using filter funnel and paper)</p> <p>M6 reference to appropriate use of at least two pieces of apparatus</p>	<p>ALLOW powder/crush the ore</p> <p>ACCEPT mix the powder with dilute sulfuric acid (in a beaker)</p> <p>ALLOW decant</p> <p>IGNORE any later steps e.g. washing / evaporation</p>	6

11	<p>OR</p> <p><u>If malachite and magnesium are both added to the acid at the same time, then:</u></p> <p>M1 powder/crush the malachite (using the pestle and mortar)</p> <p>M2 add the malachite/powder to dilute sulfuric acid and add the magnesium (in a beaker)</p> <p>M3 filter and collect/obtain the residue/copper (using filter funnel and paper)</p> <p>M4 reference to appropriate use of at least two pieces of apparatus</p>	<p>IGNORE any later steps e.g. washing / evaporation</p>	
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Total for Question 11 = 6 marks

Question number	Answer	Notes	Marks
12 (a)	<p>A (boiling point)</p> <p>The only correct answer is A because the property of hydrocarbons used to separate crude oil into fractions is their boiling point</p> <p><i>B is not correct because the property of hydrocarbons used to separate crude oil into fractions is not their chemical reactivity</i></p> <p><i>C is not correct because the property of hydrocarbons used to separate crude oil into fractions is not their density</i></p> <p><i>D is not correct because the property of hydrocarbons used to separate crude oil into fractions is not their melting point</i></p>		1
(b) (i)	camping gas / bottled gas / calor gas	<p>ALLOW (fuel for) stoves / (fuel for) cooking / (fuel for) heating</p> <p>IGNORE fuel by itself</p>	1
(ii)	<u>fuel</u> for (aero)planes	<p>ACCEPT <u>fuel</u> for jets/jet engines</p> <p>ACCEPT <u>fuel</u> for heating/lamps</p> <p>ALLOW <u>paraffin</u> heaters/lamps</p> <p>ALLOW <u>kerosene</u> heaters/lamps</p>	1
(iii)	bitumen		1

Question number	Answer	Notes	Marks
12 (c) (i)	silica / alumina	ACCEPT SiO ₂ / Al ₂ O ₃ ACCEPT silicon dioxide / aluminium oxide ACCEPT aluminosilicate(s) ACCEPT zeolite(s)	1
(ii)	600–700 (°C)	ACCEPT any temperature or range of temperatures between 600 and 700 (°C) inclusive	1
(iii)	C ₁₄ H ₃₀ → C ₂ H ₄ + C ₁₂ H ₂₆		1
(iv)		IGNORE bond angles	1
(v)	poly(ethene) / polyethene / polythene	ALLOW polyethylene	1
(vi)	M1 it is inert M2 (so) does not biodegrade	ALLOW unreactive ALLOW description of non-biodegradable e.g. does not decompose naturally / is not broken down by microorganisms IGNORE references to burning producing harmful gases	2

Total for Question 12 = 11 marks

Question number	Answer			Notes	Marks																
13 (a)	<table border="1" data-bbox="352 331 871 663"> <thead> <tr> <th></th> <th>Initial</th> <th>After 1 min</th> <th>Increase</th> </tr> </thead> <tbody> <tr> <td>expt 1</td> <td>16.0</td> <td>19.0</td> <td>3.0</td> </tr> <tr> <td>expt 2</td> <td>16.0</td> <td>21.0</td> <td>5.0</td> </tr> <tr> <td>expt 3</td> <td>16.0</td> <td>27.5</td> <td>11.5</td> </tr> </tbody> </table> <p data-bbox="352 696 871 842">(1) mark for each correct column Mark "Increase" column CQ on initial and after 1 min readings</p>				Initial	After 1 min	Increase	expt 1	16.0	19.0	3.0	expt 2	16.0	21.0	5.0	expt 3	16.0	27.5	11.5	<p data-bbox="895 342 1238 533">Penalise missing trailing zeroes and/or extra zeroes once only e.g. 16 / 16.00</p>	3
	Initial	After 1 min	Increase																		
expt 1	16.0	19.0	3.0																		
expt 2	16.0	21.0	5.0																		
expt 3	16.0	27.5	11.5																		
(b)	<p data-bbox="352 887 871 954">M1 the reaction occurs more quickly</p> <p data-bbox="352 1021 871 1200">M2 so the heat energy/thermal energy is transferred to the water more quickly</p>			<p data-bbox="895 887 1238 954">ALLOW increased frequency of collisions</p> <p data-bbox="895 1021 1238 1267">ACCEPT the water/liquid is heated more quickly ALLOW more heat energy/thermal energy produced in same time period</p> <p data-bbox="895 1312 1238 1413">Max (1) for "more reactions occur so more heat produced"</p>	2																

Question number	Answer	Notes	Marks
13 (c) (i)	<p>M1 stays the same / does not change</p> <p>M2 because same temperature AND same surface area/size pieces of zinc OR because same concentration of acid</p>	M2 DEP on M1	2
(ii)	<p>M1 greater (temperature increase)</p> <p>M2 same amount of heat energy/thermal energy transferred/produced</p> <p>M3 (but) smaller volume/amount of solution/acid to transfer energy to</p>	<p>ALLOW "heat" or "energy" in place of "heat energy"</p> <p>ALLOW (but) smaller volume/amount of solution/acid to heat up</p>	3

Total for Question 13 = 10 marks

Question number	Answer	Notes	Marks
14 (a)	<p>M1 0.01740×0.0200</p> <p>OR $\frac{17.4(0) \times 0.0200}{1000}$</p> <p>M2 $3.48 \times 10^{-4} / 0.000348$ (mol)</p>	<p>ACCEPT 3.5×10^{-4}</p> <p>ALLOW errors in powers of 10 in converting cm^3 to dm^3 e.g. 0.348 / 0.35 / 348 / 350 for M2</p>	2
(b)	M2 from (a) $\times 5$ evaluated correctly and quoted to at least two significant figures	If (a) was correct, this should be $1.74 \times 10^{-3} / 0.00174$ (mol) ACCEPT 0.0017	1
(c)	answer from (b) $\times 56.0$ evaluated correctly and quoted to at least two significant figures	If (b) was correct, this should be 0.0974 (g) ACCEPT 0.09744 / 0.097	1
(d)	answer from (c) divided by 0.298 and then $\times 100$ and evaluated correctly and quoted to at least two significant figures	If (c) was correct, this should be 32.7 (%) ACCEPT 33 / 32.68 / 32.6 from 0.097(g)	1

Total for Question 14 = 5 marks

Question number	Answer	Notes	Marks
15 (a)	<p>M1 break down/decomposition of a compound</p> <p>M2 using electricity</p>	<p>ALLOW electrolyte/ substance for compound IGNORE separation</p> <p>ALLOW using dc / direct current</p>	2
(b)	<p>(graphite) will not react with chlorine</p> <p>OR</p> <p>magnesium will react with chlorine</p>	<p>ALLOW because it is (an) inert (electrode) ALLOW graphite does not react with zinc chloride IGNORE references to graphite being a better conductor IGNORE references to cost</p> <p>ALLOW magnesium reacts with zinc chloride ALLOW magnesium will displace zinc</p>	1
(c)	<p>B (both products are elements)</p> <p>The only correct answer is B because when molten zinc chloride is electrolysed both products (zinc and chlorine) are elements</p> <p>A is not correct because the pale green substance is chlorine not chloride</p> <p>C is not correct because the pale green substance forms at the positive electrode not the negative electrode</p> <p>D is not correct because the shiny grey solid is zinc not zinc chloride</p>		1

Question number	Answer	Notes	Marks
15 (d)	<p>M1 should be $- 2e^-$ / electrons are on wrong side (of equation) / electrons should be on right hand side (of equation)</p> <p>M2 should be Cl_2</p>	<p>ALLOW chlorine is diatomic</p> <p>If correct ionic half-equation written, then score (2)</p> <p>If <u>both</u> errors are identified but not corrected e.g. "it shouldn't be $+ 2e^-$ and it shouldn't be $2Cl$" then score max (1)</p>	2
(e)	<p>M1 the ions cannot flow/move</p> <p>M2 so no loss/gain of electrons takes place at the electrodes</p>	<p>ALLOW zinc chloride solidifies</p> <p>ALLOW ions not discharged at the electrodes</p>	2

Total for Question 15 = 8 marks

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