Mark Scheme (Results)

Summer 2018

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

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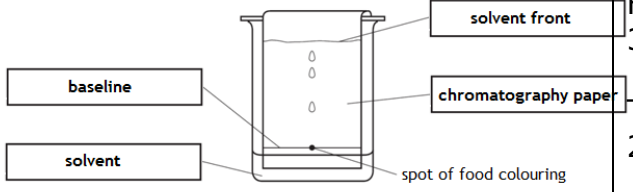
General Marking Guidance

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

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

Total for Question 1 = 7 marks

Question number	Answer	Notes	Marks
2 (a)	**C** (tap funnel) The only correct answer is C because the apparatus containing the dilute hydrochloric acid is called a tap funnel ***A*** *is not correct because the apparatus containing the dilute hydrochloric acid is not called a burette* ***B*** *is not correct because the apparatus containing the dilute hydrochloric acid is not called a pipette* ***D*** *is not correct because the apparatus containing the dilute hydrochloric acid is not called a thistle funnel*		1
(b)	$CaCO_3$ + **2** HCl → $CaCl_2$ + CO_2 **+ H_2O** **M1** H_2O **M2** correct balancing	**ACCEPT** multiples **M2** DEP on **M1** Use of lower case letters, incorrect subscript / superscript, penalise **M1**, but can score **M2**	2
(c)	**B** (it turns limewater milky) The only correct answer is B because carbon dioxide turns limewater milky ***A*** *is not correct because carbon dioxide does not turn red litmus blue* ***C*** *is not correct because carbon dioxide does not relight a glowing spill* ***D*** *is not correct because carbon dioxide does not burn with a squeaky pop*		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** H_2O(**l**) → **2** NaOH(**aq**) + **(1)** H_2(**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)	**C** (elements) The only correct answer is C because the substances found in the Periodic Table are elements ***A*** *is not correct because the substances found in the Periodic Table are not alloys* ***B*** *is not correct because the substances found in the Periodic Table are not compounds* ***D*** *is not correct because the substances found in the Periodic Table are not mixtures*		1
(b)	**A** (atomic number) The only correct answer is A because the substances found in the Periodic Table (elements) are arranged in order of increasing atomic number ***B*** *is not correct because the substances found in the Periodic Table (elements) are not arranged in order of increasing mass number* ***C*** *is not correct because the substances found in the Periodic Table (elements) are not arranged in order of increasing nucleon number* ***D*** *is not correct because the substances found in the Periodic Table (elements) are not arranged in order of increasing relative atomic mass*		1

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>4 (c)</td><td>
<table>
<tr><th>Gas</th><th>Symbol</th><th>Boiling point</th><th>Reaction</th></tr>
<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>
</table>
</td><td>REJECT NE/ne/nE

IGNORE units</td><td>3</td></tr>
<tr><td>(d)</td><td>M1 argon does not react with tungsten/filament

M2 (because) argon has full outer shell of
electrons / does not (easily) gain or lose
or share electrons

OR

tungsten/filament reacts with oxygen</td><td>ALLOW metal
ALLOW argon is inert / unreactive

ALLOW metal
ALLOW tungsten combusts in oxygen /is oxidised in oxygen</td><td>2</td></tr>
</table>

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)	**IGNORE** any initial steps that try to remove impurities e.g. filter / wash **M1** heat/boil (the filtrate / evaporating basin) **M2** until reach crystallisation point / until solution is concentrated/ saturated / until crystals form on the end of a glass rod **M3** leave the solution (to cool) and filter (to remove the crystals) **M4** wash the crystals (with a small amount of deionised water) **M5** dry the crystals on filter/tissue paper / in a (warm) oven	**ALLOW** evaporate **ALLOW** until most/some of the water has evaporated If solution is <u>heated to evaporate all water</u> at this stage see **METHOD 2** below. 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 **IGNORE** just "dry it" **ALLOW** leave (the crystals) to dry **REJECT** hot oven or any method of direct heating (eg Bunsen burner)	5

5 (f)	**METHOD 2** If the filtrate is <u>heated to evaporate all water</u>: **M1** heat/boil (the filtrate / evaporating basin) **M4** wash the crystals (with a small amount of deionised water) **M5** dry the crystals on filter/tissue paper / in a (warm) oven	 **ALLOW** evaporate **IGNORE** just "dry it" **ALLOW** leave to dry **REJECT** hot oven or any method of direct heating (eg Bunsen burner) **M5 DEP** on **M4** <u>in METHOD 2 only</u>	
(g) (i)	$CoCl_2.2H_2O + 4\ H_2O \rightarrow CoCl_2.6H_2O$		1
(ii)	**B** (dehydration) The only correct answer is B because when the pink solid $CoCl_2.6H_2O$ is heated to from the blue solid $CoCl_2$ it is losing water which is dehydration ***A** is not correct because when the pink solid $CoCl_2.6H_2O$ is heated to from the blue solid $CoCl_2$ it is losing water which is not crystallisation* ***C** is not correct because when the pink solid $CoCl_2.6H_2O$ is heated to from the blue solid $CoCl_2$ it is losing water which is not hydration* ***D** is not correct because when the pink solid $CoCl_2.6H_2O$ is heated to from the blue solid $CoCl_2$ it is losing water which is not a redox reaction*		1

Total for Question 5 = 12 marks

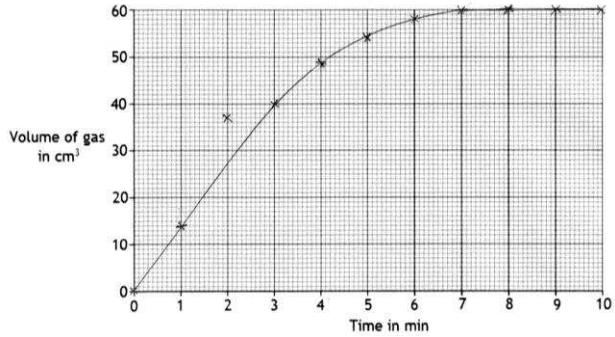
Question number	Answer	Notes	Marks
6 (a)	ammonia / NH_3	If name and formula given, both must be correct	1
(b)	K^+		1
(c) (i)	**M1** (test 3A) no carbonate (ion) present	**ACCEPT** CO_3^{2-} **ALLOW** hydrogencarbonate/ HCO_3^-	2
	M2 (test 3B) no halide (ion) present	**ACCEPT** no chloride, bromide or 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	
(ii)	sulfate / SO_4^{2-}	If name and formula given both must be correct	1

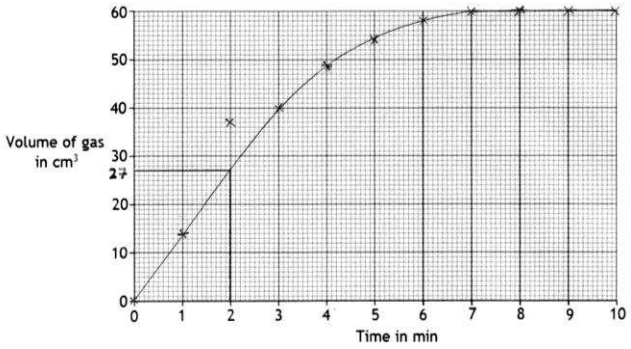
Total for Question 6 = 5 marks

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)	Sb_2O_4 + **2** C → **2** Sb + **2** CO_2		1

Question number	Answer	Notes	Marks
7 (b) (i)	Bi^{3+}		1
(ii)	**M1** strong electrostatic forces/attractions between the (oppositely-charged) ions	**ACCEPT** strong ionic bonding/bonds / many ionic bonds **IGNORE** giant ionic structure / lattice	2
	M2 large amount of (thermal / heat) <u>energy</u> required to overcome these forces/attractions	**ACCEPT** large amount of (thermal/heat) <u>energy</u> required to break the bonds **IGNORE** more energy required **M2** DEP on **M1** or near miss e.g. "strong bonds" If reference to intermolecular forces /metallic/covalent bonding, then score 0 out of 2	
(iii)	$Bi_2O_3 + 6\ HCl \rightarrow 2\ BiCl_3 + 3\ H_2O$ **M1** H_2O as only product not containing Bi **M2** equation fully correct i.e. formula of $BiCl_3$ and balanced	**ACCEPT** multiples and halves **M2** DEP on **M1**	2

Total for Question 7 = 7 marks

Question number	Answer	Notes	Marks
8 (a) (i)			
	M1 and **M2** all points plotted correctly (± half a square)	**IGNORE** plotting of (0, 0). Deduct one mark for each point plotted incorrectly.	2
(ii)	suitable curve drawn, avoiding the anomalous point	**ALLOW** curve drawn ± 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)			
	M1 value read correctly (± 1cm^3) from candidate's graph		2
	M2 vertical line drawn at 2 min intersecting curve **OR** horizontal line drawn from vertical axis intersecting curve at 2 min	**ALLOW** a cross on the curve at 2 mins	

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

Total for Question 8 = 11 marks

Question number	Answer	Notes	Marks
9	(magnesium): **M1** delocalised electrons **M2** are able to flow/move (through the structure) (solid $MgCl_2$): **M3** (positive and negative) ions **M4** are in fixed positions /can only vibrate / cannot move (aqueous $MgCl_2$): **M5** (positive and negative) ions **M6** can move/flow (to electrodes of opposite charge)	**IGNORE** any references to carrying charge throughout the question **ALLOW** sea of electrons **IGNORE** free electrons **ALLOW** are mobile **M2** DEP on mention of electrons in **M1** Any mention of <u>moving</u> ions / atoms /nuclei / protons loses **M1** & **M2** **IGNORE** refs to electrons **M4** DEP on **M3** **REJECT** refs to electrons **M6** DEP on **M5**	6

Total for Question 9 = 6 marks

Question number	Answer	Notes	Marks
10 (a)	**M1** the (mean/average) energy of the molecules/particles increases **M2** molecules/particles/they escape (from the liquid) **OR** intermolecular forces are broken **AND** the molecules/particles move further apart	**ACCEPT** molecules/ particles gain energy **ACCEPT** the (mean/average) speed/velocity of the molecules increases **ACCEPT** molecules move faster **IGNORE** evaporate	2
(b)	$Br_2 + H_2O \rightarrow HBr + HBrO$	**ALLOW** reactants in either order **ALLOW** products in either order	1

Question number	Answer	Notes	Marks
10 (c) (i)	**M1** *n*[$MgBr_2.6H_2O$] = 0.125 (mol) **M2** mass of $MgBr_2.6H_2O$ = 0.125 × 292 **M3** = 36.5 (g) **OR** **M1** mass of $MgCO_3$ = 0.125 × 84 **OR** 10.5 (g) **M2** 84 (g) of $MgCO_3$ give 292 (g) of $MgBr_2.6H_2O$ **OR** mass of $MgBr_2.6H_2O$ = (292 ÷ 84) × 10.5 (g) **M3** mass of $MgBr_2.6H_2O$ = 36.5 (g) **OR** **M1** mass of $MgBr_2$ = 0.125 × 184 **OR** 23 (g) **M2** mass of $6H_2O$ = 0.125 x 6 x 18 **OR** 13.5 (g) **M3** 23 + 13.5 = 36.5 (g) **OR** 36.5 ÷ 292 = 0.125 scores **(3)**	**M3** DEP on valid working in **M2** **M3** DEP on valid working in **M2**	3

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

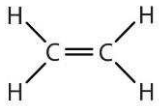
Total for Question 10 = 8 marks

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

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

Total for Question 11 = 6 marks

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

Question number	Answer	Notes	Marks
12 (c) (i)	silica / alumina	**ACCEPT** SiO_2 / Al_2O_3 **ACCEPT** silicon dioxide / aluminium oxide **ACCEPT** aluminosilicate(s) **ACCEPT** zeolite(s)	1
(ii)	600—700 (ºC)	**ACCEPT** any temperature or range of temperatures between 600 and 700 (ºC) inclusive	1
(iii)	$C_{14}H_{30} \rightarrow C_2H_4 + C_{12}H_{26}$		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

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>13 (a)</td><td>
<table>
<tr><th></th><th>Initial</th><th>After 1 min</th><th>Increase</th></tr>
<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>
</table>
(1) mark for each correct column

Mark “Increase” column CQ on initial and after 1 min readings</td><td>Penalise missing trailing zeroes and/or extra zeroes once only
e.g. 16 / 16.00</td><td>3</td></tr>
<tr><td>(b)</td><td>M1 the reaction occurs more quickly

M2 so the heat energy/thermal energy
is transferred to the water more
quickly</td><td>ALLOW increased frequency of collisions

ACCEPT the water/liquid is heated more quickly
ALLOW more heat energy/thermal energy produced in same time period

Max (1) for “more reactions occur so more heat produced”</td><td>2</td></tr>
</table>

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

Total for Question 13 = 10 marks

Question number	Answer	Notes	Marks
14 (a)	**M1** 0.01740 × 0.0200 **OR** $\frac{17.4(0) \times 0.0200}{1000}$ **M2** 3.48×10^{-4} / 0.000348 (mol)	 **ACCEPT** 3.5×10^{-4} **ALLOW** errors in powers of 10 in converting cm^3 to dm^3 e.g. 0.348 / 0.35 / 348 / 350 for **M2**	2
(b)	**M2** from (a) × 5 evaluated correctly and quoted to at least two significant figures	If (a) was correct, this should be 1.74×10^{-3} / 0.00174 (mol) **ACCEPT** 0.0017	1
(c)	answer from (b) × 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 × 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)	**M1** break down/decomposition of a compound **M2** using electricity	**ALLOW** electrolyte/ substance for compound **IGNORE** separation **ALLOW** using dc / direct current	2
(b)	(graphite) will not react with chlorine **OR** magnesium will react with chlorine	**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 **ALLOW** magnesium reacts with zinc chloride **ALLOW** magnesium will displace zinc	1
(c)	**B** (both products are elements) The only correct answer is B because when molten zinc chloride is electrolysed both products (zinc and chlorine) are elements **A** *is not correct because the pale green substance is chlorine not chloride* **C** *is not correct because the pale green substance forms at the positive electrode not the negative electrode* **D** *is not correct because the shiny grey solid is zinc not zinc chloride*		1

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

Total for Question 15 = 8 marks

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