PEARSON EDEXCEL GCSE COMBINED SCIENCE (HIGHER) · 1SC0

CHEMISTRY



MARK SCHEME

TOPIC 3: CHEMICAL CHANGES: ELECTROLYTIC PROCESSES (PAPER 1)

SCORE	PERCENTAGE
/130	%

STEMUP

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Mark Scheme

Q1.

	Answer	Acceptable answers	Mark
(a)(i)	electrolysis	Allow any phonetically correct spelling	**(1)**
(a)(ii)	A description including **two** of the following • Burns/ ignites (1) • Squeaky (1) • pop/explodes (1) • water formed (1)	Ignore references to splint	**(2)**
(b)(i)	**B**hydrochloric acid		**(1)**

(b)(ii)	**C** calcium carbonate		**(1)**
(b)(iii)	An explanation linking **two** of the following • alkali/ base (1) • (remedy) reacts with/ reduces/ removes (acid) (1) • (that is in) excess (1) • neutralises (acid) / pH raised/ forms water (1) • pain {removed/relieved} (1)		**(2)**
(c)	magnesium nitrate / $Mg(NO_3)_2$ (1) water /H_2O (1)	Reject hydrogen oxide	**(2)**

(**Q01 1SC0/1CF, June 2013**)

Q2.

Question Number	Answer	Acceptable answers	Mark
(a)	magnesium nitrate water carbon dioxide all three correct (2) magnesium nitrate + one other correct (1)	allow correct formulae	**(2)**

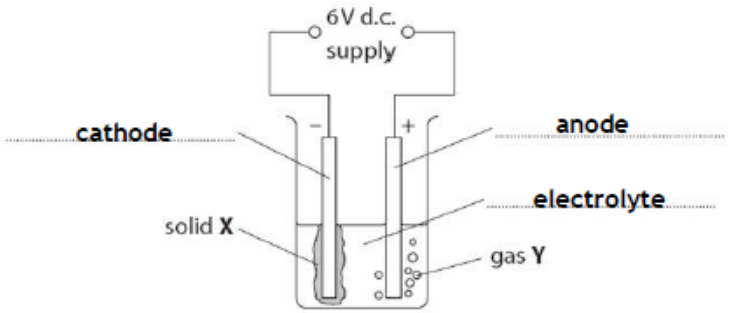
Question Number	Answer	Acceptable answers	Mark
(b)(i)	C – neutralisation		**(1)**

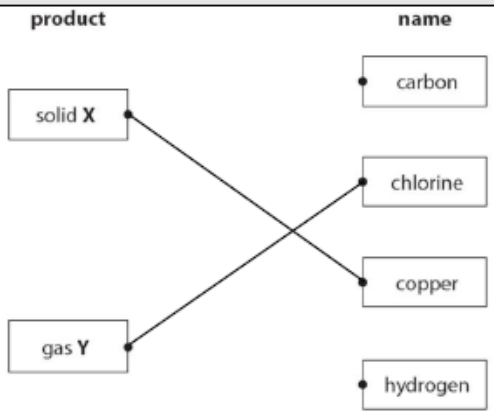
Question Number	Answer	Acceptable answers	Mark
(b)(ii)	$ZnO + 2HCl \rightarrow ZnCl_2 + H_2O$ (3) LHS (1) RHS (1) balancing of correct formula (1)	correct multiples ignore state symbols	**(3)**

Question Number		Indicative Content	Mark
QWC	* **(c)**	A description including some of the following points experiment set up • hydrochloric acid in container • carbon rods in acid • attach rods to electrical supply • d.c. supply(or reference to positive and negative) • test tubes to collect gases test hydrogen • lighted splint • squeaky pop (with air)/burns test chlorine • (damp blue) litmus paper • (turns red then) bleaches/white	**(6)**
Level	**0**	No rewardable content	
1	**1 – 2**	• a limited description e.g. simple description/diagram of electrolysis set up OR description of test for one of the gases. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 – 4**	• a simple description e.g. a full description of electrolysis OR test for both gases OR simple description of electrolysis and the test for one of the gases. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 – 6**	• a detailed description e.g. description of electrolysis and test for both gases OR a full description of electrolysis and of one gas test. • The answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(**Q01 1SC0/1CH, June 2014**)

Q3.

Question number	Answer	Additional guidance	Mark
(i)		All 3 correct scores 2 marks 1 or 2 correct scores 1 mark allow copper chloride **solution** to replace electrolyte	**AO1-2 (2)**

Question number	Answer	Additional guidance	Mark
(ii)		one mark for each line do not award mark if more than one line is drawn from each box on the left	**AO1-2 (2)**

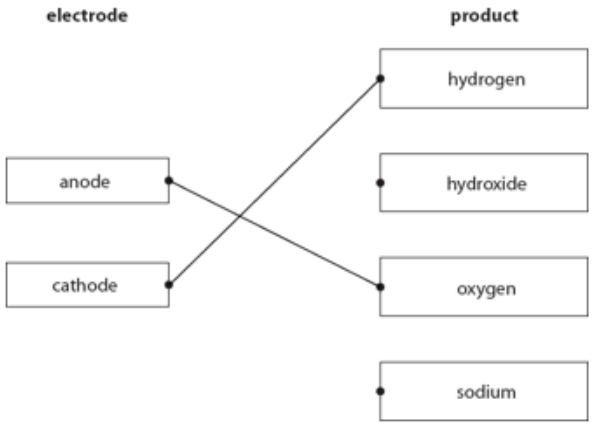
Question number	Answer	Additional guidance	Mark
(iii)	An explanation linking the following • no current will flow / solid ionic compounds do not conduct electricity (1) • (because) **ions** can't move / **ions** in a lattice (1)	Allow reverse arguments allow no electricity flows do not accept 'nothing happens' ignore charged particles reject electrons/atoms/molecules can't move if no other mark awarded allow 1 mark for if 'copper chloride isn't dissolved' / 'it will only work if ions are in solution'	**AO1-1 (2)**

(**Q02b 1SC0/1CF, June 2023**)

Q4.

Question number	Answer	Additional guidance	Mark
(i)	does not react / chemically stable (1) conducts (electricity) / a conductor (1)	allow inert (1) ignore cheap / not soluble	(2) AO 1-1

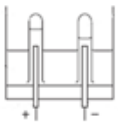
Question number	Answer	Mark
(ii)	**D** SO_4^{2-} and OH^- ions is the only correct answer **A** is not correct as H^+ would be attracted to the negative electrode **B** is not correct as SO_4^{2-} and OH^- ions would be attracted to the positive electrode **C** is not correct as H^+ and Na^+ would be attracted to the negative electrode	(1) AO 1-1

Question number	Answer	Additional guidance	Mark
(iii)		do not award answers with more than one line from any of the boxes on the left	(2) AO 1-1

(**Q04c 1SC0/1CF, June 2024**)

Q5.

Question number	Answer	Additional guidance	Mark
(i)	An explanation linking • it contains (hydrogen / sulfate) **ions** (1) • which can move (1)	MP2 depends on MP1 reject electrons for MP1 and MP2 allow formula for {hydrogen ion / sulfate ions} even if incorrect allow charged particles / cations / anions allow hydrogen or sulfate ions even if charge or formula is incorrect allow which are dissociated / are free / in a liquid / in a solution / go to electrodes ignore 'it conducts electricity'	**(2)** AO1-1

Question number	Answer	Mark
(ii)	**A**  **B**, **C** and **D** are incorrect because they show the incorrect ratio of gases that are produced	**(1)** AO2-2

Question number	Answer	Additional guidance	Mark
(iii)	$4OH^- \rightarrow O_2 + 2H_2O + 4e^{(-)}$ (2)	correct species (1) balancing of only correct species (1) allow incorrect cases / subscripts allow 1 mark for O_2 + $2H_2O$ on RHS allow 1 mark for + $4e^{(-)}$ on RHS	**(2)** AO2-1

(**QU04a 1SC0/1CH, June 2024**)

Q6.

Question number	Answer	Additional guidance	Mark
(i)	A description to include • wash / rinse (1) • dry / leave to dry / allow any solvent to evaporate (1)	mark independently reject clean with sandpaper / scrape off the copper for both marks allow dip in {propanone / water} ignore wipe / clean allow water, propanone for solvent allow pat dry	**(2)** AO1-2

Question number	Answer	Additional guidance	Mark
(ii)	An explanation linking • {copper **ions** / **cations** / **positive ions**} **and** {gain electrons/ are reduced} (1) • to form {copper / atoms} (on cathode) (1)	allow incorrect size of positive charge on copper ion half-equation (even if incorrect size of positive charge on copper ion or incorrectly balanced) can score MP1 and MP2 if no other marks awarded allow max 1 for {copper **ions** / **cations** / **positive ions**} go to cathode	**(2)** AO1-1

Question number	Answer	Additional guidance	Mark
(iii)	An explanation linking • {Cu^{2+} / cations / ions} enter solution (from anode) and leave solution (at cathode) (1) • no change in {concentration / amount / number} of {Cu^{2+}/ cations / ions} (1)	allow constant / same concentration of {Cu^{2+}/cations / ions} allow concentration of copper sulfate	**(2)** AO3-2

(**QU04b 1SC0/1CH, June 2024**)

Q7.

Question number	Answer	Additional guidance	Mark
	• copper is deposited on the cathode, therefore mass deposited = 1.57 – 1.28 (1) • = 0.29 (g) (1)	Award full marks for correct numerical answer without working.	**(2)**

(**Q03b 1SC0/1CF, SAM 2016**)

Q8.

Question Number	Answer	Mark
	C lead and bromine is the only correct answer **A** is incorrect because lead is produced at the cathode **B** is incorrect because lead and bromine are produced **D** is incorrect because bromine is produced at the anode	**(1)**

(**Q06b 1SC0/1CF, June 2019**)

Q9.

Question number	Answer	Mark
	C lead and bromine is the only correct answer **A** is incorrect because lead is produced at the cathode **B** is incorrect because lead and bromine are produced **D** is incorrect because bromine is produced at the anode	**(1)**

(**Q02b 1SC0/1CH, June 2019**)

Q10.

Question number	Answer	Additional guidance	Mark
(i)	A description including • apply lighted splint (1) • gas burns / (squeaky) pop (1)	 allow flame / ignite gas ignore 'squeaky pop test' / glowing splint second mark is dependent on first	**(2)**

Question number	Answer	Mark
(ii)	**B** oxygen **The only correct answer is B** **A, C** & **D** these gases are not produced in the electrolysis of sodium sulfate solution	**(1)**

Question number	Answer	Additional guidance	Mark
(iii)	• electrical energy / electricity (1) • {decomposes / breaks down / splits} {electrolytes / (ionic) compounds / substances} (1)	allow electric current allow **separates** ions reject decomposing elements for MP2	(2)

(**Q05a 1SC0/1CF, Nov 2020**)

Q11.

Question number	Answer	Additional guidance	Mark
(i)	A description including • apply lighted splint (1) • gas burns / (squeaky) pop (1)	allow flame / ignite gas ignore 'squeaky pop test' / glowing splint second mark is dependent on first	(2)

Question number	Answer	Mark
(ii)	**B** oxygen **is the only correct answer** **A, C** & **D** these gases are not produced in the electrolysis of sodium sulfate solution	(1)

Question number	Answer	Additional guidance	Mark
(iii)	• electrical energy / electricity (1) • {decomposes / breaks down / splits} {electrolytes / (ionic) compounds / substances} (1)	allow electric current allow **separates** ions reject decomposing elements for MP2	(2)

(**Q01a 1SC0/1CH, Nov 2020**)

Q12.

Question number	Answer	Additional guidance	Mark
(i)	Diagram to show • electrodes in solution (1) • wires and power supply connected to give a complete circuit (1)	max 1 mark if no labelling Ignore any charges on the diagram	(2) AO1

Question number	Answer	Additional guidance	Mark
(ii)	• anode: smaller because copper atoms form ions (and go into solution) / oxidation of Cu atoms (1) • cathode: larger because copper atoms are formed (from ions in the solution) / reduction of Cu^{2+} (1) • solution: the same number of ions enter and leave solution (1)		(3) AO1

(**Q03d 1SC0/1CH, Nov 2021**)

Q13.

Question number	Answer	Additional guidance	Mark
	Diagram showing • two (copper) electrodes in {beaker / suitable container} of {copper sulfate / solution / electrolyte} (1) • connected to {power supply / battery / cell} (1)	diagram needs to be labelled to score full marks electrodes must go into solution for MP1 reject AC / mains supply	(2) AO1-2

(**QU03a 1SC0/1CH, June 2022**)

Q14.

Question number	Answer	Additional guidance	Mark
(i)	H^+ **and** Na^+ **only** circled		**(1) AO1-1**

Question number	Answer	Additional guidance	Mark
(ii)	so that they do not react (with the electrolyte/sodium sulfate solution / products formed)	allow graphite is unreactive allow so they do not corrode	**(1) AO1-1**

Question number	Answer	Additional guidance	Mark
(iii)	An explanation linking: • **electrons** (1) • move (through graphite) / are {delocalised / free / sea of electrons} (1)	 ignore 'charged particles' for MP1 but allow for MP2 reject ions for MP1 and MP2 'electrons in bonds/ electrons in outer shell' scores MP1 only MP2 depends on **electrons** or charged particles being mentioned ignore any other material about structure of graphite, correct or otherwise	**(2) AO1-1**

(**Q04c 1SC0/1CF, June 2022**)

Q15.

Question Number	Indicative content	Mark
*	An answer that combines knowledge (3 marks) and understanding (3 marks) to provide a logical description: • place zinc chloride in crucible • heat to melt zinc chloride • use inert electrodes • connect to d.c. supply • zinc chloride is ionic • contains zinc ions and chloride ions • ions can move in liquid • positive zinc ions move to cathode • zinc ions gain electrons • zinc metal forms • as silver shiny solid formed • negative chloride ions move to anode • chloride ions lose electrons • chlorine forms • as (yellow-) green gas	**(6)**

Level	Mark	Descriptor
	0	No awardable material.
Level 1	1-2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) • Presents a description which is not logically ordered and with significant gaps. (AO1)
Level 2	3-4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) • Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) • Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)

(**Q06e 1SC0/1CF, SAM**)

Q16.

Question Number	Answer	Additional guidance	Mark
(i)	A diagram of a workable apparatus showing a complete circuit including • electrodes labelled in (copper sulfate) solution (1) • {power supply / power pack / battery} connected (1)	max 1 if circuit not complete allow labelling as 'electrodes' or 'anode' and 'cathode' or 'copper' ignore 'connected to mains' allow symbol for cell/battery even if wrong way round	(2) AO 1 2

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation linking the following point to a maximum of four • anode lost copper **and** cathode gained copper / reaction at cathode is reverse of reaction at anode / copper ions move into solution at anode AND copper ions move out of solution at cathode (1) and any three from • at anode copper atoms become copper ions (1) and lose **two** electrons (1) OR (at anode) $Cu \rightarrow Cu^{2+} + 2e$ (2) • at cathode copper ions become copper atoms (1) and gain **two** electrons (1) OR (at cathode) $Cu^{2+} + 2e \rightarrow Cu$ (2)	ignore references to zinc, chlorine and zinc chloride allow copper atoms are oxidised (1) marking points independently allow copper ions are reduced (1) marking points independently penalise wrong use of atom / ion once only penalise wrong use of reduced / oxidised once only	(4) AO 2 1

(**Q12 1SC0/1CH, June 2018**)

Q17.

	Answer	Acceptable answers	Mark
(i)	An explanation linking: Marking point 1 • {hydroxide/OH^-} ions (from water) (1) Marking point 2 • (ions) lose electrons /are	 half equation, even unbalanced, showing hydroxide ions losing electrons (2) do not allow marking point 1 if only {oxygen/sulfate} ions mentioned	(2)

	oxidised (1)		
(ii)	1.27 / 63.5 (1) (= 0.02)	0.02 with no working (1) correct working with incorrect answer (1)	**(1)**

(**Q36 1SC0/1CH, June 2013**)

Q18.

Question Number	Answer	Mark
(i)	**C** chlorine zinc **The only correct answer is C** ***A*** *is not correct because oxygen cannot be produced by the electrolysis of this molten salt* ***B*** *is not correct because hydrogen cannot be produced by the electrolysis of this molten salt* ***D*** *is not correct because hydrogen and oxygen cannot be produced by the electrolysis of this molten salt*	**(1)** AO 2 1

Question Number	Answer	Mark
(ii)	**D** it contains ions that can move **The only correct answer is D** ***A*** *is not correct because molten zinc chloride does not contain molecules* ***B*** *is not correct because molten zinc chloride does not have a giant structure* ***C*** *is not correct because delocalised electrons are not present*	**(1)** AO 1 1

(**Q11 1SC0/1CH, June 2018**)

Q19.

Question Number	Answer	Additional guidance	Mark
(i)	so that the ions can move	allow the solid does not conduct allow conducts when {in solution/liquid} ignore conducts when molten allow so cations / anions can move ignore so particles can move reject electrons move	**(1)** AO 2 2

Question Number	Answer	Mark
(ii)	OH^- and Cl^- only circled	**(1)** AO 1 1

Question Number	Answer	Additional guidance	Mark
(iii)	An explanation linking one of the following pairs of points • use a crucible/metal container (instead of a beaker) (1) • which will not break/melt (when heated strongly) (1) OR • add a Bunsen burner (under the container) (1) • because heat needed to melt the lead bromide / to make the lead bromide a liquid (1)	allow blow torch ignore hot water bath	**(2)** AO 3 3b

(**Q13 1SC0/1CF, June 2018**)

Q20.

	Answer	Acceptable answers	Mark
(i)	B H^+ and Na^+ ions		**(1)**
(ii)	An explanation linking • electron(s) (1) • (have been) lost/removed (1) conditional on electrons	ignore reference to number of electrons do not allow negative charge chlorine gains electrons (0) allow chlorine loses electrons (1)	**(2)**
(iii)	Any one from	ignore solution has pH greater than 7	**(1)**

	• it contains (excess) {hydroxide/OH^-} ions (1) • {sodium/Na^+} ions and {hydroxide/ OH^-} ions remain (1) • it is sodium hydroxide/NaOH (1) • {hydrogen/H^+} ions have been removed (at the cathode) (1)	allow no hydrogen ions left/acidic **ions**removed	
(iv)	use {molten/liquid} {sodium chloride /electrolyte} / melt {it/sodium chloride/electrolyte}	ignore just liquid/liquid sodium	**(1)**

(**Q35 1SC0/1CH, June 2013**)

Q21.

Question Number		Indicative Content	Mark
QWC	*	An explanation including some of the following points **copper chloride powder** • does not conduct • solid ionic compounds do not conduct • ions not free to move **copper chloride solution** • conducts • (ionic) solutions conduct • ions are free to move • red-brown solid is copper/copper produced at cathode • yellow green gas is chlorine/chlorine produced at anode **explanation in terms of ions for copper chloride solution** • negatively charged ions/chloride ions attracted to the anode • positively charged ions/copper ions attracted to the cathode More detailed explanation of electrode reactions/half equations not required but must be credited	**(6)**

Level	0	No rewardable content
1	1 - 2	• a limited explanation e.g. products are identified • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	• a simple explanation e.g. identifies the products and limited explanation of either powder or solution • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	5 - 6	• a detailed explanation e.g. a detailed explanation of copper chloride solution identifying the products • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

(**Q12 1SC0/1CF, June 2015**)

Q22.

Question Number	Answer	Acceptable answers	Mark
(i)	electrical (energy) / electricity / direct (electric) current		**(1)**

Question Number	Answer	Acceptable answers	Mark
(ii)	A description including • {light / ignite} gas / lighted splint (1) • gas burns / (squeaky) pop (if air is present) (1)	 reject glowing splint second mark conditional on first	**(2)**

(**Q01 5CH1H/01, June 2015**)

Q23.

Question Number		Indicative Content	Mark
QWC	*	A description / explanation including some of the following points marks can be scored from diagrams incorrectly balanced equations can be used as evidence of reaction occurring but po not otherwise credited **electrolysis process** • ions move when current passed • negative ions move to anode • overall decomposition of water • $2H_2O \rightarrow 2H_2+O_2$ **Anode/ positive electrode** • sulphate ions move to anode • hydroxide ions move to anode • hydroxide ions lose electrons/oxidation • hydroxide ions form oxygen • half equation: $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ • half volume gas at this electrode • oxygen test: glowing splint in gas relights **cathode/ negative electrode** • sodium ions move to cathode • hydrogen ions move to cathode • hydrogen ions gain electrons / reduction • hydrogen ions form hydrogen • half equation: $2H^+ + 2e^- \rightarrow H_2$ • double volume gas at this electrode • hydrogen test: lit splint in gas burns/ pops • hence double volume of hydrogen gas	**(6)**

Level	**0**	No rewardable content
1	**1 - 2**	• a limited description e.g. states which ions go to which electrode • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	**3 - 4**	• a simple explanation e.g. explain formation of one product • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	**5 - 6**	• a detailed explanation e.g. explaining formation of BOTH products at electrodes • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

(**Q11 5CH1H/01, June 2015**)

Q24.

Question Number	Answer	Acceptable answers	Mark
(i)	An explanation including • decomposing / breaking down of (compounds) (1) • using electrical energy / electricity /direct current /d.c. supply (1)	 allow 'splitting up' ignore 'separate' reject breaking down of elements	**(2)**

Question Number	Answer	Acceptable answers	Mark
(ii)	A description including • (damp blue) litmus • turns (red then) white / bleached	use of any suitable indicator (1) with correct result (1) eg universal indicator paper is bleached (2)	**(2)**

Question Number	Answer	Acceptable answers	Mark
(iii)	An explanation including any two of • (chlorine) could escape/leak (1) • (chlorine is) toxic / corrosive / poisonous (1) • an effect on people eg death / injury / damage lungs /damage eye	 Ignore 'chlorine is dangerous' Allow harmful to people	**(2)**

Question Number	Answer	Acceptable answers	Mark
(iv)	Any one of • (to make) plastics / PVC / bleach • to purify / sterilise water	 Ignore '(cleans) swimming pools'	**(1)**

(**Q03 1SC0/1CF, June 2015**)

Q25.

	Answer	Acceptable answers	Mark
(a)	Na^+ **and** Mg^{2+}	reject if any other ions are given allow names	**(1)**
(b)	An explanation linking (reduction is) gain of electrons(2)	if cathode gains electrons – 1 mark loss of oxygen – 1 mark	**(2)**
(c)	An explanation linking three of the following {ions / particles} cannot move in solid (1) {ions / particles} move **in molten liquid**/ lattice structure is **broken on melting**(1) {bromide (ions) / negatively charged (ions /bromine)} {move / attracted} to anode (1) bromide (ions) lose electrons / (bromide ions) are oxidised(1) to form bromine atoms (1) bromine molecules / Br_2 formed (1)	Half equation, even unbalanced, showing bromide ions losing electrons (2)	**(3)**

		Indicative Content
QWC	***(d)**	A description / explanation including some of the follo anode • the anode decreases in mass / size • copper atoms form ions by losing electrons • copper ions pass into electrolyte • oxidation takes place at the anode • (anode) sludge forms as • impurities {are left behind / fall to the bottom} electrode) cathode • the cathode increases in mass / size • copper ions gain electrons to form copper • pure copper deposits on the cathode • reduction takes place at the cathode electrolyte • copper sulfate solution does not change in col • no change in concentration of copper ions • copper ions in the electrolyte move toward the
Level	**0**	No rewardable content

1	**1 - 2**	• a limited description e.g. copper leaves the anode and deposits on the cathode. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description e.g. copper leaves the anode and deposits on the cathode and impurities fall to the bottom of the beaker. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description and explanation e.g. copper atoms from the anode lose electrons to form copper ions; copper ions are attracted to the cathode where they gain electrons to form pure copper. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(**Q44 1SC0/1CH, June 2013**)

Q26.

Question Number	Answer	Acceptable answers	Mark
(a)	improves resistance to corrosion	ignore rusting	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	An explanation to include • anode dissolves / half equation given / atoms lose electrons /copper becomes ions/copper (atoms) oxidised (1) • copper ions moving from anode to cathode (1) • copper plated on cathode / half equation given / ions gain electrons/copper ions reduced/copper ions form atoms (1) • {difference/0.2g} is impurities (1) • would expect same decrease in mass (as increase) (1)	ignore references to mass increase of cathode and mass decrease of anode ignore 'impure copper (ions)' for the second marking point allow difference is metal around it eaten away/ impurities/sludge fallen to bottom of container /under anode (1) (there needs to be a reference to the difference in electrode masses for this point)	**(3)**

Question Number	Answer	Acceptable answers	Mark
(c)	$2O^{2-} \rightarrow O_2 + 4e^{(-)}$ (2) OR $O^{2-} \rightarrow O + 2e^{(-)}$ (1) $2O \rightarrow O_2$ (1)	Unbalanced equation (1)	**(2)**

Question Number		Indicative Content	Mark
QWC	*** (d)**	A description including some of the following points • sodium chloride is melted and ions are free to move at cathode • {sodium / positive} ions move to cathode • (sodium) metal forms at cathode • sodium ions gain electrons ... • to form atoms • this is reduction • $Na^+ + e^- \rightarrow Na$ at anode • {chloride / negative} ions move to anode • (chlorine) gas forms at anode • chloride ions lose electrons ... • to form atoms • this is oxidation • two chlorine atoms combine to form a chlorine molecule / share electrons • $Cl^- \rightarrow Cl + e^-$ / $2Cl^- \rightarrow Cl_2 + 2e^-$ • $2\,Cl \rightarrow Cl_2$	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description e.g. gives at least one relevant description or explanation • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description e.g. for anode or cathode gives at least three descriptions or relevant explanations • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description e.g. for both anode and cathode gives a total of at least five descriptions or relevant explanations • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(**Q10 1SC0/1CH, June 2014**)

Q27.

Question Number	Answer	Acceptable answers	Mark
(a)	Cl^- and OH^-	Reject if any other ions given Allow names / chloride and hydroxide	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)	**D** lead and bromine		**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)	A explanation to include: oxidation is the loss of electrons (1) reduction is the gain of electrons (1)	 oxidation is the gain of electrons **AND** reduction is the loss of electrons (1)	**(2)**

Question Number	Answer	Acceptable answers	Mark
(d)	A explanation to include any two from: to put a layer of one metal onto another metal (1) change / improve the appearance (of metal objects) (1) improve the resistance to corrosion (of metal objects) (1) qualified reference to cost eg thin layer of expensive metal on cheaper metal (1)	 allow to give shiny appearance / look nicer allow prevents corrosion ignore rusting unless linked to iron/steel	**(2)**

(**Q12 5CH1H/01, June 2015**)

Q28.

Question Number	Answer	Acceptable answers	Mark
(i)	cathode Reject anode		**(1)**

Question Number	Answer	Acceptable answers	Mark
(ii)	A description to include ANODE/IMPURE COPPER/ +VE ELECTRODE • becomes smaller/ loses mass / loses copper / copper atoms form ions / copper is oxidised / copper (ions) enter solution (1) CATHODE/ PURE COPPER/ -VE ELECTRODE • {red-brown/copper} deposit/ becomes larger / gains mass / gains copper / copper ions are reduced / copper (ions) from solution add to electrode (1)	allow half equation allow half equation	**(2)**

Question Number	Answer	Acceptable answers	Mark
(iii)	**D** reduction		**(1)**

Question Number	Answer	Acceptable answers	Mark
(iv)	An explanation linking **<u>ions</u>** / cations / copper ions / anions / sulfate ions (1) (are free to) <u>move</u> (in solution) (1)	 **reject electrons** / atoms / molecules ignore 'charged particles' allow flow 2nd mark dependent on 1st MP	**(2)**

(**Q10 5CH1H/01, June 2015**)

Q29.

Question Number	Answer	Acceptable answers	Mark
(a)(i)	NaCl	Must be capital N, C; small a, l	**(1)**

Question Number	Answer	acceptable answers	Mark
(a)(ii)	as a coolant/ removes **heat** energy	(good) conductor of heat Ignore what would happen if no coolant eg 'meltdown' etc.	**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(i)	reduction Exact spelling required.		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(ii)	**A** ions can only move freely in molten lead bromide		**(1)**

Question Number	Answer	Acceptable answers	Mark
(b)(iii)	(lead bromide →) lead (1) + bromi**n**e (1)	reject bromide or any formulae ignore state symbols	**(2)**

Question Number	Answer	Acceptable answers	Mark
(c)(i)	**A** and **B** both required for mark.		**(1)**

Question Number	Answer	Acceptable answers	Mark
(c)(ii)	• **A** permanent hardness because scum/ no lather (even after boiling) (1) • **B** temporary hardness because lather /no scum (only) after boiling (1) • **C** soft because lather / no scum (before boiling) / does not conduct /no ions (1)	If no or some/all incorrect explanations, then allow: 3 correctly classified with 2 correct explanations = 3 marks 3 correctly classified with 1 correct explanation = 2 marks 3 correctly classified with 0 correct explanations = 1 Allow statements such as 'only in test 3' to mean 'after boiling'	**(3)**

(**Q12 1SC0/1CH, June 2014**)

Q30.

	Answer	Acceptable answers	Mark
(a)(i)	B H^+ and Na^+ ions		**(1)**
(a)(ii)	An explanation linking • electron(s) (1)	ignore reference to number of electrons do not allow negative charge	**(2)**

	• (have been) lost/removed (1) conditional on electrons	chlorine gains electrons (0) allow chlorine loses electrons (1)	
(a)(iii)	Any one from • it contains (excess) {hydroxide/OH^-} ions (1) • {sodium/Na^+} ions and {hydroxide/ OH^-} ions remain (1) • it is sodium hydroxide/NaOH (1) • {hydrogen/H^+} ions have been removed (at the cathode) (1)	ignore solution has pH greater than 7 allow no hydrogen ions left/acidic **ions**removed	**(1)**
(a)(iv)	use {molten/liquid} {sodium chloride /electrolyte} / melt {it/sodium chloride/electrolyte}	ignore just liquid/liquid sodium	**(1)**
(b)(i)	An explanation linking: Marking point 1 • {hydroxide/OH^-} ions (from water) (1) Marking point 2 • (ions) lose electrons /are oxidised (1)	half equation, even unbalanced, showing hydroxide ions losing electrons (2) do not allow marking point 1 if only {oxygen/sulfate} ions mentioned	**(2)**
(b)(ii)	1.27 / 63.5 (1) (= 0.02)	0.02 with no working (1) correct working with incorrect answer (1)	**(1)**

(**Q29 1SC0/1CH, June 2013**)

Q31.

	Answer	**Acceptable answers**	**Mark**
	an explanation linking the following • decomposition (of compound/substance /electrolyte)(1)	splitting up/breaking down/breaking up ignore separating reject splitting of	(2)

	• using (direct) current (1)	atoms/elements/molecules for M1 using {electrical energy /electricity} reject alternating current/ac	
	• (damp blue) litmus (paper) (1) • (turns red then) {bleaches / goes white} (1)	allow bleaches indicator for 1 mark ignore indicator goes lighter ignore smells of chlorine/swimming pools ignore any incorrect middle colour mentioned use of suitable named indicator with correct result e.g. (damp) universal indicator paper (1) (turns red then) bleaches (1) starch-iodide paper(1) turns blue-black(1)	(2)
	poly(chloroethene)	PVC/polyvinylchloride/ polychloroethene/poly(chlorethene)	(1)

(**Q05 1SC0/1CH, June 2013**)

Q32.

Question number	Indicative content	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** • Mg^{2+} and SO_4^{2-} ions are present in magnesium sulfate solution • water splits to form H^+ and OH^- ions • negative ions / anions move positive electrode / anode • sulfate ions / SO_4^{2-} and hydroxide / OH^- ions move to anode • can credit ions shown on diagram • hydroxide ions / OH^- lose electrons • loss of electrons is oxidation • hydroxide ions are oxidised • $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ • positive ions / cations move to negative electrode / cathode • magnesium ions / Mg^{2+} and hydrogen ions / H^+ move to cathode • hydrogen forms as it's less reactive than magnesium • hydrogen ions / H^+ gain electrons • gain of electrons is reduction • hydrogen ions are reduced • $2H^+ + 2e^- \rightarrow H_2$	**(6) AO1.1**

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

Level	Mark	Descriptor	Additional Guidance
	0	No rewardable material.	Read whole answer and ignore all incorrect material and any references to other metals / discard any contradictory material then:
Level 1	1–2	Additional Guidance Identifies ions from magnesium sulfate Identifies ions from water Identifies correct movement of ions Oxidation & reduction	Possible candidate response (all examples, not a definitive list) Mg^{2+} / SO_4^{2-} / H^+ / OH^- ions (any one ion) present (1) Identifies at least two ions present (2) Negative ions move to anode (1) Negative ions move to {anode/positive electrode} and positive ions move to {cathode/negative electrode} (2) Oxidation at anode and reduction at cathode (2)
Level 2	3–4	Additional Guidance Identifies one ion and states where it moves to during electrolysis Identifies at least 2 ions present and their movement during electrolysis Identifies H^+ or OH^-, states direction of movement and product formed Describes oxidation and reduction	Possible candidate response Mg^{2+} present and moves to cathode (3) Mg^{2+} and SO_4^{2-} ions are present, Mg^{2+} moves to negative electrode, SO_4^{2-} moves to the positive electrode (4) Hydrogen ions present, move to negative electrode / cathode and form hydrogen (4) Oxidation is loss of electrons at anode; reduction is gain of electrons at cathode (4)

Level 3	5–6	<u>Additional Guidance</u> Identifies both H^+ and OH^-, states direction of movement and products formed Identifies all ions present and gives the direction of movement to correct electrodes Identifies at least one cation **and** at least one anion, states direction of movement of ions, what happens at electrode (loss/gain of electrons) for one ion and identifies product Identifies at least one cation **and** at least one anion, states direction of movement of both ions, what happens at electrode (loss/gain of electrons or reduction/oxidation) for both ions and identifies products; MAY attempt half equations, but not essential Correctly write both half equations	<u>Possible candidate response</u> Hydrogen ions and hydroxide ions present, H^+ move to negative electrode form hydrogen, OH^- move to anode and form oxygen (5) Magnesium, sulfate, hydrogen and hydroxide ions are present, the magnesium and hydrogen ions move towards the negative electrode, sulfate and hydroxide move towards the positive electrode (5) Mg^{2+} ions are present; H^+ move to cathode, the H^+ gain electrons OR are reduced to form H_2. (5) Mg^{2+} and SO_4^{2-} are present from the magnesium sulfate, H^+ and OH^- are present from the water. Mg^{2+} and H^+ move to cathode, the H^+ gains electrons and is reduced to form H_2. (6) Mg^{2+} and SO_4^{2-} are present from the sodium sulfate, H^+ and OH^- are present from the water. Na^+ and H^+ move to cathode, the hydrogen is reduced to form H_2. OH^- and SO_4^{2-} move to anode and oxygen is produced; $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ (6) $2H^+ + 2e^- \rightarrow H_2$ and $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ (6)

(**QU05c 1SC0/1CH, June 2025**)

Q33.

Question number	Answer	Additional guidance	Mark
(i)	An explanation linking • at anode copper / atoms {lose electrons / oxidised} / (copper) ions leave anode (– cause mass loss) (1) • (copper) ions (in solution) move to cathode (1) • At cathode (copper) **ions** {gain electrons / reduced} (- cause mass increase) (1)	allow Cu → $Cu^{2+} + 2e^{(-)}$ reject mass loss is due to loss of electrons ignore copper dissolves allow $Cu^{2+} + 2e^{(-)} \rightarrow$ Cu reject mass gain is due to gain of electrons if no other mark scored allow oxidation at anode and reduction at cathode (1)	**(3)** AO3-2

Question number	Answer	Additional guidance	Mark
(ii)	An explanation linking • mass of copper increased by {3x / calculated 2.34/0.78} (=3) (1) • (so) need (3x) / more {current / voltage} passing through solution (1)	allow need (3 x) {greater surface area of electrode / larger electrode / greater concentration (of copper sulfate solution)} / reduce distance between electrodes allow power in place current or voltage 3x { current / voltage / power }= 2 marks	**(2)** AO2-2

(**QU03c 1SC0/1CH, June 2022**)

Q34.

Question Number	Answer	Additional guidance	Mark
	An explanation linking: • (calcium) nitrate {is soluble/ dissolves}/ (calcium) carbonate {is insoluble/ does not dissolve} (1) • so **ions** {free to move in solution / not free in solid} (1)	calcium nitrate dissolves so ions can move (2) or reverse argument for calcium carbonate	**(2)**

(**Q06c 1SC0/1CF, June 2019**)

Q35.

Question number	Answer	Mark
	An explanation that combines identification – understanding (1 mark) and reasoning/justification – understanding (3 marks): • hydrogen (H^+) and sodium (Na^+) ions attracted to cathode, hydroxide (OH^-) ions and sulfate (SO_4^{2-}) ions attracted to anode (1) • because the ions are attracted to the oppositely charged electrode (1) • 2 hydrogen ions/2 H^+ accept 2 e to form hydrogen molecule/H_2 (1) • 4 hydroxide ions/4 OH^- lose 4 e to form oxygen molecule/O_2 (1)	**(4)**

(**Q04c 1SC0/1CH, SAM 2016**)

Q36.

Question Number	Indicative content	Mark
	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1.2** • copper atoms form copper ions at anode • (copper atoms are oxidised / lose electrons) • $Cu \rightarrow Cu^{2+} + 2e$ • copper ions pass into solution • copper ions move to / are attracted by the cathode • cathode increases in size / gains mass • pink/ brown colour on the surface of the cathode • solid copper deposited on the cathode • (copper ions are reduced/gain electrons) • copper ions form copper atoms • $Cu^{2+} + 2e \rightarrow Cu$ • copper sulfate solution is blue colour • colour remains same since for every copper ion entering the solution at the anode, one is removed from the solution at the cathode • concentration of copper sulfate (solution) remains the same • solid is the insoluble impurities falling from the anode	**(6)**

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) • Presents a description which is not logically ordered and with significant gaps. (AO1)
Level 2	3-4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) • Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) • Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)

Marker Guidance			
Level	**Mark**	**Additional Guidance**	**General additional guidance – the decision within levels** Eg - At each level, as well as content, the scientific coherency of what is stated backed up by further detail will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	Additional guidance A simple statement about one of the three observations	Possible candidate responses • the cathode increases in size and anode decreases in size • solid beneath the anode is the impurities • the amount of copper in solution stays the same / same blue colour throughout
Level 2	3–4	Additional guidance Explains at least one of the observations OR gives two or more partial explanations	Possible candidate responses • solid copper deposits on the cathode, so size increases • solid beneath the anode is the insoluble impurities • copper ions moving and direction from anode to cathode
Level 3	5–6	Additional guidance Explains at least two observations OR at least one in detail	Possible candidate responses • the ions move to the correct electrodes linked with the correct change in size • colour does not change since copper ions enter solution at anode copper ions removed from solution at cathode • copper atoms form copper ions at the anode and pass into the solution, so size of anode decreases; copper ions in the solution are attracted to the cathode

(**Q06d 1SC0/1CF, June 2019**)

Q37.

Question number	**Answer**	**Additional guidance**	**Mark**
	An explanation linking • (electrodes) cleaned (using emery paper) (or similar) (1) • to remove {surface oxide / grease / impurities} (1)	 allow scrubbed allow dip / wash into named organic solvent allow dirt / other substances reject rust	**(2)** AO1-2

(**QU03b 1SC0/1CH, June 2022**)

Q38.

Question number	Answer	Additional Guidance	Mark
	An explanation including: • the copper (ions are) neither oxidised nor reduced (1) • the copper (ions) do not lose **or** gain electrons/ Cu^{2+} present at start and end (1)	mark independently with no ecf allow copper oxide not oxidised or reduced allow 'neither' allow copper (ions) have **same** number of electrons/ have **same** charge ignore references to spectator ions	**AO1 1 (2)**

(**QU05e 1SC0/1CH, June 2023**)

Q39.

Question Number	Answer	Mark
	An explanation that combines identification via a judgment (1 mark) to reach a conclusion via justification/reasoning (1 mark) • solution is alkaline (1) • excess hydroxide ions are present / sodium and hydroxide ions in solution / sodium hydroxide solution formed (1)	**(2)**

(**Q03c 1SC0/1CH, SAM**)

Q40.

Question Number	Answer	Mark
	An explanation that combines identification - application of knowledge (1 mark) and reasoning/justification - application of understanding (1 mark): • sodium and chloride ions present (1) • these ions can move (in solution) (1)	(2)

(**Q06d 1SC0/1CF, SAM**)