AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.4.3.1

The process of electrolysis

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**39**
Available paper years	**2008–2025**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

4.4.3.1 The process of electrolysis

Answer 01 · Mark scheme

January 2008 | CHY2F | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
(a)(i)	ionic		1
(a)(ii)	elements		1
(b)(i)	chlorine (gas)	allow Cl_2 / Cl / Cl^2 allow chloride	1
(b)(ii)	hydrogen (gas)	allow H / H_2 / H^2	1
(b)(iii)	sodium hydroxide (solution)	allow NaOH allow sodium solution	1
total			5

4.4.3.1 The process of electrolysis

Answer 01 · Mark scheme January 2008 | CHY2F | Original Q4 | Legacy

CHY2F

Answer 02 · Mark scheme March 2008 | CHY1AP | Original Q5 | Legacy

Five	**A**	iron	**2**
	B	aluminium	**3**
	C	copper	**4**
	D	gold	**1**

Answer 03 · Mark scheme June 2008 | CHY2F | Original Q4 | Legacy

question	answers	extra information	mark
4(a)	the bag gets cold because heat energy is taken in from the surroundings		1
4(b)	endothermic		1
4(c)	any **two** from: • mix / spread (the ammonium nitrate and water) • dissolve faster • get cold faster **or** so the whole bag gets cold • particles collide more **or** more collisions	allow increase rate **or** quicker reaction	2
Total			**4**

4.4.3.1 The process of electrolysis

Answer 03 · Mark scheme

June 2008 | CHY2F | Original Q4 | Legacy

COMPONENT NUMBER: CHY2F

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: June 2008

4.4.3.1 The process of electrolysis

Answer 04 · Mark scheme June 2008 | CHY2F | Original Q8 | Legacy

question	answers	extra information	mark
8(a)	(propanone) has a low(er) boiling point **or** (propanone) evaporates fast(er) owtte	**or** water has a high(er) boiling point **or** water evaporates slow(er) allow propane / solution / it allow evaporates at lower temperature **or** boils quicker ignore density / reactivity / melting point	1
8(b)(i)	0.29	ignore + **or** – ignore units	1
8(b)(ii)	any **two** sensible suggestions eg: • weighing error • (copper) lost during washing owtte • (copper) lost during electrolysis / reaction owtte • electrodes not completely dry • impurities in the electrode • copper falling off when removing electrode / copper from cell	 accept human error **or** inaccurate measurements allow different washing of electrodes ignore timing errors ignore 'fair test' ignore sludge ignore gases produced	2

Question 8 continued on next page…

4.4.3.1 The process of electrolysis

Answer 04 · Mark scheme

COMPONENT NUMBER: CHY2F

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: June 2008

Question 8 continued…

question	answers	extra information	mark
8(c)	any **four** from: • impure copper is anode / positive (electrode) • pure copper is cathode / negative (electrode) • copper sulfate solution **or** any soluble copper salt in solution • copper loses electrons **or** copper is oxidised • copper forms positive ions / particles • copper gains electrons **or** copper reduced at negative electrode • copper attracts to / collects at negative electrode • sludge / impurities collect at the bottom owtte • impurities not attracted to electrode	as alternative to these two points $Cu \rightarrow Cu^{2+} + 2e^{-}$ = **2** marks **or** $Cu^{2+} + 2e^{-} \rightarrow Cu$ at negative electrode allow sludge left behind **or** sludge left in solution **or** impurities separated from copper ignore get rid of impurities	4
Total			**8**

4.4.3.1 The process of electrolysis

Answer 05 · Mark scheme

June 2009 | CHY2F | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	covalent		1
4(b)(i)	liquid		1
4(b)(ii)	fluorine	accept F / F_2 do **not** accept fluoride	1
4(c)(i)	should fluoride ions be added to drinking water?		1
4(c)(ii)	any **one** from: • not enough reliable/valid evidence • may be other factors involved • it is an opinion / choice / belief / ethics issue • it can't be scientifically investigated	mark independently of (c)(i) allow can't do an experiment ignore test	1
Total			**5**

4.4.3.1 The process of electrolysis

Answer 05 · Mark scheme

June 2009 | CHY2F | Original Q4 | Legacy

CHY2F

Answer 06 · Mark scheme

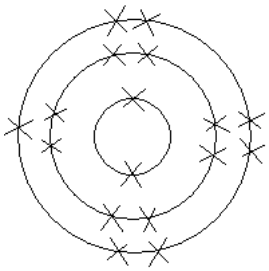
November 2009 | CHY1AP | Original Q9 | Legacy

Nine	**4**	**3**	**2**	**1**

4.4.3.1 The process of electrolysis

Answer 07 · Mark scheme

Question 7

question	answers	extra information	mark
7(a)		accept dots / crosses / e must be drawn on diagram electrons do not need to be paired ignore brackets or + or −charges ignore 2,8,7	1
7(b)	(one) electron lost / given away / transferred from sodium / transferred to chlorine owtte	recognition that electrons are involved must be linked to electrons accept loses electron(s) for **2** marks NB loses 2 or more electrons gains **1** mark reference to sharing / covalent max **1** mark ignore charges on ions formed	1 1
7(c)(i)	any **one** from: • ions / atoms / they are / it is negatively charged / anions • opposite (charges) attract	 accept they are negative accept they are attracted or it is oppositely charged ignore opposite forces attract	1
7(c)(ii)	hydrogen	accept H_2 ignore H or H^+	1

Question 7 continues on next page

CHY2F

Question 7 continued

question	answers	extra information	mark
7(d)(i)	poisons released into environment (owtte)	accept any sensible idea of harm / harmful / poisons / poisonous / pollution / damaging do **not** accept answers such as global warming / ozone layer etc. ignore safety unless qualified	1
7(d)(ii)	any **one** sensible idea eg • loss of work / unemployment **or** company goes out of business • any adverse effect on local economy (owtte) • any adverse effect on paper production / cost of paper / cost of water (treatment) • chlorine (compounds) have been used (for many years) without causing harm owtte • only a tiny amount of chlorine is released so it would not cause harm	eg shops / house prices etc. allow less expensive to use chlorine or converse ignore uses of chlorine to treat drinking water unless qualified	1
7(d)(iii)	ideas related to bias	accept more reliable or valid or fair ignore more accurate / fair test	1
Total			**8**

4.4.3.1 The process of electrolysis

Answer 07 · Mark scheme January 2010 | CHY2F | Original Q7 | Legacy

CHY2F

Answer 08 · Mark scheme March 2010 | CHY1AP | Original Q2 | Legacy

Two	**A**	iron	**3**
	B	aluminium	**4**
	C	gold	**1**
	D	stainless steel	**2**

4.4.3.1 The process of electrolysis

Answer 09 · Mark scheme

June 2010 | CHY2F | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)(i)	(different) properties	allow ideas of different property / behaviour / element	1
7(a)(ii)	any **one** from: • they had high status **or** they were lecturers / doctors / professors / famous scientists • other scientists repeated experiments • they had proof **or** lots of / strong / conclusive / enough / clear evidence	they = Crawford + Cruikshank allow experiment could be repeated allow other scientists showed they had different properties ignore evidence unqualified	1
7(a)(iii)	other scientists obtained similar results / proved it **or** experiments were repeated		1

Question 7 continues on the next page

4.4.3.1 The process of electrolysis

CHY2F

Question 7 continued

question	answers	extra information	mark
7(b)(i)	any **one** from: • mass of solid / strontium (chloride) / barium (chloride) • volume of water • type of container	allow amount / volume allow amount / mass allow initial / starting temperature (of water) ignore room temperature / time / concentration ignore reference to hydrochloric acid	1
7(b)(ii)	2 **and** takes in heat / energy **or** 2 **and** temperature goes down (owtte)		1
7(b)(iii)	temperature increased for one experiment and decreased for the other (owtte) **or** one was exothermic and one was endothermic (owtte)	accept experiment 1 was exothermic	1
7(c)	any **one** from • positive / + (charge) • opposite (charges) attract	do **not** accept incorrect further qualification eg electrons / atoms / electrodes	1
Total			**7**

4.4.3.1 The process of electrolysis

Answer 10 · Mark scheme

November 2010 | CHY1AP | Original Q5 | Legacy

Five	**A**	uses another metal	**3**
	B	does **not** use a chemical reaction	**2**
	C	could be done in a blast furnace	**4**
	D	is called electrolysis	**1**

	A	**B**	**C**	**D**

4.4.3.1 The process of electrolysis

Answer 11 · Mark scheme

Question 6

question	answers	extra information	mark
6(a)(i)	low percentage / very little of metal (in the ore)	accept only 0.5% metal in the ore **or** over 99% waste in the ore **or** nearly 100% waste in the ore ignore reference to percentage of metal in the Earth's crust **or** energy used or pollution	1
6(a)(ii)	any **one** from • iron uses less energy / fuel for extraction • iron has more uses • more demand for iron • iron is stronger • cheaper / costs less • easier to extract	(it = iron) ignore electrolysis / uses electricity / reactivity ignore high abundance in the Earth's crust / high percentage of metal in ore ignore harder	1
6(b)(i)	has melting point lower than 950°C	(it = aluminium) allow has a low melting point ignore boiling point	1
6(b)(ii)	electrode(s) made of carbon oxygen reacts with electrode(s) / carbon	 accept $C + O_2 (\rightarrow CO_2)$ NB oxygen reacts with the carbon electrode(s) = **2** marks	1 1

Question 6 continues on the next page

4.4.3.1 The process of electrolysis

CHY1F

Question 6 contd

question	answers	extra information	mark
6(b)(iii)	any **two** from: • saves resources / non renewable • landfill problem • saves energy / fuel / electricity • less carbon dioxide / carbon emissions or reduces carbon footprint • less quarrying / mining	accept aluminium / ore will run out or conserves aluminium accept aluminium does not corrode ignore global warming ignore consequences of quarrying / mining ignore pollution / harms environment / costs / easy to recycle	2
Total			**7**

4.4.3.1 The process of electrolysis

Answer 11 · Mark scheme

January 2011 | CHY1F | Original Q6 | Legacy

CHY1F

4.4.3.1 The process of electrolysis

Answer 12 · Mark scheme

January 2011 | CHY2F | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	diagram **A**		1
3(b)	the atoms can slide over each other. the atoms are in layers		1 1
3(c)(i)	sulfuric		1
3(c)(ii)	bubbles are produced the magnesium disappears		1 1
3(c)(iii)	crystallisation		1
Total			7

4.4.3.1 The process of electrolysis

Answer 12 · Mark scheme

January 2011 | CHY2F | Original Q3 | Legacy

CHY2F

4.4.3.1 The process of electrolysis

Answer 13 · Mark scheme

Question 6

question	answers	extra information	mark
6(a)	the ions can move / travel / flow / are free **or** the ions carry the charge / current	accept particles / they for ions allow delocalised ions ignore delocalised / free electrons ignore references to collisions accept converse with reference to solid ignore ions carry electricity	1
6(b)	any **one** from: • because they are negative / anion • opposite charges / attract	allow Cl^- ignore chlorine	1
6(c)	13		1
6(d)(i)	reasonable attempt at straight line which misses the anomalous point	must touch all five crosses do **not** allow multiple lines	1
6(d)(ii)	40	ignore 2.2	1

Question 6 continues on the next page

CHY2F

Question 6

question	answers	extra information	mark
6(d)(iii)	any **two** sensible errors from: • gas escapes • weighing error • error in measuring (volume / amount) of hydrogen • error in measuring (volume / amount) of water • incorrect concentration • timing error • change in voltage / current • change in temperature • recording / plotting error	ignore systematic / human / apparatus / zero /experimental / random / measurement / reading errors unless qualified allow NaCl not measured correctly allow error in measuring volume / scale for **1** mark if neither hydrogen or water mentioned allow NaCl not fully dissolved **or** spilled **or** impure allow faulty power supply	2
6(d)(iv)	any **one** from: • repeat the experiment • results compared with results from /other students / other groups / other laboratories / internet / literature. • results compared with another method	ignore 'do more tests'	1
6(d)(v)	increases owtte	allow directly proportional or positive correlation allow rate / it is faster / quicker	1
Total			**9**

4.4.3.1 The process of electrolysis

Answer 13 · Mark scheme

January 2011 | CHY2F | Original Q6 | Legacy

CHY2F

4.4.3.1 The process of electrolysis

Answer 14 · Mark scheme

June 2011 | CHY1F | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)(i)	heat / high temperature / hot / vaporise	if (fractional) distillation / hydrogenation mentioned as the method = max 1 allow thermal decomposition ignore evaporation do **not** accept 'burns' do **not** accept temperature < 100	1
	catalyst **or** silica / alumina / porous pot **or** steam	ignore other named catalyst allow heat (the vapour) to a very high temperature / >800°C for **2** marks	1
7(a)(ii)	C_2H_3Cl	ignore attempts to balance equation	1
7(a)(iii)	single bonds between C – H, C – Cl **and** C – C	do **not** accept symbols outside the bracket	1
7(b)(i)	so that the amount of plasticiser / (sample of) PVC is the independent / only variable that affects the bending / flexibility of the samples	allow because different sizes would give different results accept because size is a control variable ignore references to reliability / precision etc	1
7(b)(ii)	to improve the reliability (of the investigation)	accept to calculate a mean accept to check for anomalous results **or** to check the range of results ignore accuracy / precision etc	1

Question 7 continues on the next page

4.4.3.1 The process of electrolysis

Question 7 continued

question	answers	extra information	mark
7(b)(iii)	23	correct answer with or without working = **2** marks if answer is incorrect allow $\frac{22+23+24}{3}$ **or** 21 for **1** mark	2
7(b)(iv)	(PVC) sample had been stretched / used / tested in first three tests	accept higher temperature allow worn **or** become weaker ignore (human) error ignore more flexible / softer ignore intermolecular forces	1
7(c)	does not bend (easily / much) **or** it is not flexible **or** it is rigid	ignore non-biodegradable / low maintenance ignore sturdy / stronger / harder	1
Total			**10**

The AQA UMS Conversion Calculator is available on the Results statistics page of the AQA Website

4.4.3.1 The process of electrolysis

Answer 15 · Mark scheme

November 2011 | CHY1AP | Original Q9 | Legacy

Nine	**3**	**2**	**1**	**2**

4.4.3.1 The process of electrolysis

Answer 16 · Mark scheme

January 2012 | CH1FP | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)	reduction		1
2(b)	carbon is less reactive than aluminium		1
2(c)	aluminium (ions) / they are positively charged so they are attracted **or** they move towards the negative electrode **OR** aluminium (ions) / they need to gain electrons (1) which come from the negative electrode (1)	they = aluminium ions ignore particle names accept aluminium (ions) / they are cations allow aluminium (ions) / they have an opposite charge if no other marks awarded allow 'opposites attract' for **1** mark	 1 1
2(d)	aluminium has a low density aluminium is resistant to corrosion		1 1
2(e)	**advantage** less carbon dioxide is produced **disadvantage** used aluminium cans have to be collected and transported		1 1
Total			**8**

4.4.3.1 The process of electrolysis

Answer 16 · Mark scheme

January 2012 | CH1FP | Original Q2 | Legacy

CH1FP

4.4.3.1 The process of electrolysis

Answer 17 · Mark scheme

June 2012 | CH1FP | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)	any **one** from: • there are many stages needed (to extract titanium) • more energy / materials are needed (to extract titanium) • titanium cannot be extracted by using carbon	ignore references to cost / mining / availability allow longer / slower / more complicated process / batch process ignore higher temperature ignore reference to electrolysis do **not** accept titanium extracted by electrolysis	1
7(b)	carbon dioxide	allow CO_2	1
7(c)	magnesium chloride is electrolysed / used / decomposed magnesium and / or chlorine are recycled / reused	 allow the products of electrolysis are recycled word / symbol equation = **1** mark	1 1
7(d)	 because oxygen / nitrogen (in air) would react with the magnesium **or** would produce magnesium oxide / nitride whereas argon is inert / unreactive **or** argon does not react with magnesium	accept titanium for magnesium ignore argon is in Group 0 / noble gas	 1 1
7(e)	240		1
7(f)	250	allow range 245 to 250	1
Total			**8**

4.4.3.1 The process of electrolysis

Answer 17 · Mark scheme

June 2012 | CH1FP | Original Q7 | Legacy

CH1FP

4.4.3.1 The process of electrolysis

Answer 18 · Mark scheme June 2012 | CH2FP | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	cryolite		1
4(a)(ii)	lower the melting point of the aluminium oxide		1
4(b)(i)	opposite charges **or** oxide ions are negative attract		1 1
4(b)(ii)	carbon		1
4(b)(iii)	reacts with oxygen **or** forms carbon dioxide	accept burns	1
4(c)	**Structure mark**: **either** Al (atoms) in layers / rows **or** alloy (atoms) not in layers / rows **Sliding mark**: **either** so (Al layers) can slide **or** so (alloy) layers cannot slide	 accept Al (atoms) all the same size allow Al (atoms) in lines accept different sizes of atoms in alloy allow alloy (atoms) not in lines	1 1
Total			**8**

4.4.3.1 The process of electrolysis

Answer 18 · Mark scheme

June 2012 | CH2FP | Original Q4 | Legacy

CH2FP

4.4.3.1 The process of electrolysis

Answer 19 · Mark scheme

January 2013 | CH2FP | Original Q8 | Legacy

question	answers	extra information	mark
8(a)(i)	because they are positively charged	accept they are positive / H^+ accept oppositely charged **or** opposites attract ignore they are attracted	1
8(a)(ii)	gains one / an electron	accept $H^+ + e^- \rightarrow H$ or multiples allow gains electrons	1
8(b)	3 bonding pairs 1 lone pair	 accept 2 non-bonding electrons on outer shell of nitrogen	1 1
8(c)(i)	hydroxide / OH^-	do **not** accept sodium hydroxide	1
8(c)(ii)	$H^+ + OH^- \rightarrow H_2O$	ignore state symbols ignore word equation	1

4.4.3.1 The process of electrolysis

January 2013

CH2FP

question	answers	extra information	mark
8(d)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5.		6

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant content.	There are basic descriptions of advantages or disadvantages of the electrolysis cells.	There are clear descriptions of environmental or economic advantages or disadvantages of the electrolysis cells. Comparisons may be implied.	There are detailed descriptions of environmental and economic advantages and disadvantages, comparing the electrolysis cells.

examples of chemistry points made in the response:

Accept converse where appropriate.

- mercury cell is more expensive to construct
- mercury is recycled but membranes must be replaced
- mercury is toxic but membrane / polymer is not
- removing traces of mercury from waste is expensive
- mercury cell uses more electricity
- mercury cell produces chlorine that is purer
- mercury cell produces higher concentration / better quality of sodium hydroxide (solution)

Total			12

UMS conversion calculator www.aqa.org.uk/umsconversion

4.4.3.1 The process of electrolysis

Answer 20 · Mark scheme

June 2013 | CH1FP | Original Q7 | Legacy

Question 7

question	answers	extra information	Mark
7(a)	any **two** from: • copper / ores are running out / harder to find • there are no / very small amounts of high-grade copper ores left • copper metal is in demand • copper is expensive • now economical to extract copper from low-grade ores	it = copper allow new methods of extraction e.g. bioleaching and phytomining allow high-grade ores are running out for **2** marks	2
7(b)(i)	large amounts / 98% of rock to dispose of as waste **or** waste rock takes up a lot of space	accept contains toxic (metal) compounds / bioleacher	1
7(b)(ii)	(copper sulfide reacts with oxygen to) produce sulfur dioxide / SO_2 that causes acid rain	allow (sulfur reacts with oxygen to) produce sulfur dioxide / SO_2 allow description of effects of acid rain **or** sulfur dioxide if no other mark awarded allow CO_2 produced which causes global warming **or** CO_2 produced by burning fuel or heating the furnace for **1** mark	1 1
7(b)(iii)	any **one** from: • large amounts of fuels / energy used (for the furnace and electrolysis) • (the extraction has) many steps / stages / processes • large amounts of ore / material have to be mined	allow large amounts of electricity needed ignore high temperature / electrolysis unqualified allow (extraction) is a long process / takes a lot of time allow ores contain a low percentage of copper	1

Question 7 continues on the next page

4.4.3.1 The process of electrolysis

Question 7 continued

question	answers	extra information	Mark
7(b)(iv)	(copper ions move towards) the negative electrode / *cathode*		1
	because copper ions / Cu^{2+} are positively charged **or** are oppositely charged **or** copper ions need to gain electrons	allow because metal ions are positive **or** opposites attract	1
7(b)(v)	(growing) plants		1
Total			**9**

4.4.3.1 The process of electrolysis

Answer 21 · Mark scheme June 2013 | CH2FP | Original Q4 | Legacy

Question 4

question	answers	extra information	Mark
4(a)(i)	was well qualified		1
4(a)(ii)	check the results of the experiment		1
4(b)(i)	cannot move		1
4(b)(ii)	melt it / make it a liquid	allow heat it allow dissolve (in water) / make a solution	1
4(b)(iii)	they are positive	allow opposites attract **or** opposite charges	1
4(b)(iv)	atoms		1
Total			**6**

4.4.3.1 The process of electrolysis

Answer 22 · Mark scheme June 2014 | CH1FP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
5(a)(i)	economical		1	1 / 1.3.1a	A
5(a)(ii)	phytomining		1	1 / 1.3.1g	A
5(a)(iii)	carbon dioxide		1	1 / 1.3.1d/f	A
5(b)(i)	copper / Cu iron sulfate / $FeSO_4$		1 1	2 / 1.3.1h	E
5(b)(ii)	copper/ ions have a positive charge	it = copper ions allow copper ions have a different charge accept copper / ions are free to move accept to gain electrons accept copper / ions are attracted to the negative electrode **or** opposite charges attract	1	1 / 1.3.1h	E
5(c)	any **two** from: • copper ores are limited / running out • copper can be recycled • copper can be reused • copper is expensive • landfill sites are filling up • copper compounds are toxic	ignore not biodegradable or does not decay allow copper is running out allow copper is toxic	2	3 / 1.3.1j	E
Total			**8**		

4.4.3.1 The process of electrolysis

Answer 22 · Mark scheme

June 2014 | CH1FP | Original Q5 | Legacy



4.4.3.1 The process of electrolysis

Answer 23 · Mark scheme June 2014 | CH2FP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
5(a)(i)	ions cannot move	*allow only conducts as a liquid*	1	1 / 2.7.1a	E
5(a)(ii)	chlorine		1	2 / 2.7.1b	G
5(a)(iii)	they are positively / oppositely charged **or** they are attracted		1	1 / 2.7.1c	E
5(a)(iv)	2		1	2 / 2.7.1e	G
5(b)(i)	any **one** from: • not all the magnesium was collected • *used less time* ***or*** *lower current* ***or*** *different battery / power pack* ***or*** *different balance* ***or*** *lower voltage* • error in reading balance • error in recording result	*allow some magnesium was lost*	1	3 / 2.7.1	E
5(b)(ii)	1.11	correct answer with or without working gains **2** marks. if answer incorrect, allow **1** mark for 0.99 **or** for 1.13+1.11+1.09	2	2 + 3 / 2.7.1	E
5(c)(i)	*25 – 25.3*	correct answer with or without working gains **2** marks. If answer incorrect, allow **1** mark for 24/95	2	2 / 2.3.3a	E
5(c)(ii)	71		1	2 / 2.3.1f	A
5(d)(i)	reversible reaction		1	1 / 2.3.3f	A
5(d)(ii)	decreases		1	1 / 2.5.1c	A
Total			**12**		

4.4.3.1 The process of electrolysis

Answer 23 · Mark scheme

June 2014 | CH2FP | Original Q5 | Legacy



4.4.3.1 The process of electrolysis

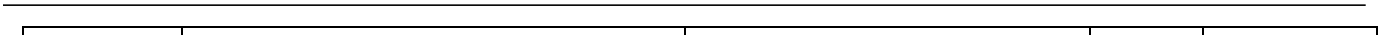
Answer 24 · Mark scheme June 2015 | CH2FP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	any **one** from: • protection/improve lifespan • improve appearance		1	**AO2** 2.7.1d
4(b)(i)	Bleach		1	**AO1** 2.7.1i
4(b)(ii)	Hydrogen is less reactive than sodium.		1	**AO2** 2.7.1f
4(b)(iii)	1 bonding pair of electrons 6 unbonded electrons on Cl	accept dot, cross or e or – or any combination	1	**AO1** 2.7.1e
4(b)(iv)	Covalent		1	**AO1** 2.7.1f
4(b)(v)	Hydrogen chloride has a low boiling point. Hydrogen chloride is made of simple molecules.		1 1	**AO1** 2.2.1a 2.1.1g
4(c)(i)	oxygen	accept carbon dioxide	1	**AO1** 2.7.1h
4(c)(ii)	aluminium ions are positive so are attracted (to the negative electrode)	allow opposites attract	1 1	**AO1/AO2** 2.7.1h 2.2.2b
4(c)(iii)	Reduction		1	**AO1** 2.7.1e
4(c)(iv)	slide	allow move	1	**AO1** 2.2.4b
4(d)(i)	C		1	**AO1** 2.2.3a,c
4(d)(ii)	strong covalent bonds		1	**AO1** 2.2.3a
Total			**14**	

4.4.3.1 The process of electrolysis

Answer 24 · Mark scheme

June 2015 | CH2FP | Original Q4 | Legacy



4.4.3.1 The process of electrolysis

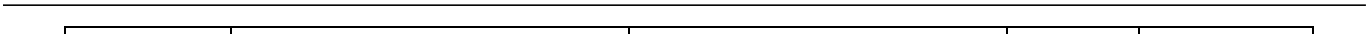
Answer 25 · Mark scheme June 2016 | CH2FP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / SpecRef
3(a)	electricity	allow an electric current	1	AO1 2.7.1a; 2.2.2b
3(b)(i)	chlorine/Cl_2	do **not** accept chloride	1	AO2 2.7.1b
3(b)(ii)	(zinc ions are) positive and (opposite charges) attract	ignore to gain electrons	1 1	AO1/AO2 2.7.1c
3(b)(iii)	reduction		1	AO1 2.7.1e
3(c)(i)	in alloy: different sized atoms/particles **or** no layers/rows so cannot slide	accept converse accept layers distorted	 1 1	AO1/AO2 2.2.4b,c
3(c)(ii)	shape memory (alloys)	accept smart	1	AO1 2.2.4d
Total			**8**	

4.4.3.1 The process of electrolysis

Answer 25 · Mark scheme

June 2016 | CH2FP | Original Q3 | Legacy



4.4.3.1 The process of electrolysis

Answer 26 · Mark scheme June 2017 | CH2FP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	58.5		1	AO2 2.5.1b
4(b)	water		1	AO2 2.3.3a
4(c)(i)	prevents loss of thermal energy	allow prevents heat loss	1	AO1 2.6.1
4(c)(ii)	13/thirteen		1	AO3 2.5.1
4(c)(iii)	temperature changes/results are all similar	accept no anomalous results allow they are all similar do **not** accept temperature	1	AO2 2.5.1
4(c)(iv)	exothermic	allow giving out energy	1	AO3 2.5.1
4(d)(i)	ions move	allow they move ignore free ions do not accept movement of electrons	1	AO1 2.7.1a 2.2.2b
4(d)(ii)	(chloride ions are) negative	accept opposites attract do **not** accept chlorine is negative	1	AO1 2.7.1c
4(d)(iii)	Tick (✓) by: soap		1	AO1 2.7.1i
4(d)(iv)	1 bonding pair of electrons 6 unbonded electrons on Cl	accept dot, cross, e or – or any combination	1 1	AO2 2.1

4.4.3.1 The process of electrolysis

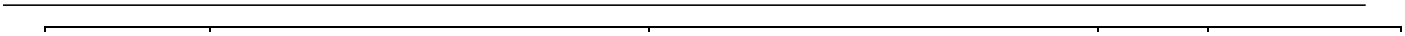
Answer 26 · Mark scheme

4(d)(v)	Tick (✓) by: $\frac{1}{36.5}$ x 100		1	**AO2** 2.3.3a
Total			**12**	

4.4.3.1 The process of electrolysis

Answer 26 · Mark scheme

June 2017 | CH2FP | Original Q4 | Legacy



Answer 27 · Mark scheme

June 2018 | 8462/1F | Original Q1

The full source mark scheme begins on page 70. Follow original question 1 in that document.

Answer 28 · Mark scheme

June 2018 | 8462/1F | Original Q4

The full source mark scheme begins on page 70. Follow original question 4 in that document.

4.4.3.1 The process of electrolysis

Answer 29 · Mark scheme

June 2019 | 8462/1F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	$\frac{184}{(232 + 6)} \times 100$ = 77 (%)	an answer of 77 (%) scores **2** marks an answer of 78.63247863 (%) correctly rounded to at least 2 significant figures scores **1** mark allow 77.31092437 (%) correctly rounded to at least 2 significant figures	1 1	AO2 4.3.3.2
06.2	$\frac{38}{100} \times 40$ = 15 (kg)	an answer of 15 (kg) scores **2** marks allow 15.2 (kg)	1 1	AO2 4.4.1.3
06.3	(2 x 27) + (3 x 16) = 102	an answer of 102 scores **2** marks ignore units	1 1	AO2 4.3.1.2
06.4	$\frac{28.4}{31.8} \times 100$ = 89.3081761 (%) = 89.3 (%)	an answer of 89.3 (%) scores **3** marks allow 89.3081761(%) correctly rounded to at least 2 significant figures allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses the masses in the question	1 1 1	AO2 4.3.3.1

4.4.3.1 The process of electrolysis

Answer 29 · Mark scheme

06.5	aluminium is more reactive than carbon (so) carbon cannot displace aluminium **or** (so) carbon cannot reduce aluminium oxide	allow aluminium is above carbon in the reactivity series allow (so) carbon cannot replace aluminium allow (so) carbon cannot remove oxygen from aluminium oxide allow (so) carbon will not react with aluminium oxide	1 1	AO1 4.4.1.1 4.4.1.2 4.4.1.3 4.4.3.3
Total			**11**	

4.4.3.1 The process of electrolysis

Answer 30 · Mark scheme

November 2020 | 8462/1F | Original Q4

Question 4

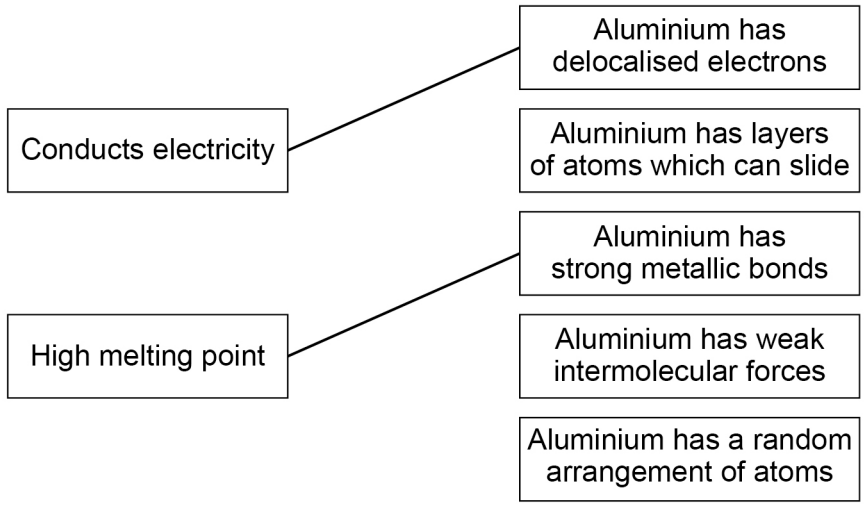
Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	(negative electrode) solid produced	allow the electrode changes colour ignore metal produced	1	AO3 4.4.3.4 RPA 3
	(positive electrode) bubbles / fizzing / effervescence	ignore gas produced	1	
04.2	potassium nitrate		1	AO3 4.4.3.4 RPA 3
	hydrogen is not a metal	allow hydrogen is a gas allow hydrogen is not a solid allow the products at both electrodes are gases allow the product at the negative electrode is not potassium allow potassium is more reactive than hydrogen	1	
04.3	(graphite) conducts (electricity)	allow (graphite) has delocalised / free electrons	1	AO1 4.2.3.2 4.4.3.4 RPA 3
	(graphite) is inert	allow (graphite) is unreactive	1	
04.4	the ions move towards the positive electrode		1	AO3
	the electrode attracts ions of the opposite charge	allow opposite charges attract	1	AO1 4.4.3.1
Total			**8**	

4.4.3.1 The process of electrolysis

Answer 31 · Mark scheme

November 2020 | 8462/1F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	 additional line from a box on the left negates the mark from that box		1 1	AO1 4.2.1.5 4.2.2.7 4.2.2.8
05.2	a mixture of metals	allow a mixture of a metal with other elements	1	AO1 4.2.2.7
05.3	bauxite contains a variable percentage of aluminium	allow converse argument allow bauxite does not have a fixed proportion / percentage of aluminium	1	AO3 4.1.1.1
05.4	any **two** from: • danger of dam bursting • leakage of toxic substances from mud to environment • water pollution • damage to habitats • visual pollution • (dam) blocks light • reduces the value of houses	allow the lake (of mud) could overflow allow unpleasant smell	2	AO3 4.4.3.3

4.4.3.1 The process of electrolysis

Question 5 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	10 / ten		1	AO2 4.1.1.1
05.6	to lower the melting point of the mixture		1	AO1 4.4.3.3
05.7	oxygen carbon	must be in this order	1 1	AO1 4.4.3.3
05.8	$\frac{25}{100}$ × 300 000 =75 000 (kg) = 7.5 ×10^4 (kg)	 allow correct conversion to standard form of an incorrectly calculated mass	1 1 1	AO2 4.4.3.3
Total			**13**	

4.4.3.1 The process of electrolysis

Answer 32 · Mark scheme

November 2021 | 8462/1F | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(zinc-carbon) cheap(est) (alkaline) long(est) lasting (nickel-metal hydride) rechargeable	 allow do not have to be thrown away	1 1 1	AO3 4.5.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	any **one** from: • (metal / alkaline waste) can be toxic / harmful / corrosive • (metal / alkaline waste) could cause pollution in landfill sites • recycling would save resources	 allow (batteries) can ignite / explode ignore dangerous	1	AO3 4.5.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	copper and iron		1	AO2 4.5.2.1

Question 2 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	any **one** from: • temperature (of electrolyte / solution) • concentration (of electrolyte / solution)	ignore type of electrode / electrolyte allow size / mass / length of electrode allow surface area of electrode allow distance between electrodes allow volume of solution / electrolyte	1	AO3 4.5.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	hydrogen oxygen	allow H_2 allow O_2	1 1	AO2 4.5.2.2

Total			8

4.4.3.1 The process of electrolysis

Answer 33 · Mark scheme

November 2021 | 8462/1F | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	by filtration		1	AO3 4.1.1.2

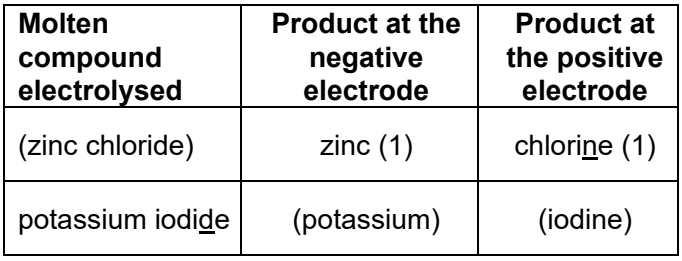
Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	10 minutes per 2 cm on x-axis	allow 5 minutes per 1 cm on x-axis	1	AO2 4.4.3.4
	all points plotted correctly	allow a tolerance of ± ½ a small square allow **1** mark for 3 or 4 points plotted correctly	2	
	line of best fit	allow line of best fit drawn using incorrect plots	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	0.14 (g)	allow ecf from question **07.2** allow a tolerance of ± ½ a small square	1	AO2 4.4.3.4

Question 7 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	(copper sulfate solution) pink / orange / red / brown solid (sodium chloride solution) bubbles / effervescence / fizzing	 allow copper plating allow metal for solid if no other mark awarded allow **1** mark for copper **and** hydrogen	 1 1	AO2 4.4.1.2 4.4.3.4 RPA3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	toxic / poisonous (fumes)	allow harmful / corrosive (fumes) ignore dangerous / deadly / lethal	1	AO3 4.4.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6			 2 1	AO2 4.4.3.2

Molten compound electrolysed	Product at the negative electrode	Product at the positive electrode
(zinc chloride)	zinc (1)	chlorine (1)
potassium iodide	(potassium)	(iodine)

allow **1** mark if zinc and chlorine the wrong way round

Total			12

4.4.3.1 The process of electrolysis

Answer 34 · Mark scheme

June 2022 | 8462/1F | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	hydroxide ions		1	AO1 4.4.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	27 (cm^3)		1	AO2 4.4.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	ions cannot move (freely in a solid)	allow ions are fixed in place (in a solid)	1	AO1 4.2.2.1 4.2.2.3 4.4.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4				AO2 4.4.3.2

Molten compound	Product at negative electrode	Product at positive electrode	Mark
Potassium iodide	Potassium	**Iodine**	1
Zinc bromide	**Zinc**	Bromine	1

4.4.3.1 The process of electrolysis

Answer 34 · Mark scheme June 2022 | 8462/1F | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	carbon is less reactive than sodium		1	AO1 4.4.1.2 4.4.1.3 4.4.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6	(I)		1	AO1 4.2.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.7	(percentage atom economy =) $\frac{48}{80} \times 100$ = 60 (%)		1 1	AO2 4.3.3.2

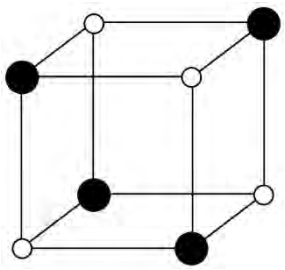
Total Question 8		**9**

4.4.3.1 The process of electrolysis

Answer 35 · Mark scheme

June 2023 | 8462/1F | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1		allow **1** mark for 2 Na^+ and 2 Cl^-	2	AO1 4.2.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	the ions can move (in the liquid)	do **not** accept reference to moving / delocalised electrons	1	AO1 4.4.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3				AO2 4.4.3.2

Molten compound	Product at the negative electrode	Product at the positive electrode	
Magnesium bromide	Magnesium	**Bromine**	1
Potassium chloride	**Potassium**	Chlorine	1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	the mixture has a lower melting point than pure aluminium oxide		1	AO1 4.4.3.3

4.4.3.1 The process of electrolysis

Answer 35 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	water		1	AO1 4.4.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	hydrogen is less reactive than sodium		1	AO2 4.4.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.7	the volume of hydrogen is twice the volume of oxygen	allow the volume of hydrogen is greater than the volume of oxygen allow the volume of hydrogen is (directly) proportional to the volume of oxygen	1	AO3 4.4.3.4

Total Question 7	9

4.4.3.1 The process of electrolysis

Answer 36 · Mark scheme

June 2024 | 8462/1F | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	ions can move through the molten substance to the electrodes		1	AO1 4.4.3.1

Question	Answers	Mark	AO / Spec. Ref.
06.2	<table><tr><th>Molten compound</th><th>Product at negative electrode</th><th>Product at positive electrode</th></tr><tr><td>Lead chloride</td><td>Lead</td><td>Chlorine</td></tr><tr><td>Potassium iodide</td><td>Potassium</td><td>Iodine</td></tr><tr><td>Zinc bromide</td><td>Zinc</td><td>Bromine</td></tr></table>	1 1 1	AO2 4.4.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	$2Al_2O_3 \rightarrow 4Al + 3O_2$	allow **1** mark for 4 Al allow **1** mark for 3 O_2	2	AO2 4.1.1.1 4.4.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(M_r =) (27 × 2) + (16 × 3) = 102		1 1	AO2 4.3.1.2

4.4.3.1 The process of electrolysis

Answer 36 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	(by electrolysis) any **one** from: • potassium / K • lithium / Li	 allow aluminium / Al allow sodium / Na allow calcium / Ca allow magnesium / Mg	1	AO3 4.4.1.2 4.4.1.3 4.4.3.3
	(by carbon reduction) any **one** from: • zinc / Zn • tin / Sn	 allow iron / Fe allow copper / Cu	1	

Total Question 6	**10**

4.4.3.1 The process of electrolysis

Answer 37 · Mark scheme

June 2024 | 8462/1F | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	6 (V)		1	AO2 4.5.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	sodium chloride solution		1	AO3 4.4.3.1 4.5.2.1

4.4.3.1 The process of electrolysis

Answer 37 · Mark scheme

June 2024 | 8462/1F | Original Q7

Question	Answers	Mark	AO / Spec. Ref.
07.3	**Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO3 4.5.2.1
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content • set up a cell • **add an electrolyte** • into a beaker • **add two (different) metals** • **measure the voltage** • using a voltmeter • **repeat using different metals** • same volume of electrolyte • same concentration of electrolyte • same type of electrolyte • one metal kept the same each time		

Total Question 7	8

4.4.3.1 The process of electrolysis

Answer 38 · Mark scheme

June 2025 | 8462/1F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	sodium chloride solution		1	AO2 4.4.3.1 4.5.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	(metal) **B** (reason) the two metals must be different (to produce a voltage)	 allow the voltage is 0.0 V MP2 is dependent upon the award of MP1	1 1	AO3 4.5.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	(most reactive) **D** **A** **C** (least reactive) **B**		1	AO3 4.5.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	(number of cells =) $\frac{14.4}{3.6}$ = 4		1 1	AO2 4.5.2.1

4.4.3.1 The process of electrolysis

Answer 38 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	water		1	AO1 4.5.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	reversed	ignore faster	1	AO1 4.5.2.1

Total Question 3	**8**

4.4.3.1 The process of electrolysis

Answer 39 · Mark scheme

June 2025 | 8462/1F | Original Q5

Question 5

Question	Answers	Mark	AO / Spec. Ref.
05.1	<table><tr><td>molten compound</td><td>product at the negative electrode</td><td>product at the positive electrode</td></tr><tr><td>copper chloride</td><td>**copper**</td><td>chlorine</td></tr><tr><td>potassium bromide</td><td>potassium</td><td>**bromine**</td></tr></table>	1 1	AO2 4.4.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	O_2		1	AO1 4.1.1.1 4.2.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	aluminium ions are positive(ly charged) (so) are attracted to the negative electrode	 allow (and) opposite charges attract	1 1	AO1 4.4.3.1 4.4.3.2 4.4.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	(the mixture) has a lower melting point (than aluminium oxide) (so) less energy is required		1 1	AO3 AO1 4.4.3.3

4.4.3.1 The process of electrolysis

Answer 39 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	carbon reacts with the oxygen produced		1	AO1 4.4.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	3.4 cm^3		1	AO2 4.4.3.4 RPA3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.7	hydrogen is less reactive than magnesium		1	AO1 4.4.3.4 RPA3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.8	the volume of hydrogen collected depends on **both** the current and the time		1	AO3 4.4.3.4 RPA3

4.4.3.1 The process of electrolysis

Answer 39 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.9	(change in volume = 3.8 – 1.9 =) 1.9 (cm^3)	allow any correct matching pairs of values of volume and time for **2** marks	1	AO2 4.4.3.4 RPA3
	(change in time = 5 – 2.5 =) 2.5 (min)		1	
	(gradient =) $\frac{1.9}{2.5}$	allow correct use of incorrectly determined values of volume and / or time	1	
	= 0.76 (cm^3/min)	allow correct use of incorrectly determined values of volume and / or time	1	

Total Question 5	**15**

4.4.3.1 The process of electrolysis

AQA

GCSE
CHEMISTRY

8462/1F - PAPER 1 FOUNDATION TIER

Mark scheme

8462

June 2018

Version/Stage: 1.0 Final

4.4.3.1 The process of electrolysis

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

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PMT

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do not accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

4.4.3.1 The process of electrolysis

Step 1: Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2: Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this.

The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

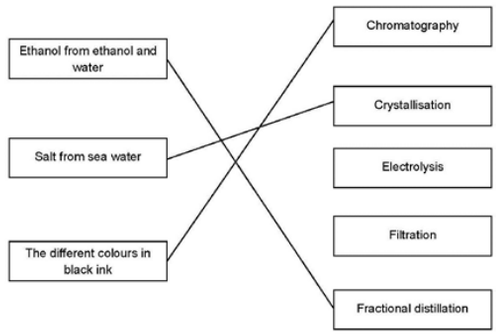
Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1			1 1 1	AO1 4.1.1.2
01.2	include a (filter) funnel	allow funnel drawn on the diagram ignore clamp stand	1	AO3 4.1.1.2
01.3	evaporate condense	must be this order	1 1	AO1 4.1.1.2
01.4	$\frac{2}{20} \times 100$ = 10 (%)	an answer of 10 (%) scores **2** marks an answer of 11.1(%) **or** 90 (%) scores **1** mark	1 1	AO2 4.2.2.7
01.5	an alloy		1	AO1 4.2.2.7
01.6	the layers in the mixture are distorted		1	AO1 4.2.2.7

4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	8000 nm^3		1	AO2 4.2.4.1
Total			**11**	

4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	7		1	AO1 4.1.2.6
02.2	small molecule		1	AO2 4.1.2.6 4.2.2.4
02.3	F_2		1	AO1 4.1.1.1 4.1.2.6
02.4	the reactivity decreases (going down Group 7)	allow the reactivity decreases from chlorine to iodine	1	AO1 4.1.2.6
	(because) chlorine displaces bromine and iodine	allow (because) chlorine has two reactions allow (because) neither bromine nor iodine can displace chlorine	1	AO3 4.1.2.6
	(and) bromine displaces iodine **or** iodine does not react	allow (and) bromine has one reaction **or** iodine has no reactions allow (and) iodine cannot displace bromine	1	AO3 4.1.2.6
02.5	80		1	AO2 4.3.1.2

4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	(1.2 kg =) 1200 (g) **or** (900 g =) 0.9 (kg)	an answer of 75 (%) scores **2** marks	1	AO2 4.3.3.1
	$(\frac{900}{1200} \times 100) = 75(\%)$ **or** $(\frac{0.9}{1.2} \times 100) = 75(\%)$	allow an answer correctly calculated from: $(\frac{900}{\text{incorrect attempt at conversion of 1.2}} \times 100)$ **or** $(\frac{\text{incorrect attempt at conversion of 900}}{1.2} \times 100)$	1	
Total			**9**	

4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	nucleus neutron neutron electron proton	must be in this order	1 1 1 1 1	AO1 4.1.1.3 4.1.1.4 4.1.1.5
03.2	$(A_r)\ \frac{(63 \times 70) + (65 \times 30)}{100}$ = 63.6	an answer of 63.6 scores **2** marks	1 1	AO2 4.1.1.6
03.3	copper / Cu	allow ecf from answer to question **03.2**	1	AO2 4.1.1.1
03.4	$\frac{1.2 \times 10^{-10}}{10\,000}$ **or** $1.2 \times 10^{-10} \times 1 \times 10^{-4}$ $= 1.2 \times 10^{-14}$ (m)	an answer of 1.2×10^{-14} (m) scores **2** marks a correct answer not in standard form scores **1** mark	1 1	AO2 4.1.1.5
Total			**10**	

4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	3.6 (cm^3)		1	AO2 4.4.3.4
04.2	hydrogen line only		1	AO3 4.4.3.4
04.3	both lines		1	AO3 4.4.3.4
04.4	graphite has delocalised electrons		1	AO1 4.2.3.2
04.5	**cathode** zinc (1) **anode** chlorine (1) hydrogen (1) bromine (1)	do **not** accept chloride allow **1** mark if chlorine and zinc the wrong way around do **not** accept bromide allow **1** mark if bromine and hydrogen the wrong way around	1+1 1+1	AO2 4.4.3.2 4.4.3.4
Total			**8**	

4.4.3.1 The process of electrolysis

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	gas		1	AO1 4.2.2.2
05.2	the gas escapes	allow carbon dioxide escapes do **not** accept references to evaporation	1	AO1 4.3.1.3
05.3	5.12 (g)		1	AO2 4.3.1.3
05.4	4.00 (g) trial 1	allow 2.89 written in either space, or ringed in the table, unless contradicted by mass of copper carbonate or trial number	1	AO3 4.3.1.3
05.5	reheat (and reweigh) until constant mass	 an answer of heat to constant mass scores **2** marks if no other mark scored allow for **1** mark heat for longer **or** (heat at a) higher temperature **alternative approach**: (1) continue heating and pass gas through limewater (1) until the (lime)water stops bubbling **or** until the limewater no longer turns cloudy	1 1	AO3 4.3.1.3

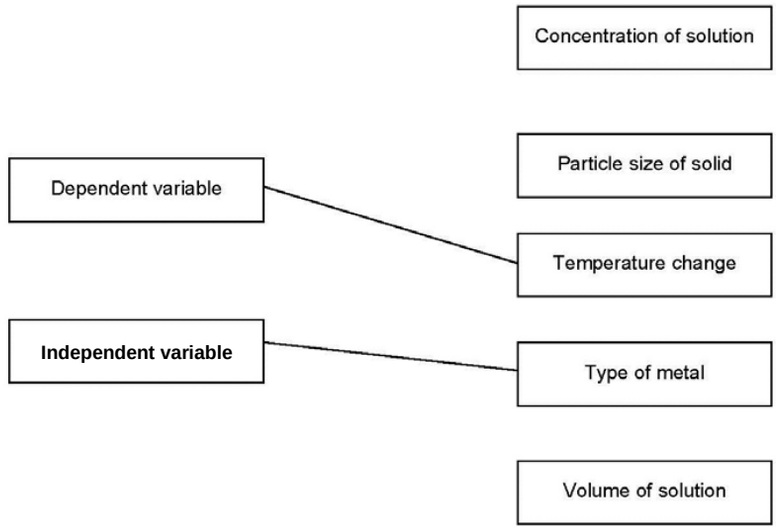
4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	straight line of best fit	must touch at least 5 of the 6 plots	1	AO2 4.3.1.3
05.7	correct value read from line of best fit in Figure 8	allow tolerance of ± ½ small square	1	AO2 4.3.1.3
05.8	(mass =) $168 \times \frac{\text{answer from question } \mathbf{05.7}}{8.4}$	a correctly calculated value from their answer to question **05.7** scores **2** marks allow (mass =) answer from question **05.7** × 20	1	AO2 4.3.1.3
	correctly calculated value (g)		1	
Total			**10**	

4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	 allow **one** mark if answers are reversed		1 1	AO1 4.5.1.1
06.2	polystyrene is a better insulator		1	AO3 4.5.1.1
06.3	both bars labelled both bars correctly plotted	 allow tolerance of ± ½ small square ignore width and spacing of bars if no other mark scored, allow **1** mark for any one bar correctly plotted and labelled	1 1	AO2 4.5.1.1

4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	temperature increases **or** temperature does not decrease	ignore because it is exothermic allow (because) energy / 'heat' is transferred to the surroundings energy / 'heat' is not taken in from the surroundings allow the energy of the products is less than the energy of the reactants	1	AO3 4.5.1.1
06.5	(most reactive) magnesium (zinc) nickel	this order only	1	AO3 4.5.1.1 4.4.1.2
06.6	suitable method described the observations / measurements required to place in order an indication of how results would be used to place the unknown metal in the reactivity series **approaches that could be used:** **approach 1:** add the unknown metal to copper sulfate solution (1) measure temperature change (1) place the metals in order of temperature change (1)		1 1 1	AO3 4.4.1.2 4.5.1.1

4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6 cont.	**approach 2:** add the metal to salt solutions of the other metals **or** heat the metal with oxides of the other metals (1) measure temperature change (only if salt solutions used) **or** observe whether a chemical change occurs (1) compare temperature change or whether there is a reaction to place in correct order (1) **approach 3:** add all of the metals to an acid (1) measure temperature change or means of comparing rate of reaction (1) place the metals in order of temperature change or rate of reaction (1) **approach 4:** set up electrochemical cells with the unknown metal as one electrode and each of the other metals as the other electrode (1) measure the voltage of the cell (1) place the metals in order of voltage (1)			
06.7	D		1	AO1 4.5.1.2
06.8	C		1	AO1 4.5.1.2
Total			**12**	

4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	sodium oxide	allow Na_2O	1	AO2 4.1.1.1 4.1.2.5 4.4.1.1
07.2	oxidation		1	AO1 4.4.1.1
07.3	13		1	AO1 4.4.2.4
07.4	sodium hydroxide		1	AO2 4.1.1.1
07.5	OH^-		1	AO1 4.4.2.4
07.6	(volume =) $\frac{250}{1000}$ or ¼ or 0.25 (dm^3) **or** (mass per cm^3 =) $\frac{40}{1000}$ (g) or 0.04 (g) ($\frac{250}{1000}$ × 40 =) 10 (g)	an answer of 10 (g) scores **2** marks	1 1	AO2 4.3.2.5

4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.7	all points correct	allow a tolerance of ± ½ a small square allow **1** mark for 3 points correct ignore any attempt at a line of best fit	2	AO2 4.1.2.5
07.8	39 (°C)	allow any value from 34 to 46 (°C)	1	AO2 4.1.2.5
Total			**10**	

4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	any **one** from: • metal • (metal) hydroxide • (metal) carbonate • alkali	allow named example allow correct formula ignore base allow ammonium hydroxide allow ammonium carbonate allow soluble base allow ammonia	1	AO1 4.4.2.1 4.4.2.2 4.4.2.3
08.2	$Ca(NO_3)_2$	allow $Ca^{2+}(NO_3^-)_2$	1	AO2 4.4.2.2

4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Mark	AO / Spec. Ref.
01.3	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 4.4.2.3
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	Indicative content • use magnesium oxide and sulfuric acid • add sulfuric acid to a beaker • warm sulfuric acid • add magnesium oxide • stir • continue adding until magnesium oxide is in excess • filter • using a filter paper and funnel • to remove excess magnesium oxide • heat solution in an evaporating basin • to crystallisation point • leave to crystallise • pat dry with filter paper credit may be given for diagrams		
Total			**8**

4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	FeS_2	do **not** accept equations	1	AO2 4.2.1.3
09.2	26 30 26	must be this order	1 1 1	AO2 4.1.1.4 4.1.1.5
09.3	any **two** from: • iron has a high(er) melting / boiling point • iron is dense(r) • iron is hard(er) • iron is strong(er) • iron is less reactive • iron has ions with different charges • iron forms coloured compounds • iron can be a catalyst	allow the converse statements for sodium allow transition metal for iron allow Group 1 metal for sodium ignore references to atomic structure ignore iron rusts allow iron is less malleable / ductile allow specific reactions showing difference in reactivity allow iron is magnetic	2	AO1 4.1.2.5 4.1.3.1 4.1.3.2

4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	carbon is more reactive (than nickel)	allow converse	1	AO1 4.4.1.2 4.4.1.3
	(so) carbon will displace / replace nickel (from nickel oxide) **or** (so) carbon will remove oxygen (from nickel oxide)	allow (so) nickel ions gain electrons allow (so) carbon transfers electrons to nickel (ions)	1	
09.5		an answer of 67.8 (%) scores **3** marks an answer of 67.8160919 (%) or correctly rounded answer to 2, 4 or more sig figs scores **2** marks an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		AO2 4.3.3.2
	(total M_r of reactants =) 87		1	
	(percentage atom economy) $= \frac{59}{87} \times 100$	allow (percentage atom economy) $= \frac{59}{\text{incorrectly calculated } M_r} \times 100$	1	
	= 67.8 (%)	allow an answer from an incorrect calculation to 3 sig figs	1	
Total			**11**	

4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	copper, zinc, sodium chloride solution		1	AO2 4.5.2.1
10.2	a reactant is used up	allow the reaction stops allow electrolyte / electrode / ions / metal / metal hydroxide / alkali for reactant	1	AO1 4.5.2.1
10.3	the reaction is not reversible		1	AO1 4.5.2.1
10.4	$2H_2 + O_2 \rightarrow 2H_2O$	allow fractions / multiples allow **1** mark for O_2	2	AO1 AO2 4.1.1.1 4.5.2.2

4.4.3.1 The process of electrolysis

MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

<table>
<tr><th>Question</th><th>Answers</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td rowspan="5">10.5</td><td>Level 3: A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.</td><td>5–6</td><td>AO3</td></tr>
<tr><td>Level 2: Some logically linked reasons are given. There may also be a simple judgement.</td><td>3–4</td><td>AO3</td></tr>
<tr><td>Level 1: Relevant points are made. This is not logically linked.</td><td>1–2</td><td>AO2</td></tr>
<tr><td>No relevant content</td><td>0</td><td></td></tr>
<tr><td>Indicative content

reasons why fuel cells could be judged as better
<table>
<tr><th>from the table</th><th>from other knowledge</th></tr>
<tr><td>• time for refuelling a fuel cell is faster than recharging
or
a fuel cell does not need to be recharged
• a fuel cell has a greater range</td><td>• hydrogen can be renewable if made by electrolysis using renewable energy
• lithium-ion batteries can catch fire
• produces only water
or
no pollutants produced
• lithium-ion batteries may release toxic chemicals on disposal
• lithium-ion batteries (eventually cannot be recharged so) have a finite life</td></tr>
</table>
reasons why the lithium-ion battery could be judged as better
<table>
<tr><th>from the table</th><th>from other knowledge</th></tr>
<tr><td>• lithium-ion uses energy more efficiently
• cost of lithium-ion car much less
• cost of recharging much less than refuelling with hydrogen</td><td>• hydrogen is often made from fossil fuels so is not renewable
• charging points are more widely available than hydrogen filling stations
• hydrogen takes up a lot of space
or
is difficult to store
• hydrogen can be highly flammable / explosive
• no emissions produced
• (catalyst in the hydrogen fuel-cell eventually becomes poisoned so) have a finite life</td></tr>
</table></td><td></td><td>4.4.3.4
4.5.2.1
4.5.2.2</td></tr>
<tr><td>Total</td><td></td><td></td><td>11</td></tr>
</table>

4.4.3.1 The process of electrolysis

Answer 27 · Examiner comments

June 2018 | 8462/1F | Original Q1

Question 1 (low demand)

01.1 74% of students achieved two or more marks, with 34% of students achieving all three. The vast majority of students knew that black ink would be separated by chromatography, but filtration was a popular incorrect answer for obtaining salt from seawater.

01.2 This question was not well answered. Many students did not know what to call a funnel, referring to it as a plastic cone. Other errors were to use more pieces of paper, or to suggest substituting a beaker for the conical flask. Answers which gave diagrams gained credit.

01.3 69% of students gained both marks, with about one in eight scoring neither.

01.4 51% of students scored both marks on this, the first calculation on the paper. Partial credit was given to those who calculated 2 ÷ 18 as a percentage rather than 2 ÷ 20, or who correctly calculated the percentage of metal A instead of metal B.

01.5 68% of students knew that a mixture of metals is an alloy. The most popular incorrect answer was ‘a compound’.

Answer 27 · Examiner comments

June 2018 | 8462/1F | Original Q1

01.6 48% of students realised that the correct answer is that the layers in the mixture are distorted. 25% of students thought that the correct answer is that ‘the mixture has a giant structure’. Whilst true, this statement does not give the correct explanation for the extra hardness of the mixture.

01.7 74% of students could calculate the volume of the cube correctly. The most popular distractor was 400 nm^3, with 400 nm^2 being the surface area of one face.

4.4.3.1 The process of electrolysis

Answer 28 · Examiner comments

June 2018 | 8462/1F | Original Q4

Question 4 (low and standard demand)

04.1 72% of students could read off the volume correctly, although 4.4 cm^3 was a popular wrong answer. Some students seem unfamiliar with 'upside down' apparatus.

04.2 This question was answered well, with 70% of students recognising a straight line through the origin as showing proportionality. The idea that neither line showed proportionality was more popular than that both showed proportionality.

04.3 77% of students recognised that both lines showed a positive correlation.

04.4 All four statements about graphite were true and 70% of students could pick out 'delocalised electrons' as the reason for graphite's electrical conductivity.

Answer 28 · Examiner comments

June 2018 | 8462/1F | Original Q4

04.5 Students found this question tough. Full marks were very rare, although 27% of students did achieve three marks.

Most suggested potassium, rather than hydrogen, would be a product from the electrolysis of potassium bromide solution. Partial credit was given for the correct products at the opposite electrodes. As a result many students achieved a mark for having zinc and chlorine the wrong way round.

4.4.3.1 The process of electrolysis

Answer 29 · Examiner comments — June 2019 | 8462/1F | Original Q6

Question 6 (low and standard demand)

06.1 Approximately 60% of students calculated the percentage atom economy correctly.

A final answer of 77.3 with a dot over the 3 signifying a recurring 3 was a common error.

06.2 Approximately two-thirds of students performed the percentage calculation correctly.

06.3 Approximately 70% of students calculated the relative formula mass correctly.

06.4 The requirement to give the answer to 3 significant figures made this calculation more challenging. However, approximately a half of students scored all 3 marks.

A final answer of 89.3 with a dot over the 3 signifying a recurring 3 was a common error.

06.5 Students found this question difficult. Almost three-quarters of students scored 0 marks.

For those students who scored 1 mark, it was almost always for the relative reactivity of aluminium and carbon.

Answer 34 · Examiner comments — June 2022 | 8462/1F | Original Q8

Question 8 (Low demand)

08.1 Fewer than 40% of students recognised the hydroxide ion as the source of oxygen; the most popular distractor was hydrogen ions.

08.2 Most students could read the volume of gas in the inverted measuring cylinder. Some tried to read the scale upwards and gave a response of 33 cm^3.

08.3 Only about 20% of students were awarded the mark. Students needed to explain why ionic solids do not conduct, rather than why solutions or molten compounds do conduct. Even when directed to answer in terms of ions, some students still thought that electrons were somehow involved.

08.4 This was well answered, with the great majority of students naming both correct products.

08.5 Over a half of students gave the correct reason in terms of the relative reactivity of carbon and sodium. The electrical conductivity of carbon was a popular distractor.

08.6 About a half of students gave (aq) as the state symbol for a molten substance.
Only about 30% gave the correct answer (l).

08.7 Correct answers to this calculation were given by the great majority of students.

4.4.3.1 The process of electrolysis

Answer 35 · Examiner comments — June 2023 | 8462/1F | Original Q7

Question 7 (low and standard demand)

07.1 This question was answered by fewer than half of the students showing that many students do not read the entire question, but focus only on the sentence above an answer line. As there was no answer line, the instruction to complete Figure 8 was missed. Of those who did respond, most scored at least one mark.

Most of those who did answer realised that two of each ion should be drawn, but many placed the ions directly under the same type of ion, instead of in the alternate positions.

07.2 This standard demand question proved to be difficult even with the prompt to refer to ions. There were few references to electrons, showing that students had taken note of this prompt; however, the idea that ions can move in the liquid state was not given by many students.

07.3 This question was well answered, with more than three quarters of students scoring both marks. Potassium was nearly always correct, but bromine was often incorrectly described as bromide.

07.4 Only a half of the students knew that the mixture has a lower melting point than pure aluminium oxide, with the majority of the rest opting for a higher melting point.

Answer 35 · Examiner comments — June 2023 | 8462/1F | Original Q7

07.5 Only a half of students knew that the source of the hydrogen and oxygen is water. Most of the other chose sulfate ions.

07.6 Again, roughly a half of students knew the reason for the production of hydrogen rather than sodium, with nearly as many choosing the incorrect statement that hydrogen is more reactive than sodium.

07.7 Some students were not specific enough about the relationship of the volumes, merely stating that as one increased, so did the other. However, many gave excellent descriptions of the volume of hydrogen being twice that of oxygen. Just over a half of students scored the mark.

Answer 36 · Examiner comments — June 2024 | 8462/1F | Original Q6

Question 6 (low and standard demand)

06.1 Fewer than a half of students identified the reason why molten substances can be electrolysed. The incorrect distractor that electrons can move through the substance was almost as popular.

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4.4.3.1 The process of electrolysis

Answer 36 · Examiner comments June 2024 | 8462/1F | Original Q6

06.2 Nearly three quarters of students could name all three substances correctly. The most common errors were iodide instead of iodine and zinc bromine instead of zinc bromide.

06.3 Nearly a half of students gave a completely balanced equation. The oxygen was correctly balanced more often than the aluminium.

06.4 Nearly three fifths of students set out their work clearly and obtained the correct answer. The most common incorrect answers were 27 + 16 = 43 and 27 × 16 = 432.

06.5 Fewer than two thirds of students scored one or two marks, with fewer than one third scoring both marks. It was expected that students would chose appropriate metals from the list provided, but other correct answers were accepted. Gold was not given credit, since students should know that gold is found in the Earth as the metal itself, so does not need chemical extraction. Carbon was often given as a response.

Answer 37 · Examiner comments June 2024 | 8462/1F | Original Q7

Question 7 (low and standard demand)

07.1 The great majority of students realised that the voltage would be 4 times that of a single cell.

07.2 Two thirds of students identified sodium chloride solution as the correct substance to be an electrolyte. The two distractors, pure water and solid lead bromide, were equally popular.

07.3 Very few students managed to reach Level 3, which required mention of a control variable to make the outcome valid. However, two fifths of students managed to reach level 2 by mentioning some key steps in the procedure. Nearly one quarter of students did not attempt the question even though a diagram of a cell had been provided as a prompt.

There was much confusion with electrolysis, and with 'watching to see if there is a reaction.' Many students thought that a voltmeter produces a voltage rather than measuring it. Many students did not understand what a chemical cell is, despite the diagram, and many used electrodes of the same metal, or even just one electrode. Some referred to a power pack, not realising that the cell itself is the source of the voltage.

4.4.3.1 The process of electrolysis

Answer 38 · Examiner comments

June 2025 | 8462/1F | Original Q3

Question 3 (low and standard demand)

03.1 Two thirds of students were able to identify sodium chloride solution as the only possible electrolyte. Water was the more popular distractor, but a surprising number chose solid potassium bromide.

03.2 This was answered less successfully, with only an eighth of students scoring both marks. Even those who identified **B** as copper were often unable to give a correct reason for their choice. Many students chose **D** on the grounds that it has the highest voltage, completely missing the point that the two metals must be different in order to produce a voltage. Others suggested **D** on the grounds that it is a good conductor. A surprising number thought that a voltage of zero meant that the metal was a non-conductor. Those who did give the correct answer usually gave the reason that it does not produce a voltage, which was an acceptable alternative to the voltage being 0.0 V.

03.3 This was very well answered, with 5 sixths of students giving the correct order. A few reversed the order and some swapped **A** and **C**.

03.4 This was answered correctly by the vast majority of students. There was a multitude of ways of establishing that 4 cells were needed, rather than simply dividing the total voltage required by the voltage produced by one cell.

03.5 Fewer than a half of students knew that the product is water, with all three options being chosen many times.

03.6 Fewer than one in six students knew that the reaction would be reversed. 'Reversible' was also accepted. Most tried to answer in terms of endothermic or exothermic, without anything to base that choice on, and many gave the name of a substance, often ammonia, perhaps referring back to the previous question.

4.4.3.1 The process of electrolysis

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Question 5 (low and standard demand)

05.1 This was very well answered, although a few said bromide rather than bromine. Four fifths of students scored both marks.

05.2 Three quarters of students chose the correct formula. The most popular distractor was O^2.

05.3 Students found this question difficult and one in ten did not attempt it. Many stated that aluminium, rather than aluminium ions, is positive. The attraction between the positive ions and the negative electrode was better expressed.

05.4 Again, students found this difficult despite the data provided as a prompt, and again one in ten made no attempt. Few students stated clearly that the mixture has a lower melting point, and even fewer that less energy is therefore required. Some stated that the melting point is lowered by cryolite, which was not accepted; the melting point of aluminium oxide is a fixed value. Some did not make a clear reference to energy, referring to fuel or heat instead. Many referred to boiling points instead of melting points, despite also quoting the given values of melting point. Just over a quarter of students scored 1 mark but only one in 20 scored both.

05.5 About half of students gave the correct answer, with the two distractors both being very popular.

05.6 Three quarters of students gave the correct value, with 2.7 cm^3 being the more popular distractor.

05.7 Three fifths of students gave the correct reason, though a surprising number thought that hydrogen is more reactive than magnesium.

05.8 Only a half of students gave the correct answer, with nearly as many thinking that the volume did not depend on the time.

05.9 There were very many fully correct answers, with a half of students scoring full marks. A few measured the change in volume as 1.8 cm^3 instead of 1.9 cm^3, and some inverted

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the expression for gradient even though it was provided. Any matching pairs of change in volume and change in time were accepted. Even those who read incorrectly from the graph were able to gain partial credit for showing how to manipulate their values correctly.