AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.4.1.3

Extraction of metals and reduction

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**52**
Available paper years	**2007–2025**

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.

4.4.1.3 Extraction of metals and reduction

Answer 01 · Mark scheme March 2007 | CHY1A | Original Q5 | Legacy

Five	**A**	aluminium	**4**
	B	calcium	**2**
	C	sodium	**1**
	D	zinc	**3**

Answer 02 · Mark scheme June 2007 | CHY1A | Original Q6 | Legacy

The full source mark scheme begins on page 55. Follow original question 6 in that document.

Answer 03 · Mark scheme June 2007 | CHY1F | Original Q4 | Legacy

The full source mark scheme begins on page 59. Follow original question 4 in that document.

Answer 04 · Mark scheme June 2007 | CHY1F | Original Q7 | Legacy

The full source mark scheme begins on page 59. Follow original question 7 in that document.

Answer 05 · Mark scheme November 2007 | CHY1A | Original Q5 | Legacy

Five	**A**	Metal **A**	**3**
	B	Metal **B**	**2**
	C	Metal **C**	**4**
	D	Metal **D**	**1**

Answer 06 · Mark scheme November 2007 | CHY1A | Original Q8 | Legacy

Eight	**1**	**4**	**2**	**3**

4.4.1.3 Extraction of metals and reduction

Answer 07 · Mark scheme November 2007 | CHY1A | Original Q9 | Legacy

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

Answer 08 · Mark scheme November 2007 | CHY1B | Original Q9 | Legacy

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

Answer 09 · Mark scheme March 2008 | CHY1AP | Original Q2 | Legacy

Two	**A**	carbon	**3**
	B	carbon dioxide	**2**
	C	tin	**4**
	D	tin oxide	**1**

Answer 10 · Mark scheme March 2008 | CHY1AP | Original Q5 | Legacy

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

Answer 11 · Mark scheme June 2008 | CHY1AP | Original Q8 | Legacy

Eight	**1**	**4**	**3**	**1**

4.4.1.3 Extraction of metals and reduction

Answer 12 · Mark scheme

June 2008 | CHY1F | Original Q6 | Legacy

question	answers	extra information	mark
6(a)	(an alloy) that can return to its original shape (after being deformed / bent / twisted)	accept (on heating / cooling) it returns to its shape	1
6(b)	any **two** from: • brass / it is a mixture • zinc changes structure / disrupts patterns or layers • copper metal atoms / layers able to slide over each other	 accept brass / it is not pure accept zinc prevents atoms / layers sliding over each other	2
6(c)(i)	oxygen / O_2 / O		1
6(c)(ii)	lead remains (in furnace) because of its high boiling point zinc boils / evaporates (out of furnace) because of its low boiling point	 if neither mark awarded then allow **1** mark for different boiling points ignore references to melting points	1 1
Total			**6**

4.4.1.3 Extraction of metals and reduction

Answer 12 · Mark scheme June 2008 | CHY1F | Original Q6 | Legacy

COMPONENT NUMBER: CHY1F

COMPONENT NAME: Science B / Chemistry

STATUS: Final

DATE: June 2008

Answer 13 · Mark scheme November 2008 | CHY1AP | Original Q4 | Legacy

Four	**A**	a mixture	**2**
	B	expensive to extract from its ore	**1**
	C	a good conductor	**4**
	D	hard-wearing	**3**

Answer 14 · Mark scheme November 2008 | CHY1AP | Original Q9 | Legacy

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

* This question was removed from the mark scheme and this test was marked out of 35.

Answer 15 · Mark scheme March 2009 | CHY1AP | Original Q2 | Legacy

Two	**A**	carbon	**2**
	B	cast iron	**4**
	C	iron	**3**
	D	iron oxide	**1**

Answer 16 · Mark scheme June 2009 | CHY1AP | Original Q2 | Legacy

Two	**A**	haematite	**2**
	B	silver ore	**3**
	C	chalcopyrite	**1**
	D	bauxite	**4**

Answer 17 · Mark scheme June 2009 | CHY1AP | Original Q6 | Legacy

Six	**4**	**2**	**1**	**3**

4.4.1.3 Extraction of metals and reduction

Answer 18 · Mark scheme

June 2009 | CHY1AP | Original Q9 | Legacy

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

4.4.1.3 Extraction of metals and reduction

Answer 19 · Mark scheme

June 2009 | CHY1F | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)(i)	3 / three		1
6(a)(ii)	5 / five		1
6(b)	any **one** from: • less / no transport • less / no (fossil) fuel used	 accept less / no distance ignore references to carbon dioxide / carbon emissions	1
6(c)(i)	carbon dioxide / CO_2 (causes) global warming / climate change / greenhouse gas **or** (cement) particles / smoke (1) (causes) asthma / dust / (global) dimming (1) **or** sulfur dioxide / SO_2 / nitrogen oxides / NO_x (1) (causes) acid rain (1)	for a correct emission explanation must be correct for named emission ignore ozone layer accept breathing problems do **not** accept nitrogen or water vapour for emissions do **not** accept no named emission	1 1

Question 6 continues on the next page…

4.4.1.3 Extraction of metals and reduction

Answer 19 · Mark scheme

CHY1F

Question 6 Continued

question	answers	extra information	mark
6(c)(ii)	absorb / trap / capture / filter / pass through water / scrub / electrostatic attraction	ignore condense / off setting / different fuel	1
Total			**6**

4.4.1.3 Extraction of metals and reduction

Answer 19 · Mark scheme June 2009 | CHY1F | Original Q6 | Legacy

CHY1F

Answer 20 · Mark scheme November 2009 | CHY1AP | Original Q2 | Legacy

Two	**A**	metal ore	**1**
	B	reactive metal	**4**
	C	transition metal	**3**
	D	metal alloy	**2**

Answer 21 · Mark scheme November 2009 | CHY1AP | Original Q9 | Legacy

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

Answer 22 · Mark scheme March 2010 | CHY1AP | Original Q2 | Legacy

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

Answer 23 · Mark scheme June 2010 | CHY1AP | Original Q7 | Legacy

Seven	**1**	**2**	**3**	**4**

Answer 24 · Mark scheme June 2010 | CHY1AP | Original Q8 | Legacy

Eight	**2**	**1**	**1**	**2**

Answer 25 · 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**

4.4.1.3 Extraction of metals and reduction

Answer 26 · Mark scheme

November 2010 | CHY1AP | Original Q9 | Legacy

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

4.4.1.3 Extraction of metals and reduction

Answer 27 · Mark scheme

January 2011 | CHY1F | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)	crust	ignore Earth's	1
	core	ignore inner and/or outer	1
3(b)	bar chart		1
	all heights are correct	accept correctly plotted points	1
	all labels are correct for nitrogen, oxygen and other / argon		1
3(c)(i)	decomposed		1
3(c)(ii)	global warming		1
Total			7

4.4.1.3 Extraction of metals and reduction

Answer 27 · Mark scheme

January 2011 | CHY1F | Original Q3 | Legacy

CHY1F

4.4.1.3 Extraction of metals and reduction

Answer 28 · Mark scheme

January 2011 | CHY1F | Original Q6 | Legacy

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

4.4.1.3 Extraction of metals and reduction

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**

4.4.1.3 Extraction of metals and reduction

Answer 28 · Mark scheme January 2011 | CHY1F | Original Q6 | Legacy

CHY1F

Answer 29 · Mark scheme March 2011 | CHY1AP | Original Q3 | Legacy

Three	**A**	Carbon	**1**
	B	Gold	**2**
	C	Magnesium	**4**
	D	Zinc	**3**

Answer 30 · Mark scheme March 2011 | CHY1AP | Original Q9 | Legacy

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

Answer 31 · Mark scheme June 2011 | CHY1AP | Original Q4 | Legacy

Four	**A**	Aluminium	**4**
	B	Copper	**3**
	C	Tin	**2**
	D	Iron	**1**

Answer 32 · Mark scheme June 2011 | CHY1AP | Original Q6 | Legacy

Six	**2**	**3**	**4**	**3**

Answer 33 · Mark scheme November 2011 | CHY1AP | Original Q1 | Legacy

Question	Key		
One	**A**	hard	**3**
	B	resistant to corrosion	**4**
	C	easily shaped	**2**
	D	brittle	**1**

4.4.1.3 Extraction of metals and reduction

Answer 34 · Mark scheme

November 2011 | CHY1AP | Original Q9 | Legacy

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

4.4.1.3 Extraction of metals and reduction

Answer 35 · 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**

4.4.1.3 Extraction of metals and reduction

Answer 35 · Mark scheme

January 2012 | CH1FP | Original Q2 | Legacy

CH1FP

4.4.1.3 Extraction of metals and reduction

Answer 36 · 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

4.4.1.3 Extraction of metals and reduction

Answer 36 · Mark scheme

June 2012 | CH1FP | Original Q7 | Legacy

CH1FP

4.4.1.3 Extraction of metals and reduction

Answer 37 · Mark scheme

January 2013 | CH1FP | Original Q4 | Legacy

question	answers	extra information	mark
4(a)(i)	Positive impact any **one** from: • provides employment **or** • improves local economy • improved transport - new roads are built, new rail links • after use the quarry could provide recreation facilities Negative impact any **one** from: • destruction of animal habitats • fewer plants and trees to absorb carbon dioxide • visual pollution **or** noise pollution **or** atmospheric / air pollution • more traffic • uses non-renewable resources	 allow dust pollution allow pollutants from burning diesel	1 1
4(a)(ii)	economical		1
4(b)	carbon / coke burns (in oxygen / air)	accept carbon / coke reacts with oxygen / air	1
4(c)(i)	iron oxide (reactant) carbon dioxide (product)	must be words	1 1
4(c)(ii)	reduction		1

4.4.1.3 Extraction of metals and reduction

Answer 37 · Mark scheme

CH1FP

question	answers	extra information	mark
4(d)(i)	oxygen reacts with carbon **or** oxygen and carbon produce carbon dioxide / carbon monoxide carbon dioxide / carbon monoxide is a gas **or** the carbon is removed as a gas		1 1
4(d)(ii)	much harder		1
4(e)	Advantage: less carbon dioxide is produced Disadvantage: there are different types of steel which must be sorted		 1 1
Total			**12**

4.4.1.3 Extraction of metals and reduction

Answer 37 · Mark scheme

January 2013 | CH1FP | Original Q4 | Legacy

CH1FP

Answer 38 · 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

Question 7 continued

question	answers	extra information	Mark
7(b)(iv)	(copper ions move towards) the negative electrode / *cathode* 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 1
7(b)(v)	(growing) plants		1
Total			**9**

4.4.1.3 Extraction of metals and reduction

Answer 39 · 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**		

4.4.1.3 Extraction of metals and reduction

Answer 39 · Mark scheme

June 2014 | CH1FP | Original Q5 | Legacy



4.4.1.3 Extraction of metals and reduction

Answer 40 · Mark scheme June 2015 | CH1FP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)(i)	central block		1	1 / 1.3.3a
2(a)(ii)	conducts electricity		1	1 / 1.3.3a
2(b)	any **two** from: • visual pollution • noise pollution • dust pollution • habitat destruction		2	2 / 1.3.1b
2(c)(i)	to concentrate the ore/copper carbonate **or** to remove / separate the rock		1	2 / 1.3.1b
2(c)(ii)	12 (tonnes)	If answer is incorrect allow one mark for (127 + 132) – 247 or 259 - 247	2	2 / 1.1.3c
2(c)(iii)	any **one** from: • so no reactant is wasted/left unreacted • so they know how much product they will make • need to record/compensate for the carbon dioxide produced	allow so they can work out their carbon footprint	1	3 / 1.1.3c
Total			**8**	

4.4.1.3 Extraction of metals and reduction

Answer 40 · Mark scheme

June 2015 | CH1FP | Original Q2 | Legacy



4.4.1.3 Extraction of metals and reduction

Answer 41 · Mark scheme

June 2016 | CH1FP | Original Q3 | Legacy

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)	because it is a good conductor of electricity.		1	AO1 1.3.3b
3(b)(i)	2.1 (%)		1	AO2 1.3.1c
3(b)(ii)	correct bar for calcium at 3.6 % correct bar for iron at 5.0 %	allow error of +/- 0.05% allow error of +/- 0.05%	1 1	AO2 1.3.1c
3(c)(i)	decomposition		1	AO1 1.1.3b; 1.2.1b/c
3(c)(ii)	carbon dioxide		1	AO1 1.2.1c
3(c)(iii)	carbon = 1 oxygen = 3	allow one allow three	1 1	AO2 1.1.3 a
3(c)(iv)	44 (g)	allow forty four	1	AO2 1.1.3 c
3(d)(i)	to make alloys for specific uses.		1	AO1 1.3.2a/b/c
3(d)(ii)	any **three** from: • to conserve resources of iron or iron ore • to avoid the need for quarrying/mining • to conserve energy resources or fossil fuels • to limit the amount of carbon dioxide produced or to reduce global warming • to reduce the amount of landfill	"it" = steel ignore cost and reuse and time and waste allow steel instead of iron or iron ore allow limited resource or non-renewable	3	AO1 1.3.1j
Total			13	

4.4.1.3 Extraction of metals and reduction

Answer 42 · Mark scheme

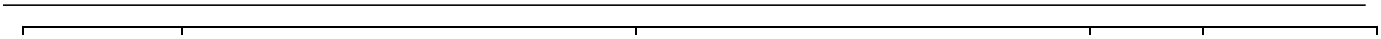
June 2017 | CH1FP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)	magnesium oxide	allow MgO but must be correct formula do **not** allow extra products	1	AO2 1.1.3b
3(b)(i)	carbon	ignore C ignore any numbers eg 3 carbon	1	AO1 1.1.1b
3(b)(ii)	loss of oxygen	allow iron gains electrons do **not** allow loss of oxide do **not** allow iron oxide gains electrons	1	AO2 1.3.1d
3(b)(iii)	brittle soft alloys **or** steels		1 1 1	AO1 1.3.2a;b;c
Total			**6**	

4.4.1.3 Extraction of metals and reduction

Answer 42 · Mark scheme

June 2017 | CH1FP | Original Q3 | Legacy



Answer 43 · Mark scheme

June 2018 | 8462/1F | Original Q9

The full source mark scheme begins on page 71. Follow original question 9 in that document.

4.4.1.3 Extraction of metals and reduction

Answer 44 · Mark scheme

June 2019 | 8462/1F | Original Q6

Question 6

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

4.4.1.3 Extraction of metals and reduction

Answer 44 · 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**	

4.4.1.3 Extraction of metals and reduction

Answer 45 · Mark scheme

November 2020 | 8462/1F | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	they form ions with different charges		1	AO1 4.1.3.1 4.1.3.2
	they have high melting points		1	
09.2	the (grey) crystals are silver		1	AO3 4.4.1.2
	the copper ions (produced) are blue	allow the copper nitrate / compound (produced) is blue	1	
	(because) copper displaces silver		1	

Question 9 continued

Question	Answers	Mark	AO/ Spec. Ref
09.3	**Level 2:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	3–4	AO1 AO3 4.4.1.2 4.5.1.1 RPA 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 **Key steps** • add the metals to (dilute) hydrochloric acid • measure temperature change **or** compare rate of bubbling **or** compare colour of resulting solution for copper: • no reaction • shown by no temperature change **or** shown by no bubbles for magnesium and iron: • magnesium increases in temperature more than iron **or** magnesium bubbles faster than iron **or** magnesium forms a colourless solution and iron forms a coloured solution **Control variables** • same concentration / volume of hydrochloric acid • same mass / moles of metal • same particle size of metal • same temperature (of acid if comparing rate of bubbling)		

4.4.1.3 Extraction of metals and reduction

Answer 45 · Mark scheme

November 2020 | 8462/1F | Original Q9

Question 9 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	$\frac{(203 \times 30) + (205 \times 70)}{100}$ **or** $\frac{6090 + 14\,350}{100}$ = 204.4	 ignore units	1 1	AO2 4.1.1.6
Total			**11**	

4.4.1.3 Extraction of metals and reduction

Answer 46 · Mark scheme

November 2021 | 8462/1F | Original Q10

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	(3 × M_r H_2O = 3 × (2 + 16) =) 54 (A_r **R** = 150 – 54 =) 96 **alternative approach**: (M_r **R**O_3 = 150 – 6 =) 144 (1) (A_r **R** = 144 – (3 × 16) =) 96 (1)	 ignore units ignore units	1 1	AO2 4.3.1.1 4.3.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	(**R** =) molybdenum / Mo	allow ecf from question **10.1**	1	AO3 4.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	(total M_r of reactants) = 163 (% atom economy =) $\frac{119}{163}$ (×100) = 73 (%)	 allow correct use of an incorrectly calculated value of total M_r allow 73.00613 (%) correctly rounded to at least 2 significant figures	1 1 1	AO2 4.3.1.2 4.3.3.2

Question 10 continued

Question	Answers	Mark	AO/ Spec. Ref
10.4	**Level 2:** Some logically linked reasons are given. There may also be a simple judgement.	3–4	AO3 4.4.1.3
	Level 1: Relevant points are made. They are not logically linked.	1–2	
	No relevant content	0	
	Indicative content • carbon and iron are the cheapest reactants • hydrogen is the most expensive reactant • separating solid products is expensive • separating solid products is time consuming • in method 1, tungsten needs to be separated from tungsten carbide • in method 1, some tungsten is lost as tungsten carbide • in method 1, the carbon dioxide produced will escape • in method 2, the water vapour produced will escape • in method 2, no separation of solids is needed • in method 3, tungsten needs to be separated from iron oxide		

Total			10

4.4.1.3 Extraction of metals and reduction

Answer 47 · 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			1 1	AO2 4.4.3.2

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

4.4.1.3 Extraction of metals and reduction

Answer 47 · Mark scheme

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

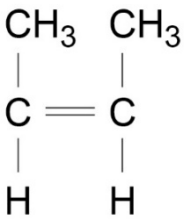
Total Question 8		**9**

4.4.1.3 Extraction of metals and reduction

Answer 48 · Mark scheme

June 2022 | 8462/2F | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	C=C bond		1	AO2 4.7.3.1
	2x C-H bonds **and** 2x C-CH_3 bonds	do **not** accept extra bonds	1	
		an answer of  scores **2** marks		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	any **one** from: • (otherwise) the copper (produced) would be impure • (otherwise) the copper (produced) would be a mixture • (otherwise) the insulation would burn / melt (during recycling) • copper and poly(butene) are recycled by different methods	allow (otherwise) the copper (produced) would be contaminated allow (otherwise) poly(butene) could produce toxic fumes	1	AO3 4.10.2.2

4.4.1.3 Extraction of metals and reduction

Answer 48 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	(wire heated until) copper melts (re)cast / reformed (into pipes)	 allow (re)shaped / extruded / (re)moulded	1 1	AO1 4.10.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	 any **two** from: (recycling scrap copper) • uses less energy • conserves copper (ore) • (produces) less waste • specified environmental impact	allow converse statements for extracting copper from ores ignore references to cost allow less landfill required	 2	AO1 4.10.1.1 4.10.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	 sodium hydroxide (solution) blue precipitate	MP2 dependent on MP1 allow NaOH for sodium hydroxide allow blue solid	 1 1	AO1 4.8.3.2 RPA7

4.4.1.3 Extraction of metals and reduction

Answer 48 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6	(add acidified) barium chloride (solution)	MP2 dependent on MP1 allow $BaCl_2$ for barium chloride allow (add acidified) barium nitrate (solution) do **not** accept add sulfuric acid	1	AO1 4.8.3.5 RPA7
	white precipitate	allow white solid	1	

Total Question 8		**11**

Answer 49 · Mark scheme

June 2023 | 8462/1F | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	Fe_2O_3 + 3 C → **2** Fe + **3** CO	allow multiples allow **1** mark for 2 Fe **or** allow **1** mark for 3 CO	2	AO2 4.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	(iron oxide) loses oxygen	ignore references to gain of electrons	1	AO2 4.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	(M_r =) (2 × 56) + (3 × 16) = 160	allow 112 + 48	1 1	AO2 4.3.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	(percentage atom economy =) $\frac{63.5}{2 + 79.5} \times 100$ = 77.9 (%)	 allow 77.914110 (%) correctly rounded to at least 2 significant figures	1 1	AO2 4.3.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	any **one** from: • colour change (in solution) • colour change (in metal) • change of temperature	 allow bubbles	1	AO3 4.1.1.1 4.4.1.2

4.4.1.3 Extraction of metals and reduction

Answer 49 · Mark scheme June 2023 | 8462/1F | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6	(most reactive) **D** **B** **A** (least reactive) **C** (reason) more reactive (metals) displace less reactive (metals)	 allow **D** has most (displacement) reactions **and C** does not react allow the more reactive metals have more (displacement) reactions	1 1	AO3 4.4.1.2

Total Question 8	**10**

4.4.1.3 Extraction of metals and reduction

Answer 50 · 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

4.4.1.3 Extraction of metals and reduction

Answer 50 · 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**

4.4.1.3 Extraction of metals and reduction

Answer 51 · Mark scheme

June 2025 | 8462/1F | Original Q5

Question 5

Question	Answers	Mark	AO / Spec. Ref.
05.1	molten compound: copper chloride; product at the negative electrode: **copper**; product at the positive electrode: chlorine — 1 molten compound: potassium bromide; product at the negative electrode: potassium; product at the positive electrode: **bromine** — 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)		1	AO1 4.4.3.1 4.4.3.2 4.4.3.3
	(so) are attracted to the negative electrode	allow (and) opposite charges attract	1	

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

Answer 51 · 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

4.4.1.3 Extraction of metals and reduction

Answer 51 · 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**

Answer 52 · Mark scheme

June 2025 | 8462/1F | Original Q10

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	(substance reduced) SnO_2	allow tin oxide	1	AO2 4.4.1.1 4.4.1.3
	(reason) (SnO_2) loses oxygen	allow (tin oxide) loses oxygen MP2 is dependent upon MP1 being awarded	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	carbon is more reactive than tin	allow tin is less reactive than carbon	1	AO3 4.4.1.2 4.4.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.3	(total M_r = 128 + 12 =) 140	allow (total M_r = 112 + 12 + 16 =) 140	1	AO2 4.3.3.2
	(% atom economy =) $\frac{112}{140} \times 100$	allow correct use of an incorrectly determined total M_r	1	
	= 80 (%)		1	

4.4.1.3 Extraction of metals and reduction

Answer 52 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.4		allow the converse for potassium allow the transition metal for tungsten allow the Group 1 metal for potassium ignore references to atomic structure		
	any **two** from: tungsten • has a higher melting / boiling point • is denser • is harder • is stronger • is less reactive • has ions with different charges • forms coloured compounds • can be a catalyst	 allow is less malleable / ductile allow specific reactions showing difference in reactivity	2	AO1 4.1.2.5 4.1.3.1 4.1.3.2

4.4.1.3 Extraction of metals and reduction

Answer 52 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.5	(sum of relative formula masses on left hand side =) 232 + (3 × 2) = 238 (is equal to sum of relative formula masses on right hand side =) 184 + (3 × 18) = 238	allow (sum of relative formula masses on left hand side =) 232 + 6 = 238 allow (is equal to sum of relative formula masses on right hand side =) 184 + 54 = 238 if no other mark awarded, allow **1** mark for 232 + 6 = 184 + 54 **or** allow **1** mark for both sides = 238	1 1	AO2 4.3.1.1 4.3.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.6	for sustainable development **or** for economic reasons	allow to minimise use of limited resources allow to minimise use of energy allow to minimise waste ignore references to yield	1	AO1 4.3.3.2

Total Question 10	11

Version1.2:15/08/07

ASSESSMENT and QUALIFICATIONS ALLIANCE

GCSE

Science A 4461

Chemistry 4421

CHY1A F & H

Mark Scheme

2007 examination - June series

4.4.1.3 Extraction of metals and reduction

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' 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 to download from the AQA Website: www.aqa.org.uk

Copyright © 2007 AQA and its licensors. All rights reserved.

COPYRIGHT
AQA retains the copyright on all its publications. However, registered centres for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to centres to photocopy any material that is acknowledged to a third party even for internal use within the centre.

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334).
Registered address: AQA, Devas Street, Manchester M15 6EX
Dr Michael Cresswell Director General

4.4.1.3 Extraction of metals and reduction

CHY1A (Products from Rocks)

Foundation Tier

Question	Key		
One	**A**	atom	**3**
	B	compound	**2**
	C	element	**4**
	D	symbol	**1**
Two	**A**	gold (Au)	**3**
	B	lithium (Li)	**4**
	C	calcium (Ca)	**1**
	D	sulfur (S)	**2**
Three	**A**	a bond	**3**
	B	an electron	**2**
	C	a molecule	**4**
	D	a nucleus	**1**
Four	**A**	Aluminium	**2**
	B	Iron	**3**
	C	Mercury	**1**
	D	Potassium	**4**
Five	**A**	one	**2**
	B	four	**3**
	C	five	**1**
	D	seven	**4**
Six	**A**	hard	**3**
	B	resistant to corrosion	**4**
	C	easily shaped	**2**
	D	brittle	**1**

	A	B	C	D
Seven	**2**	**4**	**3**	**2**
Eight	**1**	**2**	**2**	**3**
Nine	**1**	**2**	**4**	**3**

4.4.1.3 Extraction of metals and reduction

CHY1A (Products from Rocks)

Higher Tier

Question	Key		
One	**A**	hard	**3**
	B	resistant to corrosion	**4**
	C	easily shaped	**2**
	D	brittle	**1**
Two	**A**	an alloy	**4**
	B	an element	**1**
	C	a hydrocarbon	**2**
	D	a mixture of compounds	**3**

	A	B	C	D
Three	**1**	**2**	**2**	**3**
Four	**1**	**2**	**4**	**3**
Five	**3**	**2**	**1**	**1**
Six	**4**	**4**	**3**	**3**
Seven	**3**	**2**	**3**	**3**
Eight	**1**	**3**	**2**	**3**
Nine	**2**	**3**	**2**	**3**

Version 1.0: 0707

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science B 4462 / Chemistry 4421

CHY1F Unit Chemistry 1

Mark Scheme

2007 examination - June series

4.4.1.3 Extraction of metals and reduction

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' 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 to download from the AQA Website: www.aqa.org.uk

Copyright © 2007 AQA and its licensors. All rights reserved.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales (company number 3644723) and a registered charity (registered charity number 1073334). Registered address: AQA, Devas Street, Manchester M15 6EX.
Dr Michael Cresswell, Director General.

4.4.1.3 Extraction of metals and reduction

MARK SCHEME

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 and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

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

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 lines 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.)

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates 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)

Candidate	Response	Marks awarded
1	4,8	0
2	green, 5	0
3	red*, 5	1
4	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a candidate 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

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

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 are 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 e.c.f. 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 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use professional judgement to award credit where a candidate has given an unexpected correct answer which is not covered by the mark scheme. The Examiner should consult with the Team Leader to confirm the judgement. The Team Leader should pass this answer on to the Principal Examiner with a view to informing all examiners.

4.4.1.3 Extraction of metals and reduction

CHY1F Question 1

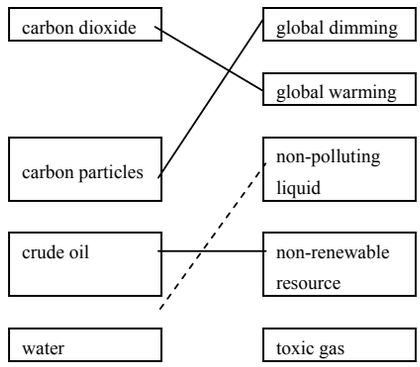
	answers	extra information	mark
(a)	low density unreactive		1 1
(b)	a polymer		1
(c)	any **one** from: • not broken down by (microorganisms) • does not decay (naturally)	ignore cannot recycle / degrade / disintegrate	1
total			4

CHY1F Question 2

	answers	extra information	mark
(a)(i)	additive		1
(b)	any **three** from: • colour 1 is made up of only one colour / dye • colour 2 is made up of only one colour / dye • colour 3 is made up of two colours / dyes **or** more colours (than colours 1 and 2) • colours 1, 2 and 3 are all different • colour 1 is less dark than colour 2	accept colour 3 is a mixture of colours 1 and 2 for **3** marks accept E-number or additive instead of colour ignore comments about height / level	3
total			4

4.4.1.3 Extraction of metals and reduction

CHY1F Question 3

	answers	extra information	mark
(a)	hydrogen	ignore formulae	1
(b)	any **two** from: • different sized molecules / more or less (carbon) atoms (in molecules) • fuels have <u>different</u> boiling points • fuels condense at <u>different</u> temperatures	ignore different densities	2
(c)		all three correct = **3** marks two correct = **2** marks one correct = **1** mark	3
total			6

4.4.1.3 Extraction of metals and reduction

CHY1F Question 4

	answers	extra information	mark
(a)(i)	any **one** from: • iron ore is a limited resource / non-renewable • iron is in high demand • provide jobs • economic advantage		1
(ii)	any **two** from: • would damage (wildlife) habitats / countryside / greenfield sites • extra traffic • visual (pollution) / eyesore • noise (pollution) / sound (pollution) • dust (pollution) • river (pollution) • carbon dioxide (from traffic) / adds to greenhouse effect / global warming • damage roads / buildings by <u>vibrations</u> / <u>shockwaves</u>		2
(b)(i)	carbon monoxide / carbon	accept formulae CO / C	1
(ii)	atoms are all the same (size) / type	accept (particles) are all the same (size) / type for one mark	1 1

Continued on next page

4.4.1.3 Extraction of metals and reduction

Question 4 continued

	answers	extra information	mark
(iii)	any **two** from: • impurities / carbon / different (sized) atoms **or** elements **or** metals • changes the structure / disrupts the pattern or layers • prevents layers sliding over each other • it is an alloy		2
total			8

4.4.1.3 Extraction of metals and reduction

CHY1F Question 5

	answers	extra information	mark
(a)	core	ignore outer or inner	1
	mantle		1
(b)(i)	carbon dioxide	accept formula CO_2	1
	oxygen	accept formulae O_2 / O	1
(ii)	4%		1
(iii)	carbon dioxide has <u>decreased</u> / from 95% to 0%		1
	oxygen has <u>increased</u> / from 0% to 21%		1
	any **one** from: (carbon dioxide decrease) • carbon dioxide used during photosynthesis / by plants • carbon dioxide dissolves in oceans • carbon dioxide is locked up in rocks / carbonates / fossil fuels (oxygen increase) • oxygen released during photosynthesis / by plants		1
total			8

4.4.1.3 Extraction of metals and reduction

CHY1F Question 6

	answers	extra information	mark
(a)	any **two** from: • nitrogen • carbon dioxide • water (vapour) / steam	 accept formulae N / N_2 accept formula CO_2 ignore CO accept formula H_2O	2
(b)	any **three** from: <u>limestone</u> • abundant / local • natural material **or** no 'processing' needed • relatively easy to cut • appearance better <u>concrete</u> • <u>raw materials</u> are abundant • can be reinforced (by steel rods) / strong(er) / supported (by steel rods) • concrete mixture can be poured / moulded / constructed on site • less reactive with acid rain / weathering / erosion	no mark for 'limestone' or 'concrete' on first line – mark advantages only ignore ideas of speed of production or easier to use accept 'can build higher' ignore density / extraction / quarrying / pollution / cost	3
total			5

4.4.1.3 Extraction of metals and reduction

CHY1F Question 7

	answers	extra information	mark
(a)(i)	$Cu_2S + 2O_2 \rightarrow 2CuO + SO_2$	accept fractions and multiples	1
(ii)	any **two** from: • sulfur dioxide • causes acid rain • consequence of acid rain eg kills fish / plants	 accept sulphur dioxide / sulphur oxide / SO_2 ignore other comments eg global warming / ozone / global dimming / greenhouse effect	2
(b)	any **two** from: • heat (copper oxide with carbon) • oxygen is removed by carbon **or** carbon monoxide / carbon dioxide is produced **or** carbon displaces copper • because carbon is more reactive than copper	 accept copper (oxide) loses oxygen **or** carbon gains oxygen accept carbon oxide accept a correct word or balanced symbol equation allow a correct comparison of reactivity	2
(c)(i)	electrolysis	accept electroplating	1
(ii)	(electrical) wiring / appliances / coins / pipes / cladding for buildings / jewellery / making alloys **or** named alloys		1

Continued on next page

4.4.1.3 Extraction of metals and reduction

Question 7 continued

	answers	extra information	mark
(d)	any **three** explanations from: <u>for recycling</u> • less acid rain (pollution) • copper reserves last longer / conserved **or** do not run out • energy for extraction (saved) **or** less energy required • less mining / quarrying • less waste (copper) / electrical appliances dumped **or** less landfill <u>against recycling</u> • collection problems • transport problems • difficult to separate copper from appliances • energy used to melt the collected copper	ignore electrolysis / pollution ignore ideas about less machinery / plant ignore idea of cost	3
total			10

4.4.1.3 Extraction of metals and reduction

AQA

GCSE
CHEMISTRY

8462/1F - PAPER 1 FOUNDATION TIER

Mark scheme

8462

June 2018

Version/Stage: 1.0 Final

4.4.1.3 Extraction of metals and reduction

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

Copyright © 2018 AQA and its licensors. All rights reserved.
AQA retains the copyright on all its publications. However, registered schools/colleges for AQA are permitted to copy material from this booklet for their own internal use, with the following important exception: AQA cannot give permission to schools/colleges to photocopy any material that is acknowledged to a third party even for internal use within the centre.

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.

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.

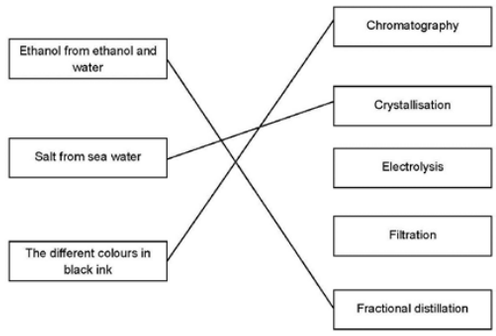
Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

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.

4.4.1.3 Extraction of metals and reduction

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

4.4.1.3 Extraction of metals and reduction

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**	

4.4.1.3 Extraction of metals and reduction

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

4.4.1.3 Extraction of metals and reduction

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**	

4.4.1.3 Extraction of metals and reduction

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**	

4.4.1.3 Extraction of metals and reduction

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**	

4.4.1.3 Extraction of metals and reduction

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

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

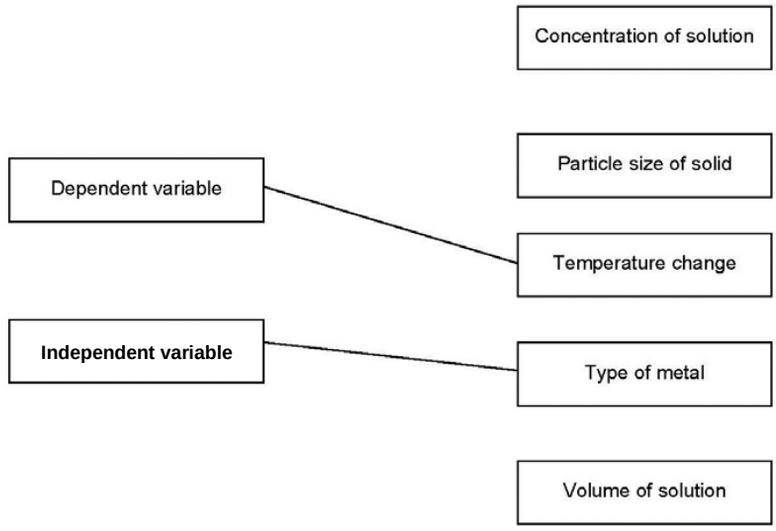
4.4.1.3 Extraction of metals and reduction

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**	

4.4.1.3 Extraction of metals and reduction

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

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

4.4.1.3 Extraction of metals and reduction

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**	

4.4.1.3 Extraction of metals and reduction

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

4.4.1.3 Extraction of metals and reduction

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**	

4.4.1.3 Extraction of metals and reduction

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

4.4.1.3 Extraction of metals and reduction

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**

4.4.1.3 Extraction of metals and reduction

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

4.4.1.3 Extraction of metals and reduction

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**	

4.4.1.3 Extraction of metals and reduction

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

<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 rowspan="5">AO3

AO3

AO2

4.4.3.4
4.5.2.1
4.5.2.2</td></tr>
<tr><td>Level 2: Some logically linked reasons are given. There may also be a simple judgement.</td><td>3–4</td></tr>
<tr><td>Level 1: Relevant points are made. This is not logically linked.</td><td>1–2</td></tr>
<tr><td>No relevant content</td><td>0</td></tr>
<tr><td colspan="2">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></td></tr>
<tr><td>Total</td><td colspan="2"></td><td>11</td></tr>
</table>

Answer 43 · Examiner comments

Question 9 (standard demand)

09.1 Because the question asked for the formula rather than the empirical formula, an answer of Fe_9S_{18} was accepted. Even so, 21% of students were able to answer this correctly.

Many students ignored the necessity for correct capital and lower case letters, with a lower case 'f' being seen quite frequently. Others did not count the atoms correctly, or used a large figure '2' in an inappropriate position.

09.2 This question worked very well. 84% of students managed to achieve at least one mark, with 51% achieving two or more. The most frequent error was in the number of neutrons.

09.3 Whilst 56% of students achieved at least one mark, 34% of these students achieved both.

- Many students repeated information in the stem of the question. And some appeared to ignore it as they declared sodium to be a non-metal.
- Many gave differences in the structure of the atoms instead of differences in properties of the substances.
- Some effectively gave the same difference twice, for example writing that sodium is soft on one line and iron is hard on the other.

09.4 26% of students achieved at least one mark on this question, although some very good answers were seen. As with some other questions, students were sometimes prone to imprecise use of language.

Many students thought that carbon is more reactive than oxygen rather than nickel, or said that carbon is reacting with oxygen (it is not, it is reacting with nickel oxide to remove the oxygen). Those who tried to answer in terms of electron transfer often struggled to gain all the marks.

09.5 Students struggled with this calculation; with 9% of students providing a fully correct answer. This question relies on knowledge of the expression for atom economy. Those who quoted the expression often did not know what was meant by 'reactants'.

It was also common to include the M_r of all the products instead of just the nickel, leading to an answer of 100%, which is clearly incorrect as there is more than one product.

There seemed to be trouble with the interpretation of some calculator displays. Many students lost the final mark because they gave an answer of $67.\dot{8}$. This answer is neither correct (it is not 67.8888888…) nor to three significant figures (it is to an infinite number of significant figures). Some even recognised this latter point and rounded, incorrectly, to 67.9.

4.4.1.3 Extraction of metals and reduction

Answer 44 · 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 47 · 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.

Answer 48 · Examiner comments

June 2022 | 8462/2F | Original Q8

Question 8 (Standard demand)

08.1 This was well answered by a small minority of students with around 10% of students scoring both marks. The most common errors were to omit the double bond, to add additional bonds or atoms to the carbon atoms. Brackets and/or the inclusion of the letter n were ignored.

08.2 The better responses correctly referred to the insulation being burned or melted or the lack of purity or 'contamination' of the copper produced. Uncreditworthy responses often made comments such as 'so you only get copper'. Around 40% of the students scored this mark.

08.3 This was reasonably well answered as responses such as the copper melting and being reformed/moulded into new pipes were seen. Responses referring to 'heating the wire' were insufficient to gain credit. Around 40% of the students scored both marks.

08.4 The most common correct responses referred to the conservation of copper and the use of less energy in this process. Relatively few answers identified specified environmental impacts.

Weaker responses referred to 'pollution' alone which was too vague to gain credit. Some referred to cost without making a link to the amount of energy needed. Less than 10% of students were able to identify two advantages of recycling, though just over 40% could identify one.

08.5 The test for copper(II) ions was not well known.

A variety of tests were chosen, with the most common incorrect response being the use of flame tests. The addition of acids, especially hydrochloric acid, was also often suggested.

Acceptable results included shades of blue precipitate, e.g. pale/light blue, but answers giving two colours such as green/blue were not credited. Around 1% of students scored both the marks.

08.6 The use of barium chloride or barium nitrate as the reagent for the test was generally followed by the correct result.

The test was often incorrect, with the result, therefore, not able to be awarded a mark. The most common incorrect reponses were the use of a flame test or an incorrect reagent(s). Again, around 1% of students scored both the marks.

Answer 49 · Examiner comments June 2023 | 8462/1F | Original Q8

Question 8 (low and standard demand)

08.1 The great majority of students scored at least one mark, with three-fifths scoring both. Most could give the correct coefficient for Fe, but that for CO proved to be more challenging, with values of 5 or 6 being seen quite frequently. This question discriminated well.

08.2 Just over a quarter of students were able to articulate that iron oxide loses oxygen. Many expressed their answer as if decomposition of iron oxide were occurring.

08.3 There were many correct answers, with three fifths of students scoring both marks. However, many students do not realise that all they have to do is add the relative atomic masses of two Fe and three O atoms. 56 x 112 was frequently seen. Some students used three Fe atoms and two O instead of the other way round, misunderstanding the subscripts in the formula. Those who made an arithmetic error but had shown their working were able to score one mark. The question discriminated well.

08.4 This question also discriminated well. Most students could substitute the values correctly into the given expression. However, some did not know how to evaluate that expression and some incorrectly rounded a value of 77.9% to 77% instead of 78%.

08.5 About two thirds of students gave an acceptable observation**.** The majority of students gave bubbling as an observation. This was accepted as bubbles do form as a side reaction to the main displacement reaction. The expected observations of a colour change in either the metal or the solution, or a temperature change, were more rarely seen.

08.6 About three-quarters of students placed the metals in the correct order, but fewer could give a coherent reason. It was common to see the metals listed in reverse order. Students sometimes did not understand the difference between a metal and a metal sulfate, giving incorrect statements such as ‘C had most ticks’.

Answer 50 · 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.

© 2024 AQA and its licensors. All rights reserved.

4.4.1.3 Extraction of metals and reduction

Answer 50 · 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 51 · Examiner comments — June 2025 | 8462/1F | Original Q5

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

Answer 51 · Examiner comments — June 2025 | 8462/1F | Original Q5

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.

Answer 52 · Examiner comments

June 2025 | 8462/1F | Original Q10

Question 10 (standard demand)

10.1 Students found this question difficult and fewer than one in ten could give the correct substance. Many gave tin (the result of the reduction) as the answer instead of tin oxide, and many did not appreciate that reduction is loss of oxygen.

10.2 One in six students could give an acceptable answer in terms of reactivity. Students were expected to compare the reactivities of carbon and tin, so both needed to be named. There was some ambiguous use of the word 'it'.

10.3 Whilst a third of students scored one mark, only about one in ten scored all three. Many could not recall the expression for percentage atom economy and therefore did not attempt to find the total M_r of the reactants. A significant minority added the two relative atomic masses provided to give 124 and then divided by 128.

4.4.1.3 Extraction of metals and reduction

Answer 52 · Examiner comments June 2025 | 8462/1F | Original Q10

10.4 Nearly a half of students scored at least one mark. Many answers were not comparative so could not gain credit. Some gave two halves of the same comparison as two different differences in properties, e.g. tungsten is hard for one answer and potassium is soft for the other. Answers in terms of atomic structure, rather than properties of the element, did not gain credit.

10.5 Nearly a half of students scored both marks by producing working to show that the total M_r on each side was 238.

10.6 One in five students scored the mark. Common correct responses included minimising waste or making more profit. Common incorrect answers included references to yield, rate or safety.

Answer 52 · Examiner comments

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.