AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.1.1.6

Relative atomic mass

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**51**
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.

4.1.1.6 Relative atomic mass

Answer 01 · Mark scheme January 2008 | CHY2H | Original Q3 | Legacy

The full source mark scheme begins on page 134. Follow original question 3 in that document.

Answer 02 · Mark scheme January 2008 | CHY2H | Original Q7 | Legacy

(c)	7		1
(d)(i)	steeper line from around the same starting point and left of the points levelling off at 99	allow crosses if they are fully correct for **1** mark accept short level line at 99 ± ½ square	1 1
(d)(ii)	any **three** from: • particles / molecules / atoms/ ions have more energy • move faster • collide <u>more</u> often **or** <u>more</u> chance of collisions **or** bump into each other <u>more</u> • collide with <u>more</u> force / energy **or** <u>more</u> particles have the activation energy **or** <u>more</u> collisions result in reaction **or** <u>more</u> collisions are successful	allow given / gain / get energy ignore move about more ignore vibrate more / faster ignore collide quicker / faster	3
total			8

4.1.1.6 Relative atomic mass

CHY2H

Question 2

question	answers	extra information	mark
(a)	any **one** from: • they are made of layers • atoms / ions / particles / layers (of atoms) can slide over each other	do **not** accept line / rows / lattice	1
(b)	any **one** from: • smaller / tiny **or** very small • correct size range 1 to 100 nanometres • a few hundred atoms in size	do **not** allow small alone if they state smaller and give a size outside range ignore size if it is less than 20,000	1
(c)	harder plus **one** from: • so does not wear as quickly / erode as quickly • less vulnerable to damage owtte • because they have a high surface area to volume ratio **or** stronger (1) plus **one** from: (1) • less likely to break / do not break • not as vulnerable to damage owtte • do not bend out of shape • because they have a high surface area to volume ratio	 ignore corrode harder to wear down = **1** mark accept withstand pressure harder and stronger alone gains **1** mark	1 1
total			4

4.1.1.6 Relative atomic mass

CHY2H

Question 3

question	answers	extra information	mark
(a)	N_2O		1
(b)	13.8 to 14	gains full marks without working if answer incorrect 13 gains **1** mark **or** 14/101 × 100 gains **1** mark	2
total			3

4.1.1.6 Relative atomic mass

CHY2H

Question 4

question	answers	extra information	mark
(a)	electric current / electricity		1
	plus **one** from:		1
	• is passed through ionic compound / substance / electrolyte • passed through molten/aqueous compound / substance	must be linked to electricity allow liquid compound / substance do **not** allow solution / liquid alone	
	• causing decomposition	accept split up / breakdown / breaking up owtte ignore separated accept elements are formed ignore new substances form	
(b)	hydrogen	accept H_2 do **not** accept H / H^2	1
(c)	one electron from each atom	accept each carbon is bonded to three other carbon atoms leaving one (unbonded) electron owtte	1
	is delocalised / free (to move)	must be linked to electrons answers of delocalised / free electrons only, gains **1** mark accept each carbon is bonded to three other carbon atoms leaving delocalised / free electrons = **2** marks **maximum 1** mark if graphite described as a metal / giant ionic lattice	1
total			5

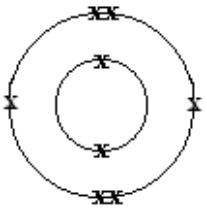
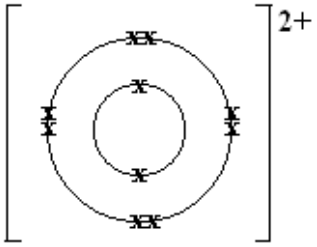
4.1.1.6 Relative atomic mass

Answer 02 · Mark scheme

January 2008 | CHY2H | Original Q7 | Legacy

CHY2H

Question 5

question	answers	extra information	mark
(a)	any **one** from: • gives out heat / energy • transfers energy from a substance to the surroundings • ΔH / energy change / enthalpy change is negative	accept releases / gives off owtte ignore references to light	1
(b)	$2Mg + O_2 \rightarrow 2MgO$	accept correct multiples / fractions	1
(c)		electrons do not need to be paired accept dots / circles / e instead of crosses do **not** allow 2.6 without diagram	1
(d)		electrons do not need to be paired allow without brackets must have the charge accept dots / circles / e instead of crosses ignore extra empty outer shells ignore nucleus do **not** allow $[2.8]^{2+}$ without diagram	1

continued…

4.1.1.6 Relative atomic mass

CHY2H

Question 5 continued…

question	answers	extra information	mark
(e)	oppositely charged (ions / atoms)	allow positive and negative(ions / atoms)	1
	(they) attract	must be in correct context accept held by electrostatic forces ignore ionic bonding **maximum 1** if they refer to intermolecular forces / attractions / covalent bonds	1
(f)	magnesium chloride	accept $MgCl_2$ (if correctly written)	1
total			7

4.1.1.6 Relative atomic mass

CHY2H

Question 6

question	answers	extra information	mark
(a)	**Compound A** any **one** from: • sodium bromide • potassium bromide • ammonium bromide • hydrogen bromide • any metal bromide except silver and lead. **Compound B** silver nitrate	accept correct formulae accept silver sulfate	1 1
(b)	the silver compound will decompose / silver ions be reduced to silver (owtte)	accept film would darken owtte accept any idea of light changing silver bromide / silver ions / silver nitrate / silver sulfate allow 'forms a black solid' / it would turn black	1
(c)	precipitation	accept descriptions of precipitation reactions accept double decomposition accept precipitate do **not** allow displacement	1
(d)	electrons are gained	 the second mark **must** be linked to electrons accept it / silver / silver ions gains electrons for **both** marks ignore references to oxygen	1 1
total			6

4.1.1.6 Relative atomic mass

CHY2H

Question 7

question	answers	extra information	mark
(a)	1213.8 to 1214.3 correct answer not given then check working 1) moles of N_2 = $\frac{1000}{28}$ = 35.7 mol 2) moles of NH_3 = 2 × (answer from (1)) = 71.4 mol 3) mass of NH_3 = (answer from 2) × 17 = 71.4 × 17 = 1214 g **or** • 28g of N_2 → 34g of NH_3 • 1g of N_2 → $\frac{34}{28}$ = 1.214g NH_3 • 1000 g of N_2 → 1000 × 1.214 = 1214g **or** • $1000 \times \frac{34}{28}$ **or** **other correct methods**	gains **3** marks without working **1** mark for each correct step do **not** penalise rounding errors in this part **1** mark for each correct step do **not** penalise rounding errors in this part allow error carried forward eg gains **2** marks if correct answer not given $1000 \times \frac{28}{34}$ gains **1** mark, **2** marks if correctly calculated (823.5g) $1000 \times \frac{28}{17}$ gains **1** mark if calculated correctly (1647.05g) look for the key ideas in the methods above	3

continued…

CHY2H

Question 7 continued…

question	answers	extra information	mark
(b)	25 / 25.035 **or** ecf from (a)	gains **2** marks even when there is no working incorrect answer then 304/(their answer from (a)) × 100 gains **1** mark	2
	or using figures from part (b)		
	27.6 / 28	gains **2** marks even when there is no working accept 27 for **1** mark if answers incorrect then304/1100 × 100 gains **1** mark	
(c)(i)	increase yield		1
	reaction is exothermic		1
	or		
	allow decreased yield because rate of reaction is slower / fewer collisions for **2** marks	**must** get both points for **2** marks	
(c)(ii)	increase yield		1
	plus **one** from: • more (gaseous) reactant molecules than (gaseous) product molecules (owtte) • increased rate of reaction / more collisions	accept greater volume on the left than the right owtte	1

continued…

4.1.1.6 Relative atomic mass

CHY2H

Question 7 continued…

question	answers	extra information	mark
(d)	any **one** from: **economic** • large town provides workforce • workers do not have to travel far to the factory. (owtte) • transport infrastructure already in place for large town. (owtte) • factory brings prosperity to town (owtte) • factory provides employment • reduced tourism • reduction in local house prices • any other sensible economic factor linked to town		1
	any **one** from: **safety** • <u>escape</u> of dangerous / harmful chemicals / gases (owtte) • <u>danger</u> of increased traffic • risk of explosion.(owtte) /danger of high pressure • consequences of an accident could be severe if the town is close • any other sensible safety idea	do **not** allow polluting gases unqualified	1

continued…

4.1.1.6 Relative atomic mass

CHY2H

Question 7(d) continued…

question	answers	extra information	mark
	any **one** from: **environmental** • factory might be unsightly (owtte) • screening of factory (owtte) • loss of habitats (owtte) • plant trees/ hedges etc on and around plant site • pollution of water / air / soil could harm plants / animals **or** noise pollution • CO_2 is produced by burning fuels / heating • CO_2 causes global warming / any effect of global warming • eye sore • any other sensible environmental factor	must be explained	1
total			12

4.1.1.6 Relative atomic mass

Answer 03 · Mark scheme

question	answers	extra information	mark
1(a)	157	correct answer with **or** without working (2 ×19 + 119) for **1** mark only allow (119 + 19 =) 138 for **1** mark only ignore units	2
1(b)	24.2	accept answers in the range 24 to 24.2038..... ignore incorrect rounding after correct answer 25 only without working gains **1** mark **or** 38/157 × 100 gains **1** mark **or** (19/157 × 100 =) 12 to 12.1 gains **1** mark allow error carried forward from part(a) 38/(a) × 100 gains **2** marks if calculated correctly (19/138 ×100 =) 13.8 gains **1** mark	2
1(c)	0.29	accept answers in the range 0.28 to 0.3 allow error carried forward from part (b) (b)/100 × 1.2 correctly calculated ignore units	1

Question 1 continued on the next page…

4.1.1.6 Relative atomic mass

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: June 2008

Question 1 continued…

question	answers	extra information	mark
1(d)	an <u>electron</u>	allow electrons allow electron shared / lost for **1** mark apply list principle for additional particles	1
	is gained owtte	must be linked to electron accept can hold / take in if in correct context eg it can hold another electron (in its outer shell) = **2** marks it can take an electron (from another atom) = **2** marks ignore reference to fluoride ions incorrect number of electrons gained does **not** gain the second mark	1
Total			**7**

4.1.1.6 Relative atomic mass

Answer 03 · Mark scheme

June 2008 | CHY2H | Original Q1 | Legacy

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: June 2008

4.1.1.6 Relative atomic mass

Answer 04 · Mark scheme June 2008 | CHY2H | Original Q5 | Legacy

question	answers	extra information	mark
5(a)	Pb Cl C O		
	$\frac{76}{207}$ $\frac{13}{35.5}$ $\frac{2.2}{12}$ $\frac{8.8}{16}$	**1** mark for dividing **one** mass by A_r allow upside down ratio to lose this mark only	1
	= 0.367 = 0.366 = 0.183 = 0.55	**1** mark for **one** correct proportion – accept to one d.p. or rounded up to 1 d.p.	1
		1 mark for **all four** correct proportions correctly rounded	1
	2 2 1 3 **or $Pb_2Cl_2CO_3$**	**1** mark for correctly written formula **or** correct whole number ratio correct formula without working gets only **1** mark. e.c.f. can be allowed from incorrect proportions to formula **or** ratio	1
5(b)(i)	any **one** from: • $NaOH^-$ / sodium hydroxide is <u>formed</u> / an alkali • hydroxide / OH^- ions <u>formed</u>	**not** just alkali is formed increase number of hydroxide / OH^- ions	1
5(b)(ii)	filter	accept centrifuge / decant allow filter and evaporate ignore further steps unless contradictory	1
Total			**6**

4.1.1.6 Relative atomic mass

Answer 04 · Mark scheme

June 2008 | CHY2H | Original Q5 | Legacy

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: June 2008

4.1.1.6 Relative atomic mass

Answer 05 · Mark scheme

Question 2

question	answers	extra information	mark
2(a)	hydrogen / H^+ /$2H^+$ / H_3O^+	allow H / 2H do **not** accept H_2 apply list principle	1
2(b)(i)	143	correct answer with or without working = **2** marks ignore units if answer is not correct 40 + (2 × 35.5) + (2 × 16) gains **1** mark	2
2(b)(ii)	49.7% (49.6 to 50)	correct answer with or without working = **2** marks answer 49 gains **1** mark if answer is not correct: (71 ÷ 143) × 100 gains **1** mark allow error carried forward from part (b)(i) ie. (71 or their (2 × 35.5) ÷ answer to (b)(i)) × 100 gains **2** marks if calculated correctly and **1** mark if not calculated correctly. **Special case** 35.5 ÷ 143 × 100 = 24.8 to 25% **or** 35.5 ÷ answer to (b)(i) x 100 correctly calculated for **1** mark	2
2(b)(iii)	9.9 to 10g	allow ecf from (b)(i) or (b)(ii)	1

Question 2 continues on the next page…

4.1.1.6 Relative atomic mass

CHY2H

Question 2 Continued

question	answers	extra information	mark
2(c)(i)	an alkali	apply list principle accept named alkali accept hydroxide accept soluble base ignore base	1
2(c)(ii)	a solid / insoluble substance (owtte)		1
2(c)(iii)	filter / filtration	allow decant / centrifuge accept filtration followed by evaporation **or** filtration and evaporation do **not** accept filtration or evaporation do **not** accept evaporation and filtration	1
Total			**9**

4.1.1.6 Relative atomic mass

Answer 05 · Mark scheme

June 2009 | CHY2H | Original Q2 | Legacy

CHY2H

4.1.1.6 Relative atomic mass

Answer 06 · Mark scheme

June 2009 | CHY2H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	C H O		
	0.60 0.15 0.40 12 1 16	**1** mark for dividing the correct amount or multiples of correct amount by A_r	1
	= 0.05 = 0.15 = 0.025	**1** mark for proportions	1
	2 6 1	**1** mark for whole number ratio – accept any multiple	1
	C_2H_6O	**1** mark for correctly written simplest formula correct formula without working gets only **2** marks correct formula gains full marks provided steps 1 and 2 are correct. ecf can be allowed from step 2 to 3 **or** step 3 to 4 formula can be in any order eg OH_6C_2	1
6(b)	intermolecular forces / bonds		1
	are weak	(covalent) bonds are weak = 0	1
	or		
	forces between molecules **or** bonds between molecules (1)	(attractive) forces are weak = 1	
	are weak (1)	if no marks awarded, allow low boiling point **or** small M_r for **1** mark	

Question 6 continues on the next page…

CHY2H

Question 6 Continued

question	answers	extra information	mark
6(c)(i)	to check the safety of the perfume (owtte)	accept references to possible harmful / dangerous effects of perfume **or** possible reactions on skin eg to show it does not damage skin / cause cancer etc. allow to see what it smells like <u>on the skin</u> allow so the company do not have to test on animals	1

Question 6 continues on the next page…

4.1.1.6 Relative atomic mass

CHY2H

Question 6 Continued

question	answers	extra information	mark
6(c)(ii)	any **two** from: idea from text **linked with** an explanation • the company claim to have tested the product: but we cannot be certain they have **or** how thorough they are **or** how accurately reported • companies did not disclose how they did their tests: so they could not be checked **or** so they could not be shown to be reliable / valid **or** so they could not be repeated • companies may not have repeated their tests: so they may not be reliable • companies do their own tests: so they may be biased **or** so they may not be truthful about their results **or** so they may not be reliable • the companies are using different tests: so the results cannot be compared **or** so results will be different **or** so results will not be fair / valid / reliable • companies would not give false information because of damage to reputation **or** it might lead to litigation	or converse eg companies should disclose how they did their tests so that results can be checked etc. or converse eg independent tests should be done so as to ensure there is no bias etc. or converse eg companies should do the same tests so that the results will be fair etc.	2
Total			**9**

4.1.1.6 Relative atomic mass

Answer 07 · Mark scheme

Question 3

question	answers	extra information	mark
3(a)	$^{2}_{1}H$	2 and 1 must be on the left 2 must be above half-way on the H and the 1 below half-way accept diagram with 2 <u>different</u> particles in centre and 1 particle on circle	1
3(b)(i)	18	ignore working ignore units	1
3(b)(ii)	forces (of attraction) between molecules **or** bonding between molecules **or** intermolecular forces /intermolecular bonds are weak **or** not much energy needed to break them **or** easily overcome	 must be linked to first mark if no other mark awarded allow <u>small</u> molecules / small M_r for **1** mark allow forces / bonds are weak for **1** mark do **not** allow covalent bonding is weak	1 1

Question 3 continues on next page

CHY2H

Question 3 contd

3(c)		any reference to <u>more</u> protons = **0** marks	
	H-2 atoms have 1 proton and 1 neutron	allow H-2 has more neutrons / particles for **1** mark	1
	H-1 atoms have one proton **or** H-2 atom has one neutron (1) H-1 atom has no neutrons (1)	allow H-2 has two particles and H-1 has one particle for **1** mark allow H-2 atom has one more neutron for **2** marks	1
		NB heavy water (molecule) has 2 <u>more</u> neutrons = **2** marks heavy water (molecule) has more neutrons / particles = **1** mark if no other mark awarded then heavy water molecule has M_r of 20 = **1** mark ignore reference to electrons	
Total			**6**

4.1.1.6 Relative atomic mass

Answer 07 · Mark scheme

January 2010 | CHY2H | Original Q3 | Legacy

CHY2H

4.1.1.6 Relative atomic mass

Answer 08 · Mark scheme

June 2010 | CHY2H | Original Q1 | Legacy

Question 1

question	answers	extra information	mark
1(a)(i)	(nitrogen) + hydrogen → ammonia	accept H_2 and NH_3 ignore incorrect symbols ignore balancing	1
1(a)(ii)	any **one** from: • catalyst • to speed up the reaction • lower activation energy	 ignore causes reaction ignore heat / reference to particles 	1
1(a)(iii)	any **two** from: • cooled • ammonia condenses / turns into liquid • nitrogen and hydrogen do not condense / turn into liquid **or** nitrogen and hydrogen stay as gases	it = ammonia ignore references to boiling point if no marks awarded accept pass through / separated in condenser **or** unreacted nitrogen and hydrogen / gases recycled for **1** mark	2

Question 1 continues on the next page

CHY 2H

Question 1 continued

question	answers	extra information	mark
1(b)	80	correct answer with or without working gains **2** marks ignore units if answer incorrect, evidence of correct working gains **1** mark eg 14 + (4 x 1) + 14 + (3 x 16) (= 70) **or** 2N + 4H +30	2
1(c)	fertiliser is **C** evidence of correct working	 examples of minimum correct working: 39/101 **or** 14/101 **or** 38.61/100 **or** 13.86/100	1 1
Total			**8**

4.1.1.6 Relative atomic mass

Answer 08 · Mark scheme

June 2010 | CHY2H | Original Q1 | Legacy

CHY 2H

4.1.1.6 Relative atomic mass

Answer 09 · Mark scheme

June 2010 | CHY2H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	84 / 84.5 / 83.98	correct answer with or without working gains **3** marks (moles of NaN_3 =) 130/65 (1) moles of nitrogen = 3 (1) mass of nitrogen = 3 x 28 = 84 (1) **or** 2 x (23 + (3 x 14)) (1) 3 x (2 x14) (1) **or** $2NaN_3$ = 130 (1) $3N_2$ = 84 (1) if answer is incorrect then look for evidence of correct working. allow ecf from previous stage **1** mark lost for each mistake in the working if they do not have the correct answer.	3
4(a)(ii)	72 / 72.24 / 72.2 **or** 69 **or** 68.8	allow ecf from part (i) × 0.86 ignore working	1
4(b)(i)	2 **and** 5		1
4(b)(ii)	any **one** from: • corrosive / burns • alkaline / basic • attacks / destroys / damages living tissue / cells	do **not** accept acidic allow irritant ignore reference to reactivity ignore reference to silicates ignore harmful / toxic	1
Total			**6**

4.1.1.6 Relative atomic mass

Answer 09 · Mark scheme

June 2010 | CHY2H | Original Q4 | Legacy

CHY 2H

4.1.1.6 Relative atomic mass

Answer 10 · Mark scheme

January 2011 | CHY2H | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)(i)	65	correct answer with or without working = **2** marks if answer incorrect evidence of (81 – 16) for **1** mark ignore units	2
2(a)(ii)	zinc	accept error carried forward from (a)(i) allow correct symbol answer given should be element / metal closest to their answer do **not** allow compounds	1
2(b)(i)	• it loses electrons • three electrons	sharing / covalency = max **1** mark	1 1
2(b)(ii)	8 electrons shown in second shell.	accept dots / crosses / mixture of dots and crosses / e electrons do not need to be paired do **not** allow extra electrons in first shell	1
Total			**6**

4.1.1.6 Relative atomic mass

Answer 10 · Mark scheme

January 2011 | CHY2H | Original Q2 | Legacy

CHY2H

4.1.1.6 Relative atomic mass

Answer 11 · Mark scheme

June 2011 | CHY2H | Original Q2 | Legacy

Question 2

question	answers	extra information	mark
2(a)	because they are gases	ignore vapours / evaporate / (g) allow it is a gas	1
2(b)(i)	80 / 79.5	correct answer with or without working = **2** marks ignore units if no answer **or** incorrect answer then evidence of 64 / 63.5 + 16 gains **1** mark	2
2(b)(ii)	80 / 79.87 / 79.9 / 79.375 / 79.38 / 79.4	correct answer with or without working = **2** marks if no answer **or** incorrect answer then evidence of $\frac{64}{80}$ **or** $\frac{63.5}{79.5}$ (x100) gains **1** mark accept (ecf) $\frac{64 or 63.5}{answer(b)(i)}(\times 100)$ for **2** marks if correctly calculated. if incorrectly calculated evidence of $\frac{64 or 63.5}{answer(b)(i)}(\times 100)$ gains **1** mark	2
2(b)(iii)	3.2	correct answer with or without working = **1** mark allow (ecf) 4 x ((b)(ii)/100) for **1** mark if correctly calculated	1

Question 2 continues on the next page

Question 2 continued

question	answers	extra information	mark
2(c)(i)	3.3	accept 3.33…….. or $3\frac{1}{3}$ or 3.3$^{\bullet}$ or 3.3^{r}	1
2(c)(ii)	measure to more decimal places **or** use a more sensitive balance / apparatus	allow use smaller scale (division) **or** use a smaller unit ignore accurate / repeat	1
2(c)(iii)	any **two** from: • different balances used **or** faulty balance • reading / using the balance incorrectly **or** recording error • spilling copper oxide / copper • copper oxide impure • not all of the copper oxide was reduced / converted to copper **or** not enough / different amounts of methane used • heated for different times • heated at different temperatures • some of the copper made is oxidised / forms copper oxide • some of the copper oxide / copper blown out / escapes (from tube) • some water still in the test tube	ignore systematic / human / apparatus / zero / measurement / random / weighing / reading errors unless qualified ignore dirty apparatus accept incorrect weighing of copper / copper oxide allow some copper left in tube allow impure copper (produced) accept not all copper oxide (fully) reacted accept Bunsen burner / flame at different temperatures ignore some copper oxide / copper lost	2
Total			**10**

4.1.1.6 Relative atomic mass

Answer 11 · Mark scheme June 2011 | CHY2H | Original Q2 | Legacy

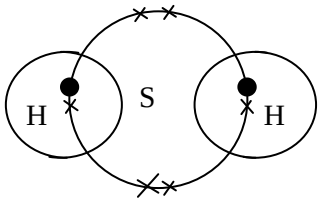
CHY2H

4.1.1.6 Relative atomic mass

Answer 12 · Mark scheme

June 2011 | CHY2H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	$\frac{6.21}{207}$ $\frac{0.64}{16}$	**1** mark for dividing mass by A_r max **2** if A_r divided by mass	1
	= 0.03 = 0.04	**1** mark for correct proportions	1
	3 4	**1** mark for correct whole number ratio (allow multiples) can be awarded from correct formula	1
	Pb_3O_4	**1** mark for correct formula **ecf** allowed from **step 2 to step 3** and **step 3 to step 4** if sensible attempt at **step 1** correct formula with no working gains **2** marks	1
6(b)(i)		allow all dots **or** all crosses **or** e **or** e^- ignore inner shells and any inner electrons allow 4 non-bonded electrons anywhere on shell as long as not in overlap – need not be paired	1

Question 6 continue on the next page

4.1.1.6 Relative atomic mass

Question 6 continued

question	answers	extra information	mark
6(b)(ii)	forces of attraction / bonds <u>between</u> molecules are weak (owtte) **or** <u>intermolecular</u> forces / bonds are weak (owtte) **or** it is made of small molecules with weak forces of attraction	do **not** accept intramolecular forces / covalent bonds are weak do **not** accept reference to ions if **2** marks not awarded made of small molecules / simple molecular gains **1** mark forces of attraction are weak (without specifying between molecules / intermolecular) gains **1** mark (accept easily broken / not much energy needed to break instead of weak) bonds are weak without specifying intermolecular would not gain a mark and would be ignored	2
6(b)(iii)	4		1
Total			**8**

4.1.1.6 Relative atomic mass

Answer 12 · Mark scheme

June 2011 | CHY2H | Original Q6 | Legacy

CHY2H

4.1.1.6 Relative atomic mass

Answer 13 · Mark scheme

June 2012 | CH2HP | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	52.9(411765) / 53	correct answer with or without working = **2** marks if answer incorrect allow 2 x 27= 54 **or** 27/102 x 100 **or** 26.5 for **1** mark	2
5(b)(i)	because it lowers the melting point (of the aluminium oxide) so less energy is needed (to melt it)	allow lowers the temperature needed do **not** accept lowers boiling point accept so that the cell / equipment does not melt	1 1
5(b)(ii)	**2** O^{2-} on left hand side **4e**$^{-}$ on right hand side	accept correct multiples or fractions accept –**4e**$^{-}$ on left hand side	1 1
5(b)(iii)	because the electrode reacts with oxygen **or** because the electrode burns to form carbon dioxide **or** electrode made from carbon / graphite		1 1
Total			**8**

4.1.1.6 Relative atomic mass

Answer 13 · Mark scheme

June 2012 | CH2HP | Original Q5 | Legacy

CH2HP

4.1.1.6 Relative atomic mass

Answer 14 · Mark scheme

June 2012 | CH2HP | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	because calcium is +2 and hydroxide is –1 **or** to make the compound neutral (in terms of charges)	accept to balance the charges allow calcium needs to lose 2 electrons and hydroxide needs to gain one electron	1
6(b)	particles of size 1-100 nm **or** particles with a few hundred atoms / ions **or** particles with a high surface area (to volume ratio) **or** as different properties to 'normal' size particles of the same substance	allow clear comparison to 'normal' size particles	1
6(c)	M_r CaO = 56 **and** M_r $Ca(OH)_2$= 74 2/56 (x74) **or** 0.036 (x74) **or** 74/56 (x2) **or** 1.3(214…) (x2) 2.6(428…) in range 2.6 to 2.96	 allow ecf from step 1 correct answer with or without working gains **3** marks allow ecf carried through from step 1 ignore final rounding to 3	1 1 1
Total			**5**

4.1.1.6 Relative atomic mass

Answer 14 · Mark scheme

June 2012 | CH2HP | Original Q6 | Legacy

CH2HP

4.1.1.6 Relative atomic mass

Answer 15 · Mark scheme

January 2013 | CH2HP | Original Q3 | Legacy

question	answers	extra information	mark
3(a)(i)	to increase the rate of reaction		1
3(a)(ii)	H_2SO_4 on the left hand side H_2O on right hand side		1 1
3(a)(iii)	filtration	allow centrifuging **or** decanting ignore evaporation if after filtration	1
3(a)(iv)	crystallisation **or** evaporation / heating / boiling / cooling	ignore reference to filtration unless given as an alternative	1
3(a)(v)	any **one** from: • because of an incomplete reaction • because some (copper sulfate) lost on filtering **or** when poured into evaporating basin **or** boiled over **or** left in apparatus • weighing error (of copper sulfate)	 accept not all acid reacted accept impure reactants accept unexpected reaction ignore reversible reaction must specify when lost accept some (copper sulfate **or** acid) spilt	1
3(b)(i)	reversible (reaction)		1
3(b)(ii)	300(J) (energy) given out / released	allow the same accept exothermic / – ignore increasing **or** decreasing energy	1 1

Question 3 continues on the next page

4.1.1.6 Relative atomic mass

January 2013

CH2HP

Question 3 cont'd

question	answers	extra information	mark
3(c)	$\frac{3.81}{63.5}$ $\frac{0.28}{14}$	**1** mark for dividing mass by A_r (max **2** if A_r divided by mass)	1
	= 0.06 = 0.02	**1** mark for correct proportions	1
	3 1	**1** mark for correct whole number ratio (allow multiples). Can be awarded from formula	1
	Cu_3N	**ecf** allowed from **step 2 to step 3** and **step 3 to step 4** if sensible attempt at step 1 correct formula gains **1** mark	1
Total			**13**

4.1.1.6 Relative atomic mass

Answer 15 · Mark scheme

January 2013

CH2HP

4.1.1.6 Relative atomic mass

Answer 16 · Mark scheme

January 2013 | CH2HP | Original Q7 | Legacy

question	answers	extra information	mark
7(a)	copper has delocalised electrons	accept copper has free electrons ignore sea of electrons **or** mobile electrons	1
	(electrons) which can move through the metal / structure	allow (electrons) which can carry a charge through the metal / structure	1
7(b)(i)		correct answer with or without working gains **3** marks	
	(M_r $FeCl_3$ =) 162.5 **or** 2 (moles of) $FeCl_3$ = 325 **or** 112 → 325	can be credited from correct substitution in step **2**	1
	$\frac{11.20}{56} \times 162.5$	allow ecf from step 1 accept $\frac{325}{112} \times 11.2$	1
	= 32.5	accept 32.48	1
7(b)(ii)	74.8	accept 74.77 - 75 accept ecf from 7 (b)(i) if there is no answer to part(i) **or** if candidate chooses not to use their answer then accept 86.79 - 87	1
Total			**6**

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

4.1.1.6 Relative atomic mass

Answer 17 · Mark scheme

June 2013 | CH2HP | Original Q1 | Legacy

Question 1

question	Answers	extra information	Mark
1(a)(i)	the more sodium hydrogencarbonate the greater the temperature change up to 8 spatula measures then the temperature change is constant	accept examples from the table accept any correct indication of when change occurs if no marks awarded allow **1** mark for: the more sodium hydrogencarbonate the lower the final temperature	1 1 1
1(a)(ii)	energy is taken in from the surroundings **or** endothermic		1
1(b)(i)	gas / carbon dioxide / steam / water is produced	accept carbon dioxide is a gas **or** steam / water is a gas allow gas / air expands when heated	1
1(b)(ii)	no, because (reaction) is exothermic **or** yes, to start the reaction	allow no, because (reactants) were formed by heating ignore references to cooling	1
1(c)(i)	84	correct answer with or without working gains **2** marks if no answer or incorrect answer then evidence of 23 +1 + 12 + (3 × 16) gains **1** mark	2
1(c)(ii)	14.29	accept rounding to 14.3 or 14 allow ecf from (c)(i)	1
Total			**9**

4.1.1.6 Relative atomic mass

Answer 18 · Mark scheme

June 2013 | CH2HP | Original Q3 | Legacy

Question 3

question	Answers	extra information	Mark
3(a)(i)	M_r of NH_3 = 17 **or** 2 (moles of) NH_3 = 34 **or** 14 → 17 **or** 28 → 34	correct answer with or without working gains **3** marks accept correct rounding of intermediate answers can be credited from correct substitution from step 2	1
	(28/34) x 6.8 **or** (14/17) x 6.8	allow ecf from step 1	1
	= 5.6	allow ecf from step 1	1
3(a)(ii)	61.8	accept 61.76 **or** 62 **or** 61.76… correct answer with or without working gains **2** marks if answer is not correct evidence of 4.2 / 6.8 x 100 gains **1** mark if answer not correct 0.618 or 0.62 gains **1** mark	2
3(a)(iii)	reaction is reversible	accept reaction reaches equilibrium allow reaction does not reach completion ignore some is lost	1
3(b)	3 bonding pairs	do **not** accept extra electrons on hydrogen	1
	1 lone pair	accept 2 non-bonding electrons on outer shell of nitrogen	1
3(c)(i)	hydroxide / OH^-	accept phonetic spelling	1

Question 3 continues on the next page

4.1.1.6 Relative atomic mass

Question 3 continued

question	Answers	extra information	Mark
3(c)(ii)	neutralisation	accept acid-base allow exothermic	1
3(c)(iii)	nitric (acid)	allow HNO_3 ignore incorrect formula	1
3(c)(iv)	$(NH_4)_2SO_4$	allow $(NH_4^+)_2SO_4^{2-}$	1
Total			**12**

4.1.1.6 Relative atomic mass

Answer 19 · Mark scheme June 2014 | CH2HP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
4(a)(i)	so ions can move (and carry charge)	accept so current can flow *allow so it can conduct (electricity)* *allow so charged particles can move* *do **not** accept so electrons can move*	1	1 / 2.7.1a/b	E
4(a)(ii)	because zinc ions gain electrons 2 (electrons) zinc is formed	accept because zinc ions are reduced *accept correct half equation for **3** marks* *if no mark gained allow* *positive ions go to negative electrode **or*** *opposites attract **or*** *reduction (of zinc) **or*** *(zinc) gains electrons for **1** mark*	1 1 1	1 + 2 / 2.7.1b/c/e	E
4(a)(iii)	**2** Cl^- ⟶ Cl_2 + **2** e^-	must be completely correct	1	1 / 2.7.1g	E
4(b)(i)	because the magnesium is *a gas*	*allow magnesium goes from solid to gas*	1	2 / 2.6.1a	E
4(b)(ii)	(a reaction which) takes in energy (from the surroundings)	*accept more energy needed to break bonds than released by forming bonds* *accept correct reference to energy level diagram* *allow (a reaction which) takes in heat (from the surroundings)*	1	1 / 2.5.1a/b	E

4.1.1.6 Relative atomic mass

Answer 19 · Mark scheme

June 2014 | CH2HP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
4(b)(iii)	*(M_r* MgO =) 40	*accept (2 M_r* MgO =) 80	1	2 / 2.3.3c	E
	1.2/24 (x40) **or** 0.05 (x40) **or** 40/24 (x1.2) **or** 1.67 (x1.2)	allow ecf from step 1	1		
	2(.0)	allow ecf carried through from step 1 correct answer with or without working gains **3** marks	1		
4(b)(iv)	75(%)		1	2 / 2.3.3e	E
4(b)(v)	any **one** from: • the reaction is reversible • *some lost /escaped/ released (when* separated) • some of the reactant may react in different ways from the expected reaction • *impure reactant(s)*	*accept incomplete reaction* *ignore equilibrium not reached* *ignore measurement and calculation errors*	1	1 / 2.3.3d/f	E
Total			**12**		

4.1.1.6 Relative atomic mass

Answer 19 · Mark scheme

June 2014 | CH2HP | Original Q4 | Legacy



4.1.1.6 Relative atomic mass

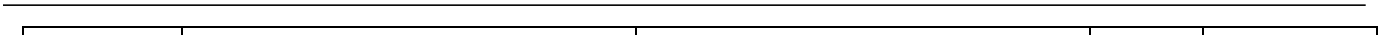
Answer 20 · Mark scheme June 2015 | CH2HP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	because this lithium atom has 3 protons and 4 neutrons mass number is total of neutrons and protons	 accept protons and neutrons have a mass of 1 accept number of neutrons = 7 - 3(protons) ignore mass of electron is negligible	 1 1 1	**AO1/ AO2** 2.3.1abc
4(b)	grams ^{12}C	accept g allow carbon-12 **or** C-12 ignore hydrogen **or** H	1 1	**AO1** 2.3.1eg
4(c)	 any **three** from: • both have 8 protons • ^{18}O has 10 neutrons • ^{16}O has 8 neutrons • both have 8 electrons	max **2** if no numbers given numbers if given must be correct accept same number of protons } accept different number of neutrons or ^{18}O has two more neutrons for **1** mark accept same number of electrons	3	**AO1/ AO2** 2.3.1d
Total			**8**	

4.1.1.6 Relative atomic mass

Answer 20 · Mark scheme

June 2015 | CH2HP | Original Q4 | Legacy



4.1.1.6 Relative atomic mass

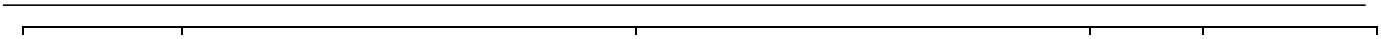
Answer 21 · Mark scheme June 2015 | CH2HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)(i)	silver nitrate	allow $AgNO_3$	1	**AO3** 2.6.1d
5(a)(ii)	potassium carbonate **or** sodium carbonate	allow K_2CO_3 allow Na_2CO_3	1	**AO3** 2.6.1d
5(b)	base	allow ionic ignore insoluble or soluble ignore alkali	1	**AO1** 2.6.2a
5(c)(i)	evaporate **or** crystallise	allow heat or boil or leave (to evaporate) allow cool ignore filtration unless given as an alternative do **not** accept freeze or solidify	1	**AO1** 2.6.1c
5(c)(ii)	2 (HNO_3)	accept multiples	1	**AO2** 2.6.1b
5(c)(iii)	9	accept nine	1	**AO2** 2.6.1b 2.1.1a
5(d)	6.21/207 0.72/16 = 0.03 = 0.045 2 3 Pb_2O_3	**1** mark for dividing mass by A_r **1** mark for correct proportions (allow multiples) **1** mark for correct whole number ratio (allow multiples). Can be awarded from formula. allow O_3Pb_2 **ecf** allowed throughout if sensible attempt at step 1 correct formula with no working gains **1** mark	1 1 1 1	**AO2** 2.3.3b
Total			**10**	

4.1.1.6 Relative atomic mass

Answer 21 · Mark scheme

June 2015 | CH2HP | Original Q5 | Legacy



4.1.1.6 Relative atomic mass

Answer 22 · Mark scheme

June 2016 | CH2HP | Original Q2 | Legacy

Question	Answers	Extra information	Mark	AO / SpecRef
2(a)	endothermic		1	AO1 2.5.1d
2(b)	82 (%)	correct answer with working gains **3** marks if 17 or 34 not shown in working **max 2** marks accept 82.4 accept 82.35 to full calculator display (82.35294...) correctly rounded to at least 2 sf if no answer or incorrect answer, then (M_r =) 17 gains **1** mark **or** 14/17 gains **2** marks **OR** ($2M_r$ =) 34 gains **1** mark **or** 28/34 gains **2** marks **OR** 14/their M_r shown gains **1** mark **or** correct calculation of 14/their M_r gains **2** marks	3	AO2 2.3.3a, 2.3.1f
2(c)(i)	7 / seven		1	AO1 2.6.2d
2(c)(ii)	$H^+ + OH^- \rightarrow H_2O$		1	AO1 2.6.2e
2(c)(iii)	ammonium chloride	allow NH_4Cl ignore an incorrect formula	1	AO1 2.6.2b

Question 2 continues on the next page

Question 2 continued

Question	Answers	Extra information	Mark	AO / SpecRef
2(d)			6	2AO2 / 4AO3 2.6.2c

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 and apply a 'best-fit' approach to the marking.

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
No relevant content.	Suggestion with a reference to a graph.	Suggestion with reasons referring to more than one graph.	Suggestion with reasons from all three graphs, and linking of ideas which may explain a compromise.

Examples of chemistry points made in response:
A reasonable suggested amount of fertiliser would be in the region of 200 kg (per ha). Accept any suggestion from about 180 kg (per ha) to 500 kg (per ha).

Yield:

- Using fertiliser improves yield.
- Yield improved most up to about 200 kg (per ha) of fertiliser.
- Yield only increased slightly above about 200 kg (per ha).

Profit:

- About 200 kg of fertiliser gives the most profit.
- Above about 200 kg (per ha) of fertiliser profit declines.

Run off:

- Run off is at low levels until about 300 kg (per ha) of fertiliser.
- Above about 300 kg (per ha) of fertiliser, run off increases.

Examples of linking of ideas:

- Overall 200 kg gives high crop yield and most profit.
- In conclusion 200 kg gives high crop yield and low run off.
- 200 kg gives most profit and low run off.

Examples of compromise:

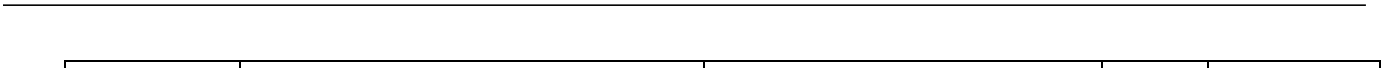
- Profits go down after about 200 kg (per ha) of fertiliser because cost of fertiliser is not covered by increased yield.
- 200 kg gives the highest profit although it is not the highest yield.
- 500 kg gives the best yield but has the most runoff.

Total			13

4.1.1.6 Relative atomic mass

Answer 22 · Mark scheme

June 2016 | CH2HP | Original Q2 | Legacy



Answer 23 · Mark scheme

June 2017 | CH2HP | Original Q4 | Legacy

The full source mark scheme begins on page 149. Follow original question 4 in that document.

4.1.1.6 Relative atomic mass

Answer 24 · Mark scheme June 2018 | 8462/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	FeS_2	do **not** accept equations	1	AO2 4.2.1.3
02.2	26 30 26	must be this order	1 1 1	AO2 4.1.1.4 4.1.1.5
02.3	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

4.1.1.6 Relative atomic mass

Answer 24 · Mark scheme

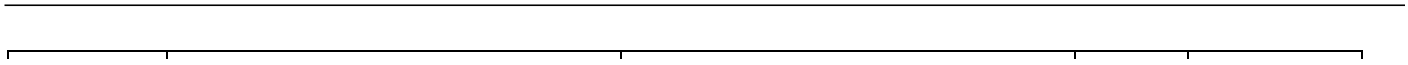
June 2018 | 8462/1H | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	carbon is more reactive (than nickel) (so) carbon will displace / replace nickel (from nickel oxide) **or** (so) carbon will remove oxygen (from nickel oxide)	allow converse allow (so) nickel ions gain electrons allow (so) carbon transfers electrons to nickel (ions)	1 1	AO1 4.4.1.2 4.4.1.3
02.5	 (total M_r of reactants =) 87 (percentage atom economy) $= \frac{59}{87} \times 100$ = 67.8 (%)	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 allow (percentage atom economy) $= \frac{59}{\text{incorrectly calculated } M_r} \times 100$ allow an answer from an incorrect calculation to 3 sig figs	 1 1 1	AO2 4.3.3.2
Total			11	

4.1.1.6 Relative atomic mass

Answer 24 · Mark scheme

June 2018 | 8462/1H | Original Q2



4.1.1.6 Relative atomic mass

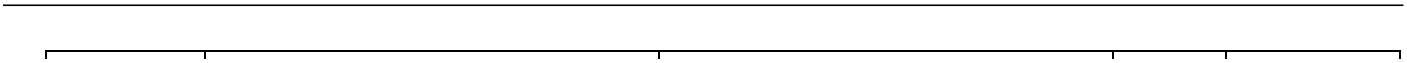
Answer 25 · Mark scheme June 2018 | 8462/1H | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	B		1	AO1 4.1.1.3
04.2	C		1	AO2 4.1.1.3
04.3	A		1	AO2 4.1.1.3
04.4	sum of protons and neutrons	allow number of protons and neutrons	1	AO1 4.1.1.5
04.5	between 69.5 and 70.0		1	AO2 4.1.1.6
04.6	Chadwick provided the evidence to show the existence of neutrons (this was necessary because) isotopes have the same number of protons **or** (this was necessary because) isotopes are atoms of the same element but with different numbers of neutrons	allow Chadwick discovered neutrons allow (this was necessary because) isotopes have the same atomic number ignore isotopes have the same number of electrons allow but with different mass (numbers)	1 1 1	AO1 4.1.1.3 AO3 4.1.1.5 AO1 4.1.1.5
Total			**8**	

4.1.1.6 Relative atomic mass

Answer 25 · Mark scheme

June 2018 | 8462/1H | Original Q4



4.1.1.6 Relative atomic mass

Answer 26 · Mark scheme June 2018 | 8462/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	chlorine is toxic	allow carbon monoxide is toxic allow poisonous for toxic ignore harmful / deadly / dangerous allow a poisonous gas is used / produced allow titanium chloride is corrosive	1	AO3 4.1.2.6 4.4.1.3
08.2	any **one** from: • very exothermic reaction • produces a corrosive solution • produces hydrogen, which is explosive / flammable	 allow explosive allow violent reaction ignore vigorous reaction ignore sodium is very reactive allow caustic for corrosive ignore alkaline allow flames produced ignore sodium burns	1	AO3 4.1.2.5 4.4.1.3
08.3	argon is unreactive / inert oxygen (from air) would react with sodium / titanium **or** water vapour (from air) would react with sodium / titanium	allow argon will not react (with reactants / products / elements) allow elements / reactants / products for sodium / titanium	1 1	AO3 4.1.2.4 4.1.2.5 4.4.1.1 4.4.1.3

4.1.1.6 Relative atomic mass

Answer 26 · Mark scheme

June 2018 | 8462/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	metal chlorides are usually ionic	allow titanium chloride is ionic	1	AO1 4.1.2.6 4.1.3.1
	(so)(metal chlorides) are solid at room temperature **or** (so)(metal chlorides) have high melting points	allow titanium chloride for metal chlorides	1	4.2.1.2 4.2.2.3 4.2.2.4
	(because) they have strong (electrostatic) forces between the ions **or** (but) must be a small molecule or covalent	ignore strong ionic bonds allow molecular allow alternative approach: titanium chloride must be covalent **or** has small molecules (1) with weak forces between molecules do **not** accept bonds unless intermolecular bonds(1) (but) metal chlorides are usually ionic (1)	1	
08.5	sodium (atoms) lose electrons	do **not** accept references to oxygen	1	AO1 4.4.1.4
08.6	$Na \rightarrow Na^+ + e^-$	do **not** accept e for e^-	1	AO2 4.1.1.1 4.4.1.4

4.1.1.6 Relative atomic mass

Answer 26 · Mark scheme

June 2018 | 8462/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.7		an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps		AO2 4.3.1.2 4.3.2.1 4.3.2.2 4.3.2.4
	(M_r of $TiCl_4$ =) 190		1	
	(moles Na) = $\frac{20\,000}{23}$ =) 870 (mol	allow **1** mark for 0.870 mol Na **and** 0.211 mol $TiCl_4$	1	
	$\left(\text{moles } TiCl_4 = \frac{40\,000}{190} =\right)$ 211 (mol)	allow use of incorrectly calculated M_r from step 1	1	
	either (sodium is in excess because) 870 mol Na is more than the 844 mol needed **or** (because) 211 mol $TiCl_4$ is less than the 217.5 mol needed	the mark is for correct application of the factor of 4 other correct reasoning showing, with values of moles or mass, an excess of sodium or insufficient $TiCl_4$ is acceptable allow use of incorrect number of moles from steps 2 and / or 3	1	
		alternative approaches: **approach 1:** (M_r of $TiCl_4$ =) 190(1) (40 kg $TiCl_4$ needs) $\frac{40}{190} \times 4 \times 23$ (kg Na) (1) (=) 19.4 (kg) (1) so 20 kg is an excess (1) **approach 2:** (M_r of $TiCl_4$ =) 190(1) (20 kg Na needs) $\frac{20}{4 \times 23} \times 190$ (kg $TiCl_4$) (1) (=) 41.3 (kg) (1) so 40 kg is not enough (1)		

4.1.1.6 Relative atomic mass

Answer 26 · Mark scheme

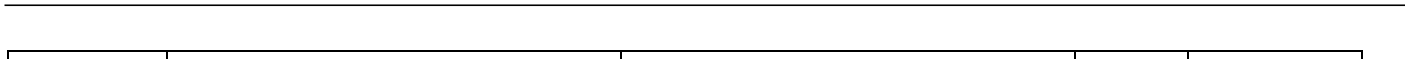
June 2018 | 8462/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.8	(actual mass =) $\frac{92.3}{100} \times 13.5$ **or** (actual mass =) 0.923×13.5 = 12.5 (kg)	an answer 12.5 (kg) scores **2** marks allow 12 / 12.46 / 12.461 / 12.4605 (kg)	1 1	AO2 4.3.3.1
Total			**15**	

4.1.1.6 Relative atomic mass

Answer 26 · Mark scheme

June 2018 | 8462/1H | Original Q8



4.1.1.6 Relative atomic mass

Answer 27 · Mark scheme

June 2019 | 8462/1H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	(neutron) 1 0 proton 1 (+1)	both needed allow (neutron) 1 neutral both needed	1 1	AO1 4.1.1.4 4.1.1.5
04.2	number of protons plus neutrons	allow number of protons and neutrons ignore protons and neutrons unqualified do **not** accept references to mass or relative mass of protons and / or neutrons	1	AO1 4.1.1.5
04.3	(the isotopes contain) different numbers of neutrons		1	AO2 4.1.1.5
04.4	most (alpha) particles passed (straight) through (the gold foil) (so) the mass of the atom is concentrated in the nucleus / centre **or** (so) most of the atom is empty space some (alpha) particles were deflected **/** reflected (so) the atom has a (positively) charged nucleus / centre	 if not awarded for MP2, allow (so) the mass of the atom is concentrated in the nucleus / centre.	1 1 1 1	AO1 4.1.1.3
Total			**8**	

4.1.1.6 Relative atomic mass

Answer 28 · Mark scheme

June 2019 | 8462/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	mixture has a lower melting point (than aluminium oxide) (so) less energy needed	allow cryolite lowers melting point (of aluminium oxide) ignore boiling point do **not** accept cryolite is a catalyst ignore cost	1 1	AO1 4.4.3.3
07.2	aluminium ions gain electrons		1	AO1 4.4.1.4 4.4.3.3
07.3	$2O^{2-} \rightarrow O_2 + 4e^-$	allow multiples allow **1** mark for an unbalanced equation containing correct species	2	AO2 4.1.1.1 4.4.3.1 4.4.3.3
07.4	the electrode reacts with oxygen the electrode is carbon / graphite (so) carbon dioxide is produced	 allow (so) the electrode / carbon / graphite is used up allow (so) the electrode / carbon / graphite is burned away ignore (so) the electrode / carbon / graphite is worn away ignore (so) the electrode / carbon / graphite is corroded	1 1 1	AO1 4.4.3.3

Answer 28 · Mark scheme

Question 7 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	(M_r of Al_2O_3 =) 102	an answer of 941 (kg) scores **4** marks	1	AO2 4.3.2.2
	$\left(\frac{2\,000\,000}{102} =\right)$ 19 608 (mol Al_2O_3)	allow correct calculation using incorrectly calculated value of M_r of Al_2O_3	1	
	$\left(19\,608 \times \frac{3}{2} =\right)$ 29 412 (mol O_2)	allow correct calculation using incorrectly calculated value of moles of Al_2O_3	1	
	$\left(\frac{29\,412 \times 32}{1000} =\right)$ 941 (kg)	allow 941.1764706 (kg) correctly rounded to at least 2 significant figures allow correct answer using incorrectly calculated value of moles of O_2	1	
	alternative approach: (2 M_r of Al_2O_3 =) 204 (1) 204 (kg of Al_2O_3) gives 96 (kg of O_2) (1) (2000 kg of Al_2O_3 gives) $\frac{2000}{204}$ × 96 (kg of O_2) **or** $\frac{2000000}{204}$ × 96 (g of O_2) (1) = 941 (kg) (1)			

4.1.1.6 Relative atomic mass

Answer 28 · Mark scheme

June 2019 | 8462/1H | Original Q7

07.6	hydrogen (gas) would be produced (instead of sodium) (because) sodium is more reactive than hydrogen		1 1	AO3 4.4.1.2 4.4.3.3 4.4.3.4
07.7	$\left(\frac{150\,000}{71} =\right)$ 2113 (mol of Cl_2) **or** (volume of 1 g of $Cl_2 = \frac{24}{71} =$) 0.34 (dm^3) ($\frac{150\,000}{71}$ x 24) = 50700 (dm^3)	an answer of 50700 (dm^3) scores **2** marks an answer of 50.7 (dm^3) scores **1** mark allow 50704.22535 (dm^3) correctly rounded to at least 2 significant figures allow correct calculation using their calculated number of moles and/or calculated volume of 1 g	1 1	AO2 4.3.5
Total			**16**	

4.1.1.6 Relative atomic mass

Answer 29 · Mark scheme

June 2019 | 8462/1H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	to make sure all of the oxide (of copper) has reacted **or** to make sure all water (produced) is removed	ignore to ensure complete reaction unqualified ignore to make sure all of the hydrogen has reacted	1	AO3 4.3.2.3
08.2	to prevent hydrogen escaping (into the air) (because) hydrogen is explosive	 ignore hydrogen is flammable	1 1	AO3 4.3.2.3
08.3	(mass of copper) 8.66 (g) (mass of water) 2.45 (g)		1 1	AO2 4.3.2.3

4.1.1.6 Relative atomic mass

Answer 29 · Mark scheme

June 2019 | 8462/1H | Original Q8

08.4	moles Cu = 0.04 **or** $\frac{2.54}{63.5}$ = 0.04 moles H_2O = 0.04 **or** $\frac{0.72}{18}$ = 0.04 ratio = 1:1 so equation 2 is correct **alternative approach A** (calculating mass of water from copper) moles Cu= 0.04 **or** $\frac{2.54}{63.5}$ = 0.04(1) 0.02 x 18 = 0.36 (g of water for equation 1) (1) 0.04 x 18 = 0.72 (g of water) so equation 2 is correct (1) **alternative approach B** (calculating mass of copper from water) moles H_2O=0.04 **or** $\frac{0.72}{18}$=0.04 (1) 0.08 x 63.5 = 5.08 (g of copper for equation 1) (1) 0.04 x 63.5 = 2.54 (g of copper) so equation 2 is correct (1)	**alternative approach C** (mass ratio) (copper : water for equation 1) 127 : 18 = 7.06 : 1 (1) (copper : water for equation 2) 63.5 : 18 = 3.53 : 1 (1) 2.54 : 0.72 = 3.53 : 1 = 63.5 : 18 so equation 2 is correct (1)	1 1 1	AO2 4.3.2.1 4.3.2.3
Total			**8**	

4.1.1.6 Relative atomic mass

Answer 30 · Mark scheme

June 2019 | 8462/1H | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	polystyrene is a better (thermal) insulator (so) reduces energy exchange (with the surroundings)	allow polystyrene is a poorer (thermal) conductor allow (so) reduces energy / heat loss (to the surroundings)	1 1	AO3 4.5.1.1
09.2	all six points plotted correctly line of best fit through points plotted from Table 6 both lines of best fit extrapolated correctly until they cross	allow a tolerance of ± ½ a small square allow **1** mark for at least 3 points plotted correctly	2 1 1	AO2 4.5.1.1
09.3	11 (cm^3)	allow ecf from question **09.2** allow answers in the range 10.75 to 11.25 (cm^3) allow a tolerance of ± ½ a small square	1	AO2 4.5.1.1
09.4	(27.5 – 18.9) = 8.6 (°C)	allow ecf from question **09.2** allow answers in the range 8.5 to 8.7 (°C) allow a tolerance of ± ½ a small square	1	AO2 4.5.1.1

Answer 30 · Mark scheme

Question 9 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5		an answer of 0.62 (mol/dm^3) for concentration in mol/dm^3 scores **4** marks an answer of 0.31 (mol/dm^3) for concentration in mol/dm^3 scores **3** marks		AO2/2 4.3.1.2 4.3.2.5 4.3.4 4.4.2.5
	(moles H_2SO_4 = 0.500 × $\frac{15.5}{1000}$) = 0.00775		1	
	(moles KOH = 2 x moles H_2SO_4 = 2 x 0.00775) = 0.0155	allow correct calculation using incorrectly calculated value of moles of H_2SO_4	1	
	(conc KOH = moles KOH x $\frac{1000}{25.0}$) = 0.0155 x $\frac{1000}{25.0}$	allow correct calculation using incorrectly calculated value of moles of KOH	1	
	= 0.62 (mol/dm^3)	allow correct answer using incorrectly calculated value of moles of KOH	1	
	(M_r KOH =) 56		1	
	(conc = M_r x conc in mol/dm^3 = 56 x 0.62) = 34.7 (g/dm^3)	allow 35 or 34.72 (g/dm^3) allow correct answer using incorrectly calculated value of concentration in mol/dm^3 and/or incorrect M_r	1	
	alternative approach for step 1 to step 4 $\frac{2}{1} = \frac{25 \times \text{conc KOH}}{15.5 \times 0.500}$ (2) (conc KOH) = $\frac{2 \times 15.5 \times 0.500}{25.0}$ (1) = 0.62 (mol/dm^3) (1)	allow **1** mark if mole ratio is incorrect		

4.1.1.6 Relative atomic mass

Answer 30 · Mark scheme

Total			**14**

4.1.1.6 Relative atomic mass

Answer 31 · Mark scheme

June 2019 | 8462/2H | Original Q10

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	$\frac{6}{34} \times 100$ = 17.6 (%)	an answer of 17.6470588 (%) correctly rounded to at least 2 significant figures scores **2** marks allow 17.6470588 (%) correctly rounded to at least 2 significant figures	1 1	AO2 4.3.3.2
10.2	higher yield (of hydrogen or carbon monoxide or product) (because) fewer moles / molecules / particles on left hand side **or** (because) more moles / molecules / particles on right hand side	allow converse arguments in terms of higher pressure ignore references to rate allow more hydrogen or more carbon monoxide or more product allow equilibrium moves to the right allow equilibrium moves in the forward direction allow (because) the reverse reaction produces fewer moles / molecules / particles **or** allow (because) the forward reaction produces more moles / molecules / particles do **not** accept fewer / more atoms	1 1	AO2 4.6.2.4 4.6.2.7
10.3	no effect (on yield of hydrogen)	allow position of equilibrium unaffected by pressure ignore references to rate of reaction	1	AO2 4.6.2.7

4.1.1.6 Relative atomic mass

Answer 31 · Mark scheme

June 2019 | 8462/2H | Original Q10

		an answer of 2.25 scores **3** marks		AO2 4.10.4.1
10.4	350 (°C) and 285 (atmospheres) = 63 (%) **and** 450 (°C) and 200 (atmospheres) = 28 (%)	allow a value between 62 (%) and 64 (%) inclusive	1	
	$\frac{63}{28}$	allow a correct expression using incorrectly determined value(s) for percentage yield	1	
	= 2.25 (times greater)	allow a correct calculation using incorrectly determined value(s) for percentage yield correctly evaluated and rounded to at least 2 significant figures	1	
10.5	any **one** from: • the energy costs would be high(er) • the equipment would need to be strong(er) • high(er) pressures are (more) dangerous	allow converse arguments in terms of low(er) pressure ignore energy / cost unqualified allow the equipment would be (more) expensive (to build / maintain) allow (more) dangerous because (greater) risk of explosion	1	AO1 4.10.4.1
10.6	higher temperatures produce a lower (percentage) yield (of ammonia)	allow converse allow correct reference to shift in equilibrium ignore references to pressure	1	AO2 4.6.2.6 4.10.4.1
10.7	world population has increased any **one** from: • demand for fertiliser has increased • increased demand for other specified ammonia-based products e.g. nitric acid, drugs, dyes, explosives	allow more food needed	1 1	AO3 AO1 4.10.4.1 4.10.4.2
Total			**12**	

4.1.1.6 Relative atomic mass

Answer 32 · Mark scheme

November 2020 | 8462/1H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	they form ions with different charges		1	AO1 4.1.3.1 4.1.3.2
	they have high melting points		1	
02.2	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 2 continued

Question	Answers	Mark	AO/ Spec. Ref
02.3	**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)		

4.1.1.6 Relative atomic mass

Answer 32 · Mark scheme

November 2020 | 8462/1H | Original Q2

Question 2 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	$\frac{(203 \times 30) + (205 \times 70)}{100}$ **or** $\frac{6090 + 14\,350}{100}$ = 204.4	 ignore units	1 1	AO2 4.1.1.6
Total			**11**	

4.1.1.6 Relative atomic mass

Answer 33 · Mark scheme

November 2020 | 8462/1H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	the (minimum) energy needed for particles to react **or** the (minimum) energy needed for a reaction to occur	allow the (minimum) energy needed to start a reaction	1	AO1 4.5.1.2
06.2	(M_r of Fe_2O_3 =) 160		1	AO2 4.3.1.2 4.3.2.1 4.3.2.2 4.3.2.4
	(moles $Fe_2O_3 = \frac{3000}{160}$ =) 18.75 (mol)	allow correct use of incorrectly calculated M_r	1	
	(moles Al $= \frac{1000}{27}$ =) 37.0 (mol)	allow 37.037037 (mol) correctly rounded to at least 2 significant figures if both MP2 and MP3 are not awarded allow **1** mark for 0.01875 mol Fe_2O_3 **and** 0.037 mol Al	1	
	(aluminium is limiting because) 37.0 mol is less than the (2 x 18.75 =) 37.5 mol (aluminium needed) **or** iron oxide is in excess because 18.75 mol is more than the ($\frac{37.0}{2}$ =) 18.5 mol (iron oxide needed)	allow correct use of incorrect number of moles from steps 2 and/or 3	1	

Answer 33 · Mark scheme

November 2020 | 8462/1H | Original Q6

Question 6 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2 ctd	**alternative approaches:** **approach 1:** **(finding required mass of aluminium by moles method)** (M_r of Fe_2O_3 =) 160 (1) (moles $Fe_2O_3 = \frac{3000}{160}$ =) 18.75 (mol) (1) (moles Al needed =18.75 × 2 =) 37.5 (mol) **and** (mass Al needed = 37.5 × 27 =) 1012.5 (g) **or** 1.0125 kg (1) (so) 1.00 kg of aluminium is not enough (1) **approach 2:** **(finding required mass of aluminium by proportion method)** (M_r of Fe_2O_3 =) 160 (1) (3.00 kg Fe_2O_3 needs) $\frac{3.00}{160}$ × 2 × 27 (kg Al) (1) (=) 1.0125 (kg) (1) (so) 1.00 kg of aluminium is not enough (1)	 allow correct use of incorrectly calculated M_r allow correct use of incorrectly calculated moles of iron oxide allow correct use of incorrectly calculated moles of aluminium needed dependent on calculated mass of aluminium needed being greater than 1.00 (kg) allow correct use of incorrectly calculated M_r dependent on calculated mass of aluminium needed being greater than 1.00 (kg)		AO2 4.3.1.2 4.3.2.1 4.3.2.2 4.3.2.4

Answer 33 · Mark scheme

November 2020 | 8462/1H | Original Q6

Question 6 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2 ctd	**alternative approaches:** **approach 3:** **(finding required mass of iron oxide by moles method)** M_r of Fe_2O_3 =) 160 (1) (moles Al $= \frac{1000}{27}$ =) 37.0 (mol) (1) (moles Fe_2O_3 needed) $= \frac{37.0}{2}$) = 18.5 (mol) **and** (mass Fe_2O_3 needed = 18.5 × 160 =) 2960 (g) **or** 2.96 (kg) (1) (so) 3.00 kg of iron oxide is an excess (1) **approach 4:** **(finding required mass of iron oxide by proportion method)** (M_r of Fe_2O_3 =) 160 (1) (1.00 kg Al needs) $\frac{1.00}{2 \times 27} \times 160$ (kg Fe_2O_3) (1) (=) 2.96 (kg) (1) (so) 3.00 kg of iron oxide is an excess (1)	allow 37.037037 (mol) correctly rounded to at least 2 significant figures allow correct use of incorrectly calculated moles of aluminium allow correct use of incorrectly calculated moles of iron oxide needed allow correct use of incorrectly calculated M_r dependent on calculated mass of iron oxide needed being less than 3.00 (kg) allow correct use of incorrectly calculated M_r dependent on calculated mass of iron oxide needed being less than 3.00 (kg)		AO2 4.3.1.2 4.3.2.1 4.3.2.2 4.3.2.4

Question 6 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	$Mg(s) + Zn^{2+}(aq) \rightarrow Mg^{2+}(aq) + Zn(s)$	allow multiples allow **1** mark for $Mg^{2+} + Zn$ with missing or incorrect state symbols	2	AO2 4.1.1.1 4.2.2.2 4.4.1.4
06.4	magnesium (atoms) are oxidised because they lose electrons (and) zinc (ions) are reduced because they gain electrons	 if no other marks awarded allow **1** mark for magnesium (atoms) lose electrons and zinc (ions) gain electrons	1 1	AO2 4.4.1.4
Total			**9**	

4.1.1.6 Relative atomic mass

Answer 34 · Mark scheme

November 2020 | 8462/1H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	liquid gas		1	AO2 4.2.2.1
08.2	(boiling point) increases (down the table / group) (because) the relative formula / molecular mass increases **or** (because) the size of the molecule increases (so) the intermolecular forces increase (in strength) (so) more energy is needed to overcome the intermolecular forces	 allow (so) the forces between molecules increase (in strength) allow (so) more energy is needed to separate the molecules do **not** accept a reference to breaking bonds unless specifically between molecules	1 1 1 1	AO1 4.1.2.6 4.2.2.1 4.2.2.4
08.3	boiling point is a bulk property	allow boiling point is related to intermolecular forces (so more than one molecule is involved)	1	AO1 4.2.2.1
08.4	the gas / halogen is toxic	allow the gas / halogen is poisonous / harmful allow to prevent inhalation of the gas / halogen ignore deadly / lethal	1	AO3 4.1.2.6

4.1.1.6 Relative atomic mass

Question 8 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5		allow energy level for shell throughout		AO1 4.1.2.6
	(going down the group) the outer electrons / shell become further from the nucleus	allow the atoms become larger allow the number of shells increases ignore the number of outer shells increases	1	
	(so) the nucleus has less attraction for the outer electrons / shell	allow (so) the nucleus has less attraction for the incoming electron allow (so) increased shielding between the nucleus and the outer electrons / shell allow (so) increased shielding between the nucleus and the incoming electron	1	
	(so) an electron is gained less easily		1	

Question 8 continued

08.6	4.48 (g iron) **and** 8.52 (g chlorine) (moles Fe = $\frac{4.48}{56}$ =) 0.08 (moles Cl = $\frac{8.52}{35.5}$ =) 0.24 (Fe : Cl = 0.08 : 0.24 =) 1 : 3 $2\ Fe + 3\ Cl_2 \rightarrow 2\ FeCl_3$	 allow correct calculation using incorrectly calculated mass of iron allow correct calculation using incorrectly calculated mass of chlorine allow (moles Cl_2 = $\frac{8.52}{71}$ =) 0.12 allow correct calculation using incorrectly calculated moles of iron and / or chlorine allow multiples / fractions allow a correctly balanced equation including Fe and Cl_2 from an incorrect ratio of Fe : Cl allow **1** mark for Fe **and** Cl_2 (reactants) **and** $FeCl_3$ (product) **or** allow **1** mark for Fe **and** Cl_2 (reactants) **and** a formula for iron chloride correctly derived from an incorrect ratio of Fe : Cl (product)	1 1 1 1 2	AO2 4.1.1.1 4.1.2.6 4.3.2.3

Total			**16**

4.1.1.6 Relative atomic mass

Answer 35 · Mark scheme

November 2020 | 8462/1H | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	didn't stir (the solution enough)	allow measured the temperature before the temperature stopped falling allow measured the temperature too soon	1	AO3 4.5.1.1 RPA 4
09.2	the temperature decreases (initially) because energy is taken in (by the reaction from the solution)	allow temperature decreases (initially) because the reaction is endothermic	1	AO2 AO3 4.5.1.1 RPA 4
	when 1.5 g (of citric acid) is added the sodium hydrogencarbonate has all reacted **or** from 1.5 g the citric acid is in excess **or** when 1.5 g (of citric acid) is added the reaction is complete	allow when the temperature reaches 11.6 °C the sodium hydrogencarbonate has all reacted allow after the temperature reaches 11.6 °C the citric acid is in excess allow when the temperature reaches 11.6 °C the reaction is complete	1	
	(so) the temperature increases as energy is transferred from the room to the solution	allow (so) the temperature increases as energy is transferred from the excess citric acid to the solution	1	

Question 9 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	less steep line starting at 16.8 °C **and** reaching 1.00 g (of citric acid)	ignore any part of the line drawn beyond 1.00 g	1	AO3 4.2.2.8 4.5.1.1 RPA 4
	(as) metal is a better conductor	allow (as) polystyrene is a better insulator	1	
	(so) more energy is absorbed (from the surroundings)	allow (so) more heat is absorbed (from the surroundings)	1	
09.4	(M_r citric acid =) 192		1	AO2 4.3.2.5 4.3.4
	(moles = $\frac{250}{1000}$ × 0.0500) = 0.0125		1	
	(mass = 0.0125 × 192 =) 2.4 (g)	allow correct use of an incorrectly calculated M_r allow correct use of an incorrectly calculated number of moles	1	
	alternative approach:			
	(M_r citric acid =) 192 (1)			
	(concentration = 0.0500 × 192) = 9.6 (g/dm^3) (1)	allow correct use of an incorrectly calculated M_r		
	(mass = $\frac{250}{1000}$ × 9.6 =) 2.4 (g) (1)	allow correct use of an incorrectly calculated concentration in g/dm^3		

Question 9 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5	add the citric acid (to the flask) until there is a (permanent) colour change	ignore colours of indicator	1	AO1 4.4.2.5 RPA 2
	measure / record the volume (of citric acid) added	allow take the final (and initial) burette reading	1	
	any **one** from: • swirl • use a white tile • add the citric acid dropwise (near the end-point) • repeat **and** calculate a mean	allow add the citric acid slowly (near the end-point)	1	
09.6	any **two** from: • can add (the citric acid) in small increments	allow can add (the citric acid) drop by drop allow can add (the citric acid) slowly	2	AO1 4.4.2.5 RPA 2
	• can measure variable volumes	allow has a scale		
	• more accurate than a measuring cylinder			

Answer 35 · Mark scheme

November 2020 | 8462/1H | Original Q9

Question 9 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.7	(moles citric acid = $\frac{13.3}{1000}$ × 0.0500) = 0.000665		1	AO2 4.3.4 4.4.2.5 RPA 2
	(moles NaOH = 3 × 0.000665) = 0.001995	allow correct use of an incorrectly calculated number of moles of citric acid	1	
	(conc = $\frac{1000}{25}$ × 0.001995) = 0.0798 (mol/dm^3)	allow 0.08 or 0.080 (mol/dm^3) allow correct use of an incorrectly calculated number of moles of NaOH	1	
	alternative approach: $\frac{25.0 \times \text{conc NaOH}}{13.3 \times 0.0500} = \frac{3}{1}$ (1) (conc NaOH =) 3 × $\frac{13.3 \times 0.0500}{25.0}$ (1) = 0.0798 (mol/dm^3) (1)	allow $\frac{13.3 \times 0.0500}{25.0 \times \text{conc NaOH}} = \frac{1}{3}$ allow 0.08 or 0.080 (mol/dm^3)		

Total			18

4.1.1.6 Relative atomic mass

Answer 36 · Mark scheme

November 2021 | 8462/1H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	(atoms with the) same number of protons	allow atoms with the same atomic number allow atoms of the same element ignore the same number of electrons	1	AO1 4.1.1.4 4.1.1.5
	(but with) different numbers of neutrons	ignore (but with) different mass numbers do **not** accept (but with) different relative atomic mass	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	$(A_r =) \frac{(69 \times 60) + (71 \times 40)}{100}$		1	AO2 4.1.1.6
	= 69.8		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	(number of electrons) = 31		1	AO2 4.1.1.4
	(number of neutrons) = 38		1	4.1.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	Ga^{3+}		1	AO3 4.2.1.2

4.1.1.6 Relative atomic mass

Question 2 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	(gallium) fitted in a gap (Mendeleev had left)		1	AO2 4.1.2.2
	(gallium's) properties were predicted correctly (by Mendeleev)	allow (gallium's) properties matched the rest of the group	1	

Total			**9**

4.1.1.6 Relative atomic mass

Answer 37 · Mark scheme

November 2021 | 8462/1H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	($3 \times M_r$ 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.
03.2	**(R** =) molybdenum / Mo	allow ecf from question **03.1**	1	AO3 4.1.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	(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 3 continued

Question	Answers	Mark	AO/ Spec. Ref
03.4	**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**

4.1.1.6 Relative atomic mass

Answer 38 · Mark scheme

November 2021 | 8462/1H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	potassium chloride	allow KCl	1	AO1 4.4.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	$H^+ + OH^- \rightarrow H_2O$	ignore state symbols	1	AO1 4.1.1.1 4.4.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	copper carbonate and copper oxide only		1	AO1 4.4.1.2 4.4.2.2 4.4.2.3 RPA1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	(Step 2) to speed up the reaction (Step 5) to make sure all the (hydrochloric) acid reacts (Step 6) to remove the excess magnesium oxide	 ignore to remove impurities	1 1 1	AO1 4.4.2.3 RPA1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	using a (boiling) water bath **or** using an electric heater		1	AO1 4.4.2.3 RPA1

4.1.1.6 Relative atomic mass

Question 5 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	(moles Fe = $\frac{14}{56}$ =) 0.25 (mol)		1	AO2 4.3.2.1 4.3.2.2 4.3.5
	(moles Cl_2 = $\frac{3}{2}$ × 0.25 =) 0.375 (mol)	allow correct use of an incorrectly calculated number of moles of Fe	1	
	(volume Cl_2 = 24 × 0.375) = 9.0 (dm^3)	allow correct use of an incorrectly calculated number of moles of Cl_2	1	

Total			**10**

4.1.1.6 Relative atomic mass

Answer 39 · Mark scheme

November 2021 | 8462/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1		allow voltage for electricity allow potential difference for electricity allow (electrical) current for electricity		AO1 4.4.3.1 4.5.2.1
	electrolysis uses electricity to produce a chemical reaction	allow electrolysis uses electricity to decompose a compound / electrolyte	1	
	(but) cells use a chemical reaction to produce electricity		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	$2\,Br^- \rightarrow Br_2 + 2\,e^-$	allow multiples allow **1** mark for Br_2 **and** e^-	2	AO2 4.1.1.1 4.4.3.1 4.4.3.2 4.4.3.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3				AO2 4.4.1.2 4.4.3.4 RPA3

Salt solution	Product at positive electrode	Product at negative electrode	Mark
(copper nitrate)	oxygen (1)	(copper)	1
(potassium iodide)	iodine (1)	hydrogen (1)	2

Question 7 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	filter the mixture wash and dry the copper / residue weigh the copper collected add to the increase in mass of the electrode		1 1 1 1	AO3 4.1.1.2 4.4.3.4 RPA3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	(for given current) straight line through the origin	allow (for given current) when time doubles, mass doubles	1	AO3 4.4.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	(for given time) when current doubles, mass doubles with supporting data		1	AO3 4.4.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.7	copper ions are discharged (from the solution)	allow the solution becomes less concentrated allow copper ions are removed (from the solution) allow copper ions are used up (from the solution)	1	AO3 4.4.3.1

Answer 39 · Mark scheme

November 2021 | 8462/1H | Original Q7

Question 7 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.8	(number of moles = $\frac{0.24}{63.5}$ =) 3.78×10^{-3} **or** 0.00378		1	AO2 4.3.2.1
	(number of atoms =) $0.00378 \times 6.02 \times 10^{23}$	allow correct use of an incorrectly calculated number of moles	1	
	$= 2.28 \times 10^{21}$	allow a correct evaluation to 3 significant figures of an incorrect expression which involves only a mass from the graph, the A_r of copper and the Avogadro constant	1	

Total			17

4.1.1.6 Relative atomic mass

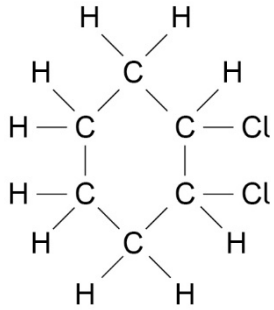
Answer 40 · Mark scheme

November 2021 | 8462/2H | Original Q6

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	(test) (add) bromine (water) (result) (changes from) brown / orange to colourless	 ignore clear	 1 1	AO1 4.7.1.4 4.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	C_nH_{2n-2}		1	AO2 4.7.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3		allow **1** mark for the structure of 1, 1-dichlorocyclohexane **or** 1, 3-dichlorocyclohexane **or** 1, 4-dichlorocyclohexane	2	AO2 4.7.2.2

4.1.1.6 Relative atomic mass

Question 6 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	(M_r ($C_6H_{10}Cl_2$) =) 153		1	AO2 4.3.1.2
	(% chlorine=) $\frac{71}{153}$ × 100	allow correct use of an incorrectly calculated value of M_r	1	
	= 46.4 (%)	allow 46.405228758 (%) correctly rounded to at least 2 significant figures	1	

Total			**8**

4.1.1.6 Relative atomic mass

Answer 41 · Mark scheme

June 2022 | 8462/1H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	any **one** from: • more vigorous bubbling (for rubidium) • bigger / brighter flame (for rubidium)	allow converse statements for potassium allow (rubidium) catches fire more quickly allow (rubidium) moves around more quickly allow (rubidium) explodes allow (rubidium) disappears more quickly allow (rubidium) melts more quickly	1	AO3 4.1.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2		allow energy level for shell throughout allow converse argument in terms of potassium		AO1 4.1.2.5 4.4.1.2
	(rubidium's) outer shell / electron is further from the nucleus	allow the (rubidium) atom is larger allow (rubidium) has more shells	1	
	(so) there is less (electrostatic) attraction between the nucleus and the outer electron (in rubidium)	allow (so) there is more shielding between the outer electron and the nucleus (in rubidium)	1	
	(so) the (outer) electron (in rubidium) is more easily lost	allow (so) less energy is needed to remove the (outer) electron (in rubidium)	1	

4.1.1.6 Relative atomic mass

Answer 41 · Mark scheme

June 2022 | 8462/1H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	$2\ Rb + 2\ H_2O \rightarrow 2\ RbOH + H_2$	ignore state symbols allow multiples allow **1** mark for H_2 allow **1** mark for RbOH	3	AO2 4.1.1.1 4.1.2.5 4.3.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	the noble gases have boiling points that increase going down the group		1	AO1 4.1.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	(relative atomic mass =) $\frac{(90.48 \times 20)+(0.27 \times 21)+(9.25 \times 22)}{100}$ = 20.1877 = 20.2	allow (relative atomic mass =) $\frac{1809.6 + 5.67 + 203.5}{100}$ allow (relative atomic mass =) 18.096 + 0.0567 + 2.035 allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses all of the values in **Table 1** ignore units	1 1 1	AO2 4.1.1.6

Total Question 5		11

4.1.1.6 Relative atomic mass

Answer 42 · Mark scheme

June 2022 | 8462/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	silicon is less reactive than carbon	ignore references to hydrogen allow converse allow silicon is below carbon (in the reactivity series)	1	AO3 4.4.1.3
	(because) carbon displaces silicon (from silicon dioxide)	ignore (because) carbon reduces silicon dioxide	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	more energy is needed (to obtain aluminium)	ignore references to electricity	1	AO3 4.4.1.3 4.4.3.3
	(because) aluminium is obtained (from aluminium oxide) by electrolysis		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	both products are solid		1	AO3 4.4.1.3

4.1.1.6 Relative atomic mass

Answer 42 · Mark scheme

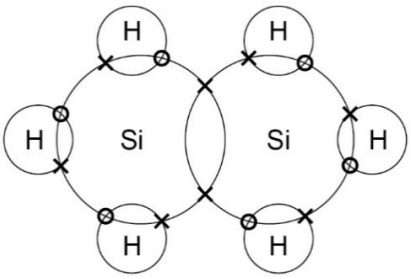
June 2022 | 8462/1H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	(M_r of SiO_2 = 28 + (2 × 16)) = 60		1	AO2 4.3.1.2 4.3.2.1 4.3.2.2
	(conversion 1.2 kg =) 1200 (g)		1	
	(number of moles of SiO_2 = $\frac{1200}{60}$) = 20	allow correct use of an incorrectly converted or unconverted mass of SiO_2 allow correct use of an incorrectly calculated M_r of SiO_2	1	
	(number of moles of Mg = 20 × 2) = 40	allow correct use of an incorrectly calculated number of moles of SiO_2	1	
	(mass of Mg = 40 × 24) = 960 (g)	allow correct use of an incorrectly calculated number of moles of Mg	1	
	alternative approach:			
	(M_r of SiO_2 = 28 + (2 × 16)) = 60 (1)			
	48 g Mg reacts with 60 g SiO_2 (1)	allow correct use of an incorrectly calculated M_r of SiO_2		
	(conversion 1.2 kg =) 1200 (g) (1)			
	48 × $\frac{1200}{60}$ (g Mg reacts with 1200 g SiO_2) (1)	allow correct use of an incorrectly calculated mass of Mg and / or incorrectly converted or unconverted mass of SiO_2		
	= 960 (g) (1)			

4.1.1.6 Relative atomic mass

Answer 42 · Mark scheme

June 2022 | 8462/1H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5		allow any combination of x, •, o, $e^{(-)}$ for electrons	1	AO2 4.2.1.4

4.1.1.6 Relative atomic mass

Answer 42 · Mark scheme June 2022 | 8462/1H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6	(volume of oxygen for 30 cm^3 Si_2H_6 = 3.5 × 30) = 105 (cm^3)		1	AO2 4.3.2.4 4.3.5
	(volume of excess oxygen = 150 – 105) = 45 (cm^3)	allow correct use of an incorrectly calculated volume of oxygen for 30 cm^3 Si_2H_6	1	
	(volume of water (vapour) = 3 × 30) = 90 (cm^3)		1	
	(volume of gases = 45 + 90) = 135 (cm^3)	allow correct use of incorrectly calculated volumes of excess oxygen and / or water vapour	1	
	allowed alternative approach: (moles Si_2H_6 = $\frac{0.03}{24}$ =) 0.00125 (1)			
	(moles water vapour formed = 3 × 0.00125 =) 0.00375 **and** (moles oxygen used = 3.5 × 0.00125 =) 0.004375 (1)	allow correct use of an incorrectly calculated number of moles of Si_2H_6		
	(moles excess oxygen = $\frac{0.15}{24}$ - 0.004375 =) 0.001875 (1)	allow correct use of an incorrectly calculated number of moles of oxygen used		
	(volume of gases = 24 × (0.00375 + 0.001875) = 0.135 dm^3 =) 135 (cm^3) (1)	allow correct use of an incorrectly calculated number of moles of excess oxygen and / or moles of water vapour formed		

Total Question 7		**15**

4.1.1.6 Relative atomic mass

Answer 43 · Mark scheme

June 2023 | 8462/1H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	a ball of positive charge with (negative) electrons embedded	do **not** accept references to protons, nuclei, neutrons	1 1	AO1 4.1.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	(earliest) electrons protons (latest) neutrons		1	AO1 4.1.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	(number of outer shell electrons) 7 (reason) (tennessine is in) Group 7	 allow the number of outer electrons is the same as the group number allow tennessine is a halogen MP2 is dependent on MP1 being awarded	1 1	AO2 4.1.2.1 4.1.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	(time needed for) peer review	allow the idea that other scientists had to check the results	1	AO3 4.1.2.2

4.1.1.6 Relative atomic mass

Answer 43 · Mark scheme

June 2023 | 8462/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	(A_r =) $\frac{(6 \times 7.6) + (7 \times 92.4)}{100}$ = 6.924 = 6.9	 allow $\frac{45.6 + 646.8}{100}$ allow (6 × 0.076) + (7 × 0.924) allow 0.456 + 6.468 allow an answer correctly rounded to 1 decimal place from an incorrect calculation which uses all the data in the table	 1 1 1	AO2 4.1.1.6

Total Question 1	9

4.1.1.6 Relative atomic mass

Answer 44 · Mark scheme

June 2023 | 8462/1H | Original Q9

Question 9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.1	(substance reduced) Fe_2O_3 (reason) (Fe_2O_3) loses oxygen	allow iron oxide MP2 is dependent upon MP1 being awarded ignore Fe^{3+} gains electrons	1 1	AO2 4.4.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.2	$\frac{3}{2}$ × 12g		1	AO2 4.3.1.1 4.3.2.1 4.3.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.3	**A** loses electrons and $\mathbf{B}^+$ gains electrons		1	AO2 4.4.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.4	**D**		1	AO3 4.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.5	(metal) **C** (explanation) aluminium forms ions with a charge 3+ (so) 3 nitrate ions are needed for 1 aluminium ion	 allow aluminium forms Al^{3+} (ions) allow (so) 3 nitrate ions are needed to balance the 3+ charge on 1 aluminium (ion)	1 1 1	AO3 4.4.1.2 4.4.3.3

4.1.1.6 Relative atomic mass

Answer 44 · Mark scheme

June 2023 | 8462/1H | Original Q9

Question	Answers	Extra information	Mark	AO / Spec. Ref.
09.6	(percentage atom economy =) $\frac{A_r\mathbf{X}}{A_r\mathbf{X} + 54} \times 100 = 77.3$		1	AO2 4.3.3.2
	100 $A_r\mathbf{X}$ = 77.3 ($A_r\mathbf{X}$ + 54)	allow $A_r\mathbf{X}$ = 0.773 ($A_r\mathbf{X}$ + 54) allow correct use of an incorrectly determined value of the M_r of the non-useful reactant atoms	1	
	22.7 $A_r\mathbf{X}$ = 4174.2	allow 0.227 $A_r\mathbf{X}$ = 41.742	1	
	$A_r\mathbf{X}$ = 184	allow 183.8854626 correctly rounded to at least three significant figures	1	
	alternative approach 1: ($3M_r$ H_2O = (3 × 16) + (6 × 1) =) 54 **and** (percentage = 100 – 77.3 =) 22.7% (1)			
	(total M_r of reactants =) $\frac{100}{22.7} \times 54$ (1)	allow correct use of an incorrectly determined value for $3M_r$ H_2O and/or percentage of unwanted products		
	= 238 (1)			
	($A_r\mathbf{X}$ = 238 – 54) **or** $\left(A_r\mathbf{X} = 238 \times \frac{77.3}{100}\right)$ = 184 (1)	allow correct use of an incorrectly determined value of total M_r of reactants and/or value for $3M_r$ H_2O allow 183.8854626 correctly rounded to at least three significant figures		

4.1.1.6 Relative atomic mass

	alternative approach 2: ($3M_r$ H_2O = (3 × 16) + (6 × 1) =) 54 **and** (percentage = 100 – 77.3 =) 22.7% (1) $\left(\frac{1}{22.7} \times 54 =\right)$ 2.3788546 (1) 2.3788546 × 77.3 (1) = 184 (1)	 allow correct use of an incorrectly determined value for $3M_r$ H_2O and/or percentage of unwanted products allow correct use of an incorrectly determined value for 1% of the total M_r of reactants allow 183.8854626 correctly rounded to at least three significant figures		

Total Question 9	**12**

4.1.1.6 Relative atomic mass

Answer 45 · Mark scheme

June 2023 | 8462/1H | Original Q10

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	(nanoparticles) any **two** from: • have a higher surface area to volume ratio • less (material) needed (for the same effect) • more light gets through	allow converse arguments for fine particles allow a thinner coating is needed	2	AO3 4.2.4.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	(M_r TiO_2 =) 80		1	AO2 4.3.1.2 4.3.2.1 4.3.2.2 4.3.5
	(conversion 100 kg =) 100 000 (g)		1	
	$\left(\text{moles } TiO_2 = \frac{100\,000}{80} =\right)$ 1250	allow correct use of an incorrectly determined M_r allow correct use of an incorrect / no conversion of mass	1	
	(moles Cl_2 = 1250 × 2 =) 2500	allow correct use of an incorrectly determined number of moles of TiO_2	1	
	(volume Cl_2 =) 2500 x 24	allow correct use of an incorrectly determined number of moles of Cl_2	1	
	= 60 000 (dm^3)		1	

Total Question 10	8

4.1.1.6 Relative atomic mass

Answer 46 · Mark scheme

June 2023 | 8462/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	$CuFeS_2$ + **$4O_2$** → $CuSO_4$+$FeSO_4$	allow multiples allow O_2 for **1** mark	2	AO2 4.1.1.1 4.3.1.1 4.10.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	(M_r = 63.5 + 56 + (2 x 32) =) 183.5		1	AO2 4.3.1.2 4.10.1.4
	(% of copper =) $\frac{63.5}{183.5}$ × 100	allow correct use of incorrectly determined M_r	1	
	= 34.6 (%)	allow 34.60490 correctly rounded to at least 2 significant figures	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3		MP2 is dependent upon MP1 being awarded		AO1 4.8.3.2 RPA7
	(test) (add) sodium hydroxide (solution)		1	
	(result) blue precipitate		1	
	OR			
	(test) flame test (1)			
	(result) green (flame) (1)	allow blue-green (flame)		

4.1.1.6 Relative atomic mass

Answer 46 · Mark scheme

June 2023 | 8462/2H | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	(the use of) bacteria to produce leachate solutions (that contain metal / copper compounds)		1 1	AO1 4.10.1.4

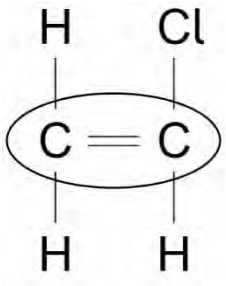
Total Question 5	**9**

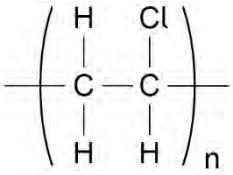
4.1.1.6 Relative atomic mass

Answer 47 · Mark scheme

June 2023 | 8462/2H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1			1	AO1 4.7.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	C-C bond 3x C-H **and** 1x C-Cl bonds 2x single bonds extending through brackets **and** n below halfway	an answer of  scores **3** marks	1 1 1	AO2 4.7.3.1

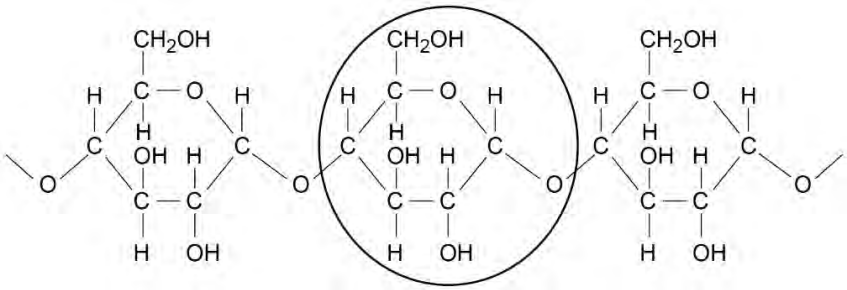
Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	composites		1	AO1 4.10.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	water	allow H_2O	1	AO1 4.7.3.3

4.1.1.6 Relative atomic mass

Answer 47 · Mark scheme June 2023 | 8462/2H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	(M_r of NH_2 and COOH) = (2 × 1) + 14 + 12 + (2 × 16) + 1 =) 61 (M_r of section = 75 – 61) = 14	 allow correct use of incorrectly determined M_r of NH_2 and COOH	1 1	AO2 4.3.1.2 4.7.3.3

Question	Answers	Mark	AO / Spec. Ref.
08.6		1	AO2 4.7.3.1 4.9.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.7	starch	allow cellulose allow glycogen allow polysaccharide	1	AO3 4.7.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.8	nucleotides		1	AO1 4.7.3.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.9	double helix	ignore DNA	1	AO1 4.7.3.4

Total Question 8	**12**

4.1.1.6 Relative atomic mass

Answer 48 · Mark scheme

June 2024 | 8462/1H | Original Q7

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	(thermal) energy is transferred by delocalised electrons	allow heat is transferred	1 1	AO1 4.2.1.5 4.2.2.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.2	 (the alloy / mixture has) different sized atoms (so the) layers are distorted (so the) layers cannot easily slide	allow (positive / metal) ions for atoms throughout allow (so the) atoms cannot slide over each other	 1 1 1	AO1 4.2.2.7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.3	$2\,Fe + 3\,Cl_2 \rightarrow 2\,FeCl_3$		1	AO2 4.3.1.1 4.3.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.4	$1\ Fe^{2+} : 2\ Fe^{3+} : 4\ O^{2-}$		1	AO2 4.4.2.2

4.1.1.6 Relative atomic mass

Answer 48 · Mark scheme

June 2024 | 8462/1H | Original Q7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.5	(M_r Fe_3O_4 =) 232		1	AO2 4.3.1.2
	(% Fe =) $\frac{3 \times 56}{232} \times 100$	allow $\frac{168}{232} \times 100$ allow correct use of an incorrectly determined M_r using the values of A_r given in the question	1	
	= 72.4 (%)	allow 72.41379 correctly rounded to at least 2 significant figures	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.6		a maximum of **4** marks can be awarded for a method which determines and uses the volume of iron oxide as a gas		AO2 4.3.2.1 4.3.2.2
	(40.0 kg =) 40 000 (g)		1	
	(moles Fe_2O_3 = $\frac{40\,000}{160}$ =) 250	allow correct use of an incorrectly converted or unconverted mass	1	
	(moles CO_2 = 250 × $\frac{3}{2}$ =) 375	allow correct use of an incorrectly determined number of moles of Fe_2O_3	1	
	(volume of CO_2 =) 375 × 24	allow correct use of an incorrectly determined number of moles of CO_2	1	
	= 9000 (dm^3)		1	

Total Question 7	15

4.1.1.6 Relative atomic mass

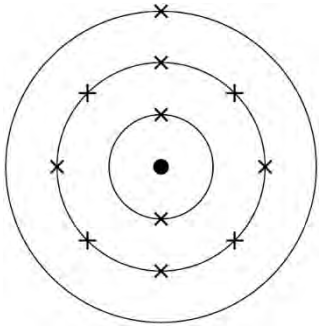
Answer 49 · Mark scheme

June 2025 | 8462/1H | Original Q1

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	towards the right **and** the top	allow a description of the position in the periodic table allow in Groups (3) 4 to 0	1	AO1 4.1.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	a melting point below 100 °C		1	AO3 4.1.2.3 4.2.2.7 4.2.2.8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3		allow any combination of ×, ●, o, $e^{(-)}$ for electrons	1	AO1 4.1.1.7

4.1.1.6 Relative atomic mass

Answer 49 · Mark scheme

June 2025 | 8462/1H | Original Q1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	any **one** from: • so elements / tellurium / iodine were in groups with similar properties • iodine has similar properties to Group 7 elements • iodine has different properties to Group 6 elements	ignore reference to atomic structure allow named element(s) for Group 6 / 7 elements allow converse arguments in terms of tellurium	1	AO1 4.1.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	argon has a full outer shell (of electrons)	allow energy level for shell allow argon has eight outer shell electrons ignore argon has no outer shell electrons	1	AO1 4.1.2.4
	(so argon) has a stable arrangement of electrons **or** (so argon) has a stable electronic structure	allow (so argon) does not gain / lose / share electrons	1	

4.1.1.6 Relative atomic mass

Answer 49 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	atoms with the same number of protons (but with) different numbers of neutrons	allow atoms of the same element allow atoms with the same atomic number ignore atoms with the same number of electrons	1 1	AO1 4.1.1.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.7	~115		1	AO2 4.1.1.6

Total Question 1	9

4.1.1.6 Relative atomic mass

Answer 50 · Mark scheme

June 2025 | 8462/1H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	(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.
03.2	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.
03.3	(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	

4.1.1.6 Relative atomic mass

Answer 50 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4		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

4.1.1.6 Relative atomic mass

Answer 50 · Mark scheme

June 2025 | 8462/1H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	(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 + (3 × 2) = 184 + (3 × 18) **or** 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.
03.6	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 3	11

4.1.1.6 Relative atomic mass

Answer 51 · Mark scheme

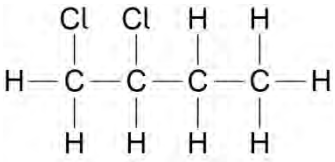
June 2025 | 8462/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	– 6 (°C)	allow a value in the range (+)4 to –16 (°C)	1	AO2 4.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	ethanol	allow C_2H_5OH	1	AO2 4.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	(test) damp litmus paper (result) litmus paper is bleached **or** litmus paper turns white	 ignore litmus paper turns red ignore litmus paper turns red	1 1	AO1 4.8.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4			1	AO2 4.7.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	propene		1	AO1 4.7.2.1

4.1.1.6 Relative atomic mass

Answer 51 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	(because of) incomplete combustion	ignore insufficient oxygen	1	AO1 4.7.2.2

4.1.1.6 Relative atomic mass

Answer 51 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.7	(conversion 24 dm^3 =) 24 000 cm^3	allow conversion of volume anywhere in method	1	AO2 4.3.1.2 4.3.2.1 4.3.5
	(M_r = (3 × 12) + (6 × 1) =) 42		1	4.7.2.1
	(moles = $\frac{2.1}{42}$ =) 0.05	allow correct use of an incorrectly determined M_r	1	
	(volume =) 24 000 × 0.05	allow correct use of an incorrectly determined number of moles allow correct use of an incorrect / no conversion of volume	1	
	= 1200 (cm^3)		1	
	alternative approach			
	(conversion 24 dm^3 =) 24 000 cm^3 (1)	allow conversion of volume anywhere in method		
	(M_r = (3 × 12) + (6 × 1) =) 42 (1)			
	(ratio of mass = $\frac{42}{2.1}$ =) 20 (1)	allow correct use of an incorrectly determined M_r		
	(volume =) $\frac{24\,000}{20}$ (1)	allow correct use of an incorrect / no conversion of volume		
	= 1200 (cm^3) (1)			

Total Question 5	12

Version 1.0: 0108

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Additional Science 4463 / Chemistry 4421

CHY2H Unit 2 Chemistry

Mark Scheme

2008 examination – January series

4.1.1.6 Relative atomic mass

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.

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4.1.1.6 Relative atomic mass

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.

4.1.1.6 Relative atomic mass

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.

4.1.1.6 Relative atomic mass

CHY2H

Question 1

question	answers	extra information	mark
(a)	sensible line of best fit which goes through or close to all the points **except** the anomalous point	allow wobbly / short double lines ± ½ square	1
(b)	loss of gas / loss of CO_2	idea of gas produced / formed	1
(c)	7		1
(d)(i)	steeper line from around the same starting point and left of the points levelling off at 99	allow crosses if they are fully correct for **1** mark accept short level line at 99 ± ½ square	1 1
(d)(ii)	any **three** from: • particles / molecules / atoms/ ions have more energy • move faster • collide <u>more</u> often **or** <u>more</u> chance of collisions **or** bump into each other <u>more</u> • collide with <u>more</u> force / energy **or** <u>more</u> particles have the activation energy **or** <u>more</u> collisions result in reaction **or** <u>more</u> collisions are successful	 allow given / gain / get energy ignore move about more ignore vibrate more / faster ignore collide quicker / faster	3
total			8

4.1.1.6 Relative atomic mass

CHY2H

Question 2

question	answers	extra information	mark
(a)	any **one** from: • they are made of layers • atoms / ions / particles / layers (of atoms) can slide over each other	 do **not** accept line / rows / lattice	1
(b)	any **one** from: • smaller / tiny **or** very small • correct size range 1 to 100 nanometres • a few hundred atoms in size	 do **not** allow small alone if they state smaller and give a size outside range ignore size if it is less than 20,000	1
(c)	harder plus **one** from: • so does not wear as quickly / erode as quickly • less vulnerable to damage owtte • because they have a high surface area to volume ratio **or** stronger (1) plus **one** from: (1) • less likely to break / do not break • not as vulnerable to damage owtte • do not bend out of shape • because they have a high surface area to volume ratio	 ignore corrode harder to wear down = **1** mark accept withstand pressure harder and stronger alone gains **1** mark	1 1
total			4

4.1.1.6 Relative atomic mass

CHY2H

Question 3

question	answers	extra information	mark
(a)	N_2O		1
(b)	13.8 to 14	gains full marks without working if answer incorrect 13 gains **1** mark **or** 14/101 × 100 gains **1** mark	2
total			3

4.1.1.6 Relative atomic mass

CHY2H

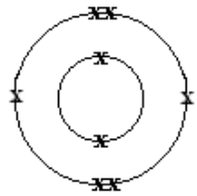
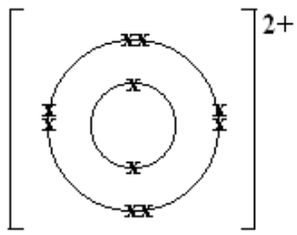
Question 4

question	answers	extra information	mark
(a)	electric current / electricity		1
	plus **one** from:		1
	• is passed through ionic compound / substance / electrolyte • passed through molten/aqueous compound / substance	must be linked to electricity allow liquid compound / substance do **not** allow solution / liquid alone	
	• causing decomposition	accept split up / breakdown / breaking up owtte ignore separated accept elements are formed ignore new substances form	
(b)	hydrogen	accept H_2 do **not** accept H / H^2	1
(c)	one electron from each atom	accept each carbon is bonded to three other carbon atoms leaving one (unbonded) electron owtte	1
	is delocalised / free (to move)	must be linked to electrons answers of delocalised / free electrons only, gains **1** mark accept each carbon is bonded to three other carbon atoms leaving delocalised / free electrons = **2** marks **maximum 1** mark if graphite described as a metal / giant ionic lattice	1
total			5

4.1.1.6 Relative atomic mass

CHY2H

Question 5

question	answers	extra information	mark
(a)	any **one** from: • gives out heat / energy • transfers energy from a substance to the surroundings • ΔH / energy change / enthalpy change is negative	accept releases / gives off owtte ignore references to light	1
(b)	$2Mg + O_2 \rightarrow 2MgO$	accept correct multiples / fractions	1
(c)		electrons do not need to be paired accept dots / circles / e instead of crosses do **not** allow 2.6 without diagram	1
(d)		electrons do not need to be paired allow without brackets must have the charge accept dots / circles / e instead of crosses ignore extra empty outer shells ignore nucleus do **not** allow $[2.8]^{2+}$ without diagram	1

continued…

4.1.1.6 Relative atomic mass

CHY2H

Question 5 continued…

question	answers	extra information	mark
(e)	oppositely charged (ions / atoms)	allow positive and negative(ions / atoms)	1
	(they) attract	must be in correct context accept held by electrostatic forces ignore ionic bonding **maximum 1** if they refer to intermolecular forces / attractions / covalent bonds	1
(f)	magnesium chloride	accept $MgCl_2$ (if correctly written)	1
total			7

4.1.1.6 Relative atomic mass

CHY2H

Question 6

question	answers	extra information	mark
(a)	**Compound A** any **one** from: • sodium bromide • potassium bromide • ammonium bromide • hydrogen bromide • any metal bromide except silver and lead. **Compound B** silver nitrate	accept correct formulae accept silver sulfate	1 1
(b)	the silver compound will decompose / silver ions be reduced to silver (owtte)	accept film would darken owtte accept any idea of light changing silver bromide / silver ions / silver nitrate / silver sulfate allow 'forms a black solid' / it would turn black	1
(c)	precipitation	accept descriptions of precipitation reactions accept double decomposition accept precipitate do **not** allow displacement	1
(d)	electrons are gained	 the second mark **must** be linked to electrons accept it / silver / silver ions gains electrons for **both** marks ignore references to oxygen	1 1
total			6

4.1.1.6 Relative atomic mass

CHY2H

Question 7

question	answers	extra information	mark
(a)	1213.8 to 1214.3 correct answer not given then check working 1) moles of N_2 = $\frac{1000}{28}$ = 35.7 mol 2) moles of NH_3 = 2 × (answer from (1)) = 71.4 mol 3) mass of NH_3 = (answer from 2) × 17 = 71.4 × 17 = 1214 g **or** • 28g of N_2 → 34g of NH_3 • 1g of N_2 → $\frac{34}{28}$ = 1.214g NH_3 • 1000 g of N_2 → 1000 × 1.214 = 1214g **or** • $1000 \times \frac{34}{28}$ **or** **other correct methods**	gains **3** marks without working **1** mark for each correct step do **not** penalise rounding errors in this part **1** mark for each correct step do **not** penalise rounding errors in this part allow error carried forward eg gains **2** marks if correct answer not given $1000 \times \frac{28}{34}$ gains **1** mark, **2** marks if correctly calculated (823.5g) $1000 \times \frac{28}{17}$ gains **1** mark if calculated correctly (1647.05g) look for the key ideas in the methods above	3

continued…

4.1.1.6 Relative atomic mass

CHY2H

Question 7 continued…

question	answers	extra information	mark
(b)	25 / 25.035 **or** ecf from (a)	gains **2** marks even when there is no working incorrect answer then 304/(their answer from (a)) × 100 gains **1** mark	2
	or using figures from part (b)		
	27.6 / 28	gains **2** marks even when there is no working accept 27 for **1** mark if answers incorrect then304/1100 × 100 gains **1** mark	
(c)(i)	increase yield		1
	reaction is exothermic		1
	or		
	allow decreased yield because rate of reaction is slower / fewer collisions for **2** marks	**must** get both points for **2** marks	
(c)(ii)	increase yield		1
	plus **one** from: • more (gaseous) reactant molecules than (gaseous) product molecules (owtte) • increased rate of reaction / more collisions	accept greater volume on the left than the right owtte	1

continued…

4.1.1.6 Relative atomic mass

CHY2H

Question 7 continued…

question	answers	extra information	mark
(d)	any **one** from: **economic** • large town provides workforce • workers do not have to travel far to the factory. (owtte) • transport infrastructure already in place for large town. (owtte) • factory brings prosperity to town (owtte) • factory provides employment • reduced tourism • reduction in local house prices • any other sensible economic factor linked to town		1
	any **one** from: **safety** • <u>escape</u> of dangerous / harmful chemicals / gases (owtte) • <u>danger</u> of increased traffic • risk of explosion.(owtte) /danger of high pressure • consequences of an accident could be severe if the town is close • any other sensible safety idea	do **not** allow polluting gases unqualified	1

continued…

4.1.1.6 Relative atomic mass

CHY2H

Question 7(d) continued…

question	answers	extra information	mark
	any **one** from: **environmental** • factory might be unsightly (owtte) • screening of factory (owtte) • loss of habitats (owtte) • plant trees/ hedges etc on and around plant site • pollution of water / air / soil could harm plants / animals **or** noise pollution • CO_2 is produced by burning fuels / heating • CO_2 causes global warming / any effect of global warming • eye sore • any other sensible environmental factor	must be explained	1
total			12

4.1.1.6 Relative atomic mass

GCSE

Additional Science / Chemistry

CH2HP
Final Mark scheme

4408 / 4402
June 2017

Version/Stage: v1.0

4.1.1.6 Relative atomic mass

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4.1.1.6 Relative atomic mass

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 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

4.1.1.6 Relative atomic mass

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, 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

Full marks can be given for a correct numerical answer, 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 or by each stage of a longer calculation.

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 '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 Accept/allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

3.9 Ignore/Insufficient/Do not allow

Ignore or insufficient is used when the information given is irrelevant to the question or not enough to gain a marking point. Any further correct amplification could gain the marking point.
Do **not** allow means that this is a wrong answer which, even if the correct answer is given, will still mean that the mark is not awarded.

4 Quality of Written Communication and levels marking

In Question 2 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: Basic

- Knowledge of basic information.
- Simple understanding.
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail.
- The spelling, punctuation and grammar are very weak.

Level 2: Clear

- Knowledge of accurate information.
- Clear understanding.
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given.
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: Detailed

- Knowledge of accurate information appropriately contextualised.
- Detailed understanding, supported by relevant evidence and examples.
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

4.1.1.6 Relative atomic mass

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)(i)	a smooth curve through or close to all points except (30,12)		1	AO2 2.4
1(a)(ii)	correct reading from the curve in 1(a)(i) (cm^3)	allow a tolerance of +/- 0.5 cm^3	1	AO2 2.4
1(a)(iii)	45-50 (seconds)		1	AO3 2.4
1(a)(iv)	line becomes less steep because gas is produced more slowly	ignore line levels out or plateaus allow examples with figures, eg 12 cm^3 gas from 0 to 20s but 1.5 cm^3 gas in last 20s ignore reaction has stopped or no more gas produced	1 1	AO3 2.4
1(a)(v)	0.6 (cm^3 per second)	allow 0.55 to 0.65	1	AO2 2.4
1(b)(i)	 temperature volume (of hydrogen peroxide)	concentration of hydrogen peroxide = max **1** ignore amount (of hydrogen peroxide)	 1 1	AO3 2.4
1(b)(ii)	 rate increases because more particles (in the same volume) so frequency of collisions increases	incorrect reference to energy = max **2** accept particles closer together allow greater chance of collisions ignore more collisions	 1 1 1	AO1 2.4.1e

4.1.1.6 Relative atomic mass

1(c)	(increasing the amount of catalyst) increases rate same final volume of gas	accept steeper graph or graph levels off earlier	1 1	**AO2** 2.4.1g
Total			**13**	

4.1.1.6 Relative atomic mass

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>2</td><td></td><td></td><td>6</td><td rowspan="6">AO1
2.1.1h
2.2.4b,c
2.2.5a,b</td></tr>
<tr><td colspan="4">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 and apply a ‘best-fit’ approach to the marking.</td></tr>
<tr><td>0 marks</td><td>Level 1
(1–2 marks)</td><td>Level 2
(3–4 marks)</td><td>Level 3
(5–6 marks)</td></tr>
<tr><td>no relevant information given</td><td>a statement about the structure or a property of a metal
or
a statement about the structure or a property of a polymer</td><td>a statement about the structure or a property of a metal
and
a statement about the structure or a property of a polymer</td><td>a statement about the structure or a property of a metal
and
a statement about the structure or a property of a polymer
and
at least one statement linking structure and property</td></tr>
<tr><td colspan="4">Statements shown as HT only are credited on both FT and HT.
However, HT only means that these statements are not expected in a FT answer.</td></tr>
<tr><td colspan="4">Examples of chemistry points made in response
Metal:
Properties
shiny
hardness
(tensile) strength
melting point/boiling point
density
malleable/flexible
ductile
conduct electricity or thermal energy</td></tr>
</table>

4.1.1.6 Relative atomic mass

Structure • metals contain atoms /((positive) ions HT only) • (the atoms/(positive) ions/particles are) closely packed / in a regular pattern / in a giant structure/in layers / in a lattice • strong bonds/(electrostatic attractions HT only) • (metal has delocalised electrons HT only) **Polymer:** **Properties** • flexible • melting/boiling point • density • can be shaped/moulded • poor conductor of electricity or thermal energy **Structure** • polymer consists of chains • polymer chains may be tangled • polymer has no cross links. • (polymer has weak intermolecular forces HT only) **Level 3:** **Examples of linked statements:** • metal can be bent and shaped because the layers can slide • some metals are soft because layers can slide • some metals are hard because they have strong bonds and/ or (the atoms/(positive) ions/particles) are closely packed / in a regular pattern / in a giant structure/ in a lattice • metal has high melting/boiling point because they have strong bonds and/ or (the atoms/(positive) ions/particles) are closely packed / in a regular pattern / in a giant structure / in a lattice • metal is strong because of strong bonds • some metals are dense because the atoms are closely packed • (metal can conduct thermal energy and electricity because metal has delocalised electrons HT only) • thermosoftening polymer melts when heated because it has no cross-links (or has weak intermolecular forces HT only) • thermosoftening polymer is flexible because the chains can move over each other	

Total			**6**

4.1.1.6 Relative atomic mass

Question	Answers	Extra Information	Mark	AO / Spec. Ref
3(a)(i)	2 bonding pairs 4 unbonded electrons on each atom	accept dots, crosses, e, - or any combination ignore any electrons on any inner shells if no other mark awarded allow **1** mark for 1 bonding pair and 6 unbonded electrons on each atom	1 1	**AO2** 2.1.1g
3(a)(ii)	covalent	allow convalent and covelant ignore single or double ignore shared, shared bond or sharing	1	**AO1** 2.1.1g
3(a)(iii)	weak intermolecular forces require little energy to overcome	reference to weak covalent or weak ionic bonds = **0** accept weak intermolecular bonds MP2 dependent on MP1 if no other mark awarded allow 1 mark for simple/small molecules	1 1	**AO1** **AO2** 2.2.1a,b

4.1.1.6 Relative atomic mass

3(b)(i)	**2** Mg + O_2 → **2** MgO	accept multiples	1	**AO2** 2.2.2
3(b)(ii)		reference to incorrect particles **or** incorrect bonding **or** incorrect structure = max **2**		**AO1** **AO2** 2.1.1a,b,c,f
	magnesium loses (electrons) **and** oxygen gains (electrons)		1	
	two (electrons transferred)		1	
	noble gas structure **or** 8 electrons in outer shells **or** (electrostatic) attraction between ions **or** forms ionic bonds	accept full outer shell (of electrons)	1	
3(b)(iii)	particles 1-100 nm in size	accept contain a few hundred atoms/ions accept have a high surface area to volume ratio ignore reference to (very) small particles do **not** accept smaller than an atom/ion	1	**AO1** 2.2.6a

4.1.1.6 Relative atomic mass

3(c)	has a high melting point	allow will not melt allow a lot of energy needed to melt ignore boiling point reference to incorrect particles or incorrect bonding or incorrect structure = max **1** from MP2 and MP3	1	**AO1** **AO2** 2.2.3a
	because all atoms linked to other atoms	allow giant structure/lattice ignore many bonds	1	
	by covalent bonds	allow strong bonds allow a lot of energy needed to break bonds accept giant covalent structure for MP2 and MP3	1	
Total			**13**	

4.1.1.6 Relative atomic mass

Question	Answers	Extra Information	Mark	AO / Spec. Ref
4(a)	add copper oxide and (sulfuric) acid		1	**AO1** **AO2** 2.6.1b,c
	excess (copper oxide)		1	
	filter (to remove excess)	ignore impurities	1	
	heat /boil / evaporate / leave (to crystallise)	do **not** accept to dryness	1	
4(b)	(M_r CuO =) 79.5		1	**AO2** 2.3.3c
	24.95/249.5 **or** 0.1 **OR** 79.5/249.5 **or** 0.3186…	allow ecf for M_r CuO from step 1 allow correct rounding to min 2SF	1	
	(24.95/249.5 x 79.5=) 7.95	allow ecf for M_r CuO from step 1 allow ecf from step 2 of incorrect calculation/ rounding of correct ratio allow correct rounding to min 2SF correct answer with or without working gains 3 marks	1	
4(c)(i)	as wealth decreases, ethene production decreases (with the exception of country C or D)	accept converse	1	**AO2** **AO3** 2.6
	sulfuric acid production is not linked to wealth		1	

4.1.1.6 Relative atomic mass

4(c)(ii)	use of products of ethene has increased	allow use of polymers / plastics / ethanol / poly(ethene) has increased ignore use of ethene as a (bio)fuel ignore cost	1	**AO3** 2.2.5
Total			**10**	

4.1.1.6 Relative atomic mass

Question	Answers	Extra Information	Mark	AO / Spec. Ref
5(a)(i)	draw line on paper put (dots of) inks on line place (bottom of) paper in solvent / water any **one** from: line drawn in pencil allow dots of ink to dry line above solvent lid		1 1 1 1	**AO1** 2.3.2b
5(a)(ii)	any **two** from: • A has 3 colours **and** B has 4 colours • 2 colours are the same • **A** has 1 colour not in **B and B** has 2 colours not in **A**	accept 3 colours are different if no other mark awarded allow **one** more colour in ink **B** than in ink **A** (or converse)	2	**AO3** 2.3.2b
5(b)(i)	substances carried by gas through column / tube / coil (packed with solid) (different substances move through the column) at different speeds	 accept (different) substances come out at different times or have different retention times	1 1 1	**AO1** 2.3.2c
5(b)(ii)	(relative) molecular mass	allow (relative) formula mass allow RFM, RMM, M_r	1	**AO1** 2.3.2c
Total			**10**	

4.1.1.6 Relative atomic mass

Question	Answers	Extra Information	Mark	AO / Spec. Ref
6(a)(i)	tick (✓) by: the initial temperature reading was too low		1	AO3 2.5
6(a)(ii)	the reaction is exothermic	allow energy is given out	1	AO3 2.5.1b
6(b)(i)	(positive/hydrogen) ions gain electrons hydrogen is below sodium in the reactivity series so hydrogen / H_2 is produced	accept (positive/hydrogen) ions are reduced accept reference to high reactivity of sodium If no other mark awarded allow hydrogen (and sodium) ions **or** positive ions are attracted to negative electrode for **1** mark	1 1 1	AO1 AO2 2.7.1c,f,i
6(b)(ii)	**2** (Cl^-) → **Cl_2 + 2e^-**	must be completely correct allow multiples	1	AO1 2.7.1g
6(b)(iii)	solution is alkaline because sodium hydroxide / NaOH is produced **or** sodium hydroxide / NaOH is left over	accept hydroxide (ions) / OH^- is produced **or** hydroxide (ions) / OH^- is left over	1 1	AO1 AO2 2.7.1i; 2.6.2d
Total			8	

4.1.1.6 Relative atomic mass

Answer 24 · Examiner comments

June 2018 | 8462/1H | Original Q2

Question 2 (standard demand)

02.1 Because the question asked for the formula rather than the empirical formula, an answer of Fe_9S_{18} was accepted. Even so, 51% of students could not count the atoms and produce a ratio of 1:2. A formula was required, not an equation which some students provided.

02.2 This was very well answered, with 88% of students achieving all three marks.

02.3 57% of students achieved both marks. However, some repeated information in the stem of the question, and some contradicted it by saying sodium is not a metal. Some gave differences in the structure of the atoms instead of differences in properties of the substances.

02.4 This was well answered, with 32% of students achieving one mark, and 57% achieving both.

A common error was to say 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.

Answer 24 · Examiner comments

June 2018 | 8462/1H | Original Q2

02.5 This question was well answered, with 60% of students achieving all three marks. However, interpretation of calculator displays did cause a bit of trouble for some students. Some 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.

4.1.1.6 Relative atomic mass

Answer 25 · Examiner comments

June 2018 | 8462/1H | Original Q4

Question 4 (standard, standard / high and high demand)

04.1 87% of students could identify the plum pudding model from the diagrams. E was the most popular distractor, where the charges were reversed.

04.2 68% of students could identify the model resulting from the alpha particle scattering experiment. The Bohr model was the most popular distractor.

04.3 72% of students could identify the Bohr model correctly. The most popular distractor being the model from the alpha particle scattering experiment.

04.4 69% of students could define mass number correctly. Some lost the mark by writing 'protons and neutrons' with no further information. Others mistakenly gave a description of relative atomic mass, or referred to the total mass of the protons and neutrons instead of the total number.

04.5 This question was well answered, with 75% of students able to estimate (or calculate) the relative atomic mass.

04.6 19% of students achieved all three marks. Two marks could be obtained just for defining isotopes. The other mark was for linking this to Chadwick's discovery of the neutron. No knowledge of how he made this discovery was required.

Many students were able to recall that Chadwick discovered the neutron, and that isotopes have different number of neutrons. Many students didn't mention that isotopes have the same number of protons, or are atoms of the same element. Clarity of expression was important here; the statement that isotopes are different forms of the same element gained no credit as it could refer to allotropes. Similarly, 'mass of an element' does not mean 'mass of an atom'.

Some students appear to think that isotopes are not 'normal' atoms of an element, and some think that isotopes are always unstable. There was some confusion of Chadwick with Rutherford, and even with Mendeleev.

Answer 26 · Examiner comments

June 2018 | 8462/1H | Original Q8

Question 8 (standard / high and high demand)

08.1 42% of students could answer this correctly. A hazard was asked for, and it was expected that students would use the correct chemical term for such a hazard; hence the idea that chlorine or carbon monoxide is **toxic** was required. Many did not use the correct term, referring instead to it being harmful (incorrect – it can kill, not merely make one ill), or dangerous or deadly (in what way?). Some students misread the equation and referred to carbon dioxide.

08.2 40**%** of students achieved the mark here. Many did not realise that their observations of a vigorous reaction with a small piece of sodium in the lab would be magnified enormously on an industrial scale. Hence the reaction would be **very** violent or explosive, not just vigorous.

08.3 There were many good attempts at this question, with 73% of students scoring at least one mark. Many students referred to the lack of reactivity of the metals with argon, but some forgot to refer to air. Then some students did not express themselves clearly, referring to one or both metals reacting with air in general, or even with gases not present in the air, such as hydrogen.

08.4 There were some excellent attempts at this difficult question, which discriminated well. 8% of students achieved full marks with 43% achieving at least one mark. Full credit could be gained by those who started with the premise that titanium chloride must be ionic so should have a high melting point; very few started from the true situation, which is that titanium chloride must exist as small molecules as its melting point is low.

The mark that was scored least often was for the explanation of the bonding and how it leads to the actual, or predicted, melting point. Some spoiled an otherwise good description of ionic bonding by also referring to ‘strong intermolecular forces’. Many referred to ‘strong electrostatic forces’ but failed to mention that those forces were between ions.

A significant number of students answered solely in terms of the separate elements, particularly titanium, rather than the compound.

08.5 51% of students achieved the mark for this question. Whilst the definition of oxidation in terms of electrons is well known, the question asked why **this** reaction is oxidation. So, it was necessary to refer to the sodium atoms losing electrons rather than giving a generalised answer. Some students referred to ‘it’ losing electrons, without specifying what ‘it’ referred to, while others referred to oxygen, which is not present.

08.6 54% of students achieved the mark here. It was not uncommon to see ‘$-e^-$’ on the right hand side. A significant number of incorrect responses showed the formation of a doubly charged sodium ion.

4.1.1.6 Relative atomic mass

Answer 26 · Examiner comments June 2018 | 8462/1H | Original Q8

08.7 This difficult unstructured calculation tested a new area of the specification, and discriminated very well. 74% of students were able to achieve at least one mark, usually for calculating the M_r of $TiCl_4$. 7% of students achieved all four marks, with 12% achieving at least three marks and there were some valiant efforts.

Common errors were:

- using 92 instead of 23 to calculate the number of moles of Na
- omitting the unit conversion from kg to g for the mole calculations
- using the 1:4 mole ratio incorrectly or not at all.

Also, it is not appropriate to leave answers in the form of a fraction, even if this is the default on their calculator. Answers should always be converted to decimal form.

08.8 This was well answered, with 74% of students achieving both marks. A few forgot the 100 in their expression and didn't realise they were making about 1000 kg more than the theoretical maximum.

4.1.1.6 Relative atomic mass

Answer 27 · Examiner comments

June 2019 | 8462/1H | Original Q4

Question 4 (standard and standard/high demand)

04.1 Approximately 80% of students scored both marks for the names / properties of the proton and the neutron.

04.2 Approximately 70% of students gave the correct definition of mass number.

However, there were some incorrect references to mass, for example, ‘mass number is the total mass of the protons and neutrons’.

04.3 Approximately 80% of students correctly answered that isotopes of the same element have different numbers of neutrons.

04.4 Most students made a good attempt at this question about the alpha particle scattering experiment.

The marks for the ideas that some particles were deflected and/or reflected and that there is a charged nucleus were the most frequently awarded.

The mark for the idea that most of the particles passed straight through the gold foil was the least frequently awarded.

Those students gained fewer marks tended to focus on expected outcomes but didn’t know exactly what happened in the experiment.

4.1.1.6 Relative atomic mass

Answer 28 · Examiner comments

June 2019 | 8462/1H | Original Q7

Question 7 (standard, standard / high and high demand)

07.1 The explanation for the use of cryolite in the extraction of aluminium does not appear to be well known. Almost two-thirds of students scored 0 marks.

A common misconception was that cryolite acts as a catalyst.

Common responses seen that were not credited included:

- to melt the aluminium oxide so that it conducts electricity
- so that the ions can move freely
- to reduce costs.

07.2 Almost 60% of students correctly identified that aluminium ions gain electrons as the process occurring at the negative electrode.

07.3 Students found the completion of the half-equation difficult. Almost 70% scored 0 marks.

Common errors included:

- including Al / Al_2O_3
- representing the oxide ion as O^- or O_2^-
- 2 electrons rather than 4 electrons being produced.

07.4 However, only approximately a quarter of students were able to state why the positive electrode needs to be replaced and hence score all 3 marks.

4.1.1.6 Relative atomic mass

Answer 28 · Examiner comments

June 2019 | 8462/1H | Original Q7

07.5 Most students scored at least 1 mark. Approximately 40% scored all 4 marks.

The most frequently scored mark was for M_r (Al_2O_3) = 102 (or '204' from the alternative approach in the mark scheme).

A common error was M_r (Al_2O_3) = 156 but students were still able to score marks for using this incorrect value in subsequent steps.

A valid variation on the reacting mass method was to calculate the percentage by mass of oxygen in Al_2O_3 and then use this to calculate the mass of oxygen in 2000 kg of Al_2O_3

It was not always clear which approach was being used. A common incorrect final answer was 1412 (kg) where students had applied the 2 : 3 mole ratio (from the main approach) as well as the 96 / 204 mass ratio (from the alternative approach).

07.6 Students found this question difficult. Almost two-thirds of students scored 0 marks.

Even when students realised that reactivity was the key idea, they sometimes compared the reactivity of the wrong species, for example, sodium and chlorine or Na^+ ions and H^+ ions

A common misconception was that sodium chloride solution does not conduct electricity.

07.7 Approximately two-thirds of students scored at least 1 mark for this calculation.

However, the most common final answer was 50.7 dm^3. The error here was the omission of the unit conversion, kg to g.

4.1.1.6 Relative atomic mass

Answer 29 · Examiner comments — June 2019 | 8462/1H | Original Q8

Question 8 (standard / high and high demand)

08.1 Only approximately a quarter of students scored this mark. They usually did so by identifying the need to ensure that the oxide of copper had completely reacted.

Common responses seen that were not credited included:

- to ensure complete reaction (unqualified)
- to ensure reliable / valid / accurate results.

08.2 Students found this question difficult. Approximately 80% of students scored 0 marks.

The idea that hydrogen is explosive was the most common correct response.

A common misconception was that, unless burned off, the hydrogen would affect the masses of the tubes and contents.

Common responses seen that were not credited included:

- Hydrogen is flammable.
- Hydrogen would react with the drying agent.

Answer 29 · Examiner comments — June 2019 | 8462/1H | Original Q8

08.3 Students found the processing of the data quite difficult. Approximately a third of students scored both marks with a similar proportion scoring 1 mark.

Common responses seen that were not credited included:

- 1.09 g (which represents the mass of oxygen)
- 2.45 g (the mass of water) recorded as the mass of copper.

08.4 Students found this question difficult. Only approximately a quarter of students scored full marks with approximately a half scoring 0 marks.

For those who scored marks, it was usually by the main approach in the mark scheme. Here, the mark for linking the mole ratio to equation 2 was the least frequently scored.

All approaches in the mark scheme were represented and students scored best when their working was set out clearly.

The most common incorrect approach was to calculate the M_r of all the reactants and products in both equations and then simply refer to conservation of mass.

4.1.1.6 Relative atomic mass

Answer 30 · Examiner comments

June 2019 | 8462/1H | Original Q9

Question 9 (standard, standard / high and high demand)

09.1 Almost a half of students scored 0 marks.

The mark scheme required the use of comparatives.

Common correct responses were:

- Better insulator
- Less heat loss

Common responses seen that were not credited included:

- good insulator
- no heat loss.

09.2 This graph question was well answered with approximately half of students scoring full marks.

Some students attempted to draw a straight line of best fit. In most cases, this was inappropriate.

Some students did not draw their line so that the two lines of best fit crossed. Instead, they drew a curved peak.

09.3 Approximately 60% of students were able to determine the neutralisation point from their graph.

In some cases, students misunderstood the scale of the x-axis, for example, reading 11 cm^3 as 10.1 cm^3.

09.4 Only approximately a third of students correctly determined the overall temperature change for the reaction from their graph.

A common incorrect answer was 8.2 °C (from subtraction of the highest and lowest temperature values in the table).

09.5 Students found this titration calculation difficult and approximately a third of students scored 0 marks.

The marks for calculating the number of moles of sulfuric acid and for calculating the relative formula mass of potassium hydroxide were the most scored. Even when these values were incorrect, this did not prevent students from gaining marks in subsequent steps.

The correct answer for the concentration in mol/dm^3 was achieved more often than the subsequent conversion to g/dm^3. A common error was to use a conversion factor of 112 (2 × M_r(KOH)) rather than 56.

4.1.1.6 Relative atomic mass

Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

Mark Ranges and Award of Grades

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

4.1.1.6 Relative atomic mass

Answer 32 · Examiner comments November 2020 | 8462/1H | Original Q2

Question 2 (standard demand)

02.1 Nearly all students scored at least one mark. The most commonly seen incorrect response was 'they form colourless compounds'.

02.2 Whilst many students realised that copper was displacing silver, most were unable to deduce that the grey crystals were silver and the blue solution was copper nitrate or a copper compound. There were many poorly worded answers which did not gain credit, such as 'it displaced silver', or 'copper is blue in solution'. It was not uncommon for the grey crystals to be described as copper nitrate crystallising from the solution.

02.3 Whilst many students included a control variable in their plan, few actually said how they would identify each metal as magnesium, iron or copper, so were unable to access the higher levels.

02.4 This calculation was very well done by most students.

Answer 33 · Examiner comments November 2020 | 8462/1H | Original Q6

Question 6 (standard, standard / high and high demand)

06.1 Most students were able to express the idea that activation energy is the minimum energy required to start a reaction. One common error was to say that it is the energy needed to make particles collide.

06.2 A variety of approaches was seen. The majority of students calculated the number of moles of both aluminium and of iron oxide and then attempted with varying degrees of success to explain why the number of moles of aluminium was insufficient for the iron oxide. Common errors were to omit to convert the mass from kilograms to grams, and/or using 54 as the 'M_r' of aluminium. Of those who did correctly calculate the number of moles of each reactant, some had difficulty in expressing clearly the idea of 2 moles of aluminium being needed to react with 1 mole of iron oxide, and therefore 37.0 moles of aluminium is less than the 37.5 moles required, or that 18.75 moles of iron oxide is more than the 18.5 moles required. Other students started with the mass of one reagent and calculated the required mass of the other, either by the moles method or by proportion. These students found it easier to express why there was insufficient aluminium or excess iron oxide.

06.3 Few students scored both marks. Aqueous zinc was often seen as a response. Many students did not understand the idea of an ionic equation and tried to include the sulfate ion.

06.4 Only a third of students scored both marks, but a lot of students were confused about which species gained electrons and which lost them. Definitions of oxidation and reduction in terms of gain and loss of oxygen were not appropriate here and were not credited.

4.1.1.6 Relative atomic mass

Answer 34 · Examiner comments — November 2020 | 8462/1H | Original Q8

Question 8 (standard, standard / high and high demand)

08.1 The majority scored the mark, but many thought bromine is a solid at 0 ºC.

08.2 This question was not well answered. Most students stated that the boiling point increased going down the group, although some were evidently confused by the negative values in the table and stated the opposite trend. However, many students then confused boiling point with reactivity and tried to explain the trend using forces within the atom rather than forces between molecules. Students should refer to intermolecular forces rather than intermolecular bonds, to avoid any confusion about which 'bonds' they are referring to in terms of breaking them to make the substance change state.

08.3 This was very poorly answered. The idea of a bulk property was very rarely seen. There was considerable confusion between the terms atom and molecule, with many stating that bromine was diatomic so there are always two molecules. The best answers referred to the fact that boiling point relates to intermolecular forces, which cannot exist if there is only one molecule.

08.4 Many students realised that the fume cupboard would prevent inhalation of the gas, which is toxic. However, some students regard a fume cupboard as insulation to prevent the escape of heat energy, or thought it was to trap and retain the gas.

08.5 Most students knew and were able to express, that the atoms get larger going down the group. Some, however, referred incorrectly to the number of outer shells increasing. Fewer were able to express that there was a reducing attraction between the nucleus and the outer electrons or the incoming electron, with many vague references to shielding without mentioning the nucleus or the relevant electrons. Even fewer were able to express the increase in difficulty of gaining (rather than merely attracting) an electron.

Answer 34 · Examiner comments — November 2020 | 8462/1H | Original Q8

08.6 Very few students scored full marks. Most students were able to calculate the mass of iron, but some calculated the mass of iron chloride instead of chlorine. They sometimes then assumed a formula of iron chloride and tried to work backwards. Of those who did calculate the masses of both iron and chlorine, most were then able to calculate the number of moles of each, but many then failed to find the simplest ratio as 1:3, instead leaving it as 0.08:0.24. Some calculated the number of moles of chlorine molecules instead of atoms; these students almost always failed to multiply by 2 to obtain the number of moles of atoms, giving a ratio of 2:3 instead of 1:3. Very few were then able to give a balanced equation; most did not use their ratio to give the formula of iron chloride as $FeCl_3$. It was rare to see the formula of chlorine written correctly as Cl_2, and iron was sometimes seen as Fe_2.

4.1.1.6 Relative atomic mass

Answer 35 · Examiner comments

November 2020 | 8462/1H | Original Q9

Question 9 (standard, standard / high and high demand)

09.1 A third of students scored this mark; some realised that the most likely error was lack of stirring; fewer suggested that the temperature was measured too early, before the temperature had stopped falling. Many suggestions contradicted the information given.

09.2 Students had great difficulty in expressing their answers using correct terminology, often using energy and temperature interchangeably. They generally find endothermic reactions difficult; they do not seem to realise that the energy taken in is not staying as thermal energy but is being converted to chemical energy. Some students gained the mark for saying that the temperature initially falls because energy is being taken in, showing an endothermic reaction. A few noted that when 1.5 g of citric acid had been added the reaction had finished and that the citric acid was in excess from there on. However, it was very rare for a correct explanation for the subsequent rise in temperature to be given. Some thought the reaction suddenly became exothermic, or that it suddenly reversed (showing a lack of understanding of reversible reactions).

09.3 Many students realised that the difference was due to the better thermal conductivity of the metal. However, many of those merely referred to the metal as a good conductor, without comparing the metal to polystyrene. The majority of students drew a steeper line, stating that the metal would lose heat more quickly. Of those who drew the correct shallower line, few could explain that the metal would conduct thermal energy in from the surroundings more quickly, reducing the temperature drop in this endothermic reaction.

09.4 Many students were able to score all three marks. Common errors were to confuse concentration with number of moles and to fail to convert 250 cm^3 to 0.25 dm^3 correctly. The symbol ‘m’ for number of moles was commonly seen instead of ‘n’ – students consequently became confused between mass and number of moles. Students who set out their working step by step were able to gain partial credit, but those who simply had a jumble of numbers, with no explanation as to what the numbers represented, were not.

09.5 Most students scored at least two marks Some students referred to ‘amount’ of acid added rather than volume, and many failed to take any burette readings at all. It was not uncommon to see a conical flask placed ‘under’ a white tile rather than on one.

09.6 This was not well answered. Most students who scored a mark did so for stating that the acid could be added drop by drop, or that the rate of flow could be controlled. Few stated that the burette could measure variable volumes (unlike a pipette). Many stated that a burette was ‘more accurate’ but did not say what they were comparing it to. Of those who

4.1.1.6 Relative atomic mass

Answer 35 · Examiner comments

did, most said it was more accurate than a pipette, which is not true. Some students confused a volumetric pipette with a dropping pipette.

09.7 This titration calculation was well done by many students. To gain full credit, working needed to be correct as well as the final answer. Students therefore need to show their working step by step in a way that can be followed by the examiner. Common errors were to omit to convert volumes to dm^3, to attempt to do so but incorrectly, or to omit the mole ratio of citric acid to sodium hydroxide. As with question 09.4, students who incorrectly used the symbol 'm' to mean moles often confused themselves; they should be encouraged to use 'm' only for mass, and 'n' for number of moles.

4.1.1.6 Relative atomic mass

Mark Ranges and Award of Grades

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

4.1.1.6 Relative atomic mass

Answer 36 · Examiner comments November 2021 | 8462/1H | Original Q2

Question 2 (standard demand)

02.1 The usual definition (atoms with the same number of protons but a different number of neutrons), was not well known. Some students contradicted themselves by referring to elements in plural, rather than atoms of the same element. This was largely caused by the incorrect use of the word 'element' instead of 'atom'. Others said that the relative atomic mass (rather than the mass number) is different. One misconception is that an isotope is a single atom whose numbers of protons and electrons are the same, but whose number of neutrons differs from the number of protons. Electrons are not part of the definition of an isotope; their inclusion can lead to this type of confusion and ambiguous answers.

02.2 This was well answered by over half of the students, although a few ignored the instruction to give their answer to one decimal place. Some students did not appear to recognise that providing an answer that was not in between the mass numbers of the two isotopes was mathematically incorrect.

02.3 This was very well answered.

02.5 Many students had difficulty in articulating their answers. Many gave generic answers about Mendeleev having left gaps, rather than pointing out specifically that gallium fitted one of those gaps. There were also vague statements about gallium's properties fitting the adjacent elements, rather than matching the rest of the group. Some mentioned Mendeleev having predicted properties, without saying that those predictions were correct.

Answer 37 · Examiner comments November 2021 | 8462/1H | Original Q3

Question 3 (standard demand)

03.1 This was well answered by many students. A common error was to not multiply the relative formula mass of hydrogen by three, leading to an answer of 100.

03.2 This was well answered. Credit was given to those who applied an incorrect response to question **03.1** correctly. Some students gave an answer which corresponded to their answer to question **03.1** used as atomic number rather than relative atomic mass.

03.3 This was well answered, although a common error was to omit the carbon in calculating the total M_r of the reactants.

03.4 The best answers gave the pros and cons of each method and then gave a judgement. One misconception was that the iron oxide in method 3 could be sold. Many concentrated only on cost, and the number of by-products, rather than what those products were and how difficult or costly further separation would be. Few students used the information provided, that solid products have to be separated. A few very good students commented on the low atom economy that method 1 would give because of some tungsten being lost as tungsten carbide.

4.1.1.6 Relative atomic mass

Answer 38 · Examiner comments

November 2021 | 8462/1H | Original Q5

Question 5 (standard, standard / high and high demand)

05.2 This equation, which is given in the specification, was not well known.

05.4 Students found this question difficult. Most students do not know why the acid is heated, and many incorrectly referred to helping the magnesium oxide dissolve. Very few appeared to understand that excess magnesium oxide is needed to ensure that all of the acid reacts. Most students knew that filtration separates solids from liquids or solutions, but many did not refer specifically to removing the excess magnesium oxide.

05.5 Very few students knew that a water bath or an electric heater should be used, despite this being stated in the specification.

Answer 38 · Examiner comments

November 2021 | 8462/1H | Original Q5

05.6 Those who followed the method provided in the question were often successful in scoring at least one mark. It was common to see the number of moles of iron calculated by dividing the mass by 112 instead of 56. Those who calculated the number of moles of chlorine often insisted on converting this to a mass and then back again to calculate the volume of chlorine.

4.1.1.6 Relative atomic mass

Answer 39 · Examiner comments

November 2021 | 8462/1H | Original Q7

Question 7 (standard, standard / high and high demand)

07.1 Very few students picked up on the link between chemical reactions and electricity given in the question. The idea that electrolysis uses electricity to produce a chemical reaction was poorly understood. Many students believe electrolysis is a method of 'separating' compounds, rather than decomposing a compound. Very few realised that a chemical cell uses a reaction to produce electricity, with many making statements about a cell using electricity.

07.2 Many students were unable to write the formula of bromine. Those who could, often scored at least one mark, although the half-equation was not always balanced.

07.3 Students found difficulty in naming all 3 products. Many students did score the mark for iodine, though iodide was a common response. Very few could work out that in the absence of a halide ion, oxygen must be produced at the positive electrode, with many suggesting nitrogen as the product.

4.1.1.6 Relative atomic mass

Answer 39 · Examiner comments November 2021 | 8462/1H | Original Q7

07.4 Of the students who recognised that the copper needed to be filtered from the solution, very few then washed and dried the copper, despite that step having been provided in the method for dealing with the electrode itself. Some said the filtered copper would be measured, rather than specifically that the mass would be measured. Some then said incorrectly that the mass would be added to the mass of the electrode, rather than the mass gain of the electrode. Many wasted time describing steps that had already been done, particularly weighing the electrode before and after the experiment.

07.5 The concept of proportionality is poorly understood. Even those who referred to the lines being straight rarely referred to their passing through the origin. Most simply described how the results showed a positive correlation, or a linear relationship.

07.6 The idea of one variable doubling (or trebling) as did the other variable was known by very few students.

07.7 Very few recognised that the blue colour was due to copper ions, which were being removed from the solution. Copper does not dissolve, and is not blue, so the phrase 'copper is removed from the solution' has no merit. Many think that the ions are being separated, rather than discharged.

07.8 Many students could make no progress as they had not calculated the number of moles of copper. Some tried to include the current, the time or both in their calculation, instead of using those values to establish the mass of copper formed from the graph.

Answer 40 · Examiner comments November 2021 | 8462/2H | Original Q6

Question 6 (standard / high and high demand)

06.1 The bromine water test was known by many students, but some of these were then unable to gain the second mark, usually because an incorrect colour change was stated.

06.2 A large number of students were able to apply their knowledge of general formulae to the unfamiliar context of cycloalkenes.

06.3 Only around a third of students gained at least one mark in this demanding question.

06.4 The vast majority of students were able to calculate the relative formula mass of $C_6H_{10}Cl_2$ as 153, although a few used 35 as the relative atomic mass for chlorine even though 35.5 was given in the question stem. Over half of students scored all three marks.

4.1.1.6 Relative atomic mass

Answer 41 · Examiner comments June 2022 | 8462/1H | Original Q5

Question 5 (Standard, standard/high and high demand)

05.1 Nearly half of students described how a specific observation would differ. Vague comments about a more violent reaction, with no specific visual observation, did not gain credit.

05.2 Most students scored at least two marks. They knew that rubidium would lose an electron more easily, and that it was the larger size of the atom that was responsible (often expressed as the rubidium atom having more shells). The description of the weaker attraction of the rubidium nucleus for the outer electron was less well expressed; some students omitted to say that the attraction was for the outer electron or that the attraction was between the outer electron and the nucleus. Some gave an inappropriate description of the attraction, such as intermolecular or magnetic. Some contradicted their attraction argument by saying that the outer electron in rubidium is less shielded from the nucleus, rather than more shielded.

05.3 Only about a sixth of students scored full marks. Many knew that one of the products was hydrogen, and could write its formula correctly. However, far fewer knew that RbOH was the other product. Of those who did, most managed to balance the equation correctly.

05.4 Fewer than half of students gave the correct answer. Nearly as many, though, stated that the noble gases all have eight outer shell electrons, appearing to forget about helium.

05.5 More than half of students completed the calculation successfully and rounded to the appropriate 3 significant figures. Common errors were to divide by 63 (sum of the mass numbers) or 3 (number of isotopes) rather than by 100.

4.1.1.6 Relative atomic mass

Answer 42 · Examiner comments June 2022 | 8462/1H | Original Q7

Question 7 (Standard, standard/high and high demand)

07.1 This was well answered, with more than half of students scoring both marks. There was, however, some ambiguous use of the word ‘it’ such as ‘it shows that it is below carbon because it displaces it’. If it was not clear what ‘it’ referred to, credit was not given.

07.2 Only 10% of students were awarded both marks, although nearly 60% scored at least one mark. Many students realised that aluminium is extracted by electrolysis, although some stated that aluminium would be extracted by the use of a more reactive metal. Although many mentioned the high energy cost of electrolysis, few compared electrolysis to the lower energy cost of heating coal to obtain carbon. Other students did state that extracting aluminium requires more energy than forming carbon, but did not explain why.

07.3 Many students realised that the products both being solids would make their physical separation difficult. Some appeared to misunderstandd what ‘separate’ means, and described the difficulty of decomposing magnesium oxide; this did not gain credit. Another common incorrect approach was to say that magnesium is high in the reactivity series. Whilst true, this was not relevant to the question set.

07.4 Those students who adopted a systematic approach, either using moles or reacting masses by proportion, had little difficulty in scoring most or all of the marks. In a multi-step calculation it is essential that each step is shown in the working so that marks for working can be awarded. The most common error was to use 48, instead of 24, for the M_r of Mg, giving an answer that was twice the correct value. Nearly all students carried out the unit conversion correctly. Some students calculated the correct final answer (960 g) but used an incorrect method. Such responses did not score full marks.

4.1.1.6 Relative atomic mass

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07.5 This was well answered. However, there were many blank responses.

07.6 This was a high demand calculation, and students found it difficult to analyse the correct approach to take. The gas molar volume was not provided, because it was not needed. Indeed, with the water being formed as a gas, a value of 24 dm^3/mol was not correct. Even so, those students who adopted the approach of converting gas volumes to moles were given full credit if they succeeded. Few did, as a four-step calculation with simple numbers was turned into a seven-step calculation with a unit conversion by electing to follow this approach.

Students needed to use the equation to realise that the SiO_2 formed is a solid, not a gas. They were also told that the oxygen is in excess; that means that the Si_2H_6 is the limiting reactant, and that the gases after reaction would therefore be the water vapour and the remaining oxygen. All that was therefore necessary was to multiply the volume of Si_2H_6 by 3 to find the volume of water vapour formed, and by 7/2 to find the volume of oxygen used. Subtracting that volume from 150 cm^3 would then give the volume of excess oxygen, and adding the volumes of the two appropriate gases together gave the final answer. Only one sixth of students scored at least one mark, which was usually for calculating the volume of water vapour produced.

Answer 43 · Examiner comments June 2023 | 8462/1H | Original Q1

Question 1 (standard demand)

01.1 Only two fifths of students scored both marks, although three quarters scored at least one mark. The plum pudding model is described in the specification. However, some students referred to a ball of positive energy rather than positive charge, and some did not name the electrons, or implied that they were outside the positive ball rather than embedded in it.

01.2 Nearly three fifths of students could give the correct order of discovery.

01.3 More than three quarters of students scored both marks by locating tennessine in Group 7 and therefore deducing that it has 7 outer shell electrons. Some ignored the instruction to use the periodic table and tried unsuccessfully to work out the electron configuration.

01.4 Only one fifth of students were familiar with the idea of peer review or could apply it to this situation. A common incorrect reason was the scarcity of the element; this was the same for the original group of scientists so does not explain the delay.

01.5 Two thirds of students gave fully correct answers, and the question discriminated well. The great majority scored at least one mark, for giving an attempt at the calculation to one decimal place. Some divided by the sum of the mass numbers instead of the sum of the percentages (ie 100). There were very few rounding errors. Some students did not realise

4.1.1.6 Relative atomic mass

Answer 43 · Examiner comments June 2023 | 8462/1H | Original Q1

that their answer must lie somewhere between 6 and 7, the two mass numbers of the isotopes.

4.1.1.6 Relative atomic mass

Answer 44 · Examiner comments

June 2023 | 8462/1H | Original Q9

Question 9 (standard, standard/high and high demand)

09.1 Students found this question difficult, with only a tenth of students scoring both marks and not many more scoring one. Most students gave incorrect responses for the substance reduced: usually iron, but sometimes carbon. Those who gave the correct substance were usually able to give the correct reason in terms of loss of oxygen. It seems that students are so well versed in the definitions of redox in terms of electrons (as in question 09.3) that they have forgotten the simpler definitions in terms of gain or loss of oxygen.

09.2 Fewer than a third of students gave the correct answer, with all three distractors being very popular. This suggests a large degree of guessing rather than using the equation to work out the mole ratio of C:Fe as 3/2 and then multiply by 12 grams.

09.3 Over three-quarters of students could correctly apply their knowledge of redox in terms of electrons. By far the most common incorrect response was **A** gains electrons and $\mathbf{B}^{+}$ loses electrons.

09.4 Fewer than one in seven students answered this high demand question correctly, with the great majority giving metal **A** as the answer. It was necessary to realise that the greatest tendency to form positive ions means the most reactive metal. It was then necessary to work out from the three reactions in the table that **A** is more reactive than **B**, **C** is more reactive than **A**, and **C** is less reactive than **D**, making **D** the most reactive.

09.5 This question discriminated well. Over half of students scored at least one mark, with just over one in ten scoring all three.

Many students tried to answer in terms of the reactivity series. This was not possible, as insufficient detail was provided to identify any of the four metals. The formula of the nitrate ion was provided but was not referenced by the majority of students. The key to answering the question was in the formulae of the nitrates; aluminium forms an ion of charge 3+, so each ion requires three nitrate ions to balance the charge. Even when students got the basic idea, they often did not express themselves clearly enough, using phrases such as ‘aluminium has a 3+ charge’ rather than referring to an aluminium ion.

09.6 Those who understood the concept of atom economy were able to complete this difficult calculation successfully; over a fifth of students scored all four marks and two fifths scored at least one.

There were two main approaches. One was to substitute values into the atom economy expression, followed by successive rearrangements of the expression to give the value of A_r of **X**. A neater solution, used by students who had a good understanding of atom economy, was to realise that the remaining 22.7% was the total M_r of the waste atoms, ie 54, and then scale either to 100% and subtract the 54, or scale straight to 77.3%. Many students misunderstood the M_r of XO_3, thinking it meant the A_r of **X** times 48. Some also misunderstood $3H_2$ or $3H_2O$, giving various values for what should have been a total of 54 for the M_r of the waste atoms. Nevertheless, correct manipulation after these errors allowed access to 3 marks.

4.1.1.6 Relative atomic mass

Answer 45 · Examiner comments

June 2023 | 8462/1H | Original Q10

Question 10 (standard/high and high demand)

10.1 About a third of students scored one mark, but far fewer scored a second mark. Many students did not give comparative answers. Many referred to nanoparticles having a larger surface area, but failed to realise that this depends on the amount used. A higher surface area to volume ratio, or a higher surface area for the same mass of material was creditworthy and was the most common correct answer. This leads on to other creditworthy answers, such as a thinner coating being needed, and hence, more light getting through the window, but these answers were rarely seen. References to cost were ignored.

10.2 This question discriminated well. The great majority of students scored at least one mark, with nearly a half scoring five or six marks. The most common error was not converting 100 kilograms to grams in order to calculate the moles, or converting incorrectly. Another common error was to calculate a spurious volume of TiO_2. Some converted the number of moles of chlorine to a mass first, before converting to a volume; whilst unnecessary, this did give the correct answer and gained full credit. Students who gained one or two marks usually calculated the relative formula mass of TiO_2 and/or converted 100 kilograms to grams. A few seemed to be concerned by the large value of the answer and introduced a division by 1000 into what would have been a correct answer.

Students sometimes tried more than one method and did not cross out the one they did not want to be marked. This led to confusion and contradictions, sometimes meaning that marks could not be awarded. Students should always cross out discarded methods; examiners will not make the choice for the student.

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Mark Ranges and Award of Grades

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

4.1.1.6 Relative atomic mass

Answer 46 · Examiner comments

June 2023 | 8462/2H | Original Q5

Question 5 (standard and standard / high demand)

05.1 Nearly all students correctly identified oxygen as the missing item in the equation and most correctly identified it as a diatomic molecule and were then able to go on to balance it correctly. Four-fifths of students gained both marks.

05.2 This calculation was well done by many students, with more than three-quarters of students scoring the mark. The commonest error was to incorrectly calculate the relative formula mass of the compound due to missing the fact that the compound contained two atoms of sulfur and not one. More than three-quarters of students scored the mark.

05.3 Many students were aware that the test for copper(II) ions produces a blue precipitate. However, there was more trouble in identifying the correct reagent and as a result a number of students scored no marks. A number of students were able to gain credit by the use of a flame test instead. Nearly half of students gained both marks.

05.4 This item was not well answered with many students incorrectly assuming that bioleaching was the same as phytomining. Of those who did know what bioleaching referred to, most were able to identify the use of bacteria, but very few gained the second mark for 'leachate solutions', either just referring to 'leachate', or by going on to say that the leachate contained copper (rather than copper compounds/ions). Only 10% of students scored both marks, although around half knew that bacteria were involved.

4.1.1.6 Relative atomic mass

Answer 47 · Examiner comments

June 2023 | 8462/2H | Original Q8

Question 8 (standard, standard / high and high demand)

08.1 The majority of students correctly circled the C=C group. A common mistake for those who didn't gain the mark was identifying the C-Cl bond or to circle the double bond alone without including the carbon atoms. More than half of students gained this mark.

08.2 There was a wide range of responses to this question. In the majority of answers MP2 was achieved with 3x C-H and 1x C-Cl bonds drawn correctly. Incorrect answers often lacked extended bonds or failed to extend them far enough or failed to replace the C=C bond by C-C.

08.3 A wide range of responses were seen to this question. Common incorrect responses included alloys, polymers, formulations, mixtures and ceramics. Around one-third of students gained this mark.

08.4 A wide range of responses were seen to this question. Common incorrect answers included alkene, hydrogen, named alkanes and alkenes, protein and nitrogen. Around one-half of students gained this mark.

08.5 Many students got this question correct. Those achieving one mark often got this for calculating the M_r of NH_2 and COOH and adding them for MP1. For those who didn't gain any marks a common mistake was subtracting the M_r of NH_2 and COOH from each other. Around three-quarters of students gained both marks

08.6 A wide variety of answers were seen. Incorrect responses included students circling individual side groups such as -OH or $-CH_2OH$ or some including both bridging oxygen atoms or neither. Correct answers varied in which repeating unit they circled – there are six valid alternatives. Nearly half of the students gained the mark.

08.7 The most common correct answers seen were starch, cellulose or glycogen. Polysaccharide was less commonly seen. Incorrect responses included alcohol, amino acids, proteins and a whole range of polymer names including polyester. Fewer than one-third of students gained this mark.

Answer 47 · Examiner comments

June 2023 | 8462/2H | Original Q8

08.8 Many students gave the answer 'bases' or gave the names of DNA bases. Fewer than one-third responded 'nucleotides'.

08.9 The majority of students (9/10) knew the shape of DNA. A common incorrect response was 'DNA'.

Answer 48 · Examiner comments June 2024 | 8462/1H | Original Q7

Question 7 (standard, standard/high and high demand)

07.1 Only a quarter of students gained both marks, and a third did not score. Many students described how solids in general conduct thermal energy, rather than answering the question which is specifically about conduction in a metal. Many students realised that the process has something to do with delocalised electrons. However, many described how electricity is conducted, rather than thermal energy. The idea of the delocalised electrons transferring thermal energy through the metal was not at all well known. As the question asked how thermal energy is conducted, repetition of the word 'conduct' did not help to explain the meaning of that word.

07.2 This question discriminated well, with over a half of students scoring 2 or 3 marks. There were many well-expressed, complete answers. Common errors often involved an attempt to describe some sort of stronger bonding (sometimes covalent or ionic) in the alloy. Some lost credit because of poor use of language; it is not 'metals' which are different sizes, but their atoms (or positive ions). A common error was to refer to different shapes of atoms. 'Particles' is also insufficient as it could refer to other types of particle than atoms. 'Intermolecular forces' were often referred to, although they are not present in either a pure metal or an alloy.

07.3 Just over a half of students identified the correct equation, spotting that the mole ratio of Fe:Cl_2 was 2:3. The most popular distractor was Fe + Cl_2 → $FeCl_2$, where the student had ignored the information provided about the reacting number of moles.

07.4 Only two fifths of students identified the correct response by working out the total charge of the various combinations and choosing the one with a net zero charge. $3Fe^{2+}$:$4O^{2-}$ was a very popular distractor, with $3Fe^{3+}$:$4O^{2-}$ not far behind.

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Answer 48 · Examiner comments June 2024 | 8462/1H | Original Q7

07.5 Over three quarters of students obtained full marks on this question. For those who did not, it was sometimes difficult to award any credit because the M_r had not been evaluated. Common errors were $56/M_r$ x 100 or $64/M_r$ x 100. Some students attempted to bring in the 0.12 and 0.18 from question **07.3**, which was about a different compound.

07.6 Those students who understand moles had little difficulty with this question; almost a half scored at least 4 marks. The most common error was a failure to convert the mass of Fe_2O_3 to grams. Some students attempted to calculate a volume of Fe_2O_3, not appreciating that it is a solid as shown by the state symbols in the equation. Some students unnecessarily calculated the mass of carbon dioxide before converting this to a volume. The mole ratio was sometimes applied incorrectly to the mass of Fe_2O_3. Despite being given the M_r of Fe_2O_3 as 160, many students used 320 instead. Whilst this sometimes led mathematically to the 'correct' answer, it is incorrect chemistry and full credit was therefore not awarded.

Answer 49 · Examiner comments

June 2025 | 8462/1H | Original Q1

Question 1 (standard demand)

01.1 Only a quarter of students scored the mark, despite the clear statement in the specification. Many referred to the right of the table, but fewer referred to the top. Those who referred to specific groups were often correct but some omitted Group 0. Some referred to a 'staircase' but did not specify what it means; it should be noted that the periodic table provided does not show a staircase.

01.2 More than three quarters of students correctly chose the low melting point as the atypical property. The last distractor, 'forms positive ions' was the least popular, but the other distractors were about equal.

01.3 Nearly all students drew the electronic structure correctly. A few tried to use either 12 or 23 electrons.

01.4 Only two fifths of students were able to make sensible comments about the properties of the elements and either the groups that they would have been in or the groups that they were moved to. However, many comments were not clear, either not mentioning similar properties to the rest of the group or referring to vague regions of the periodic table rather than groups. Some stated that the elements were placed in order of atomic number, but atomic number was not known at Mendeleev's time, so these answers were disregarded. Some referred to leaving spaces for elements that had not been discovered, which does not answer this particular question.

01.5 Students scored well on this question, with more than two thirds scoring both marks and nearly all scoring at least one. Most referred to argon having a full outer shell of electrons, although some stated that there were no electrons in the outer shell, which is meaningless as the shell is not present without electrons. Fewer scored the second mark, for explaining that argon does not gain, lose or share electrons. Very few mentioned that the electron arrangement is stable; some said that argon is stable, which is just a rewording of the question.

01.6 The vast majority of students knew that isotopes have the same number of protons but a different number of neutrons. However, just over a half did not state that isotopes are atoms with the same number of protons, or atoms of the same element, so were restricted to one mark. Some implied that an isotope is a single atom where the number of neutrons is different to the number of protons, as in carbon-13.

01.7 The vast majority of students estimated the A_r correctly as ~115. The most popular distractor was ~114. Some students did not realise that an actual calculation was not required: only an estimation from the huge proportion of the isotope with mass number 115.

Answer 50 · Examiner comments

June 2025 | 8462/1H | Original Q3

Question 3 (standard demand)

03.1 This was answered less successfully, with the majority of students choosing tin as the substance reduced. Tin is the product of the reduction, not the substance which is reduced. Those who did choose the correct substance, SnO_2, were usually able to give a correct reason; one in seven students were awarded both marks. Some tried to answer in terms of electrons, despite the instruction to answer in terms of oxygen. These answers did not gain credit for the second marking point.

03.2 Nearly three quarters of students managed to state succinctly that carbon is more reactive than tin or that tin is less reactive than carbon. However, some answers were vague and used the word 'it' which is problematic as there are three substances named in the question. 'Carbon is more reactive' is insufficient as we do not know what the reactivity is being compared to.

03.3 More than two thirds of students achieved full marks. Some did not calculate a total M_r but used the M_r of CdO instead; these answers were not creditworthy. Others added up all the M_r of reactants and products instead of just the reactants; these gained partial credit.

03.4 The question asked for two differences in properties, so comparative language was necessary (potassium is softer rather than potassium is soft). Three fifths of students scored both marks, choosing from differences in physical properties and properties exhibited by transition metals only. The most common type of error was to describe differences in atomic structure rather than differences in the properties of the metals in bulk.

03.5 The vast majority of students interpreted the equation correctly and showed that the total M_r on both sides was 238.

03.6 More than two thirds of students gave an acceptable response. Most of those who were awarded the mark answered in terms of economic reasons such as lowering the cost of the operation. Fewer answered in terms of sustainable development; of those who did, most referred to a high atom economy producing less waste. Some students confuse a high atom economy with a high yield; references to yield were ignored.

4.1.1.6 Relative atomic mass

Answer 51 · Examiner comments — June 2025 | 8462/2H | Original Q5

Question 5

05.1 Over four fifths of students correctly estimated the boiling point. Those that did not gain the mark were often giving values that were just outside of the range given in the mark scheme.

05.2 Fewer than half of the students correctly identified ethanol as the product of the reaction between ethene and steam. Many of those who did not gain this mark gave the product as alcohol, which was insufficient.

05.3 Over half of students gained both marks on this item. Where students gained one mark, about 20%, it was because 'damp' was omitted from the test and only litmus paper was given.

05.4 The product of the chlorination of butene was well known by over 90% of students.

05.5 Around three quarters of students correctly identified propene. The most common incorrect response was butene. Very few students did not identify an alkene.

05.6 Around two fifths of students knew that alkenes burn with a smoky flame due to incomplete combustion. Many of the incorrect answers seen referred to there being a double bond present, or that there was insufficient oxygen.

05.7 This multi-step calculation was well answered by over 40% of students who gained all five marks. The most common error was the omission of the volume conversion from dm^3 to cm^3. Some students divided by the volume, rather than multiplying. Equally, a number multiplied by the M_r to calculate the number of moles. In both instances, marks were awarded where clear working was shown for correct

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additional steps. when one mark alone was awarded, it was for the correct determination of the M_r.