AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.3.1.1

Conservation of mass and balanced chemical equations

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**70**
Available paper years	**2007–2025**

Using this booklet

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

Name: _____ **Date:** _____

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

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 01 · Mark scheme January 2007 | CHY1H | Original Q3 | Legacy

Question 3

	answers	extra information	mark
(a)(i)	contain enough metal to make it economical / worth while to extract		1
(ii)	reduction	accept displacement accept redox	1
(iii)	Fe + CO_2	do **not** accept Fe_2 / Fe_4	1
	correct balancing	accept multiples and halves	1
	2Fe_2O_3 + **3**C → **4**Fe + **3**CO_2	allow Fe_2 / Fe_4 as ecf	
(b)	**Pure Iron** (in pure metal all the atoms are the same size and) able to slip / slide over each other – (property soft)	OWTTE ignore references to molecules / particles. if they say 'move' both times, allow **one** mark but 'crack' or 'split' is wrong.	1
	Cast iron (in cast iron) different sized atoms / larger atoms **or** structure is distorted / disrupted	OWTTE	1
	so it is difficult for layers of atoms to slip / slide over each other	OWTTE	1
(c)	any **three** from: • conserves / saves resources / metal ores • saves energy resources (used for extraction / processing) • decreases waste materials • decreases a named pollution	accept cheaper / saves money do **not** accept acid rain	3
total			10

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 02 · Mark scheme June 2007 | CHY1A | Original Q8 | Legacy

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

Answer 03 · Mark scheme June 2007 | CHY1H | Original Q2 | Legacy

The full source mark scheme begins on page 121. Follow original question 2 in that document.

Answer 04 · Mark scheme June 2007 | CHY1H | Original Q5 | Legacy

The full source mark scheme begins on page 121. Follow original question 5 in that document.

Answer 05 · Mark scheme November 2007 | CHY1A | Original Q6 | Legacy

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

Answer 06 · Mark scheme January 2008 | CHY1H | Original Q6 | Legacy

No matching mark scheme was available in the supplied archive for this question.

Answer 07 · Mark scheme January 2008 | CHY2H | Original Q5 | Legacy

The full source mark scheme begins on page 134. Follow original question 5 in that document.

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 08 · Mark scheme

June 2008 | CHY2H | Original Q3 | Legacy

question	answers	extra information	mark
3(a)(i)	sulfuric	accept $\underline{H_2SO_4}$ accept sulphuric allow phonetic spellings	1
3(a)(ii)	$CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$	**1** mark for reactants **1** mark for products ignore state symbols max **1** mark for incorrect balancing	2
3(b)	any **two** from: • particles gain energy **or** particles have more energy • particles move faster • collide more often • collide more energetically • more of the collisions are successful **or** more particles have the activation energy	allow have more activation energy allow they collide faster / quicker ignore move / vibrate more allow more collisions **NB** more successful collisions alone = **1** mark if particles are identified as electrons = max **1** mark	2
Total			**5**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 08 · Mark scheme

June 2008 | CHY2H | Original Q3 | Legacy

COMPONENT NUMBER: CHY2H

COMPONENT NAME: Additional Science / Chemistry

STATUS: Final

DATE: June 2008

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 09 · Mark scheme June 2008 | CHY3H | Original Q4 | Legacy

question	answers	extra information	mark
4(a)	acts as barrier between sodium and air / oxygen / water (vapour)	accept because they are reactive ignore oil will not react	1
4(b)	**2**Na + **2**H_2O → **2**NaOH + H_2	allow multiples / fractions	1
4(c)	these metals react with water producing an alkaline solution **or** produce solution with pH greater than 7 / high pH	owtte allow produce OH^- ions **not** these metals are / form alkalis ignore 'strong' pH	1
4(d)		it = potassium <u>outer</u> electron must be mentioned once for all **3** marks	
	bigger atom **or** outer shell electron further from nucleus **or** more shells	**or** converse argument for sodium less reactive provided sodium is specified	1
	less attraction to nucleus **or** more shielding	**not** less magnetic attraction	1
	outer electron more easily lost	**ignore** potassium reacts more easily	1
Total			**6**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 09 · Mark scheme June 2008 | CHY3H | Original Q4 | Legacy

COMPONENT NUMBER: CHY3H

COMPONENT NAME: Chemistry

STATUS: Final

DATE: June 2008

Answer 10 · Mark scheme November 2008 | CHY1AP | Original Q7 | Legacy

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

Answer 11 · Mark scheme November 2008 | CHY1AP | Original Q9 | Legacy

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

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 12 · Mark scheme March 2009 | CHY1AP | Original Q9 | Legacy

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

Answer 13 · Mark scheme March 2009 | CHY1BP | Original Q5 | Legacy

Five	**3**	**3**	**1**	**3**

Answer 14 · Mark scheme June 2009 | CHY1AP | Original Q2 | Legacy

Two	**A** compounds **3** **B** bonds **2** **C** products **1** **D** elements **4**					
	A		**B**		**C**	**D**

Answer 15 · Mark scheme June 2009 | CHY1AP | Original Q6 | Legacy

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

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 16 · Mark scheme

June 2009 | CHY2H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	any **one** from: • they are positive / cations • they are H^+ • opposite charges attract	ignore atom	1
5(a)(ii)	potassium is more reactive (or reverse)	assume 'it' refers to hydrogen allow potassium reacts with water allow potassium is very reactive **or** most reactive metal / element allow hydrogen gains electrons more easily / is reduced more easily accept potassium is higher up the reactivity series	1
5(b)	6 **and** 2	accept correct multiples and fractions	1
5(c)(i)	the reaction / it is reversible **or** a description of a reversible reaction	allow 'it is an equilibrium' allow reversible symbol drawn correctly allow 'the reverse / back reaction'	1

Question 5 continues on the next page…

CHY2H

Question 5 Continued

question	answers	extra information	mark
5(c)(ii)	**lithium nitride** assume that 'it' or if they do not specify means lithium nitride assume lithium / lithium nitrate refers to lithium nitride • hydrogen is bonded / held / absorbed / has formed a compound / reacted with lithium nitride plus **one** of: • does not explode / cause a fire • is not free / less hydrogen • is not under pressure • does not leak • is only released slowly • compound of hydrogen with lithium nitride / product is (more) stable / less reactive / less chance of a reaction	accept converse for hydrogen as below assume that gas / hydrogen means gas in the cylinder • hydrogen (in cylinder) / gas is not bonded / held / absorbed / in a compound / reacted with lithium nitride plus **one** of: • can explode / cause a fire • is free • is under pressure • can leak • releases quickly	1 1
5(d)(i)	smaller **or** correct indication of size **or** higher surface area	allow very / really small **or** tiny accept few (100) atoms in size allow 1 to 100 nanometres or 10^{-9} metres allow absorption and / or release of hydrogen more quickly allow have different properties allow 'more particles in each volume / area' do not allow reacts more quickly	1

Question 5 continues on the next page…

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 16 · Mark scheme

June 2009 | CHY2H | Original Q5 | Legacy

CHY2H

Question 5 Continued

question	answers	extra information	mark
5(d)(ii)	greater surface area		1
5(e)(i)	loss of an electron **or** loses electrons	do not accept any ref. to oxygen	1
5(e)(ii)	full outer shell of 8 electrons on circle	need not be paired can be ×, dot or e do **not** accept if extra electrons added to inner shell	1
Total			**10**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 16 · Mark scheme June 2009 | CHY2H | Original Q5 | Legacy

CHY2H

Answer 17 · Mark scheme November 2009 | CHY1AP | Original Q7 | Legacy

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

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 18 · Mark scheme January 2010 | CHY1H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	vaporise / evaporate different condensing points / temperatures	allow boil for vaporise accept condense at different levels ignore different size molecules or different densities mention of cracking = max **1** allow boils at different temperatures and condenses for **2** marks if no other marks awarded allow fractional distillation for **1** mark	1 1
6(b)(i)	3 (C_2H_4)	accept +C_4H_8	1
6(b)(ii)	(decane / naphtha / hydrocarbon) vaporise / evaporate (passed over) a catalyst / alumina / porous pot	allow crude oil allow boil for vaporise ignore other names of catalysts	1 1
6(c)	any **two** from: • alkanes / butane (molecules) do not have a (carbon carbon) double bond / are saturated / have (carbon carbon) single bonds • alkenes / ethene (molecules) have (carbon carbon) double bonds **or** are unsaturated • alkenes / ethene molecules are able to bond to other molecules	'they' must be clarified	2
6(d)	single bonds between carbon atoms the –CH_3 group appears on each pair of carbons on the 'chain'	— C – C — NB any double bonds = **0** marks	1 1
Total			**9**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 18 · Mark scheme

January 2010 | CHY1H | Original Q6 | Legacy

CHY1H

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 19 · Mark scheme

January 2010 | CHY2H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	any **two** from: • heat water / make steam / boil water **or** heat / steam used in stage 1 • carbon dioxide from stage 3 used in stage 7 / to make urea • nitrogen and / or hydrogen recycled (owtte) • ammonia and / or carbon dioxide <u>recycled</u> (owtte)	allow reused instead of recycled in correct context allow unreacted material / gas recycled from stage 5 (to 4) allow unreacted material / gas recycled from stage 8 (to 7) NB if neither of the last two points are awarded unreacted material recycled = **1** mark	2
6(b)	any **one** from: • fertiliser / fertilise / fertile • provide nitrogen • any idea of faster / better / helps growth of crop • greater yield of crop • helps proteins / amino acids to form in plants owtte	ignore cost ignore neutralisation / minerals / to treat plants / photosynthesis allow give plants nutrients allow provides nitrate	1
6(c)	3	allow correct multiples eg $2CH_4 + 2H_2O \rightarrow 2CO + 6H_2$	1
6(d)(i)	(forward reaction is) exothermic / gives out heat	accept Le Chatelier based answers accept reverse argument eg because at high temperature the ammonia would decompose	1

Question 6 continues on the next page...

CHY2H

Question 6 continued

question	answers	extra information	mark
6(d)(ii)	reaction is too slow / takes too long **or** to make the reaction fast(er)	allow answers that imply increased rate eg more collisions / particles have more energy allow catalyst works better ignore optimum condition / compromise type answers ignore yield	1
6(e)	sulfuric / H_2SO_4	accept sulphuric	1
6(f)(i)	3400	correct answer gains all **3** marks with or without working if answer incorrect: 1700 with or without working or 6000 × (34/60) gains **2** marks **or** 6800 gains **2** marks with or without working **or** moles of urea = 6000/60 = 100 gains **1** mark moles of ammonia needed = 200 gains **1** mark **or** 6000 × (17/60) gains **1** mark **or** (2×17) → 60 gains **1** mark **or** 34 → 60 gains **1** mark	3

Question 6 continueson the next page

4.3.1.1 Conservation of mass and balanced chemical equations

CHY2H

Question 6 continued

question	answers	extra information	mark
6(f)(ii)	76.9	correct answer gains **2** marks with or without working. allow 77 or 76.923… allow 76 **or** 0.77 **or** 0.76923 for **1** mark if answer incorrect allow **1** mark for **either** identifying the mass of the useful product **or** the total M_r of reactants – this can be awarded from the numbers in the calculation: M_r of useful product = 60 M_r of reactants = 78 **or** (2×17)+44 **or** 60 +18 60/78 × 100 gains **1** mark	2
Total			**12**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 20 · Mark scheme March 2010 | CHY1AP | Original Q6 | Legacy

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

Answer 21 · Mark scheme March 2010 | CHY1BP | Original Q5 | Legacy

Five	**2**	**3**	**3**	**2**

Answer 22 · Mark scheme June 2010 | CHY1AP | Original Q9 | Legacy

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

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 23 · Mark scheme

June 2010 | CHY1H | Original Q3 | Legacy

Question 3

question	answers	extra information	mark
3(a)(i)	C	must be correct symbol do **not** accept carbon any balancing must be correct	1
3(a)(ii)	$Fe + CO_2$ 2…. + 3….	correct formulae correct balancing allow $Fe_2 + 3CO_2$ for this mark	1 1
3(a)(iii)	layers / atoms in pure iron are able to slide over each other **or** layers / atoms in cast iron are unable to slide over each other (easily)	it = pure iron accept ions for atoms ignore molecules / particles	1

Question 3 continues on the next page

4.3.1.1 Conservation of mass and balanced chemical equations

CHY1H

Question 3 continued

question	answers	extra information	mark
3(b)	any **three** from: • less iron ore used • less other metals extracted / used to make different steels • less fuel used • less specified pollution • less / no landfill space needed • less / no mining needed **or** fewer specified effects of mining	mention of ozone = max **2** accept the idea that ores would be conserved but not unspecified conservation accept the idea that ores would be conserved but not unspecified conservation accept the idea that fuels would be conserved ignore reduces energy requirements accept global warming / greenhouse effect / CO_2 / CO / carbon emissions / acid rain / SO_2 / global dimming / do **not** accept ozone layer ignore reduces waste accept effect such as eyesore / loss of habitat eg 'less mining iron ore' = **2** marks	3
Total			**7**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 23 · Mark scheme

June 2010 | CHY1H | Original Q3 | Legacy

CHY1H

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 24 · Mark scheme

June 2010 | CHY1H | Original Q6 | Legacy

Question 6

question	answers	extra information	mark
6(a)	it is a mixture (of hydrocarbons) **or** contains hydrocarbons with different boiling points	accept 'to separate (crude) oil (into fractions) **or** obtain the naphtha (fraction) accept to get useful products ignore removal of impurities	1
6(b)(i)	heat / vaporise	mention of hydrogen = max **1** accept thermal (decomposition) for heat allow boil do not allow temperatures below 100°C ignore steam	1
	catalyst	allow alumina / porous pot ignore other catalysts	1
6(b)(ii)	4 × C – H **and** C = C	ignore brackets with or without an 'n' before them do not allow poly(ethene)	1

Question 6 continues on the next page

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 24 · Mark scheme

question	answers	extra information	mark
6(c)	any **four** from: **must** be at least **one** advantage and **one** disadvantage for all four marks <u>crops</u> advantages eg: • renewable (resource) / sustainable • low / less energy / fuel needed for process **or** lower temperature [ignore heat or quoted temperatures] • can use waste plant / crop material • carbon neutral • low safety risk (processes) • low technology disadvantages eg: • batch process / process is slow • many steps in the process • ethanol is impure / may contain water • food shortages • need very large areas of (arable) land to grow crops **or** can only grow in certain areas / climates • destruction of woodland / habitat • slow growth of crops • labour intensive a conclusion with a reasoned argument based on	ignore ideas about carbon dioxide formation / photosynthesis or cost / economics / environmentally friendly candidates are only awarded **1** mark if they use equivalent pairs of bulleted points <u>crude oil</u> disadvantages eg: • *non*-renewable (resource) / finite / running out • high / more energy needed for process **or** higher temperature • not carbon neutral **or** releases locked up carbon • high safety risk (process) • high technology • risk of major oil spillage • can be used to make other products advantages eg: • continuous process / process is fast • few steps in the process • ethanol is pure • ‘conserves’ food • can accept reverse arguments there must be at least one advantage and one disadvantage, however, a	4

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 24 · Mark scheme June 2010 | CHY1H | Original Q6 | Legacy

	valid advantages **and** disadvantages	matched pair, although only awarded one mark would allow the conclusion mark to be awarded	1
Total			**9**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 25 · 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**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 25 · Mark scheme

June 2010 | CHY2H | Original Q4 | Legacy

CHY 2H

Answer 26 · Mark scheme

November 2010 | CHY1AP | Original Q6 | Legacy

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

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 27 · Mark scheme January 2011 | CHY1H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	removal of oxygen	accept definition in terms of electrons **or** oxidation numbers ignore oxides	1
4(a)(ii)	2 (Cl_2)	allow correct multiples	1
4(a)(iii)	no atoms are lost / made (during a chemical reaction) **or** the atoms are rearranged (during a chemical reaction)	accept because of (the law of) conservation of mass / matter	1
4(b)(i)	sodium is more reactive (than titanium)	accept sodium is very reactive **or** titanium is less reactive do **not** accept sodium is more reactive than argon	1
4(b)(ii)	any **one** from: • sodium / titanium would react with oxygen / air • sodium / titanium does not react with argon	 accept air / oxygen is reactive accept argon is unreactive / inert / a noble gas / in group O	1
4(c)(i)	all atoms are the same / it only contains one type of atom	accept all ions are the same do **not** accept only got one atom do **not** accept all atoms are the same size ignore particles	1
4(c)(ii)	two different / types atoms / elements / ions bonded / joined together	accept more than one type of atom / ion / element do **not** accept different size accept definite proportions do **not** accept mixture	1 1
Total			**8**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 27 · Mark scheme

January 2011 | CHY1H | Original Q4 | Legacy

CHY1H

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 28 · Mark scheme January 2011 | CHY2H | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	gives out heat / energy **or** energy / heat transferred to the surroundings	allow release / loses allow the products have less energy ignore temperature rises allow more energy given out in forming bonds than taken in to break bonds	1
4(b)(i)	speed up the reaction (owtte)	accept changes the rate accept lowers activation energy accept increases successful collisions accept allows reaction to take place at a lower temperature	1
4(b)(ii)	nitrogen (N_2) / oxygen (O_2) / products are safe **or** not harmful / pollutant / toxic / dangerous / damaging **or** (harmful) nitrogen monoxide / NO is not released into the air.	ignore releases nitrogen / oxygen unless qualified accept prevents / less acid rain ignore greenhouse gas / ozone layer	1
4(b)(iii)	2 and 2	accept correct multiples or fractions	1
4(b)(iv)	idea of catalyst not being used up	allow not changed by reaction ignore catalyst does not take part ignore catalyst not used in the reaction	1

Question 4 continues on the next page

4.3.1.1 Conservation of mass and balanced chemical equations

CHY2H

Question 4 contd

question	answers	extra information	mark
4(b)(v)	idea of different reactions (require different catalysts)	accept catalysts work for specific reactions allow different gases	1
4(c)	• smaller / very small / or any indication of very small / 1–100 nanometres / a few (hundred) atoms • big(ger) surface area • less (catalyst) needed / small amount of catalyst needed	ignore just small ignore size of the converter	1 1 1
Total			**9**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 28 · Mark scheme January 2011 | CHY2H | Original Q4 | Legacy

CHY2H

Answer 29 · Mark scheme June 2011 | CHY1AP | Original Q1 | Legacy

Question	Key		
One	**A**	electrons	**2**
	B	bonds	**3**
	C	products	**1**
	D	elements	**4**

Answer 30 · Mark scheme June 2011 | CHY1AP | Original Q6 | Legacy

Six	**1**	**2**	**1**	**2**

Answer 31 · Mark scheme June 2011 | CHY1BP | Original Q8 | Legacy

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

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 32 · Mark scheme

June 2011 | CHY1H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)	complete diagram with 2 carbon atoms and 5 hydrogen atoms each C–C and each C–H linked by a single line (bond)		1
5(b)(i)	the greater the number of (carbon) atoms (in an alkane molecule) the greater its boiling point **or** vice versa	allow as the (carbon) chain gets longer the boiling point increases ignore melting points do **not** accept reference to greater number of molecules	1
5(b)(ii)	any **two** from: • low boiling point / volatile • low viscosity • high flammability • small molecules • burn completely	they = hydrocarbons from the graph it = $C_{30}H_{62}$ accept they are gases or liquids accept easier to burn / ignite accept short chains ignore number of carbon atoms ignore speed of burning	2
5(c)(i)	16 (CO_2) + 18 (H_2O)		1
5(c)(ii)	(carbon dioxide in the Earth's early) atmosphere	accept from volcanoes (millions of years ago) **or** from dead plants / animals allow dead sea creatures ignore shells	1

Question 5 continues on the next page . . .

4.3.1.1 Conservation of mass and balanced chemical equations

CHY1H

Question 5 continued . . .

question	answers	extra information	mark
5(c)(iii)	increase in burning / use of fossil fuels		1
	locked up carbon (carbon dioxide) is released	allow carbon / carbon dioxide from millions of years ago is released accept extra carbon dioxide is not 'absorbed' (by the carbon cycle)	1
Total			**8**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 33 · Mark scheme

June 2011 | CHY2H | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	electron(s)	allow free / delocalised / negative electrons do **not** accept additional particles	1
5(a)(ii)	ion(s)	allow named ions from table ignore positive or negative do **not** accept additional particles	1
5(b)(i)	copper	accept Cu do **not** accept Cu^{2+}	1
5(b)(ii)	it is / they are positive (ions) and it is the least reactive	accept formula of positive ion	1 1
5(c)(i)	loss of electron(s)	ignore numbers	1
5(c)(ii)	$\mathbf{2H^+} + \mathbf{2e^-} \rightarrow H_2$	accept correct multiples / fractions accept e / e^- allow $\mathbf{2H^+} \rightarrow H_2 - \mathbf{2e^-}$	1
Total			**7**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 33 · Mark scheme June 2011 | CHY2H | Original Q5 | Legacy

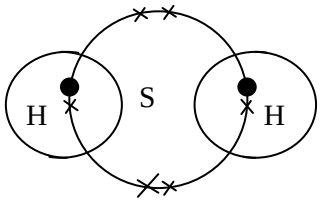
CHY2H

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 34 · 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

4.3.1.1 Conservation of mass and balanced chemical equations

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**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 34 · Mark scheme June 2011 | CHY2H | Original Q6 | Legacy

CHY2H

Answer 35 · Mark scheme November 2011 | CHY1AP | Original Q8 | Legacy

Eight	**2**	**3**	**3**	**3**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 36 · Mark scheme

January 2012 | CH1HP | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)(i)	reduction	accept redox / smelting	1
4(a)(ii)	3 4 3		1
4(b)(i)	55	ignore other units	1
4(b)(ii)	water	accept sodium hydroxide accept correct formulae H_2O or NaOH	1
4(b)(iii)	any **one** from: • save energy / fuel for transporting the ore • (old) quarries nearby for waste/red mud	accept less (cost of) transport allow transported quickly	1

Question 4 continues on the next page …….

CH1HP

Question 4 cont'd…

question	answers	extra information	mark
4(c)	**Environmental** any **one** from: • less mining / quarrying (of bauxite) • less landfill space needed / used • less use of fossil fuels / energy • less carbon dioxide produced **Ethical or social** any **one** from: • saves resources • creates (local) employment • more people aware of the need for recycling	 allow loss of habitat / less qualified noise pollution allow less red mud / waste allow using resources more than once if answers reversed and both correct award **1** mark allow less qualified noise pollution if not given in environmental	1 1
Total			**7**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 36 · Mark scheme

January 2012 | CH1HP | Original Q4 | Legacy

CH1HP

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 37 · Mark scheme

June 2012 | CH1HP | Original Q5 | Legacy

Question 5

question	answers	extra information	mark
5(a)(i)	water	accept hydrogen oxide allow H_2O	1
5(a)(ii)	carbon dioxide	allow CO_2 accept any soluble carbonate **or** carbonic acid	1
5(b)(i)	$CaCO_3$ + **2** HCl → $CaCl_2$ + CO_2 + H_2O		1
5(b)(ii)	because sulfur reacts with oxygen / air to produce sulfur dioxide **or** sulfur burns to produce sulfur dioxide and (sulfur dioxide) causes acid rain that reacts with/erodes limestone/calcium carbonate	accept correct equation ignore wears away	1 1
5(c)(i)	 because carbon dioxide is produced from burning methane because carbon dioxide is produced from decomposing calcium carbonate/limestone	it = carbon dioxide ignore references to carbon dioxide is in the air accept correct equation accept correct equation do **not** accept carbon in calcium carbonate reacting with air	 1 1
5(c)(ii)	nitrogen this is the main gas / 75 – 80% / of air	 allow there is a lot of this gas in air	1 1
Total			**9**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 37 · Mark scheme June 2012 | CH1HP | Original Q5 | Legacy

CH1HP

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 38 · Mark scheme

June 2012 | CH1HP | Original Q7 | Legacy

Question 7

question	answers	extra information	mark
7(a)	C_2H_4 a correct other product **and** balanced eg C_4H_{10}		1 1
7(b)	bubbling / fizzing / frothing / effervescence	ignore gas given off **or** solution goes cloudy	1
7(c)	any **five** from the following bullet points: To gain full marks there should be both advantageous and disadvantageous issues and their importance **Advantageous issues using sugar cane:** • sugar cane/plants absorb carbon dioxide / photosynthesise • sugar cane / plants are renewable / sustainable • low energy process	allow converse for ethanol from crude oil ignore costs – unless specified ignore safety ignore simple/low technology process ignore labour intensive as an advantage **linked importance** so is carbon neutral **or** reduce global warming and so save resources / oil **or** crude oil is non-renewable and so it saves fuel **or** / making ethanol from crude oil needs fuel for fractional distillation / cracking	5

Question 7(c) continues on the next page . . .

4.3.1.1 Conservation of mass and balanced chemical equations

Question 7(c) cont'd…

question	answers	extra information	mark
7(c)	**Disadvantageous issues using sugar cane:**	ignore fermentation releases carbon dioxide; destruction of habitats/land to build production plants; types of pollution; waste products	
	• large areas of land are needed	which leads to destruction of habitats / forest	
	• land could be used for food crops	may cause food shortages **or** increases the price of food **or** increasing world population	
	• slow process	so limits supply / production of ethanol	
	• ethanol is impure **or** contains 50% ethanol	so needs further separation or ethanol from crude oil is 100% pure	
	• batch process	so uses more labour	
	• the crop yield / supply of ethanol is unreliable	because growth is seasonal / weather dependent **or** possibility of crop failure	
	a justified conclusion	**compensation mark,** if no other mark awarded allow one mark for two or more issues	
Total			**9**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 38 · Mark scheme

June 2012 | CH1HP | Original Q7 | Legacy

CH1HP

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 39 · Mark scheme June 2012 | CH2HP | Original Q4 | Legacy

Question 4

question	answers	extra information	mark
4(a)	118		1
4(b)	it loses / transfers electrons three electrons	it = Au / gold atom sharing / covalency = max **1** mark	1 1
4(c)(i)	O_2 **2** CO and **2** CO_2 **or** correct balancing of equation from O	 accept correct multiples / fractions throughout	1 1
4(c)(ii)	 because carbon dioxide is simple molecular / small molecules there are intermolecular forces (between the molecules) so a small amount of energy needed (to separate molecules) **or** (intermolecular forces) are weak	reference to incorrect bonding = **1** mark max allow intermolecular bonds	 1 1 1

Question 4 continues on the next page . . .

4.3.1.1 Conservation of mass and balanced chemical equations

CH2HP

Question 4 cont'd…

question	answers	extra information	mark
4(d)	any **three** from: • gold is the only catalyst for some reactions • catalysts are not used up • improves speed of reaction • reduces amount of energy **or** process needs low(er) temperature • only small quantities (of catalyst) needed	if no mark awarded, allow catalyst reduce costs (of the process) for **1** mark	3
Total			**11**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 39 · Mark scheme June 2012 | CH2HP | Original Q4 | Legacy

CH2HP

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 40 · 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**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 40 · Mark scheme June 2012 | CH2HP | Original Q5 | Legacy

CH2HP

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 41 · Mark scheme

January 2013 | CH1HP | Original Q6 | Legacy

question	answers	extra information	mark
6(a)	CO_2 (+) H_2O	correct products	1
	3(O_2) **2**(CO_2) **3**(H_2O)	correct balancing	1
6(b)(i)	add bromine water	allow iodine	1
	changes (from orange) to colourless / decolourised	ignore clear	1
6(b)(ii)		ignore any references to butane (C_4H_{10}) ignore incorrect names of catalysts	
	octane vapours		1
	are passed over a catalyst (to produce ethene)		1
	OR		
	octane mixed with steam (1)	for steam cracking, second mark is conditional on 'steam'	
	at a (very) high temperature (1)		
	steam is added (to ethene)	ignore the formula H_2O / water	1
	in the presence of a catalyst (to produce ethanol)		1
		if no other marks awarded then allow **1** mark for cracking of octane **or** hydration of ethene	
Total			**8**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 41 · Mark scheme

January 2013 | CH1HP | Original Q6 | Legacy

CH1HP

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 42 · Mark scheme

January 2013 | CH2HP | Original Q5 | Legacy

question	answers	extra information	mark
5(a)	Will kelp last longer than coal as an energy source?		1
5(b)	any **two** from: • cannot be determined by experiment • based on opinion • ethical **or** environmental **or** economic reason	 allow can't predict how long kelp / coal will last allow more testing needed allow could damage ecosystem allow reference to cost	2
5(c)(i)	7		1
5(c)(ii)	sodium (atom) loses (electron) **and** iodine (atom) gains (an electron) 1 electron (electrostatic) attraction **or** forms ionic bond(s)	reference to incorrect bonding **or** incorrectly named particle = max **2** any or all marks can be obtained from a labelled diagram ignore inner shell electrons if shown	1 1 1
5(c)(iii)	<u>ions</u> can move (in the solution)		1
5(c)(iv)	**2** I^- → $\mathbf{I_2}$ + **2** e^-		1

Question 5 continues on the next page

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 42 · Mark scheme

January 2013

CH2HP

Question 5 cont'd

question	answers	extra information	mark
5(c)(v)	hydrogen is formed because sodium is more reactive (than hydrogen)		1 1
Total			**11**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 42 · Mark scheme

January 2013

CH2HP

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 43 · Mark scheme June 2013 | CH1HP | Original Q1 | Legacy

Question 1

question	answers	extra information	Mark
1(a)(i)	2.8.3	any sensible symbol can be used to represent an electron	1
1(a)(ii)	proton(s) **and** neutron(s)	both needed for the mark	1
1(a)(iii)	number of protons is equal to number of electrons	allow positive and negative charges cancel out allow same amount of protons and electrons	1
1(b)(i)	**2** Al + Fe_2O_3 → **2** Fe + Al_2O_3	equation must be balanced	1
1(b)(ii)	aluminium is more reactive (than iron)	it = aluminium accept converse accept aluminium displaces iron accept aluminium is higher in the reactivity series (than iron)	1
Total			**5**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 44 · Mark scheme June 2013 | CH2HP | Original Q4 | Legacy

Question 4

question	Answers	extra information	Mark
4(a)(i)	current / charge couldn't flow	allow could not conduct (electricity)	1
	because the ions / particles couldn't move **or** (salt) needs to be molten / dissolved (to conduct electricity) (1)	do **not** accept electrons/ molecules / atoms	1
	so that the ions / particles can move (1)	do **not** accept electrons / molecules / atoms	
4(a)(ii)	he had status **or** he had evidence / proof	accept he had authority **or** experience accept the experiment could be repeated	1
4(b)	hydrogen / H_2	do **not** allow hydrogen ions	1
	the ions are positive	accept because opposite (charges) attract	1
	potassium is more reactive (than hydrogen)	accept potassium ions are less easily discharged (than hydrogen) **or** potassium ions are less easily reduced (than hydrogen)	1
4(c)(i)	gain electron(s)	accept fully balanced correct equation for **2** marks	1
	one electron	if no other marks awarded allow (potassium ions) reduced for **1** mark	1
4(c)(ii)	**2**Cl^- → Cl_2 + **2e**$^-$	must be completely correct, including charge on electron accept correct multiples	1
4(c)(iii)	2, 8, 8	accept any combination of dots, crosses, "e" or any other relevant symbol ignore any charges if given	1
Total			**10**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 45 · Mark scheme June 2013 | CH3HP | Original Q6 | Legacy

Question 6

question	Answers	extra information	Mark
6(a)	air		1
6(b)	recycle (unreacted) nitrogen and hydrogen	allow re-use allow N_2 and H_2	1 1
6(c)	$N_2 + 3H_2 \rightarrow 2NH_3$	allow correct multiples	1
6(d)	 because a higher temperature would reduce (equilibrium) yield because a lower temperature would reduce rate	allow converse arguments ignore references to compromise allow higher temperature favours backward reaction	 1 1
6(e)(i)	(energy of) reactants greater than (energy of) products	allow converse allow (overall) energy decreases allow energy required to break bonds is less than the energy released making bonds	1
6(e)(ii)	line starting and finishing at same levels but with lower peak		1
Total			**8**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 46 · Mark scheme June 2014 | CH1HP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
4(a)(i)	phytomining		1	1 / 1.3.1g	G
4(a)(ii)	*(the land contains)* very little copper	*allow low grade ore* ***or*** *large amounts of waste* *ignore quarrying / benefits of using plants*	1	3 / 1.3.1f/g	E
	uneconomical	*accept (smelting) uses a lot of energy / fossil fuels* *allow expensive*	1		
4(a)(iii)	Cu **2** $CuO + C \rightarrow$ **2** $Cu + CO_2$	*allow* $2\ CuO + C \rightarrow Cu_2 + CO_2$ *for* ***1*** *mark*	1 1	2 / 1.3.1f	E
4(b)(i)	iron is more reactive (than copper) iron is cheap(er than copper)	*allow cheaper* ***or*** *uses less energy than electrolysis*	1 1	1 + 2 / 1.3.1h	E
4(b)(ii)	*any* ***two*** *from:* • copper / ions move **or** are attracted to the negative electrode / *cathode* • where they are reduced **or** gain (two) electrons • *where they form copper (metal / atoms)*		2	1 / 1.3.1h	E
Total			**9**		

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 46 · Mark scheme

June 2014 | CH1HP | Original Q4 | Legacy



4.3.1.1 Conservation of mass and balanced chemical equations

Answer 47 · Mark scheme June 2014 | CH2HP | Original Q3 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
3(a)	O_2 in correct space		1	2 / 2.4	E
	correct balancing	accept multiples	1		
3(b)(i)		*incorrect reference to energy = max **2***		1 / 2.4.1d	E
		ignore references to equilibrium			
	rate increases		1		
	because particles are closer together	accept because there are more particles (per unit volume)	1		
		allow particles have less space / room to move around			
	so frequency of collisions increases	*accept particles are more likely to collide*	1		
		ignore more collisions			
		ignore more successful collisions			
3(b)(ii)	has a greater surface area		1	3 / 2.4.1f/g	E
	so the reaction is faster	*accept so more frequent collisions*	1		
3(c)	the (minimum) amount of energy (particles must have) to react ***or*** *to start a reaction*	accept the energy needed to break bonds	1	1 / 2.4.1b	E
		ignore references to heat			
3(d)(i)	(potassium is) too / *very* reactive	*ignore potassium is a Group 1 / alkali metal*	1	1 + 2 / 2.6.1b	E
	so dangerous / *violent reaction*	accept hydrogen produced rapidly	1		
3(d)(ii)		accept products in either order		2 / 2.6.2b	E
		ignore names of substances			
		*do **not** accept brackets or charges in the formulae*			
	$ZnSO_4$		1		
	H_2		1		

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 47 · Mark scheme

3(d)(iii)	any **one** from: • increase concentration (of sulfuric acid) • increase temperature **or** heat it • increase surface area of zinc		1	1 / 2.4.1	E
Total			**13**		

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 47 · Mark scheme

June 2014 | CH2HP | Original Q3 | Legacy



4.3.1.1 Conservation of mass and balanced chemical equations

Answer 48 · Mark scheme

June 2014 | CH3HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
5(a)	$2NH_3$	allow NH_3 with incorrect or missing balancing for **1** mark *allow multiples*	2	2 / 3.5.1b	E
5(b)(i)	200		1	3 / 3.5	G
5(b)(ii)	rate of reaction (too) slow	*allow converse* ignore references to yield / *cost*	1	2 / 3.5.1f/h	E
5(b)(iii)	400		1	2 / 3.5	A
5(b)(iv)	lower yield	*allow converse* accept shifts equilibrium to left allow favours the backward reaction allow favours side with *more* (gaseous) molecules allow lower rate	1	2 / 3.5.1g/h	E
5(c)	(gases) cooled *ammonia* liquefied	*it = ammonia* accept *ammonia* condensed accept ammonia cooled below boiling point for **2** marks	 1 1	1 / 3.5.1b	E
Total			**8**		

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 48 · Mark scheme

June 2014 | CH3HP | Original Q5 | Legacy



4.3.1.1 Conservation of mass and balanced chemical equations

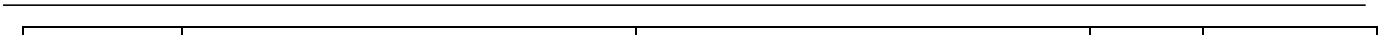
Answer 49 · Mark scheme June 2015 | CH2HP | Original Q5 | Legacy

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**	

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 49 · Mark scheme

June 2015 | CH2HP | Original Q5 | Legacy



4.3.1.1 Conservation of mass and balanced chemical equations

Answer 50 · Mark scheme

June 2016 | CH1HP | Original Q3 | Legacy

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	(thermal) decomposition	allow decomposes or endothermic	1	AO1 1.2.1b/c
3(a)(ii)	copper oxide		1	AO2 1.2.1b/c
3(b)(i)	the (potassium) carbonate did not decompose/change/react (when heated) the mass did not change or the limewater did not go cloudy because no carbon dioxide produced	allow temperature not high enough do **not** allow potassium did not decompose ignore references to reactivity	1 1 1	AO1+AO2 +AO3 1.2.1c/e; 4.5.4a
3(b)(ii)	the less reactive the metal the more (easily) its carbonate will decompose/react or vice versa	needs to be a relative comparison allow max **1** mark where the distinction between a metal and its carbonate is not clear allow **1** mark for carbonates of reactive metals do not decompose or vice versa	2	AO3 1.2.1 c; 1.3
3(c)(i)	make it economical (to extract the metal/iron)	allow make it worth extracting allow so they can make money/profit	1	AO1 1.3.1a
3(c)(ii)	Fe balanced correctly (2,3,4,3)	 not ecf allow correct balanced equation but with $2Fe_2$ on right for one mark	1 1	AO2 1.1.3b; 1.3.2c

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 50 · Mark scheme

3(c)(iii)	**iron** from the blast furnace is brittle **steel** produced is strong / flexible	"it" = iron allow steel has more/specific uses allow steel is rust-resistant	1 1	AO1 1.3.2a/b/c
3(c)(iv)	(recycling) is used to conserve iron (ore) **or** energy **or** resources **or** minimise pollution **or** reduce the need to quarry (not reuse) because of damage, paint removal, rusting/corrosion, metal fatigue/weaker (not landfill) because sites have limited space **or** loss of habitats	allow reverse arguments. allow to reduce the use of landfill	1 1 1	AO1+AO2 1.3.1j
Total			**15**	

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 51 · Mark scheme

June 2016 | CH2HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / SpecRe
5(a)		reference to incorrect particles **or** incorrect bonding **or** incorrect structure = **max 3**		AO1/AO2 2.1.1a,b,c,e,f
	magnesium loses two electrons **and** chlorine gains one electron	accept magnesium loses electrons **and** chlorine gains electrons for 1 mark ignore oxidation and reduction	2	
	one magnesium and two chlorines	accept $MgCl_2$	1	
	noble gas structure **or** eight electrons in the outer shell **or** (electrostatic) attraction between ions **or** forms ionic bonds	accept full outer shell (of electrons) do **not** accept covalent bonds	1	
5(b)(i)		accept converse for solid		AO1 2.2.2b,2.7.1a
	because ions can move	ignore ions attracted do **not** accept molecules/ atoms moving do **not** accept incorrect reference to electrons moving	1	
	(and ions move) to the electrodes **or** (and ions) carry charge		1	

4.3.1.1 Conservation of mass and balanced chemical equations

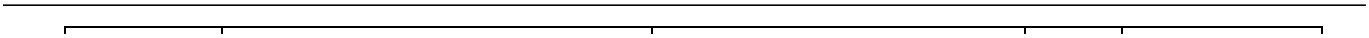
Answer 51 · Mark scheme

5(b)(ii)	magnesium (ions) attracted (to the electrode) so magnesium ions gain electrons 2 electrons	 accept magnesium ions are reduced ignore oxidised accept a correct half equation for 2nd **and** 3rd marking points	1 1 1	2AO1 / 1AO2 2.7.1b,c,d,e
5(b)(iii)	hydrogen	allow H_2	1	AO2 2.7.1f
5(b)(iv)	magnesium is more reactive than hydrogen	accept converse allow magnesium is high in the reactivity series **or** magnesium is very/too reactive. do **not** accept magnesium ions are more reactive than hydrogen ions	1	AO2 2.7.1f
5(b)(v)	**2** Cl^- → Cl_2 + **2**e^-	must be completely correct	1	AO1 2.7.1g
5(c)	 layers (of particles/atoms/ions) (particles/atoms/ions/layers) can slide	any mention of intermolecular/ weak bonds/forces = **max 1**	 1 1	AO2 2.2.4b
Total			**14**	

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 51 · Mark scheme

June 2016 | CH2HP | Original Q5 | Legacy



4.3.1.1 Conservation of mass and balanced chemical equations

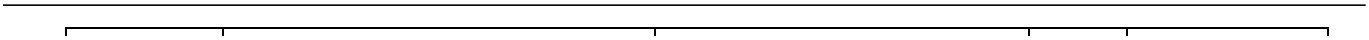
Answer 52 · Mark scheme June 2016 | CH3HP | Original Q5 | Legacy

Question	Answers	Extra information	Mark	AO / SpecRef
5(a)	CH_4 + $2O_2$ → CO_2 + $2H_2O$	allow multiples	1	AO2 3.3.1a
5(b)	3444 J	if answer incorrect: one mark for temperature increase = 16.4 °C one mark for mass of water = 50 g ecf for one incorrect value gains two marks for correct calculation no ecf for two incorrect values	3	AO2 3.3.1a
5(c)(i)	1276 (kJ per mole)	ignore + or - if answer incorrect: [(5 x 413) + 347 + 358 +467] + [(3 x 495)] = 4722 (1 mark) [(4 x 799) + (6 x 467)] = 5998 (1 mark) correct subtraction of calculated energy values (1 mark)	3	AO2 3.3.1f
5(c)(ii)	because energy released when bonds form is greater than energy used when bonds broken	allow converse if no mark awarded allow one mark for energy is used to break bonds or one mark for energy is released when bonds form	2	AO1 3.3.1e,f
5(c)(iii)	products line lower than reactants activation energy labelled overall energy change labelled		1 1 1	2AO2 / 1AO3 3.3.1d
Total			**12**	

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 52 · Mark scheme

June 2016 | CH3HP | Original Q5 | Legacy



Answer 53 · Mark scheme

June 2017 | CH2HP | Original Q3 | Legacy

The full source mark scheme begins on page 149. Follow original question 3 in that document.

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 54 · Mark scheme June 2017 | CH3HP | Original Q4 | Legacy

Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)(i)	2 (K +) 2 (H_2O →) 2 (KOH) + H_2	allow multiples allow H_2 for 1 mark allow 2 (K +) 2 (H_2O →) 2 (KOH) + 2H for 1 mark	2	**AO1** **AO2** 3.1.3a
4(a)(ii)	any **two** from: • potassium reacts more quickly / vigorously • potassium moves around more quickly • more bubbles from potassium • potassium melts • potassium produces a (lilac) flame	accept converse for Li allow dissolves more quickly allow more gas / hydrogen from potassium allow potassium catches fire	2	**AO1** **AO3** 3.1.3a
4(b)	add alkali to acid from burette until indicator changes colour take reading of volume at start and end repeat (and find mean) any **one** from • swirl / stir • add dropwise / slowly • white tile • rinse apparatus • meniscus • read at eye level	allow alternative apparatus for measuring volume allow appropriate use of pH probe allow record the volume used	1 1 1 1 1	**AO1** **AO3** 3.4.1g

4.3.1.1 Conservation of mass and balanced chemical equations

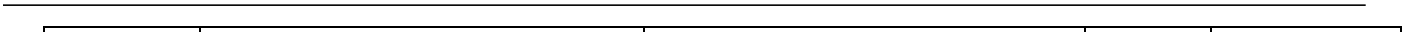
Answer 54 · Mark scheme

4(c)	0.21	if incorrect, 26.25 x 0.2/1000 or 0.00525 for 1 mark their moles x 1000/25.00 or their moles x 40 for 1 mark correct evaluation for 1 mark 0.19(0476…) gains only 1 mark with or without working	3	**AO2** 3.4.1h
Total			**12**	

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 54 · Mark scheme

June 2017 | CH3HP | Original Q4 | Legacy



4.3.1.1 Conservation of mass and balanced chemical equations

Answer 55 · Mark scheme June 2018 | 8462/1H | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	copper, zinc, sodium chloride solution		1	AO2 4.5.2.1
03.2	a reactant is used up	allow the reaction stops allow electrolyte / electrode / ions / metal / metal hydroxide / alkali for reactant	1	AO1 4.5.2.1
03.3	the reaction is not reversible		1	AO1 4.5.2.1
03.4	$2H_2 + O_2 \rightarrow 2H_2O$	allow fractions / multiples allow **1** mark for O_2	2	AO1 AO2 4.1.1.1 4.5.2.2

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 55 · Mark scheme

June 2018 | 8462/1H | Original Q3

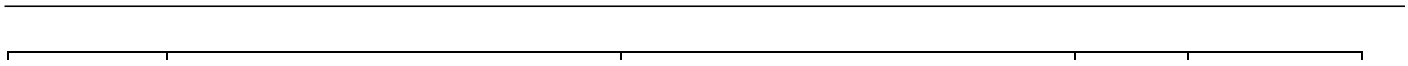
<table>
<tr><th>Question</th><th>Answers</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td rowspan="5">03.5</td><td>Level 3: A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.</td><td>5–6</td><td>AO3</td></tr>
<tr><td>Level 2: Some logically linked reasons are given. There may also be a simple judgement.</td><td>3–4</td><td>AO3</td></tr>
<tr><td>Level 1: Relevant points are made. This is not logically linked.</td><td>1–2</td><td>AO2</td></tr>
<tr><td>No relevant content</td><td>0</td><td></td></tr>
<tr><td>Indicative content

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

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 55 · Mark scheme

June 2018 | 8462/1H | Original Q3



4.3.1.1 Conservation of mass and balanced chemical equations

Answer 56 · 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

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)			

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 56 · 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**	

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 57 · Mark scheme

June 2019 | 8462/2H | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	wood is renewable **or** (natural) gas is finite (burning) wood produces the same amount of carbon dioxide as the trees absorbed **or** (burning natural) gas increases the amount of carbon dioxide (in the atmosphere)	 allow wood is carbon-neutral allow wood does not add to global warming allow (burning natural) gas adds to global warming allow (burning natural) gas adds greenhouse gases (to the atmosphere) ignore references to energy / cost	1 1	AO3 4.9.2.2 4.10.1.1
05.2	not enough oxygen (so) incomplete combustion	allow not enough air do **not** accept no oxygen / air	1 1	AO1 4.9.3.1
05.3	$\mathbf{2}CH_4(g)+\mathbf{3}O_2(g)\rightarrow\mathbf{2}CO(g)+\mathbf{4}H_2O(g)$	allow correct multiples / fractions	1	AO2 4.9.3.1

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 57 · Mark scheme June 2019 | 8462/2H | Original Q5

05.4	ratio of O_2 : CO_2 = 5 : 3 (oxygen needed = $\frac{3.60 \times 5}{3}$) = 6.0 (dm^3) (oxygen unreacted = 7.25 – 6.0) = 1.25 (dm^3) (oxygen unreacted = 1.25 × 1000) = 1250 (cm^3)	an answer of 1250 (cm^3 oxygen unreacted) scores **4** marks allow correct calculation using an incorrectly determined mole ratio allow correct subtraction of an incorrectly calculated volume of oxygen allow correct conversion to cm^3 anywhere in response **alternative approach for MP1 and MP2** moles CO_2 = 0.15 **and** moles O_2 = 0.25 (1) (0.25 x 24 =) 6.0 (dm^3 oxygen needed) (1)	1 1 1 1	AO2 4.3.5 4.7.1.3
Total			**9**	

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 58 · Mark scheme

November 2020 | 8462/1H | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	(total) mass before = 156.76 (g) **and** (total) mass after = 156.76 (g) **or** increase in mass of beaker **A** and contents = 29.96 (g) **and** decrease in mass of beaker **B** and contents = 29.96 (g) (so) the mass of products equals the mass of the reactants **or** (so) there is no change in mass during the reaction	allow 78.26 + 78.50 = 156.76 **and** 108.22 + 48.54 = 156.76 allow 108.22 – 78.26 = 29.96 **and** 48.54 – 78.50 = – 29.96 allow (so) no atoms were lost or made during the reaction	1 1	AO2 AO1 4.3.1.1
03.2	filter / filtration	allow a description of filtration	1	AO2 4.1.1.2
03.3	sodium nitrate (solution) **or** silver nitrate (solution) **or** sodium iodide (solution)	allow correct formulae allow sodium / nitrate / silver / iodide ions	1	AO2 4.1.1.2
03.4	to remove / evaporate the water	allow to dry (the solid)	1	AO3 4.1.1.2

Question 3 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	(total M_r = 170 + 150) = 320	allow (235 + 85) = 320	1	AO2 4.3.3.2
	(% atom economy =) $\frac{235}{320} \times 100$	allow correct use of incorrectly calculated total M_r	1	
	= 73.4375 (%)		1	
	= 73.4 (%)	allow an answer correctly calculated to 3 significant figures from an incorrect percentage calculation which uses the values in the question	1	
03.6	any **one** from: • for sustainable development • for economic reasons • to produce a high(er) percentage of useful product	allow to reduce waste	1	AO1 4.3.3.2
Total			**10**	

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 59 · 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

4.3.1.1 Conservation of mass and balanced chemical equations

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	

4.3.1.1 Conservation of mass and balanced chemical equations

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**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 60 · Mark scheme

November 2021 | 8462/1H | Original Q4

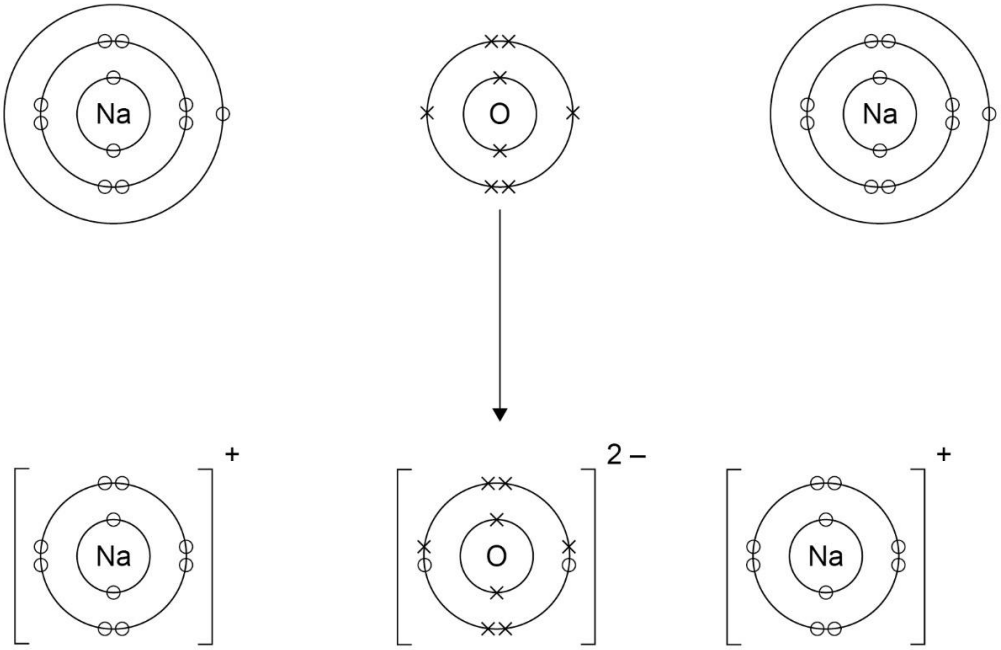
Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	any **two** from: • (potassium) floats • (potassium) melts • (potassium) moves around • potassium becomes smaller • (lilac) flame • effervescence	 allow potassium disappears allow fizzing	2	AO1 4.1.2.5 4.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	$2K + 2H_2O \rightarrow 2KOH + H_2$	allow multiples allow **1** mark for KOH **and** H_2	2	AO1 AO2 4.1.1.1 4.1.2.5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	reactivity increases (going down the group) (because) the outer electron / shell is further from the nucleus (so) there is less attraction between the nucleus and the outer electron / shell (so) the atom loses an electron more easily	 allow (because) there are more shells allow (because) the atoms get larger allow (so) there is more shielding from the nucleus do **not** accept incorrect attractions	1 1 1 1	AO1 4.1.2.5 4.4.1.2

Question 4 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	(dot and cross diagram to show) sodium atom **and** oxygen atom	allow use of outer shells only	1	AO2 4.2.1.1 4.2.1.2
	two sodium atoms to one oxygen atom	allow two sodium ions to one oxide ion	1	
	(to produce) sodium ion with a + charge		1	
	(to produce) oxide ion with a 2– charge		1	
	 scores **4** marks			

Question 4 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	(oxygen) gains electrons		1	AO1 4.4.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	giant structure	allow (giant ionic) lattice	1	AO1 4.2.1.3 4.2.2.1
	(with) strong (electrostatic) forces of attraction between (oppositely charged) ions		1	4.2.2.3
	(so) large amounts of energy are needed to break the bonds / forces	allow (so) large amounts of energy are needed to separate the ions	1	

Total			16

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 61 · 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

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**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 62 · Mark scheme

November 2021 | 8462/2H | Original Q10

Question 10

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.1	(steam / catalytic) cracking	allow thermal decomposition	1	AO1 4.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.2	high temperature steam / catalyst	allow a temperature in the range 300 – 900 °C	1 1	AO1 4.7.1.4

Question 10 continued

Question	Answers	Mark	AO/ Spec. Ref
10.3	**Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO2 4.6.1.3 4.6.2.4 4.6.2.6 4.6.2.7 4.7.2.2
	Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.	3–4	
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	
	Indicative content **Rate** • higher temperature gives higher rate • because more frequent collisions • higher pressure gives higher rate • because more frequent collisions • a catalyst can be used to give a higher rate • because the activation energy is reduced **Yield** • higher temperature gives lower yield • because the reaction is exothermic • higher pressure gives higher yield • because there are more molecules on left hand side **Other factors** • higher temperatures use more energy so costs increase • higher pressures use more energy so costs increase • higher pressures require stronger reaction vessels so costs increase **Compromise** • chosen temperature is a compromise between rate and yield • chosen temperature is a compromise between rate and cost (of energy used) • chosen pressure is a compromise between rate and cost (of energy used) • chosen pressure is a compromise between yield and cost (of energy used)		

Question 10 continued

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.4	fermentation	allow ferment(ing)	1	AO1 4.7.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.5	warm anaerobic (conditions)	allow a value in the range 25 °C to 45 °C allow without oxygen / air	1 1	AO2 4.7.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.6	(conversion) 200 km = 200,000 m (moles =) $\frac{200000 \times 1.95 \text{ (mol)}}{1300}$ = 300 (mol)	 allow correct use of incorrect / no conversion for distance	1 1 1	AO2 4.7.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
10.7	$C_4H_9OH + 6\,O_2 \rightarrow 4\,CO_2 + 5\,H_2O$	allow $C_4H_{10}O$ for C_4H_9OH allow multiples allow **1** mark for $C_4H_9OH + O_2 \rightarrow CO_2 + H_2O$ with incorrect / no multipliers ignore state symbols	2	AO2 4.1.1.1 4.3.1.1 4.7.2.3

Total			17

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	

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 63 · 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

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 64 · Mark scheme

June 2022 | 8462/2H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	crude oil is heated to vaporise (the hydrocarbons)		1	AO1 AO2 4.7.1.2
	there is a temperature gradient in the (fractionating) column	allow a (fractionating) column is cooler going up	1	
	(so) the gases condense at different levels **or** (so) lubricating oil condenses below naphtha (and petroleum gases do not condense)		1	
	(because of their) different boiling points		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	detergents		1	AO1 4.7.1.2
	solvents		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	$C_9H_{20} + 14\,O_2 \rightarrow 9\,CO_2 + 10\,H_2O$	allow multiples allow **1** mark for $C_9H_{20} + O_2 \rightarrow CO_2 + H_2O$ with incorrect / no multipliers	2	AO2 4.1.1.1 4.3.1.1 4.7.1.3

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 64 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	(when burned sulfur impurities) produce sulfur dioxide		1	AO1 4.9.3.1 4.9.3.2
	(which) causes acid rain **or** (which) causes respiratory problems	allow specified effects of acid rain allow specified respiratory problems	1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5		allow converse statements		AO2 4.7.1.3
	as molecular size increases viscosity increases		1	
	(and) heavy fuel oil has larger molecules (than kerosene)		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	(name of process) cracking		1	AO1 4.7.1.4
	(conditions) high temperature	allow a stated temperature in the range 300 to 900 °C	1	
	steam / catalyst		1	

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 64 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	C_7H_{14} and C_8H_{16}		1	AO2 4.7.1.4 4.7.2.1

Total Question 4		**16**

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 65 · Mark scheme

June 2023 | 8462/1H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	(atoms of) argon have a stable arrangement of electrons (so) argon (atoms) do not share / transfer electrons	allow (atoms of) argon have a full outer shell (of electrons)	1 1	AO1 4.1.2.3 4.1.2.4 4.2.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	PH_3	allow H_3P	1	AO2 4.1.2.1 4.2.1.4

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 65 · Mark scheme

June 2023 | 8462/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3		MP2 is dependent upon MP1 being awarded		AO3 4.1.2.3
	yes, because tellurium is towards the right of the periodic table	allow yes, because tellurium is in Group 6	1	
	(so) tellurium is a non-metal	allow (so) tellurium will gain electrons (from a metal)	1	
	OR			
	yes, because tellurium is in the same group as oxygen / sulfur (1)			
	(and) oxygen / sulfur will react with metals (1)	allow (so) tellurium is a non-metal allow (so) tellurium will gain electrons (from a metal)		
	OR			
	no, because tellurium is towards the bottom of the periodic table (1)			
	(so) tellurium is a metal (1)	allow (so) difficult for tellurium to gain electrons (from a metal) (1)		
	OR			
	cannot predict as tellurium is towards the bottom and to the right of the periodic table (1)			
	(so) don't know whether tellurium is a metal or non-metal (1)	allow (so) don't know whether tellurium will gain electrons		

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 65 · Mark scheme

June 2023 | 8462/1H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	any **two** from: • effervescence / fizzing / bubbles • barium disappears • forms a colourless solution • temperature increases	ignore references to floating / flames ignore produces a gas allow barium gets smaller allow barium moves around	2	AO3 4.1.2.1 4.4.1.2 4.4.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	$Ba + 2\ HCl \rightarrow BaCl_2 + H_2$	allow multiples allow **1** mark for $BaCl_2$ allow **1** mark for H_2 ignore state symbols	3	AO2 4.1.1.1 4.4.1.2 4.4.2.1

Total Question 8	10

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 66 · 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)		

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 66 · Mark scheme

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

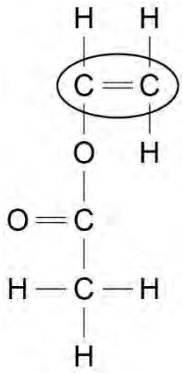
Total Question 5	**9**

4.3.1.1 Conservation of mass and balanced chemical equations

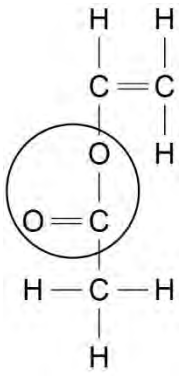
Answer 67 · Mark scheme

June 2024 | 8462/2H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1			1	AO2 4.7.2.1

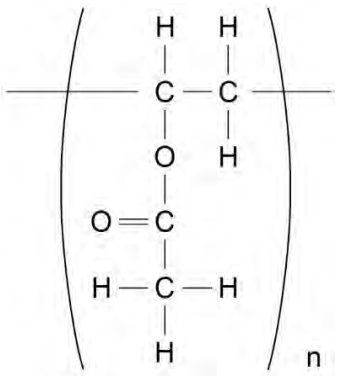
Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	orange (bromine water) turns colourless	allow yellow / brown allow is decolourised ignore clear	1 1	AO2 4.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3			1	AO3 4.7.2.4 4.7.3.2

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 67 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	$2\ C_4H_6O_2 + 9\ O_2 \rightarrow 8\ CO_2 + 6\ H_2O$	allow multiples allow **1** mark for $C_4H_6O_2 + O_2 \rightarrow$ with incorrect / no multipliers allow **1** mark for $\rightarrow CO_2 + H_2O$ with incorrect / no multipliers ignore state symbols	3	AO2 4.7.2.1 4.1.1.1 4.3.1.1 4.7.2.1 4.7.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.5	single C-C bond in polymer repeating unit n after polymer repeating unit	do **not** accept extra atoms added to trailing bonds an answer of  scores **2** marks	1 1	AO2 4.7.3.1

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 67 · Mark scheme

June 2024 | 8462/2H | Original Q8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.6	addition polymer		1	AO2 4.7.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.7	thermosoftening	allow thermoplastic	1	AO1 4.10.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.8	cross-links between (polymer) chains (so) too much energy needed to overcome the cross-links	allow covalent bonds between (polymer) chains allow (so) too much energy needed to overcome the covalent bonds between (polymer) chains	1 1	AO1 4.2.2.5 4.10.3.3

Total Question 8	13

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 68 · 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	

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 68 · 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

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 68 · Mark scheme

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

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 69 · Mark scheme

June 2025 | 8462/1H | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	–34 °C	allow a value in the range –70 to –20 °C	1	AO3 4.1.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	solid	allow (s)	1	AO3 4.1.2.6 4.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	7		1	AO1 4.1.2.1 4.1.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	HAt		1	AO2 4.1.2.1 4.1.2.6

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 69 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5		allow energy level for shell		
	reactivity decreases (going down the group)		1	AO1 4.1.2.6
	(because) the outer shell / electrons become further from the nucleus	allow (because) the atoms become larger allow (because) the atoms have more shells	1	
	(so) there is less (electrostatic) attraction between the nucleus and the outer electron(s)	allow (so) there is more shielding between the outer electron(s) and the nucleus	1	
	(so) gaining an electron is more difficult		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	$Br_2 + 2KI \longrightarrow I_2 + 2KBr$	allow multiples allow **1** mark for Br_2 **and** I_2 allow **1** mark for KI **and** KBr ignore state symbols	3	AO2 4.1.1.1 4.1.2.6

Total Question 4	11

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 70 · Mark scheme

June 2025 | 8462/2H | Original Q2

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	fractional distillation		1	AO1 4.1.1.2 4.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	(heater) evaporation (column) condensation	allow liquid to gas allow boiling allow gas to liquid	1 1	AO1 4.2.2.1 4.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	petrol		1	AO3 4.7.1.2

Question	Answers	Mark	AO / Spec. Ref.
02.4	heavy fuel oil ⟶ diesel oil ⟶ kerosene	1	AO3 4.7.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	C_4H_{10}		1	AO2 4.2.1.4 4.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	butane		1	AO1 4.7.1.1

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 70 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	$C_3H_8 + 5\ O_2 \rightarrow$ **3** CO_2 + **4** H_2O	allow **1** mark for **3** CO_2 allow **1** mark for **4** H_2O	2	AO2 4.1.1.1 4.3.1.1 4.7.1.3

Total Question 2	**9**

Version 1.0: 0707

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Science B 4462 / Chemistry 4421

CHY1H Unit Chemistry 1

Mark Scheme

2007 examination - June series

4.3.1.1 Conservation of mass and balanced chemical equations

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

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

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

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Dr Michael Cresswell, Director General.

4.3.1.1 Conservation of mass and balanced chemical equations

MARK SCHEME

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded.

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

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

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

2. Emboldening

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

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

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

3. Marking points

3.1 Marking of lists

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

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

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

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

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

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

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

3.2 Use of chemical symbols / formulae

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

3.3 Marking procedure for calculations

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

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

3.4 Interpretation of 'it'

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

3.5 Errors carried forward

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

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

3.6 Phonetic spelling

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

3.7 Brackets

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

3.8 Unexpected Correct Answers not in the Mark Scheme

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

4.3.1.1 Conservation of mass and balanced chemical equations

CHY1H Question 1

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

4.3.1.1 Conservation of mass and balanced chemical equations

CHY1H Question 2

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

Continued on next page

4.3.1.1 Conservation of mass and balanced chemical equations

Question 2 continued

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

4.3.1.1 Conservation of mass and balanced chemical equations

CHY1H Question 3

	answers	extra information	mark
(a)(i)	core		1
(ii)	plate (boundaries)	accept parts of the crust ignore crust alone	1
	sudden movement / colliding **or** normally move a few centimetres per year	accept movement but ignore movement apart accept continental drift	1
	convection currents / driven by heat from radioactive processes / decay	idea of source of energy for the movement	1
	the idea of uncertainty with an explanation eg scientists do not know (with any certainty) • what happens under the crust • where the forces / pressure are building up • we cannot measure the forces • when the forces reach their limit	ignore references to volcanoes	1
(b)(i)	78		1

Continued on next page

4.3.1.1 Conservation of mass and balanced chemical equations

Question 3 continued

	answers	extra information	mark
(ii)	marks awarded for any 2 gases from the following 3 gases	max **3** marks from CO_2	
	any **four** from: carbon dioxide has decreased: • used by plants / bacteria (stromatolites) • during photosynthesis (must be linked to CO_2 decrease) • 'locked up' in (sedimentary) rocks / carbonates / fossil fuels • dissolved in oceans **and / or** oxygen has increased because: • released by plants / bacteria (stromatolites) • during photosynthesis (must be linked to O_2 increase) **and / or** nitrogen has increased because • ammonia reacted with oxygen (to release nitrogen) • nitrogen is released by bacteria	ignore references to respiration	4
total			10

4.3.1.1 Conservation of mass and balanced chemical equations

CHY1H Question 4

	answers	extra information	mark
(a)	permitted additive / (added) chemicals **or** names / types of additives	accept the chemical name ignore food additive alone	1
(b)(i)	water and oil do not mix / are immiscible **or** don't dissolve each other	ignore density ignore emulsifier alone	1
(ii)	any **two** from: • emulsifier • forms an emulsion • holds the two components together • by lowering the surface tension	 accept description of an emulsion accept stops them separating / they mix allow bonds / binds for holds accept a description of how an emulsifier works for **two** marks eg 'tadpole' diagram or dispersal of oil drops	2
(c)(i)	(because they contain) a double (carbon carbon) bond	accept unsaturated ignore poly or mono	1
(ii)	results suggest sunflower oil is best **or** 'the one that took the least time' because (sunflower oil) has the highest amount of unsaturation / most double bonds / least saturated	 ignore uses up I_2 most quickly second mark is dependent on first	1 1

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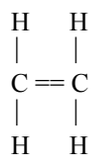
4.3.1.1 Conservation of mass and balanced chemical equations

Question 4 continued

	answers	extra information	mark
(d)(i)	any **one** from: • have a higher melting point than (vegetable) oil • are solid at (room temperature) / hardened / harder	 accept useful as spreads **or** doesn't soak into bread ignore hard / soft(er)	1
(ii)	any **two** from: • hydrogen added • to carbon carbon double bond / to saturate • (nickel) catalyst / temperature 60 - 150°C	 do **not** accept 'water' wrong catalyst doesn't get this mark ignore high / warm temperature	2
total			10

4.3.1.1 Conservation of mass and balanced chemical equations

CHY1H Question 5

	answers	extra information	mark
(a)(i)	by (fractional) distillation **or** fractionation	accept a description of the distillation process (heat and how separation works) eg heat **and** condense accept boil / vapourise etc for heat	1
(ii)	CO_2 H_2O	note the order of these products must be correct wrong way round = **1** mark	1 1
(b)(i)	(hexane) has been broken down (into smaller hydrocarbons / molecules)	accept (thermal) decomposition / cracked / split / broken up owtte	1
(ii)		accept $CH_2=CH_2$	1
(iii)	water / hydrogen oxide / steam	accept H_2O	1

Continued on next page

4.3.1.1 Conservation of mass and balanced chemical equations

Question 5 continued

	answers	extra information	mark
(c)	candidates must include both sugar cane and crude oil in their evaluation **and** both an advantage and a disadvantage to gain full marks. if they do not then the maximum mark is three any **four** from: <u>advantages of using sugar</u> • country has no wealth to buy (large quantities of) crude oil • country has limited technological development **or** underdeveloped / third world country • able / suitable climate to grow sugar cane • enough land to grow sugar cane / land cannot be used to grow food / deforestation • sugar is a renewable source **or** crude oil is a non-renewable resource / finite resource / limited resources • CO_2 / carbon neutral <u>advantages of using alkanes:</u> • economic costs are low • continuous process • country has large oil resources • country has oil refineries / cracking plants • very pure product • faster process	not 'expensive' alone	4
total			10

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

4.3.1.1 Conservation of mass and balanced chemical equations

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Dr Michael Cresswell Director General

4.3.1.1 Conservation of mass and balanced chemical equations

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4.3.1.1 Conservation of mass and balanced chemical equations

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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

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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.

4.3.1.1 Conservation of mass and balanced chemical equations

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

4.3.1.1 Conservation of mass and balanced chemical equations

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

4.3.1.1 Conservation of mass and balanced chemical equations

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

4.3.1.1 Conservation of mass and balanced chemical equations

CHY2H

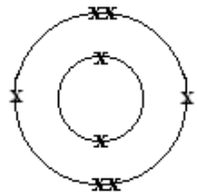
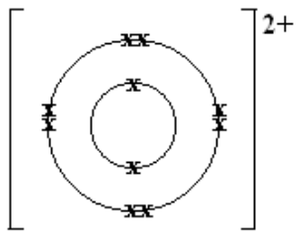
Question 4

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

4.3.1.1 Conservation of mass and balanced chemical equations

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…

4.3.1.1 Conservation of mass and balanced chemical equations

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

4.3.1.1 Conservation of mass and balanced chemical equations

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

4.3.1.1 Conservation of mass and balanced chemical equations

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…

4.3.1.1 Conservation of mass and balanced chemical equations

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…

4.3.1.1 Conservation of mass and balanced chemical equations

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…

4.3.1.1 Conservation of mass and balanced chemical equations

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

4.3.1.1 Conservation of mass and balanced chemical equations

GCSE

Additional Science / Chemistry

CH2HP
Final Mark scheme

4408 / 4402
June 2017

Version/Stage: v1.0

4.3.1.1 Conservation of mass and balanced chemical equations

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

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

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

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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

4.3.1.1 Conservation of mass and balanced chemical equations

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.

4.3.1.1 Conservation of mass and balanced chemical equations

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

4.3.1.1 Conservation of mass and balanced chemical equations

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**	

4.3.1.1 Conservation of mass and balanced chemical equations

<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>

4.3.1.1 Conservation of mass and balanced chemical equations

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**

4.3.1.1 Conservation of mass and balanced chemical equations

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

4.3.1.1 Conservation of mass and balanced chemical equations

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

4.3.1.1 Conservation of mass and balanced chemical equations

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**	

4.3.1.1 Conservation of mass and balanced chemical equations

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	

4.3.1.1 Conservation of mass and balanced chemical equations

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**	

4.3.1.1 Conservation of mass and balanced chemical equations

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**	

4.3.1.1 Conservation of mass and balanced chemical equations

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**	

Answer 55 · Examiner comments

June 2018 | 8462/1H | Original Q3

Question 3 (standard demand)

03.1 This was well answered with 67% of students recognising that there had to be two different metals, and that water alone would not be suitable as the electrolyte. A significant number of students incorrectly ticked more than one box.

03.2 62% of students answered this question on a new area of the specification correctly. Many, however, mixed up the answers to questions **03.2** and **03.3**. Many thought that charge, energy, or a product run out.

03.3 52% of students could answer in terms of the lack of reversibility of the chemical reaction in the cell.

03.4 This was well answered, with 70% of students able to give the formula for oxygen and then to balance the equation.

03.5 96% of students achieved three or more marks. However, many students limited themselves to level 2 as they just used the information from the table, without bringing in any of their own knowledge. Others failed to give a judgement on which method is better; a judgement is an essential part of a question where the command word is ‘evaluate’.

Some students wasted space and time requoting data from the table. A comment such as ‘you can go much further with a hydrogen fuel cell before having to stop to refuel’ is a better answer than ‘you can go 415 miles between refuelling with a hydrogen cell car but only 240 miles between recharges of a lithium-ion battery car’.

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 56 · 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.

Answer 56 · Examiner comments

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.

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 58 · Examiner comments November 2020 | 8462/1H | Original Q3

Question 3 (standard demand)

03.1 Many students failed to recognise or state that a reaction was taking place, merely referring to changes in mass on mixing. Some did not use the data in the question, as was required. Many students appeared to confuse conservation of mass with conservation of energy.

03.2 Most students realised that filtration would obtain the solid. Crystallisation was a commonly seen incorrect response.

03.3 Many students gave the answer 'sodium' as opposed to sodium nitrate, sodium iodide or sodium ions. Dust and bacteria were not uncommon responses.

03.4 Many students did not realise that heating was simply to dry the silver iodide, by evaporating off the water from the previous step.

03.5 This calculation was well done, although some students added up all four values of M_r instead of just those of the reactants.

03.6 Most answered correctly in terms of profitability, or reduction of waste. There was some confusion between atom economy and percentage yield.

Answer 59 · 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.

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 59 · 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.

Answer 60 · Examiner comments November 2021 | 8462/1H | Original Q4

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

04.1 Many students remembered that effervescence would be seen, but there were many vague descriptions such as 'vigorous reaction' which did not gain credit. Students often gave the same observation twice, eg, 'effervescence' and 'bubbles'. Many students incorrectly mentioned a colour change, perhaps remembering a demonstration where an indicator had been added. Very few mentioned the potassium melting.

04.2 Very few students could write the formulae for the correct products. Those who could were usually able to balance the equation. Many students approached the question from the wrong direction, trying to balance the equation by inventing fictitious products.

04.3 This was not well answered, with only a small number of students scoring full marks. Many incorrectly tried to link reactivity to melting and boiling point. Many referred to the distance and / or attraction between the nucleus and electrons in general, rather than the outer electrons. Others failed to mention the nucleus at all.

04.4 The electron arrangements of both atoms and ions were required for full marks, as well as the ratio of sodium ions to oxide ions and the correct charges on the ions. Few students scored all the marks as they did not draw the atoms of sodium and oxygen before reaction. Many tried to draw covalent structures. The ratio of 2 atoms of sodium to one of oxygen was well known. Students should be aware that electrons cannot be in two places at the same time and should not be drawn as if they are. Some students drew both ionic and covalent structures, thereby contradicting themselves and losing the marks for a correct ionic structure. A great deal of time and effort would be saved by drawing the outer electrons only, as in the specification.

04.6 Students found this question very difficult, with many referring incorrectly to intermolecular forces, even when mentioning ions. Many also referred to covalent bonds or forces between atoms. Of those who did refer correctly to the large amounts of energy required to break the strong attractions between ions, very few referred to the giant structure of the compound.

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 61 · 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.

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 61 · 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 62 · Examiner comments November 2021 | 8462/2H | Original Q10

Question 10 (standard, standard / high and high demand)

10.2 More than two thirds of students knew one condition (high temperature) and more than one third knew two.

10.3 There was a very wide range of marks but many did not score above Level 1. The main failure to reach Level 2 was that the question focuses on economics so that an answer which fails to mention energy, cost or a compromise in reaction conditions does not meet the level descriptor for Level 2. Similarly, the requirements for Level 3 were not usually met if the references did not mention the impact of reaction conditions on both rate and yield. Only a handful of students gave a Level 3 answer.

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 62 · Examiner comments

10.4 Fermentation was well known.

10.5 Around half of students scored one mark by extending their knowledge of fermentation to this unfamiliar context, 'warm' was seen much more often than 'anaerobic'.

10.6 This was completely correct in the responses of nearly half of students. Where a mark was not obtained, this was usually caused by a failure to convert kilometres to metres.

10.7 A challenging concluding equation with no scaffolding which students found difficult.

Concluding Remarks

There is still some evidence that command words are misunderstood or ignored. This limits the marks awarded, especially in extended response questions. This is particularly true where a command word demands a reasoned judgement.

Students seemed well prepared for questions based on Organic Chemistry and Chemistry of the Atmosphere. In this series they seemed less equipped to deal with Chemical Analysis, Rate of Reaction and some aspects of Using Resources.

There were a number of instances of key reagents, techniques and colour changes still not being well known.

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 62 · Examiner comments

Mark Ranges and Award of Grades

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

Answer 63 · 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.

Answer 64 · Examiner comments

June 2022 | 8462/2H | Original Q4

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

04.1 The vast majority of students wrote detailed answers to this question and the full range of marks was awarded although relatively few answers were awarded full marks. About 1 in 10 students scored all four marks, while a quarter scored three. Students often neglected to state the crude oil must be heated to begin the separation process. Some students failed to score the second marking point in the mark scheme because their description of a temperature gradient was not in the context of gases rising through a fractionating column or fractionating tower. A handful of students illustrated this idea by referring to a labelled diagram.

The idea of fractions collecting at different levels in the fractionating column was well understood but many described the collection of fractions without mentioning condensing and so could not access this mark. Some students incorrectly suggested that petroleum gases would condense at the top of the column. The idea that the separation of crude oil is based on differences in boiling points was an accessible mark but many failed to mention boiling points or simply quoted boiling point ranges from the table.

04.2 Just over a third of students were able to score both of the marks available in this multiple choice question. This suggests that the feedstock concept in the specification is not well known.

04.3 Nearly half of the students scored both marks by being able to write a correctly balanced equation for the combustion of nonane. Many were able to pick up one mark for writing the correct formulae for oxygen, carbon dioxide and water. Some students failed to score any marks because they included hydrocarbon molecules in their equation, perhaps confusing this combustion reaction with cracking. Students should be advised to take care when writing numbers in equations. A quickly written 14 sometimes looked like 19 and 19 H_2O was occasionally written by students who had double-counted the oxygen atoms in water. Similarly, excessively large subscript numbers and excessively small capital letters (especially O) are likely not to gain credit.

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 64 · Examiner comments June 2022 | 8462/2H | Original Q4

04.4 This question was generally well answered but some students stated that the combustion of sulfur would cause damage to the car engine while others appeared to confuse the effects of burning sulfur with a lack of oxygen and named the products of incomplete combustion. Some seemed to think that sulfur would be released into the air as a toxic gas but these students could still be credited for a description of the problems caused by sulfur dioxide. These problems were well known; acid rain or respiratory problems were common answers. Around 30% of the students gained both marks.

04.5 Most students scored at least one mark for this question, usually by giving a statement that heavy fuel oil has larger molecules. A relatively small proportion scored the first marking point in the mark scheme for stating the general relationship between molecular size and viscosity. A statement about heavy fuel oil being more viscous than kerosene was insufficient for credit because this repeated information given in the question. Nearly 30% of the students gained both of the marks.

04.6 The full range of marks was awarded. The name of the process was well known but a large proportion of students failed to mention either the high temperature or the use of steam or a catalyst and so gained only two of the three marks. Marks were awarded independently so even students who could not name the process could pick up two marks for correctly describing the conditions. Nearly half of the students gained all three marks here.

Answer 65 · Examiner comments

June 2023 | 8462/1H | Original Q8

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

08.1 This question was well answered, with nearly all students referencing the stability of the outer electron shell. 'Full outer shell' was accepted even though it is not strictly true for a Period 3 element. About a half of students also referred to the lack of ability to share or transfer electrons, but some simply repeated that argon does not form compounds or does not form bonds. This was insufficient as the question required students to answer in terms of electrons.

08.2 About three fifths of students were able to give a correct formula by analogy with ammonia. PH_2 was a common incorrect response.

08.3 More than two fifths of students scored both marks, with nearly two thirds scoring at least one. Those who failed to score usually did not answer in terms of the position in the periodic table, as required. Students could reference the position on the right, and/or towards the bottom, or in Group 6 (the most common answer) to deduce whether or not a reaction would occur. However, many just stated that tellurium has six electrons in its outer shell, without mentioning the position.

08.4 About two thirds of students scored one mark, but far fewer were able to give a second valid observation. The most common observation was effervescence / bubbling / fizzing, but sometimes students used two of these words as if they were separate observations. Students sometimes gave deductions (gas produced, heat produced) instead of the actual observation (bubbling, temperature increase). Other common errors were to give observations which might be seen in any chemical change (eg formation of a precipitate, or a colour change) rather than this specific one.

08.5 Over a third of students scored at least two marks on this high demand question, with most of these students scoring all three marks. Nearly three quarters scored one mark, usually for the formula H_2. Those students who managed to work out the correct formula for barium chloride often scored all three marks. Some students were unable to work out that barium chloride and hydrogen would be the products. It was not uncommon to see the wrong symbol for barium, despite its being given at the top of the page.

Answer 66 · 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.

Answer 67 · Examiner comments June 2024 | 8462/2H | Original Q8

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

08.1 Around 60% of students correctly identified the C=C bond. For students who were not awarded the mark common mistakes were incorporating the 3 Hs and 1 O atom attached to the C=C group in their circle or also circling the C=O group. Others circled only the double bond and not the carbon atoms on either side.

08.2 Those students who were awarded marking point 1 used a range of the colours allowed in the mark scheme to describe the starting colour of bromine water. The most common colours were orange or brown. A small number of students described the bromine water as turning clear rather than colourless. For students who were awarded one mark there seemed to be an even split between those awarded marking point 1 and those awarded marking point 2. Just over half scored both.

08.3 A variety of areas in the molecule were circled in an attempt to answer this question. A mistake some students made who were not awarded this mark was incorporating one of the C atoms either side of the ester bond in their circle. Around 40% of students gained credit.

08.4 Those students awarded 3 marks for this question often balanced the equation using half the values of those in the mark scheme and gained credit. A common error was use of inaccurate formulae, particularly a small O on H_2O or CO_2. Just over one-third of students gained all three marks.

08.5 For those students awarded one mark there was an even split between those achieving marking point 1 and marking point 2. A minority of students added atoms or groups to the extension bonds, which contradicted marking point 1. Around 40% gained both marks.

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4.3.1.1 Conservation of mass and balanced chemical equations

Answer 67 · Examiner comments June 2024 | 8462/2H | Original Q8

08.6 This multiple-choice question was well answered, with three quarters of students gaining the mark.

08.7 An array of answers were given for this question. Common incorrect responses included condensation, meltable, polyester, hydrocarbon and alkene. 'Thermoforming' was regarded as a process and not a description of the polymer used in that process. Nearly half of students gained a mark here.

08.8 Only around 10% of students achieved two marks for this question.

Common mistakes for marking point 1 were referencing crosslinks but saying they were between the polymers or molecules rather than the polymer chains, or mentioning bonds between polymer chains but not stating they were covalent. A number of students also referred to crosslinks between monomers in the polymer or crosslinks between bonds in the polymer.

For marking point 2 many students were not awarded the mark as they gave generalised answers about a lot of energy, or high amounts of energy being needed to break the strong bonds but did not make it clear that **too much** energy was needed to break the bonds between polymer chains.

Answer 68 · Examiner comments

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.

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 69 · Examiner comments

June 2025 | 8462/1H | Original Q4

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

04.1 More than two thirds of students were able to estimate the boiling point from the bar chart. A generous range was allowed, from -70 °C to -20 °C. A surprising number of students gave 0 °C or a positive value.

04.2 Three quarters of students were able to use the bar chart to deduce that -250 °C is below fluorine's melting point, so fluorine must be a solid at that temperature. Many stated fluorine to be a gas at that temperature, preferring to rely on what they 'knew' about fluorine than to analyse the data.

Answer 69 · Examiner comments June 2025 | 8462/1H | Original Q4

04.3 Nearly all students gave the correct answer. Some produced an answer of 3, perhaps by trying to work out the detailed electronic configuration instead of simply looking at the group number.

04.4 Fewer than three fifths gave a correct answer. Students were expected to give the formula HAt by analogy with HCl. AtH was also accepted. However, there were many instances of H_2At, HAt_2, H_2At_2 or 2HAt. Some students tried to write an equation, which is never an appropriate response when asked for a formula and did not gain credit.

04.5 This question discriminated well, with nearly all students gaining at least one mark but only one in seven scoring all four. Precise use of language was required. Most students were able to state that reactivity decreases going down Group 7. Many were also able to state that gaining an electron became more difficult going down the group, although some referred incorrectly to likelihood rather than difficulty. Far fewer students were awarded the other two marks. Many said 'they' or 'the elements' become larger or 'they' or 'the elements' have more shells rather than specifically referring to the atom. Others stated that electrons, rather than outer shell electrons, become further from the nucleus. Some stated incorrectly that atoms have more outer shells. All atoms have one outer shell. Many students referred to the attraction between the nucleus and the outer shell, rather than between the nucleus and the electrons in the outer shell. Some incorrectly described this attraction as intermolecular or gravitational. Those who tried to refer to shielding usually found difficulty in expressing the idea correctly. Some brought in trends in melting and boiling points, which were not relevant.

04.6 This question also discriminated well, with nearly two thirds of students gaining at least one mark and one third gaining all three. Most students who could write the correct formulae could also balance the equation. However, there were many incorrect formulae, with errors such as Br instead of Br_2, KI_2 instead of KI, and even interhalogen compounds as products such as BrI. Compensation marks were available for those who could write the correct formulae for the two halogens and / or the correct formulae for the two potassium halides. There was no credit for balancing incorrect formulae.

4.3.1.1 Conservation of mass and balanced chemical equations

Answer 70 · Examiner comments — June 2025 | 8462/2H | Original Q2

Question 2

02.1 Over 90% of students correctly identified fractional distillation.

02.2 More than 4 in 5 students gained both marks here. Incorrect answers gave the state alone, rather than the change.

02.3 Over 90% of students made the link between boiling point and position of production on the column. Petroleum gases was the most common incorrect response given.

02.4 Around three fifths of students correctly linked the boiling point and flammability in this multichoice question. The distractors were equally chosen.

02.5 Nearly 90% of students gained the mark for this item. The most common error was getting the number of atoms of carbon and hydrogen the wrong way round. Very few students did not gain the mark because the numbers were too big.

Answer 70 · Examiner comments — June 2025 | 8462/2H | Original Q2

02.6 4 in 5 students correctly named the alkane. Some student responses were unclear between butane and butene, most often when the handwriting was very small and indistinguishable.

02.7 Over 90% of students gained both marks in balancing the equation. Most of the remainder scored one mark, usually for balancing the number of CO_2 produced.