AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.3.1.1

Conservation of mass and balanced chemical equations

Mark schemes and examiner comments

Tier	**Foundation**
Question groups	**12**
Available paper years	**2018–2025**

Using this booklet

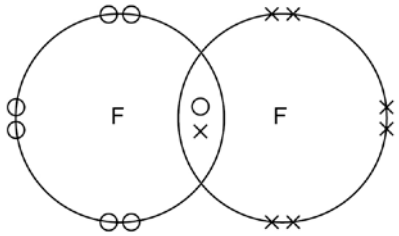
1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

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.

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 01 · Mark scheme June 2018 | 8464/C/1F | Original Q2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	group 7		1	AO1 5.1.2.6
02.2		one shared pair anywhere in overlap between two circles **or** on intersection 6 other electrons on each atom allow dots **or** crosses **or** mixture for all marks ignore any inner shell electrons	1 1	AO2 5.1.2.6 5.2.1.4
02.3	bromine potassium chloride	allow correct chemical formulae either order	1 1	AO2 5.1.1.1 5.1.2.6
02.4	displacement		1	AO1 5.1.2.6
02.5	(an) electron		1	AO2 5.1.2.6
02.6	smaller than		1	AO2 5.1.2.1 5.1.2.6

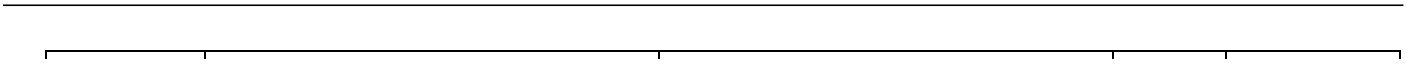
5.3.1.1 Conservation of mass and balanced chemical equations

02.7	(chlorine has) fewer levels / shells (of electrons)	mark independent of answer to question **02.6** allow converse for bromine allow (chlorine has) fewer electrons allow Cl has 3 levels / shells and Br has 4 levels / shells ignore atomic number **or** mass number **or** number of protons	1	AO2 5.1.2.1 5.1.2.6
02.8	3	allow multiples	1	AO2 5.1.1.1 5.1.2.6
02.9	there are weak forces between molecules which require little energy to overcome / break	do **not** accept weak bonds allow weak intermolecular forces for the first **2** marks allow does not need much energy to boil	1 1 1	AO1 5.1.2.6 5.2.2.4 AO1 5.1.2.6 5.2.2.4 AO2 5.1.2.6 5.2.2.4
Total			**13**	

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 01 · Mark scheme

June 2018 | 8464/C/1F | Original Q2



5.3.1.1 Conservation of mass and balanced chemical equations

Answer 02 · Mark scheme June 2018 | 8464/C/2F | Original Q6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	condenses		1	AO1 5.7.1.2
06.2	the fractions have different boiling points		1	AO1 5.7.1.2 5.7.1.3
06.3	propane	do **not** accept propene	1	AO2 5.7.1.1
06.4	C_nH_{2n+2}		1	AO1 5.7.1.1
06.5	$CH_4 + \mathbf{2}\ O_2 \rightarrow CO_2 + \mathbf{2}\ H_2O$	allow multiples	1	AO2 5.1.1.1 5.7.1.3
06.6	bromine water		1	AO1 5.7.1.4
06.7	to assess the environmental impact (of the stages in the life of a product)	allow to see the effect / harm / damage on the Earth / environment / planet ignore references to energy, pollution, carbon footprint, carbon dioxide, sustainability	1	AO1 5.10.2.1

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 02 · Mark scheme

June 2018 | 8464/C/2F | Original Q6

Question	Answers	Mark	AO / Spec. Ref.
06.8	**Level 2:** Scientifically relevant features are identified; the ways in which they are similar / different is made clear and the magnitude of the similarity / difference noted.	3–4	AO3
	Level 1: Relevant features are identified and differences noted.	1–2	AO2
	No relevant content	0	
	Indicative content • burning 10 000 bags produces 10 kg more of carbon dioxide than landfill • putting 10 000 bags in landfill produces 0.02 kg more of solid residue than burning. • putting 10 000 bags in landfill produces 50% more sulfur dioxide than burning • burning 10 000 bags produces 25 kg of carbon dioxide, but landfill only produces15 kg • putting 10 000 bags in landfill produces 0.07 kg of solid residue but burning only produces 0.05 kg • landfill produces less carbon dioxide than burning • landfill produces more solid residue than burning • burning produces less sulfur dioxide than landfill		5.10.2.1 5.10.2.2 5.9.2.2
Total			**11**

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 02 · Mark scheme June 2018 | 8464/C/2F | Original Q6

				AO

Answer 03 · Mark scheme June 2019 | 8464/C/1F | Original Q4

04.1	2 Na + Cl_2 → 2 NaCl	allow multiples	1	AO1 5.1.2.2
04.2	7.1 (g)		1	AO2 5.3.1.1
04.3	silver green yellow white	this order only allow yellow allow white	1 1 1 1	AO1 5.1.2.5
04.4	Na^+ Cl^-	if no other mark awarded allow **1** mark for +(1) charge for sodium ion and –(1) charge for chloride ion	1 1	AO1 5.2.1.2
04.5	an electron		1	AO2 5.1.2.5

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 03 · Mark scheme

04.6	potassium (atom) is larger potassium (atom) has more energy levels (of electrons) **or** potassium (atom) has more shells (of electrons)	allow converse for sodium mark independently do **not** accept more outer shells	 1 1	AO2 5.1.2.1 & 5.1.2.5

Total			**11**

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 03 · Mark scheme

June 2019 | 8464/C/1F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 04 · Mark scheme June 2019 | 8464/C/2F | Original Q3

03.1	2	allow multiples of whole equation	1	AO2 5.1.1.1 5.3.1.1 5.6.1.1 10.2.11

03.2	50 cm^3 measuring cylinder		1	AO3 5.6.1.1 10.2.11

03.3	headings: time **and** volume (of gas) units: s **and** cm^3 time values correct (and match units) volume values match time values	allow in either column allow any units of time and volume placed in relevant column ignore incorrect representation of time values if no other marks awarded allow **1** mark for time with correct units or volume with correct units	1 1 1 1	AO2 5.6.1.1 10.2.11

03.4	any **one** from: • concentration of the acid was lower (than expected) • some (gas) escaped • impure magnesium • temperature lower (than expected)	answers must relate to figure 4 ignore answers relating to amount or surface area or time	1	AO3 5.6.1.2 10.2.11

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 04 · Mark scheme June 2019 | 8464/C/2F | Original Q3

03.5	any **two** from: • length of magnesium or surface area of magnesium • volume of acid • temperature (of acid)	 allow mass of magnesium allow same form of magnesium allow same size of magnesium ignore concentration of hydrochloric acid ignore room temperature	2	AO2 5.6.1.2 10.2.11

03.6	increased particles frequently	allow went up allow got bigger allow ions or molecules ignore concentration allow often	1 1 1	AO1 5.6.1.2 5.6.1.3 10.2.11

Total			**12**

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 04 · Mark scheme

June 2019 | 8464/C/2F | Original Q3

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 05 · Mark scheme November 2020 | 8464/C/1F | Original Q4

04.1	$\frac{8}{10} \times 100$ **or** 0.8×100 = 80 (%)	 if no other mark awarded allow **1** mark for 20 (%)	1 1	AO2 5.1.2.3
04.2	any **two** from: • conducts electricity • conducts thermal energy • ductile • high melting point • malleable • shiny • strong	 allow conducts heat allow high boiling point allow can be bent / shaped allow dense allow sonorous ignore chemical properties	2	AO1 5.1.2.3
04.3	$2\ Na + Cl_2 \rightarrow 2\ NaCl$	allow multiples	1	AO2 5.1.2.5 5.1.2.6 5.3.1.1
04.4	electrostatic attractions		1	AO3 5.2.1.3 5.2.2.3
04.5	(heat sodium chloride until) molten / liquid dissolve in water	 allow form aqueous solution allow add water	1 1	AO1 5.2.2.3
Total			**8**	

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 05 · Mark scheme

November 2020 | 8464/C/1F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 06 · Mark scheme November 2020 | 8464/C/2F | Original Q6

06.1	$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$	allow multiples	1	AO2 5.1.1.1 5.7.1.3
06.2	(bubble gas through) lime water	MP2 is dependent upon correct response in MP1 allow (bubble gas through) calcium hydroxide (solution)	1	AO1.2 5.8.2.3
	turns milky / cloudy / white **or** white precipitate forms		1	
06.3	C_3H_6		1	AO2 5.1.1.1 5.7.1.4
06.4	burning / lit splint	MP2 is dependent upon correct response in MP1 allow flame do **not** accept glowing splint	1	AO1 5.8.2.1
	burns with a (squeaky) pop sound	allow pops	1	
06.5	bromine (water)	do **not** accept bromide	1	AO1 5.7.1.4
	(colour change) orange	allow 1 mark for colourless (to) orange	1	
	(to) colourless		1	
		ignore clear		
Total			**9**	

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 06 · Mark scheme

November 2020 | 8464/C/2F | Original Q6

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 07 · Mark scheme

November 2021 | 8464/C/1F | Original Q4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	alkali metals		1	AO1 5.1.2.5
04.2	98 (°C)	allow a value in the range 97–99 (°C)	1	AO2 5.1.2.5
04.3	$2\,Na + 2\,H_2O \rightarrow 2\,NaOH + H_2$	allow multiples	1	AO2 5.1.2.5 5.4.1.1
04.4	(M_r =) 23 + 16 + 1 = 40		1 1	AO2 5.1.2.5 5.3.1.2

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 07 · Mark scheme

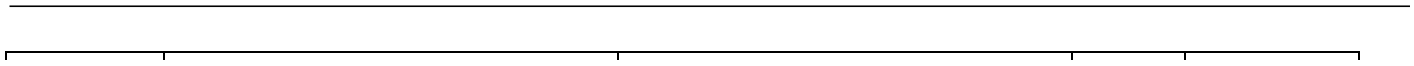
November 2021 | 8464/C/1F | Original Q4

Question	Answers	Mark	AO / Spec. Ref.
04.5	**Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.	3–4	AO1 AO2
	Level 1: Relevant features are identified and differences noted.	1–2	AO1
	No relevant content	0	
	Indicative Content: <u>Similarities – sodium and potassium both:</u> • float • move • bubble / effervesce / fizz • melt • form a ball • get smaller **or** disappear <u>Differences – potassium:</u> • moves faster • bubbles faster • reacts faster • disappears faster • catches fire • lilac flame		5.1.2.5
Total		**9**	

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 07 · Mark scheme

November 2021 | 8464/C/1F | Original Q4



5.3.1.1 Conservation of mass and balanced chemical equations

Answer 08 · Mark scheme

June 2022 | 8464/C/1F | Original Q4

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	**2** Mg + O_2 → 2 MgO	allow multiples	1	AO2 5.1.2.5 5.4.1.1

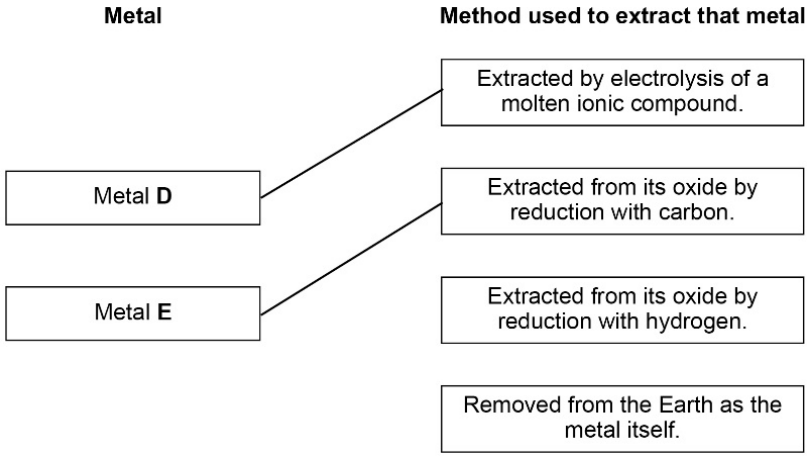
Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	any **one** from: • wear safety glasses / goggles • do not look directly at burning magnesium • wear heat proof glove	allow look through blue glass allow use tongs allow tie hair back	1	AO3 5.4.1.1 5.4.1.2 5.5.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	(M_r =) 24 + (2 × 19) = 62		1 1	AO2 5.1.2.5 5.3.1.2

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 08 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	any **one** from: • argon has a full outer shell • argon has 8 electrons in the outer shell • argon has a stable arrangement of electrons.	allow energy level for shell allow does not need to lose and / or gain electrons	1	AO2
	(so) argon is unreactive	ignore argon is a noble gas	1	AO1 5.1.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	 do **not** accept more than one line from a box on the left		1 1	AO3 5.4.1.2 5.4.1.3 5.4.3.1 5.4.3.2 5.4.3.3

5.3.1.1 Conservation of mass and balanced chemical equations

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	(because) ions (which are) free to move when molten (but are) fixed in solid	 allow reference to charged particles for MP2 and MP3	1 1 1	AO1 5.2.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	(sodium contains) delocalised electrons (which) carry (electrical) charge (through the metal / sodium)	allow free electrons ignore throughout for through ignore current / electricity	1 1	AO1 5.2.2.8

Total Question 4		13

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 09 · Mark scheme

June 2023 | 8464/C/1F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	energy / electricity		1	AO1 5.4.3.1 5.4.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	carbon dioxide		1	AO1 5.4.3.1 5.4.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	sodium reacts with air / oxygen **or** sodium is highly reactive	allow titanium (chloride) reacts with air / oxygen	1	AO3 5.1.2.5 5.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	argon		1	AO3 5.1.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	$TiCl_4 + 4\,Na \longrightarrow Ti + \mathbf{4}\,NaCl$	allow multiples	1	AO2 5.1.1.1 5.4.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	4.4 (g)		1	AO2 5.3.1.1 5.3.1.3

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 09 · Mark scheme

June 2023 | 8464/C/1F | Original Q5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.7	(the) mass decreased (because) carbon dioxide escapes (into the atmosphere)	 allow (because) carbon dioxide is a gas allow (because) a gas is produced	1 1	AO2 5.3.1.1 5.3.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.8	the copper oxide is reduced (reason) (copper oxide) loses oxygen		1 1	AO2 5.4.1.3

Total Question 5	10

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 10 · Mark scheme

June 2023 | 8464/C/2F | Original Q5

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	$CH_4 + \mathbf{2}\,O_2 \rightarrow CO_2 + \mathbf{2}\,H_2O$		1	AO2 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	hydrocarbon molecules in petrol have fewer carbon atoms than those in diesel petrol has a lower boiling point (range) than diesel	allow converse throughout allow petrol is more flammable than diesel allow petrol is less viscous than diesel	1 1	AO3 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	oxygen		1	AO1 5.8.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.4	air	allow the atmosphere allow from volcanoes	1	AO1 5.9.1.1 5.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	global dimming		1	AO2 5.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	(carbon monoxide is) colourless **or** (carbon monoxide is) odourless	ignore clear	1	AO1 5.9.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.7	(diesel) burns at a high temperature **or** (diesel) burns at a temperature greater than 100 °C		1	AO2
	(which is) above the boiling point of water		1	AO3 5.2.2.1 5.9.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.8	sulfur dioxide (is produced when diesel is burnt)		1	AO1 5.9.3.1 5.9.3.2
	(which causes) acid rain		1	
	(which results in) any **one** from: • damage to buildings / statues / bridges • damage to trees / plants • damage to aquatic life • acidification of lakes / rivers / soil • respiratory problems	allow (which affects) asthma	1	

Total Question 5	**12**

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 11 · Mark scheme

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	(molecules) made up of carbon and hydrogen (atoms only)		1	AO1 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	$C_{10}H_{22}$		1	AO2 5.7.1.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	(crude oil) is heated		1	AO1 5.7.1.2
	(so some of the hydrocarbons) vaporise		1	
	the column has a temperature gradient	allow the column gets cooler going up	1	
	(so) the hydrocarbons / fractions condense at different heights / temperatures in the column **or** (and) the hydrocarbons / fractions condense at their boiling points		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	$C_{14}H_{30} \rightarrow C_8H_{18} + \mathbf{2}\,C_3H_6$		1	AO2 5.1.1.1 5.7.1.4

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 11 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	add bromine (water) (bromine water) changes (from orange) to colourless	 allow (bromine water) decolourises ignore clear MP2 is dependent on MP1 being awarded	1 1	AO1 5.7.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	polymer	allow plastic allow hydrocarbon	1	AO1 5.2.1.4 5.7.1.4

Total Question 6	**10**

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 12 · Mark scheme June 2025 | 8464/C/2F | Original Q3

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	formulation		1	AO1 5.8.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	14		1	AO2 5.1.1.1 5.8.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	carbon monoxide is a toxic gas		1	AO1 5.9.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	$2\,CH_4O + 3\,O_2 \rightarrow 2CO_2 + 4\,H_2O$	allow multiples	1	AO2 5.1.1.1 5.3.1.1 5.7.1.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	(test) add a burning splint (result) (hydrogen burns with) a pop sound	do **not** accept glowing splint MP2 is dependent on MP1 being awarded	1 1	AO1 5.8.2.1

Answer 12 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	any **two** from: • melting ice caps • rising sea levels • more flooding • extremes of weather • increase in droughts • increase in wildfires • loss of habitats • reduction in biodiversity • change in migration patterns	allow increase in frequency of storms allow desertification ignore global warming do **not** accept acid rain do **not** accept global dimming do **not** accept deforestation do **not** accept natural disasters do **not** accept references to ozone	2	AO1 5.9.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.7	colour change (from blue to pink)		1	AO2 5.6.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.8	endothermic	allow (thermal) decomposition	1	AO2 5.6.2.2

Total Question 3	10

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 01 · Examiner comments

June 2018 | 8464/C/1F | Original Q2

Question 2 (low & standard demand)

02.4 47% of students knew that the type of reaction between chlorine and potassium bromide solution is called displacement.

02.5 73% of students knew that chlorine is more reactive than bromine because chlorine gains electrons more easily.

02.6 60% of students understood that a chlorine atom is smaller than a bromine atom.

Answer 07 · Examiner comments

November 2021 | 8464/C/1F | Original Q4

Question 4 (low and standard demand)

04.1 More than two thirds of students knew that the name of the Group 1 elements is the alkali metals.

04.2 More than two thirds of students were able to determine the melting point of sodium from the bar chart recognising the *y*-axis scale of 1 small square being equal to 4 °C.

04.3 Nearly two thirds of students were able to balance the chemical equation.

04.4 More than half of students successfully calculated the relative formula mass of sodium hydroxide.

04.5 This extended response question required students to compare the observations when sodium and potassium are reacted with water. Approximately half of students either recalled or used the figure to state that with sodium fizzing occurs. Other observations seen included sodium melting, forming a ball and moving. A comparison of the similarities and differences between these metals and also the magnitude of these was required to achieve level two.

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 08 · Examiner comments — June 2022 | 8464/C/1F | Original Q4

Question 4 (Low and standard demand)

04.1 More than 70% of students correctly balanced the equation. Some students changed the formula, usually from MgO to MgO_2

04.2 Almost three-quarters of students stated a safety precaution that should be taken when heating magnesium and oxygen. The most common correct responses were to wear eye protection and to use tongs.

04.3 Almost one-quarter of students gave the correct answer for the relative formula mass of magnesium fluoride. These students recognised that the subscript 2 means the relative atomic mass of fluorine needed to be doubled before being added to the relative atomic

Answer 08 · Examiner comments — June 2022 | 8464/C/1F | Original Q4

mass of magnesium. Many showed clear steps in their calculation. The most common errors were to either add or multiply 24 and 19.

04.4 Magnesium does not react when heated with argon - argon is unreactive because argon atoms have eight electrons in the outer shell. Common responses referred to magnesium (and argon) both being unreactive, that metals (or solids) do not react with gases or that both elements had full outer shells. This question discriminated well.

04.5 Almost 60% of students gained at least one of the two marks for correctly deducing the method used to extract a metal. The students were given a reactivity series showing the position of these two metals compared to other known metals, carbon and hydrogen.

04.6 Students found difficulty in explaning why sodium chloride conducts electricity when molten but not when a solid. Many indicated that this was due to something being able to move but failed to link this to ions or charged particles. Most referred to moving particles, atoms or electrons.

04.7 Students also found difficulty in explaning why sodium conducts electricity when solid. Delocalised electrons were rarely seen as was the concept of these delocalised electrons carrying charge through the sodium.

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 09 · Examiner comments

June 2023 | 8464/C/1F | Original Q5

Question 5 (low/standard demand)

05.1 More than a third of students knew that the extraction of aluminium is expensive because the process uses large amounts of energy. Heat was a very common response that was insufficient to gain credit.

05.2 More than 50% of students knew that carbon dioxide is produced when oxygen reacts with the positive carbon electrodes when aluminium is extracted by electrolysis from a molten mixture of aluminium oxide and cryolite.

05.3 Only a very small number of students were able to suggest that when titanium was extracted from a mixture of titanium chloride and sodium an inert atmosphere was essential to prevent the sodium reacting with air.

05.4 A third of students knew that argon is used for the inert atmosphere when titanium is extracted from a mixture of titanium chloride and sodium.

05.5 Just over half of the students correctly balanced the equation for the reaction of sodium with titanium chloride. Students should be aware that they should not change the formula of the compounds in the equation.

05.6 Students should know that the law of conservation of mass states that the mass of reactants equals to the mass of products. In this experiment the mass of carbon dioxide produced equals the difference between the sum of the mass of copper oxide and carbon (reactants) minus the mass of copper produced (other product). Only 20% of students calculated this correctly.

05.7 Students were asked to explain why the mass of a mixture of copper oxide and carbon in a crucible changed when the mixture was heated. Few students recognised that the mass would decrease because the carbon dioxide produced is a gas that escapes into the atmosphere. The term evaporation was incorrectly used by a large number of students. Only a small number of students gained two marks.

05.8 This question asked what happens to copper oxide in the reaction between copper oxide and carbon. Students should be careful with their use of technical terms as many incorrectly stated that ‘copper’ loses oxygen. Approximately 30% of students knew that copper oxide was reduced but very few students were then able to give a reason why.

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 10 · Examiner comments June 2023 | 8464/C/2F | Original Q5

Question 5

05.1 Around a third of students successfully balanced the equation. Having to balance two numbers in the equation led to many students trying to add other atoms, usually C and/or H to the equation.

05.2 One in five students gained both marks for comparing petrol and diesel. A further third gained one mark. On this occasion, students needed to interpret what the table headings meant, so many were not able to gain credit as they referred to the range of numbers of carbons, rather than the number of carbons and similarly, though more infrequent, for the boiling points.

05.3 Three in five students identified oxygen as the common element in the compounds released from a car engine.

05.4 Only 15% of students were able to identify that nitrogen came from the air. Much more common suggestions were from the engine or the diesel fuel.

05.5 This question tested a little known part of the specification, with fewer than one in twenty identifying global dimming as a consequence of particulates in the atmosphere. By far the most common incorrect response was for global warming.

05.6 Just below half of students could answer that carbon monoxide is either colourless or odourless. Many students gave both, despite being asked for one.

05.7 Fewer than one in ten gained any marks on this question, which was applying ideas from across the specification. Just a statement that water evaporates was insufficient for credit, as there needed to be a realisation that water is produced as a vapour, rather than turning into a vapour during the process.

Answer 10 · Examiner comments June 2023 | 8464/C/2F | Original Q5

05.8 Around one in ten students gained at least one mark on this question, usually for recognising that sulfur is responsible for acid rain. The consequences of acid rain were not well known, and even fewer knew that sulfur enters the atmosphere as sulfur dioxide. Global warming was the most common incorrect response.

5.3.1.1 Conservation of mass and balanced chemical equations

Answer 11 · Examiner comments

June 2024 | 8464/C/2F | Original Q6

Question 6 (standard demand)

06.1 Few students knew the definition of a hydrocarbon. A ‘mixture’ and an ‘atom’ were seen frequently.

06.2 This AO2 determination of a formula of a hydrocarbon was not done very well, with fewer than a fifth of students gaining the mark. Many responses had ‘n’ in the formula, and it was expected that the tops of the numbers were clearly below the tops of the letters, following chemical convention in writing formulas.

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5.3.1.1 Conservation of mass and balanced chemical equations

Answer 11 · Examiner comments June 2024 | 8464/C/2F | Original Q6

06.3 This question has typically been targeted at high demand in previous years. However, this year it was set at standard demand, with the diagram containing more detail and the mark scheme for loosened a little to separate the first two marking points. Most students were able to make a start on the explanation of fractional distillation.

Four marks were available for this question. Most students who gained 1 mark did so for correctly identifying that the crude oil is heated. Some students indicated that the crude oil was heated once it was in the fractional distillation column itself, which was not creditworthy. Fewer students were able to explain that some of the hydrocarbons were vaporised/evaporated/boiled or turned into a gas for marking point 2. Very few students explained that there was a temperature gradient in the column even though this could have been explained as a comparative statement, for example, the column is cooler at the top or by using sensible temperature values. Few students were able to explain that the hydrocarbons/fractions condensed or were able to give a clear description of condensation.

The most common responses that gained no marks referred to the different sizes and boiling points of the hydrocarbons/fractions.

06.4 Many students were able to correctly balance the equation. The most common incorrect response was to rewrite the formula C_3H_6 on the answer line.

06.5 The test for alkenes was not well known by students. The most common incorrect responses referred to using universal indicator, limewater or a lit splint.

When students correctly identified bromine (water) as the correct test most also then gained the second marking point for the correct colour change. The most common incorrect response identified bromine (water) as being red.

06.6 Given the prompts in the stem of this question it was expected that it would be well answered; however, this was not the case. The most common creditworthy answer was for identifying the poly(propene) as being a hydrocarbon with a few students identifying it as being a polymer or plastic. The most common incorrect response referred to it being an alkene.

Answer 12 · Examiner comments

June 2025 | 8464/C/2F | Original Q3

Question 3 (Low and Standard demand)

03.1 Well over half of all students recognised screenwash as a formulation.

03.2 Nearly three quarters of students were able to work out the number of atoms in one molecule of glycerol correctly as 14.

03.3 Most students could state that carbon monoxide is a toxic gas. The most common incorrect response was that carbon monoxide is a greenhouse gas.

03.4 Many students were able to correctly balance the equation. A significant number however incorrectly added an H or CH in front of the CO_2
There was clear evidence of many pupils working out the numbers of individual atoms to correctly balance the equation.

03.5 Many students remembered that hydrogen burns with a pop or squeaky pop however far fewer identified that a burning/lit splint was needed in order for that to happen, therefore neither mark could be awarded.

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Answer 12 · Examiner comments

June 2025 | 8464/C/2F | Original Q3

The most common incorrect response referred to using a glowing splint, confusing the test for oxygen and hydrogen.
When students correctly identified a burning/lit splint as the correct test, most also then went on to state the correct result and gained both marks.

03.6 Many students were able to correctly give one effect of global climate change, but fewer were able to correctly give two. The most common creditworthy responses were for identifying 'melting ice caps' and 'rising sea levels'.
Many responses referring to floods, storms and wildfires but could not gain credit as they were not comparative. The question was looking for the idea that there would be '*more* floods' for example, as floods happen without climate change.
Very few students answered in terms of a reduction in biodiversity or changes to migration patterns.

03.7 Many students correctly recognised that the anhydrous cobalt chloride would change colour or described the correct colour change. Incorrect responses often referred to the water or solution changing colour, or included additional observations, such as 'fizzing' or 'bubbles'.

03.8 Many students correctly identified the type of reaction as being endothermic.