AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.3.1.1

Conservation of mass and balanced chemical equations

Past-paper questions

Tier	**Foundation**
Question groups	**17**
Available paper years	**2007–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.3.1.1 Conservation of mass and balanced chemical equations

Question 01

June 2007 | CHY1A | Original Q1 | Legacy

QUESTION ONE

The balanced, symbol equation shows the atoms involved in a chemical reaction.

$Fe_2O_3(s)$	+	$3CO(g)$	→	$2Fe(s)$	+	$3CO_2(g)$
iron oxide		carbon monoxide		iron		carbon dioxide

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A atom

B compound

C element

D symbol

O is the . . . **1** . . . for oxygen.

Fe_2O_3 is the formula for the . . . **2** . . . , iron oxide.

Fe represents one . . . **3** . . . of iron.

Carbon is a soft, black, non-metal . . . **4** . . . .

4.3.1.1 Conservation of mass and balanced chemical equations

Question 02

7 Copper is a widely used metal. The main ore of copper contains copper sulfide. Copper can be extracted from copper sulfide in a three stage process.

(a) In the first stage of extraction the copper sulfide is heated in air.

(i) Balance the symbol equation for the reaction.

$$Cu_2S + ...O_2 \rightarrow .....CuO + SO_2$$

(1 mark)

(ii) Explain why there would be an environmental problem if the gas from this reaction were allowed to escape into the atmosphere.

.....

.....

.....

.....

(2 marks)

(b) In the second stage copper oxide, CuO, is reduced using carbon.

Describe and explain what happens during this reaction.

.....

.....

.....

.....

(2 marks)

4.3.1.1 Conservation of mass and balanced chemical equations

Question 02 · continued

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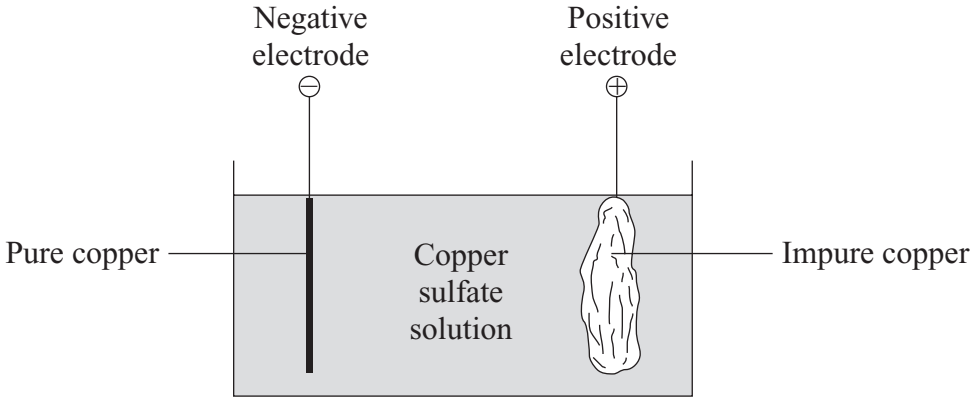
(c) During the third stage the copper can be purified as shown in the diagram.



(i) What is the name of the type of process used for this purification?

.....

(1 mark)

(ii) Give **one** use of purified copper.

.....

(1 mark)

(d) Copper-rich ores are running out.

New ways of extracting copper from low grade ores are being researched.

Recycling of copper may be better than extracting copper from its ores.

Explain why.

.....

.....

.....

.....

.....

.....

(3 marks)

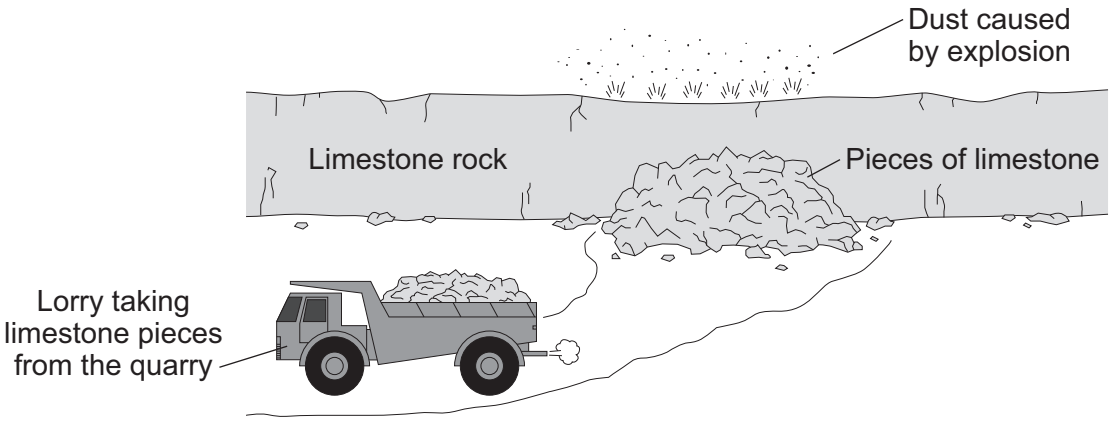
10

4.3.1.1 Conservation of mass and balanced chemical equations

Question 03

June 2010 | CHY1F | Original Q1 | Legacy

1 In a quarry, limestone is blasted into pieces by explosives.
The pieces of limestone are taken from the quarry by lorries.



1 (a) Draw a ring around the correct word in the box to complete the sentence.

Limestone can be used as a | building / plastic / smart | material.

(1 mark)

1 (b) Tick (✓) **one** possible advantage for people who live near to the limestone quarry.

Advantage	Tick (✓)
causes more traffic	
provides jobs	
attracts tourists to the area	

(1 mark)

4.3.1.1 Conservation of mass and balanced chemical equations

Question 03 · continued

1 (c) Give **two** types of pollution that would be caused by the limestone quarry.

1 .....

2 .....

(2 marks)

1 (d) Limestone contains calcium carbonate ($CaCO_3$).

Complete the **two** empty boxes in the table about the formula of calcium carbonate.

Name of element	Symbol for the element	Number of atoms in the formula
calcium	Ca	1
carbon	C	1
oxygen	.....	.....

(2 marks)

1 (e) Lorries take some of the limestone to be heated in a lime-kiln.
Calcium carbonate, in the limestone, decomposes when heated.

Use the balanced chemical equation to help you complete the word equation for the decomposition of calcium carbonate.

$CaCO_3$ → CaO + CO_2

calcium carbonate → ..... + carbon dioxide

(1 mark)

7

4.3.1.1 Conservation of mass and balanced chemical equations

Question 04

June 2011 | CHY1AP | Original Q5 | Legacy

QUESTION FIVE

A mixture of iron oxide and aluminium reacts when heated.

This is the balanced equation for the reaction:

$$Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe$$

Symbols	
Fe	Iron
O	Oxygen
Al	Aluminium

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A electrons

B bonds

C products

D elements

Iron oxide and aluminium are the reactants. Aluminium oxide and iron are the . . . **1** . . . .

Aluminium atoms and oxygen atoms combine by transferring . . . **2** . . . .

The particles (ions) in aluminium oxide are held together by . . . **3** . . . .

The equation is balanced because, in the reaction, there is no change in the total number of atoms of each of the . . . **4** . . . .

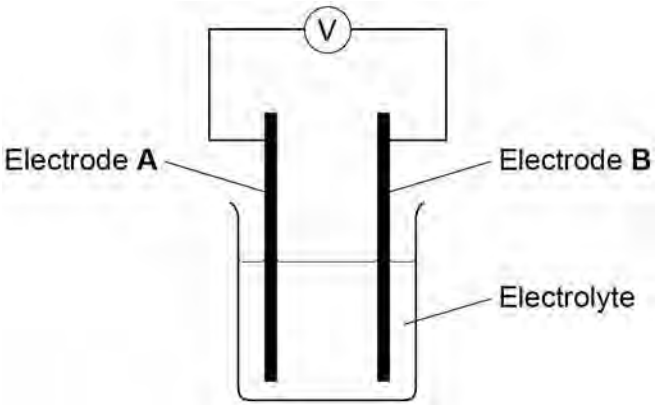
4.3.1.1 Conservation of mass and balanced chemical equations

Question 05

1 0 Chemical reactions can produce electricity.

1 0 . 1 **Figure 13** shows a simple cell.

Figure 13



Which of these combinations would **not** give a zero reading on the voltmeter in **Figure 13**?

[1 mark]

Tick **one** box.

Electrode A	Electrode B	Electrolyte	
Copper	Copper	Sodium chloride solution	☐
Zinc	Zinc	Water	☐
Copper	Zinc	Sodium chloride solution	☐
Copper	Zinc	Water	☐

4.3.1.1 Conservation of mass and balanced chemical equations

Question 05 · continued

June 2018 | 8462/1F | Original Q10

Alkaline batteries are non-rechargeable.

1 0 . 2 Why do alkaline batteries eventually stop working?

[1 mark]

1 0 . 3 Why can alkaline batteries **not** be recharged?

[1 mark]

Question 10 continues on the next page

4.3.1.1 Conservation of mass and balanced chemical equations

Question 05 · continued

Hydrogen fuel cells and rechargeable lithium-ion batteries can be used to power electric cars.

10.4 Complete the balanced equation for the overall reaction in a hydrogen fuel cell.

[2 marks]

_____ H_2 + _____ → _____ H_2O

10.5 **Table 7** shows data about different ways to power electric cars.

Table 7

	Hydrogen fuel cell	Rechargeable lithium-ion battery
Time taken to refuel or recharge in minutes	5	30
Distance travelled before refuelling or recharging in miles	Up to 415	Up to 240
Distance travelled per unit of energy in km	22	66
Cost of refuelling or recharging in £	50	3
Minimum cost of car in £	60 000	18 000

Evaluate the use of hydrogen fuel cells compared with rechargeable lithium-ion batteries to power electric cars.

Use **Table 7** and your own knowledge.

[6 marks]

4.3.1.1 Conservation of mass and balanced chemical equations

Question 05 · continued

June 2018 | 8462/1F | Original Q10

11

4.3.1.1 Conservation of mass and balanced chemical equations

Question 06

June 2018 | 8462/2F | Original Q1

0 1 This question is about copper sulfate.

Blue copper sulfate turns white when it is heated.

The word equation for the reaction is:

hydrated copper sulfate ⇌ anhydrous copper sulfate + water

blue white

0 1 . 1 What name is given to hydrated copper sulfate in this reaction?

[1 mark]

Tick **one** box.

- Catalyst ☐
- Element ☐
- Product ☐
- Reactant ☐

0 1 . 2 What does the symbol ⇌ mean?

[1 mark]

Tick **one** box.

- Endothermic ☐
- Exothermic ☐
- Reversible ☐
- Polymerisation ☐

4.3.1.1 Conservation of mass and balanced chemical equations

Question 06 · continued

0 1 . 3 Complete the sentence.

[1 mark]

The colour change when water is added to anhydrous copper sulfate

is white to _____ .

A student heats 2.5 g of hydrated copper sulfate in a test tube.

0.9 g of water is given off.

The remaining solid is anhydrous copper sulfate.

0 1 . 4 Calculate the mass of anhydrous copper sulfate produced.

[1 mark]

_____

_____

Mass of anhydrous copper sulfate = _____ g

0 1 . 5 Calculate the percentage of water contained in 2.5 g of hydrated copper sulfate.

[2 marks]

_____

_____

_____

Percentage of water = _____ %

Question 1 continues on the next page

4.3.1.1 Conservation of mass and balanced chemical equations

Question 06 · continued

0 1 . 6 Draw **one** line from each compound to the formula for the compound.

[2 marks]

Compound	Formula for the compound
Copper sulfate	CuO
	CuS
	$CuSO_4$
Water	H_2O
	H_2SO_4

4.3.1.1 Conservation of mass and balanced chemical equations

Question 07

November 2020 | 8462/1F | Original Q1

0 1 This question is about the elements in Group 7 of the periodic table.

Table 1 shows the melting points and boiling points of some of the elements.

Table 1

Element	Melting point in °C	Boiling point in °C
Fluorine	–220	–188
Chlorine	–101	–35
Bromine	–7	59

0 1 . 1 What is the state of bromine at 100 °C?

Use **Table 1**.

[1 mark]

Tick (✓) **one** box.

Gas ☐

Liquid ☐

Solid ☐

4.3.1.1 Conservation of mass and balanced chemical equations

Question 07 · continued

0 1 . 2 What temperature does chlorine gas condense at to form a liquid?

Use **Table 1**.

[1 mark]

Temperature = _____ °C

0 1 . 3 Complete the sentences.

[2 marks]

Going down Group 7 the melting points _____.

This is because the size of the molecules increases so the

intermolecular forces _____.

Question 1 continues on the next page

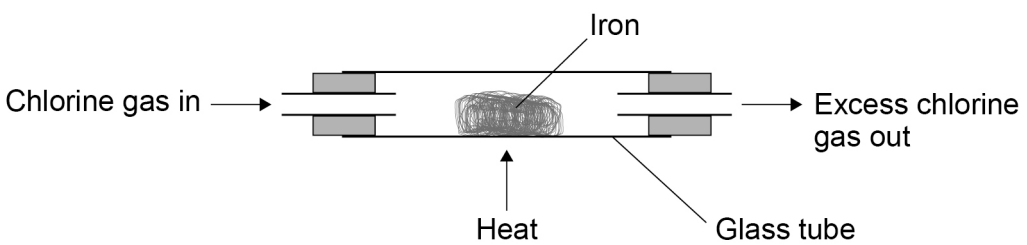
4.3.1.1 Conservation of mass and balanced chemical equations

Question 07 · continued

A teacher investigated the reaction of iron with chlorine.

Figure 1 shows the apparatus used.

Figure 1



0 1 . 4 Why did the teacher do the investigation in a fume cupboard?

[1 mark]

Tick (✓) **one** box.

Chlorine gas is coloured. ☐

Chlorine gas is flammable. ☐

Chlorine gas is toxic. ☐

4.3.1.1 Conservation of mass and balanced chemical equations

Question 07 · continued

0 1 . 5 The word equation for the reaction is:

iron + chlorine → iron chloride

Iron chloride is a solid.

The teacher weighed the glass tube and contents:

- before the reaction
- after the reaction.

What happened to the mass of the glass tube and contents during the reaction?

Give **one** reason for your answer.

[2 marks]

The mass of the glass tube and contents _____.

Reason _____

_____

Question 1 continues on the next page

4.3.1.1 Conservation of mass and balanced chemical equations

Question 07 · continued

The teacher repeated the investigation with bromine gas and with iodine gas.

Table 2 shows the results.

Table 2

Element	Observation
Chlorine	Iron burns vigorously with an orange glow
Bromine	Iron burns with an orange glow
Iodine	Iron slowly turns darker

0 1 . 6 Fluorine is above chlorine in Group 7.

Predict what you would observe when fluorine gas reacts with iron.

Use **Table 2**.

[1 mark]

0 1 . 7 Balance the equation for the reaction between iron and bromine.

[1 mark]

$$2Fe + _____ Br_2 \rightarrow 2FeBr_3$$

0 1 . 8 Calculate the relative formula mass (M_r) of $FeBr_3$

Relative atomic masses (A_r): Fe = 56 Br = 80

[2 marks]

Relative formula mass (M_r) = _____

11

4.3.1.1 Conservation of mass and balanced chemical equations

Question 08

November 2020 | 8462/1F | Original Q10

1 0 This question is about silver iodide.

Silver iodide is produced in the reaction between silver nitrate solution and sodium iodide solution.

The equation for the reaction is:

$$AgNO_3(aq) + NaI(aq) \rightarrow AgI(s) + NaNO_3(aq)$$

1 0 . 1 A student investigated the law of conservation of mass.

This is the method used.

1. Pour silver nitrate solution into a beaker labelled **A**.
2. Pour sodium iodide solution into a beaker labelled **B**.
3. Measure the masses of both beakers and their contents.
4. Pour the solution from beaker **B** into beaker **A**.
5. Measure the masses of both beakers and their contents again.

Table 7 shows the student's results.

Table 7

	Mass before mixing in g	**Mass after mixing in g**
Beaker **A** and contents	78.26	108.22
Beaker **B** and contents	78.50	48.54

Explain how the results demonstrate the law of conservation of mass.

You should use data from **Table 7** in your answer.

[2 marks]

4.3.1.1 Conservation of mass and balanced chemical equations

Question 08 · continued

1 0 . 2 Suggest how the student could separate the insoluble silver iodide from the mixture at the end of the reaction.

[1 mark]

The student purified the separated silver iodide.

This is the method used.

1. Rinse the silver iodide with distilled water.

2. Warm the silver iodide.

1 0 . 3 Suggest **one** impurity that was removed by rinsing with water.

[1 mark]

1 0 . 4 Suggest why the student warmed the silver iodide.

[1 mark]

Question 10 continues on the next page

4.3.1.1 Conservation of mass and balanced chemical equations

Question 08 · continued November 2020 | 8462/1F | Original Q10

10.5 Calculate the percentage atom economy for the production of silver iodide in this reaction.

The equation for the reaction is:

$$AgNO_3(aq) + NaI(aq) \rightarrow AgI(s) + NaNO_3(aq)$$

Give your answer to 3 significant figures.

Relative formula masses (M_r): $AgNO_3 = 170$ NaI = 150 AgI = 235 $NaNO_3 = 85$

[4 marks]

Percentage atom economy (3 significant figures) = _____ %

10.6 Give **one** reason why reactions with a high atom economy are used in industry.

[1 mark]

10

4.3.1.1 Conservation of mass and balanced chemical equations

Question 09

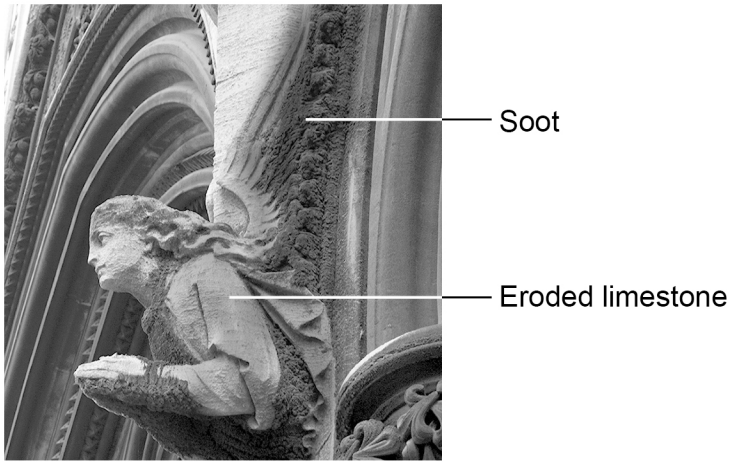
0 2 This question is about atmospheric pollution.

Figure 3 shows a limestone carving which has been damaged by atmospheric pollution.

The carving has been:

- blackened by soot
- eroded where the limestone has reacted with atmospheric pollutants.

Figure 3



0 2 . 1 What reacted with the limestone to cause the erosion?

[1 mark]

Tick (✓) **one** box.

- Acid rain ☐
- Ammonia ☐
- Carbon monoxide ☐
- Oxygen ☐

4.3.1.1 Conservation of mass and balanced chemical equations

Question 09 · continued

0 2 . 2 Soot is produced by the incomplete combustion of diesel oil.

Complete the sentences.

Choose answers from the box.

[2 marks]

ammonia	**carbon**	**methane**
	nitrogen	**oxygen**

Incomplete combustion happens when there is not enough _____.

Incomplete combustion produces particles of _____.

0 2 . 3 Complete the sentence.

[1 mark]

Particles of soot in the atmosphere cause global _____.

0 2 . 4 Carbon monoxide is produced by the incomplete combustion of methane.

Balance the equation for the reaction.

[1 mark]

$$2\,CH_4 + 3\,O_2 \rightarrow ____\,CO + 4\,H_2O$$

4.3.1.1 Conservation of mass and balanced chemical equations

Question 09 · continued

0 2 . 5 Car engines work at high temperatures.

Complete the sentences.

Choose answers from the box.

[3 marks]

air	**methane**	**oxides of nitrogen**
oxygen	**petrol**	**sulfur dioxide**

In car engines, nitrogen is present.

The nitrogen in car engines comes from _____.

At high temperatures, the nitrogen reacts with _____.

This reaction produces _____.

8

4.3.1.1 Conservation of mass and balanced chemical equations

Question 10

November 2021 | 8462/1F | Original Q5

0 5 This question is about acids and alkalis.

0 5 . 1 Which ion do acids produce in aqueous solution?

[1 mark]

Tick (✓) **one** box.

H^+ ☐ OH^- ☐ O^{2-} ☐

0 5 . 2 Acids react with alkalis.

What is the name of this type of reaction?

[1 mark]

Tick (✓) **one** box.

Decomposition ☐

Electrolysis ☐

Neutralisation ☐

Redox ☐

0 5 . 3 Balance the equation for the reaction between sulfuric acid and potassium hydroxide.

[1 mark]

$$H_2SO_4 + ____ KOH \rightarrow K_2SO_4 + ____ H_2O$$

0 5 . 4 Universal indicator turns purple in potassium hydroxide solution.

What is the pH of the solution?

[1 mark]

Tick (✓) **one** box.

1 ☐ 4 ☐ 7 ☐ 14 ☐

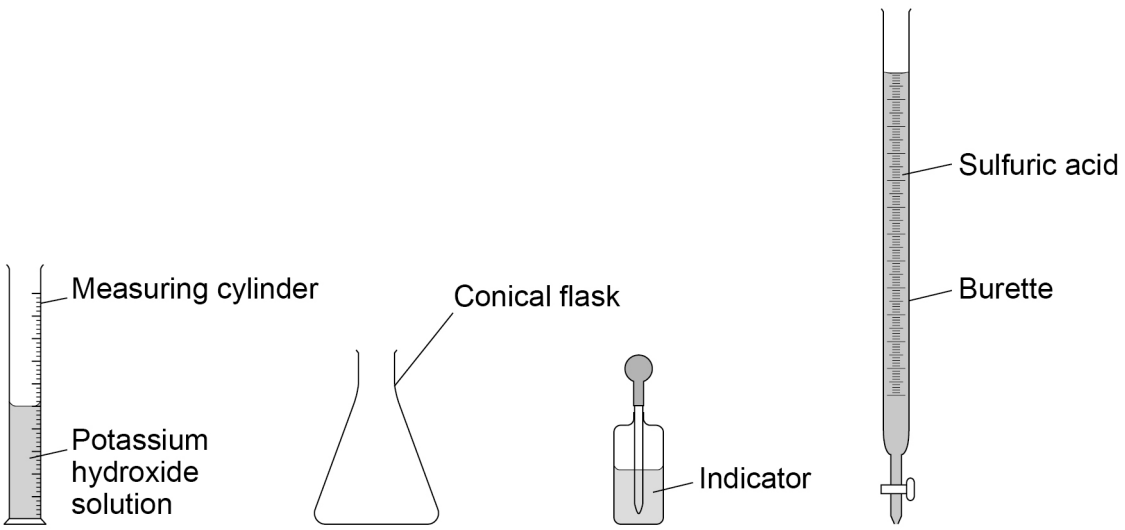
4.3.1.1 Conservation of mass and balanced chemical equations

Question 10 · continued

A student does a titration to find the volume of sulfuric acid that reacts with 25 cm^3 of potassium hydroxide solution.

Figure 7 shows the equipment used.

Figure 7



0 5 . 5 The 25 cm^3 of potassium hydroxide solution is measured with the measuring cylinder.

Which piece of equipment could the student use to measure the 25 cm^3 of potassium hydroxide solution more accurately?

[1 mark]

Tick (✓) **one** box.

- Beaker ☐
- Evaporating basin ☐
- Pipette ☐
- Test tube ☐

4.3.1.1 Conservation of mass and balanced chemical equations

Question 10 · continued

0 5 . 6 Describe how the student would use the equipment in **Figure 7** to complete the titration.

[5 marks]

10

4.3.1.1 Conservation of mass and balanced chemical equations

Question 11

November 2021 | 8462/2F | Original Q7

0 7 This question is about organic compounds.

0 7 . 1 Butane is an alkane with small molecules.

Complete the sentence.

Choose the answer from the box.

[1 mark]

fertiliser	**formulation**	**fuel**

Butane can be used as a _____.

0 7 . 2 Poly(propene) is a polymer.

What is the name of the monomer used to produce poly(propene)?

[1 mark]

Tick (✓) **one** box.

- Propane ☐
- Propanoic acid ☐
- Propanol ☐
- Propene ☐

4.3.1.1 Conservation of mass and balanced chemical equations

Question 11 · continued

Ethene and steam react to produce ethanol.

The equation for the reversible reaction is:

ethene + steam ⇌ ethanol

0 7 . 3 The reaction produces a maximum theoretical mass of 400 kg of ethanol from 243 kg of ethene and 157 kg of steam.

A company produces 380 kg of ethanol from 243 kg of ethene and 157 kg of steam.

The percentage yield of ethanol is less than 100%

Calculate the percentage yield of ethanol.

Use the equation:

$$\text{percentage yield of ethanol} = \frac{\text{mass of ethanol actually made}}{\text{maximum theoretical mass of ethanol}} \times 100$$

[2 marks]

Percentage yield = _____ %

0 7 . 4 What are **two** possible reasons why the percentage yield of ethanol is less than 100%?

[2 marks]

Tick (✓) **two** boxes.

- Ethanol is the only product of the reaction. ☐
- Ethanol is very unreactive. ☐
- Some ethanol changes back into ethene and steam. ☐
- Some ethanol escapes from the apparatus. ☐
- Some ethanol reacts with steam. ☐

4.3.1.1 Conservation of mass and balanced chemical equations

Question 11 · continued

0 7 . 5 Ethanol burns in oxygen.

Balance the equation for the reaction.

[1 mark]

$$C_2H_5OH + ___ O_2 \rightarrow 3H_2O + 2CO_2$$

0 7 . 6 Two processes for producing ethanol are:

- fermentation
- hydration (reacting ethene with steam).

Table 5 shows information about the processes.

Table 5

Feature	Process	
	Fermentation	**Hydration**
Raw material	sugar	crude oil
Energy usage	low	high
Rate of reaction	slow	fast
Purity of ethanol	15%	98%

Give **two** advantages and **two** disadvantages of using fermentation to produce ethanol.

[4 marks]

Advantage of fermentation 1 _____

_____

Advantage of fermentation 2 _____

_____

Disadvantage of fermentation 1 _____

_____

Disadvantage of fermentation 2 _____

_____

11

4.3.1.1 Conservation of mass and balanced chemical equations

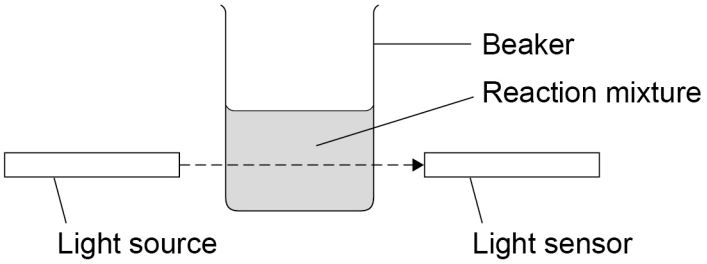
Question 12

June 2022 | 8462/2F | Original Q6

0 6 A student investigated the rate of reaction between sodium thiosulfate solution and hydrochloric acid.

Figure 7 shows the apparatus used.

Figure 7



When hydrochloric acid is added to sodium thiosulfate solution, the mixture gradually becomes cloudy.

A smaller percentage of light from the light source reaches the light sensor as the mixture becomes more cloudy.

This is the method used.

1. Measure 50 cm^3 of sodium thiosulfate solution into the beaker.
2. Add 10 cm^3 of hydrochloric acid to the sodium thiosulfate solution.
3. Immediately start a timer.
4. Record the percentage of light from the light source that reaches the light sensor every 20 seconds for 120 seconds.

0 6 . 1 Balance the equation for this reaction.

[1 mark]

$$Na_2S_2O_3 + 2\,HCl \rightarrow ____\ NaCl + H_2O + SO_2 + S$$

4.3.1.1 Conservation of mass and balanced chemical equations

Question 12 · continued

0 6 . 2 The mixture becomes cloudy because the sulfur produced is a solid.

What is the state symbol for a solid?

[1 mark]

Tick (✓) **one** box.

(aq) ☐

(g) ☐

(l) ☐

(s) ☐

0 6 . 3 The student monitored the cloudiness of the reaction mixture using a light sensor.

What other piece of equipment could be used to monitor the cloudiness of the reaction mixture?

[1 mark]

Tick (✓) **one** box.

A balance ☐

A cross on a piece of paper ☐

A gas syringe ☐

A thermometer ☐

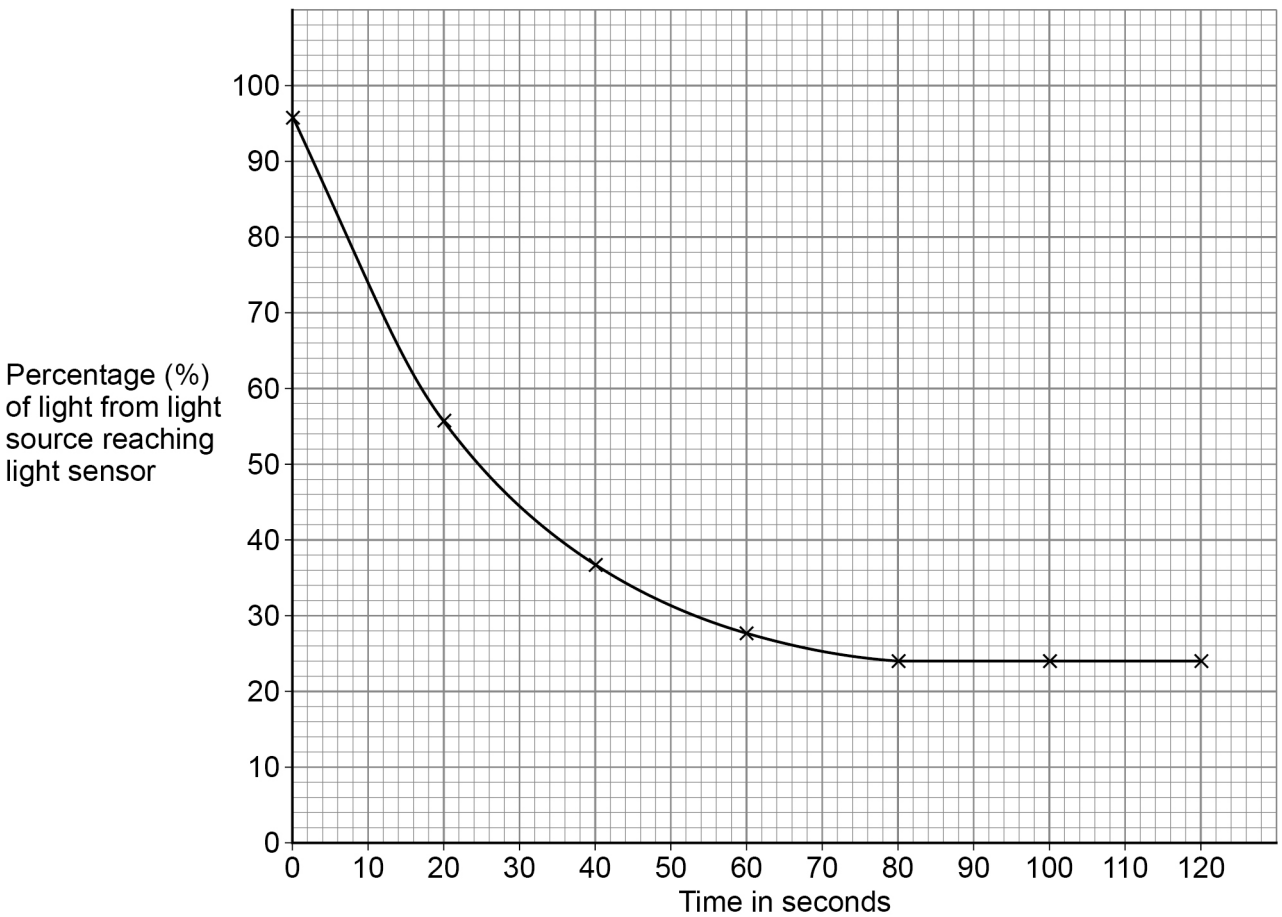
Question 6 continues on the next page

4.3.1.1 Conservation of mass and balanced chemical equations

Question 12 · continued

Figure 8 shows the results.

Figure 8



0 6 . 4 What happened to the rate of reaction between 40 and 60 seconds?

Use **Figure 8**.

[1 mark]

Tick (✓) **one** box.

The rate of reaction decreased. ☐

The rate of reaction stayed at zero. ☐

The rate of reaction increased. ☐

4.3.1.1 Conservation of mass and balanced chemical equations

Question 12 · continued

0 6 . 5 The student stopped taking measurements after 120 seconds because the percentage of light reaching the sensor stayed constant.

Why did the percentage of light reaching the sensor stay constant?

[1 mark]

Tick (✓) **one** box.

- No light was reaching the sensor. ☐
- One of the reactants was used up. ☐
- The reaction was too vigorous. ☐

0 6 . 6 The student repeated the experiment using sodium thiosulfate solution of a higher concentration.

How would the line of best fit for sodium thiosulfate solution of a higher concentration compare with the line of best fit on **Figure 8**?

[1 mark]

Tick (✓) **one** box.

- Initially the line of best fit would be less steep. ☐
- Initially the line of best fit would be the same steepness. ☐
- Initially the line of best fit would be steeper. ☐

Question 6 continues on the next page

4.3.1.1 Conservation of mass and balanced chemical equations

Question 12 · continued

0 6 . 7 The student then investigated the effect of changing the temperature on the rate of reaction.

The student used sodium thiosulfate solution and hydrochloric acid which had been kept in an ice bath.

Which are **two** effects of using reactants kept in an ice bath rather than at room temperature?

[2 marks]

Tick (✓) **two** boxes.

- Fewer reactant particles have the activation energy. ☐
- The reactant particles collide more frequently. ☐
- The reactant particles have more energy. ☐
- The reactant particles move more slowly. ☐
- There are fewer reactant particles in the same volume. ☐

8

4.3.1.1 Conservation of mass and balanced chemical equations

Question 13

June 2023 | 8462/1F | Original Q8

0 8 This question is about displacement reactions.

Iron is extracted from iron oxide by a displacement reaction with carbon.

0 8 . 1 Balance the equation for the reaction.

[2 marks]

$$Fe_2O_3 + 3\,C \rightarrow ____Fe + ____CO$$

0 8 . 2 Iron oxide is reduced in this reaction.

How does the equation show that iron oxide is reduced?

[1 mark]

0 8 . 3 Calculate the relative formula mass (M_r) of Fe_2O_3

Relative atomic masses (A_r): O = 16 Fe = 56

[2 marks]

M_r = _____

Question 8 continues on the next page

Question 13 · continued

0 8 . 4 Copper oxide reacts with hydrogen to produce copper.

The equation for the reaction is:

$$CuO + H_2 \rightarrow Cu + H_2O$$

Calculate the percentage atom economy for obtaining copper from this reaction.

Use the equation:

$$\text{Percentage atom economy} = \frac{A_r \text{ of Cu}}{M_r \text{ of } H_2 + M_r \text{ of CuO}} \times 100$$

Relative atomic mass (A_r): Cu = 63.5
Relative formula masses (M_r): H_2 = 2 CuO = 79.5

[2 marks]

Percentage atom economy = _____ %

A student investigated the reactivity of four different metals, **A**, **B**, **C** and **D**.

The student:

- added each metal to aqueous solutions of each of the metal sulfates
- observed whether a reaction took place.

0 8 . 5 Give **one** observation that would show a reaction took place.

[1 mark]

4.3.1.1 Conservation of mass and balanced chemical equations

Question 13 · continued

0 8 . 6 **Table 4** shows the results.

Table 4

	Metal sulfate solution			
Metal	**A sulfate**	**B sulfate**	**C sulfate**	**D sulfate**
A	×	×	✓	×
B	✓	×	✓	×
C	×	×	×	×
D	✓	✓	✓	×

✓ shows that a displacement reaction took place.
× shows that a displacement reaction did not take place.

Write metals **A**, **B**, **C** and **D** in order of reactivity.

Give a reason for your order of reactivity.

[2 marks]

Most reactive _____

_____

_____

Least reactive _____

Reason _____

_____

10

4.3.1.1 Conservation of mass and balanced chemical equations

Question 14

June 2024 | 8462/1F | Original Q6

0 6 This question is about electrolysis and the extraction of metals.

0 6 . 1 Why can some molten substances be electrolysed?

[1 mark]

Tick (✓) **one** box.

Electrons can move through the molten substance to the electrodes. ☐

Ions can move through the molten substance to the electrodes. ☐

Protons can move through the molten substance to the electrodes. ☐

0 6 . 2 **Table 3** shows the products of the electrolysis of some molten compounds.

Complete **Table 3**.

[3 marks]

Table 3

Molten compound	Product at negative electrode	Product at positive electrode
Lead chloride	_____	Chlorine
Potassium iodide	Potassium	_____
_____	Zinc	Bromine

4.3.1.1 Conservation of mass and balanced chemical equations

Question 14 · continued

Aluminium is extracted by electrolysing molten aluminium oxide.

0 6 . 3 Balance the equation for the reaction.

Choose numbers from the box.

[2 marks]

2	**3**	**4**	**5**

$$2Al_2O_3 \rightarrow __ Al + __ O_2$$

0 6 . 4 Calculate the relative formula mass (M_r) of aluminium oxide (Al_2O_3).

Relative atomic masses (A_r): O = 16 Al = 27

[2 marks]

Relative formula mass (M_r) = _____

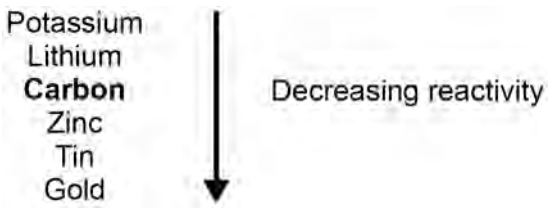
Question 6 continues on the next page

Question 14 · continued

0 6 . 5 **Figure 13** shows part of the reactivity series of metals.

The non-metal carbon has been included.

Figure 13



Metals can be extracted from their compounds by:

- electrolysis
- reduction with carbon.

Electrolysis is more expensive than reduction with carbon.

Predict one metal that would be extracted by each method.

Use Figure 13.

[2 marks]

Extracted by electrolysis _____

Extracted by carbon reduction _____

10

4.3.1.1 Conservation of mass and balanced chemical equations

Question 15

June 2025 | 8462/1F | Original Q1

0 1 This question is about elements and compounds.

0 1 . 1 What is the name of the compound with the formula $ZnBr_2$?

Use the periodic table.

[1 mark]

Tick (✓) **one** box.

Zinc bromide ☐

Zinc chloride ☐

Zinc iodide ☐

0 1 . 2 A compound has the formula C_2H_6O

Table 1 shows information about a molecule of C_2H_6O

Table 1

Symbol of element	Name of element	Number of atoms of the element in a molecule of C_2H_6O
C		2
H	Hydrogen	
	Oxygen	1

Complete **Table 1**.

Use the periodic table.

[3 marks]

4.3.1.1 Conservation of mass and balanced chemical equations

Question 15 · continued

0 1 . 3 Potassium and sulfur react to produce potassium sulfide.

Write the word equation for this reaction.

[1 mark]

_____ + _____ → _____

0 1 . 4 Aluminium reacts with fluorine to produce aluminium fluoride.

Balance the equation for this reaction.

[2 marks]

_____ Al + _____ F_2 → 2 AlF_3

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4.3.1.1 Conservation of mass and balanced chemical equations

Question 16

June 2025 | 8462/1F | Original Q10

1 0 This question is about metals and metal oxides.

Tin (Sn) is extracted from tin oxide using carbon.

The equation for the reaction is:

$$SnO_2 + C \longrightarrow Sn + CO_2$$

1 0 . 1 Which substance is reduced in this reaction?

Give **one** reason for your answer.

Answer in terms of oxygen.

[2 marks]

Substance reduced _____

Reason _____

_____

1 0 . 2 Why can carbon be used to extract tin from tin oxide?

[1 mark]

_____

_____

Question 10 continues on the next page

Question 16 · continued

10.3 Cadmium (Cd) can be extracted by the reaction of cadmium oxide with carbon.

The equation for the reaction is:

$$CdO + C \longrightarrow Cd + CO$$

Calculate the percentage atom economy for the production of cadmium in this reaction.

Relative atomic masses (A_r): C = 12 Cd = 112

Relative formula mass (M_r): CdO = 128

[3 marks]

Percentage atom economy = _____ %

10.4 Tungsten is a transition metal.

Potassium is a Group 1 metal.

Give **two** differences between the properties of tungsten and the properties of potassium.

[2 marks]

1 _____

2 _____

4.3.1.1 Conservation of mass and balanced chemical equations

Question 16 · continued June 2025 | 8462/1F | Original Q10

Tungsten oxide reacts with hydrogen to give tungsten (W) and water.

10.5 The equation for the reaction is:

$$WO_3 + 3\,H_2 \longrightarrow W + 3\,H_2O$$

The law of conservation of mass states:

'The mass of the products equals the mass of the reactants during a chemical reaction.'

Show that the equation obeys the law of conservation of mass.

Relative atomic mass (A_r): W = 184

Relative formula masses (M_r): H_2 = 2 WO_3 = 232 H_2O = 18

[2 marks]

10.6 The reaction producing tungsten has a high atom economy.

Why is it important to use reactions with a high atom economy in industry?

[1 mark]

11

4.3.1.1 Conservation of mass and balanced chemical equations

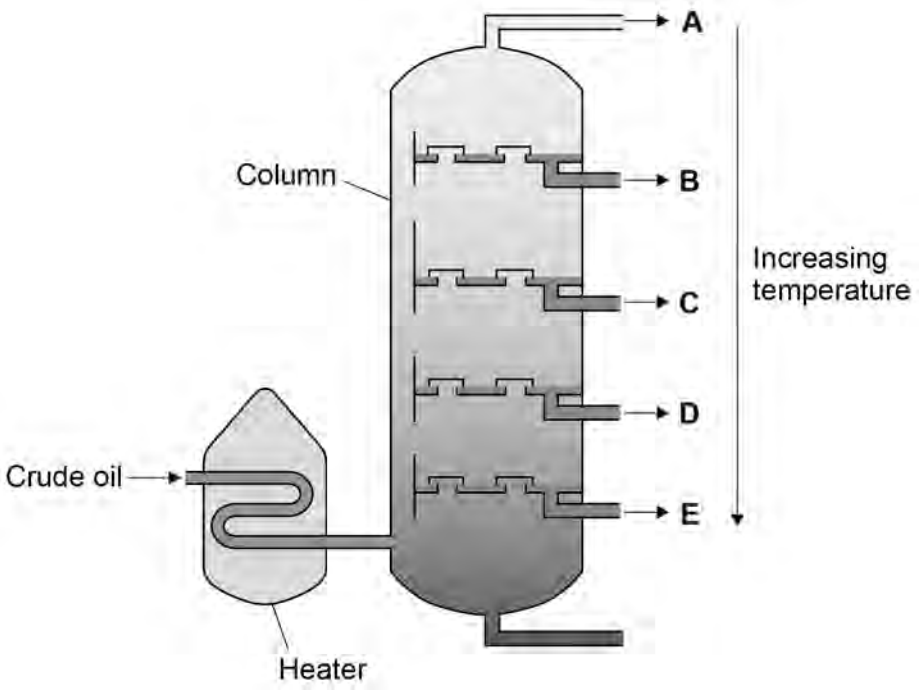
Question 17

June 2025 | 8462/2F | Original Q9

0 9 This question is about hydrocarbon fuels.

Figure 7 represents the process used to separate hydrocarbon fuels from crude oil.

Figure 7



0 9 . 1 Name the process represented by **Figure 7**.

[1 mark]

_____

0 9 . 2 Changes of state take place during the process in **Figure 7**.

Name the change of state taking place in:

- the heater
- the column.

[2 marks]

Heater _____

Column _____

Question 17 · continued

Different fuels are obtained from crude oil at the points on **Figure 7** labelled **A** to **E**.

Table 4 shows the boiling point ranges of different fuels obtained from the process in **Figure 7**.

Table 4

Fuel	Boiling point range in °C
Diesel oil	260 – 320
Heavy fuel oil	320 – 400
Kerosene	180 – 260
Petrol	40 – 110
Petroleum gases	Below 30

0 9 . 3 Which fuel is obtained at **B** in the column?

Use **Figure 7** and **Table 4**.

[1 mark]

0 9 . 4 Fuels with higher boiling point ranges contain larger molecules.

What is the order of increasing flammability of the fuels?

Use **Table 4**.

[1 mark]

Tick (✓) **one** box.

Heavy fuel oil ⟶ diesel oil ⟶ kerosene ☐

Heavy fuel oil ⟶ kerosene ⟶ diesel oil ☐

Kerosene ⟶ diesel oil ⟶ heavy fuel oil ☐

Kerosene ⟶ heavy fuel oil ⟶ diesel oil ☐

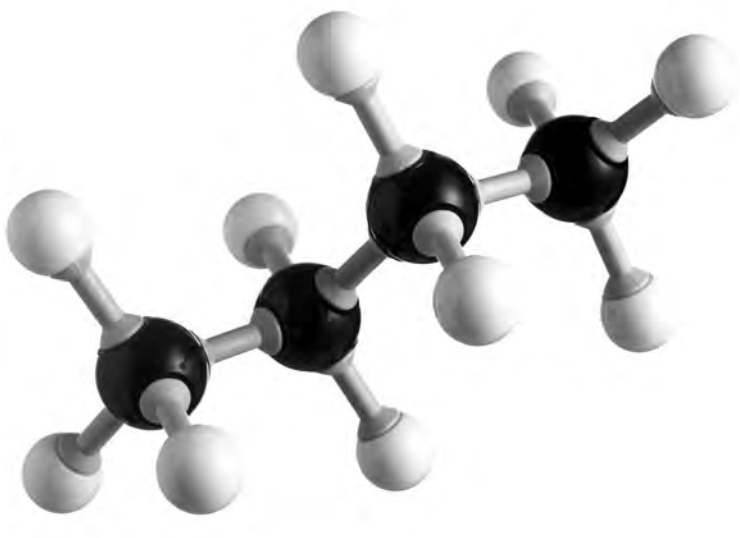
4.3.1.1 Conservation of mass and balanced chemical equations

Question 17 · continued

Liquified petroleum gases are a mixture of several different hydrocarbons.

Figure 8 shows a model of one of these hydrocarbons.

Figure 8



0 9 . 5 Write the molecular formula of the hydrocarbon represented by the model in **Figure 8**.

[1 mark]

0 9 . 6 Name the hydrocarbon represented by the model in **Figure 8**.

[1 mark]

0 9 . 7 Petroleum gases also contain a hydrocarbon with the formula C_3H_8

Balance the equation for the complete combustion of C_3H_8

[2 marks]

$$C_3H_8 + 5\ O_2 \rightarrow ___\ CO_2 + ___\ H_2O$$

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