AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.8.2.3

Test for carbon dioxide

Past-paper questions

Tier	**Higher**
Question groups	**13**
Available paper years	**2007–2023**

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.

4.8.2.3 Test for carbon dioxide

Question 01

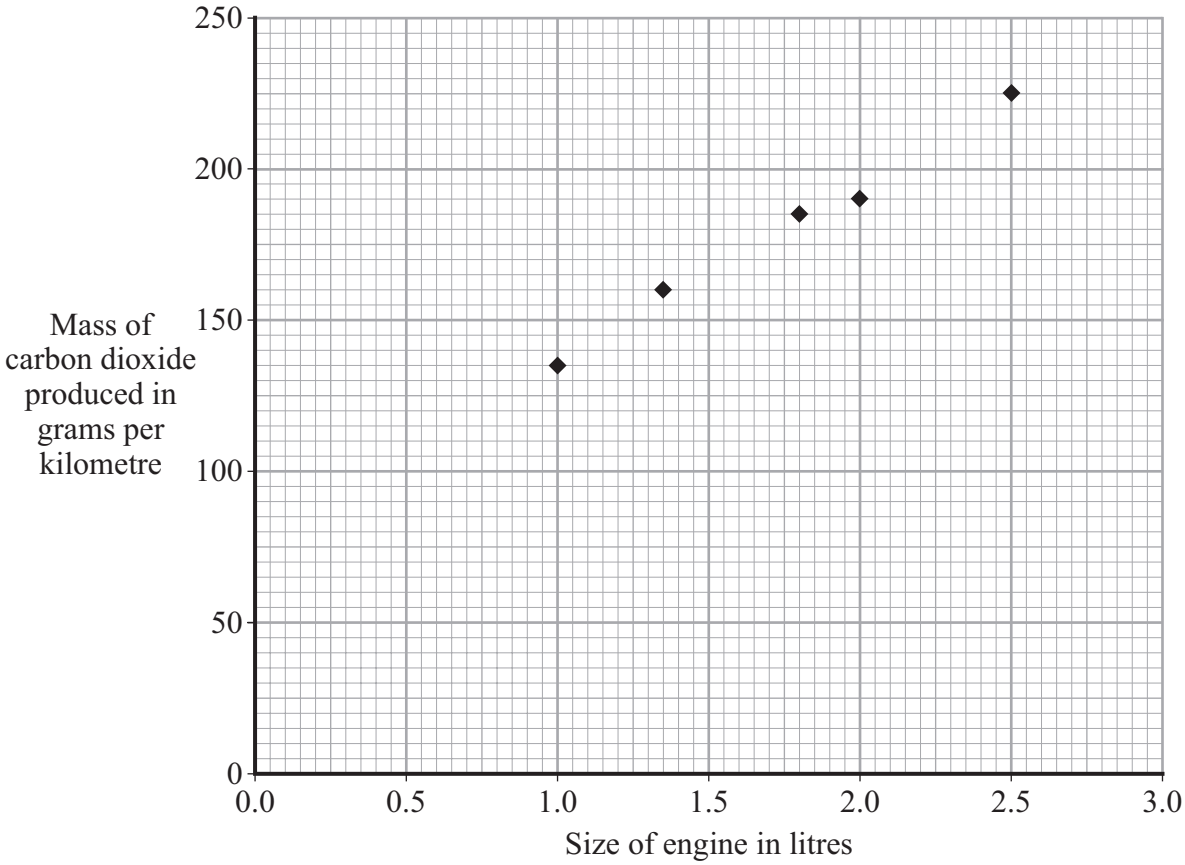
June 2007 | CHY1A | Original Q3 | Legacy

QUESTION THREE

Technicians at a car manufacturing company carried out tests on carbon dioxide emissions from their new range of cars.

First, they tested a small, lightweight, four-seater car with a 1.0 litre petrol engine.
They repeated the tests on similar cars, under similar conditions but with different engine sizes.

The results of their tests are shown on the graph.



3A What relationship is supported by these data?

1 Large engines produce more carbon dioxide per kilometre than small engines.

2 Small engines are more economical than large engines.

3 The mass of carbon dioxide produced per kilometre is directly proportional to the engine size.

4 A 2.0 litre engine produces twice as much carbon dioxide per kilometre as a 1.0 litre engine

4.8.2.3 Test for carbon dioxide

Question 01 · continued

3B What could the technicians do to improve the reliability of the data in this investigation?

1 repeat the tests with different numbers of passengers in the cars

2 repeat the tests and calculate the mean (average) mass of carbon dioxide produced

3 repeat the tests and use the lowest mass of carbon dioxide produced

4 repeat the tests and use the highest mass of carbon dioxide produced

3C A car salesman claimed that a large, heavy, eight-seater car with the same 2.5 litre petrol engine would produce only 225 grams of carbon dioxide per kilometre.

Was this a fair claim from the data?

1 No, because the reading on the graph is 230 grams of carbon dioxide per kilometre.

2 No, because the result may be different for a heavier vehicle.

3 Yes, because that is the value shown on the graph.

4 Yes, because a 2.5 litre engine will always give the same results.

3D In another series of tests under the same conditions, the small, lightweight, four-seater car with a 2.0 litre diesel engine produced 150 grams of carbon dioxide per kilometre.

What is the best conclusion about petrol and diesel engines that can be drawn from these data?

1 Diesel engines are more efficient than petrol engines.

2 Diesel engines always produce less carbon dioxide than petrol engines.

3 The type of fuel used in a car engine may affect the amount of carbon dioxide produced.

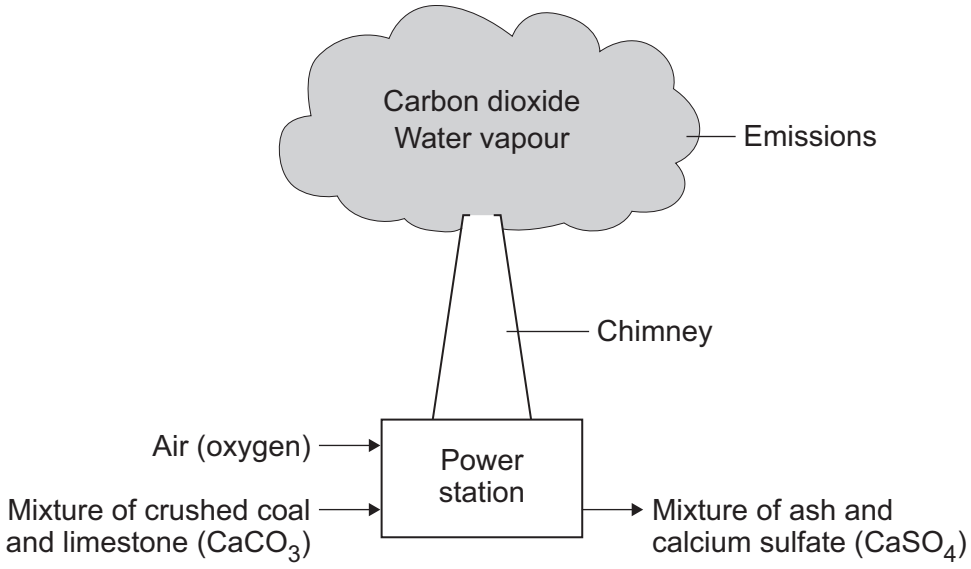
4 The type of fuel used in a car engine does not affect the amount of carbon dioxide produced.

4.8.2.3 Test for carbon dioxide

Question 02

June 2010 | CHY1H | Original Q5 | Legacy

5 Most power stations burn coal to generate electricity. Burning coal gives off sulfur dioxide gas which can be removed from the waste gases by using limestone. This prevents sulfur dioxide from entering the atmosphere and causing acid rain. One disadvantage of using limestone in a power station is that it releases 'locked up carbon dioxide' into the atmosphere.



5 (a) How does the limestone used in a power station:

5 (a) (i) release carbon dioxide

.....

.....

(1 mark)

5 (a) (ii) remove sulfur dioxide?

.....

.....

(1 mark)

4.8.2.3 Test for carbon dioxide

Question 02 · continued June 2010 | CHY1H | Original Q5 | Legacy

5 (b) The waste gases from the chimney are monitored. One toxic gas that should not be released is carbon monoxide.

Explain how carbon monoxide would be formed.

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.....

.....

(2 marks)

5 (c) The use of limestone in a power station releases 'locked up carbon dioxide' into the atmosphere.

5 (c) (i) Explain the meaning of 'locked up carbon dioxide'.

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(2 marks)

5 (c) (ii) Why does the release of this carbon dioxide cause an environmental problem?

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(1 mark)

7

4.8.2.3 Test for carbon dioxide

Question 03

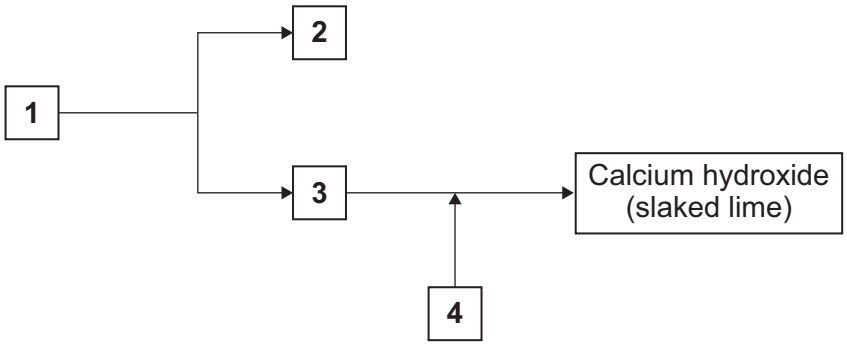
November 2010 | CHY1AP | Original Q2 | Legacy

QUESTION TWO

The equation for the reaction in a lime kiln is:

$$\underset{CaCO_3}{\text{calcium carbonate}} \longrightarrow \underset{CaO}{\text{calcium oxide}} + \underset{CO_2}{\text{carbon dioxide}}$$

The flow chart shows this reaction and a further reaction of one of the products.



Match substances, **A**, **B**, **C** and **D**, with the labels **1–4** on the flow chart.

A Water

B Calcium oxide

C Calcium carbonate

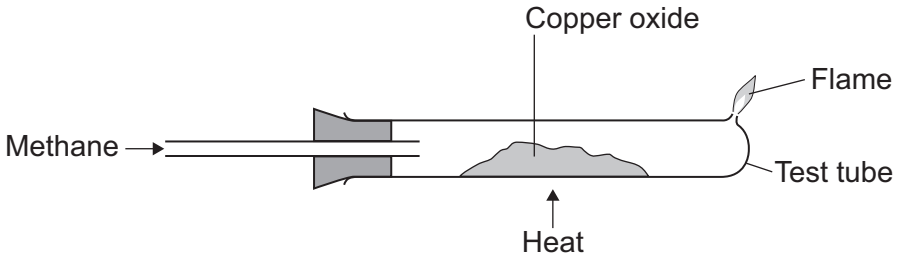
D Carbon dioxide

4.8.2.3 Test for carbon dioxide

Question 04

June 2011 | CHY2H | Original Q2 | Legacy

2 An experiment was done on the reaction of copper oxide (CuO) with methane (CH_4).



2 (a) The equation for this reaction is shown below.

$$4CuO(s) + CH_4(g) \rightarrow 4Cu(s) + 2H_2O(g) + CO_2(g)$$

The water and carbon dioxide produced escapes from the test tube.

Use information from the equation to explain why.

.....

(1 mark)

2 (b) (i) Calculate the relative formula mass (M_r) of copper oxide (CuO).

Relative atomic masses (A_r): O = 16; Cu = 64.

.....

.....

.....

Relative formula mass (M_r) = ...

(2 marks)

2 (b) (ii) Calculate the percentage of copper in copper oxide.

.....

.....

.....

Percentage of copper = ... %

(2 marks)

4.8.2.3 Test for carbon dioxide

Question 04 · continued

2 (b) (iii) Calculate the mass of copper that could be made from 4.0 g of copper oxide.

.....

.....

Mass of copper = ... g

(1 mark)

2 (c) The experiment was done three times.
The mass of copper oxide used and the mass of copper made was measured each time.
The results are shown in the table.

	Experiment		
	1	**2**	**3**
Mass of copper oxide used in g	4.0	4.0	4.0
Mass of copper made in g	3.3	3.5	3.2

2 (c) (i) Calculate the mean mass of copper made in these experiments.

.....

.....

Mean mass of copper made = ... g

(1 mark)

2 (c) (ii) Suggest how the results of these experiments could be made more precise.

.....

.....

(1 mark)

2 (c) (iii) The three experiments gave slightly different results for the mass of copper made.
This was caused by experimental error.

Suggest **two** causes of experimental error in these experiments.

1 .....

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2 .....

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(2 marks)

10

4.8.2.3 Test for carbon dioxide

Question 05

January 2012 | CH1HP | Original Q6 | Legacy

6 Limestone is used as a building material. Acid rain erodes limestone.

6 (a) Limestone contains calcium carbonate.
The symbol equation for the reaction of calcium carbonate with hydrochloric acid is shown.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

Describe a test to show that carbon dioxide is produced in this reaction.

Give the result of the test.

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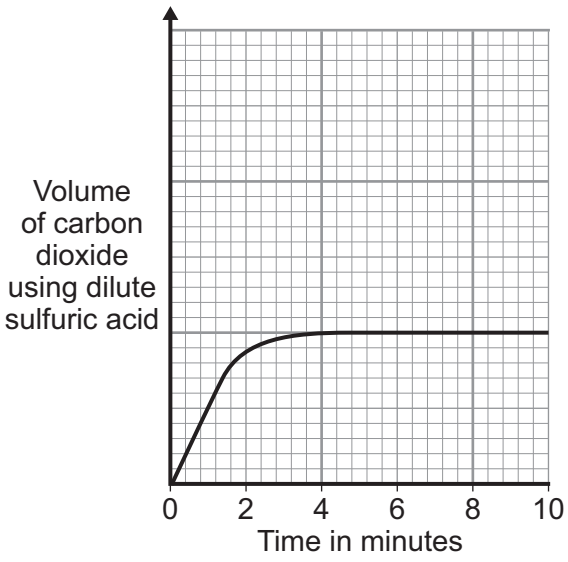
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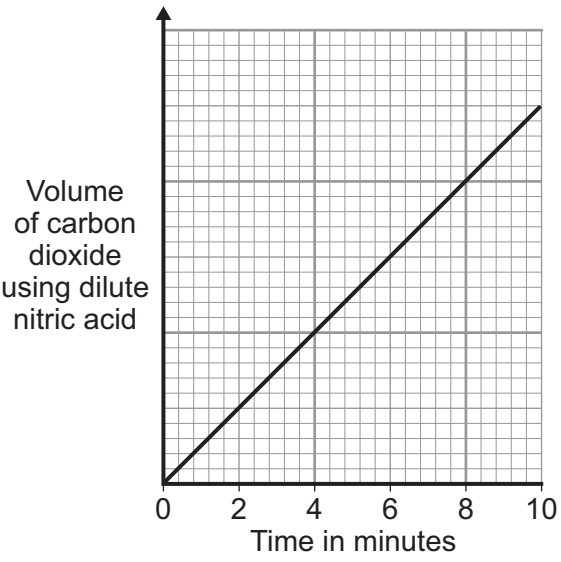
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(2 marks)

6 (b) Gases from vehicle exhausts produce sulfuric acid and nitric acid.

A student investigated the reaction of these two acids with calcium carbonate (limestone).
The type of acid was changed but all other variables were kept the same.
The student measured the volume of carbon dioxide produced each minute for a total of 10 minutes. He did this first for the reaction between dilute sulfuric acid and a cube of calcium carbonate (limestone).
The student repeated the experiment using dilute nitric acid in place of the dilute sulfuric acid.
The results are shown below.





4.8.2.3 Test for carbon dioxide

Question 05 · continued

6 (b) (i) State **two** variables that must be kept the same for this investigation.

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(2 marks)

6 (b) (ii) Reacting calcium carbonate with sulfuric acid gave different results to nitric acid.

The symbol equations for the reaction of calcium carbonate with sulfuric acid and with nitric acid are shown below.

$CaCO_3(s) + H_2SO_4(aq) \rightarrow CaSO_4(s) + H_2O(l) + CO_2(g)$

$CaCO_3(s) + 2HNO_3(aq) \rightarrow Ca(NO_3)_2(aq) + H_2O(l) + CO_2(g)$

Describe how the results for sulfuric acid are different **and** use the symbol equations to explain this difference.

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(3 marks)

7

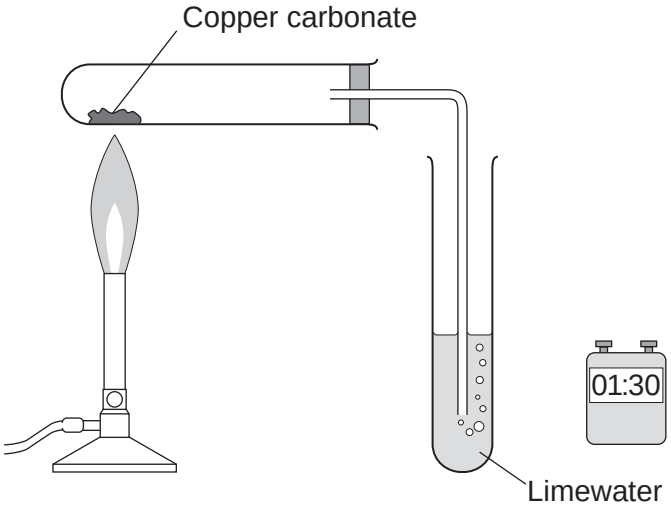
4.8.2.3 Test for carbon dioxide

Question 06

January 2013 | CH1HP | Original Q2 | Legacy

2 Carbon dioxide is produced when copper carbonate is heated.

A student investigated heating copper carbonate.
The student used the apparatus to measure how long it took for carbon dioxide to be produced.
The student also noted what happened during each minute for three minutes.



2 (a) The student used changes to the limewater to measure how long it took for carbon dioxide to be produced.

Describe how.

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.....

(2 marks)

4.8.2.3 Test for carbon dioxide

Question 06 · continued

2 (b) The student wrote down her observations.

Time interval in minutes	Observations
Between 0 and 1	A slow release of gas bubbles. The limewater did not change. The solid in the test tube was green.
Between 1 and 2	A fast release of gas bubbles. The limewater changed at 1 minute 10 seconds.
Between 2 and 3	No release of gas bubbles. The solid in the test tube was black.

2 (b) (i) Suggest the reason for the student's observations between 0 and 1 minute.

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(2 marks)

2 (b) (ii) Explain the student's observations between 1 and 2 minutes.

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(2 marks)

2 (b) (iii) Explain the student's observations between 2 and 3 minutes.

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(2 marks)

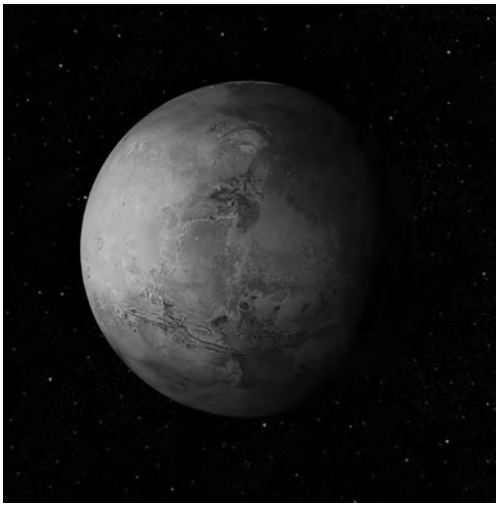
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4.8.2.3 Test for carbon dioxide

Question 07

June 2013 | CH2HP | Original Q6 | Legacy

6 Spacecraft have been to the planets Venus and Mars. The spacecraft have sent back information about the atmosphere of each planet.



6 (a) The main gas in the atmosphere of Mars is carbon dioxide.

Explain why, in terms of structure, carbon dioxide is a gas, even at low temperatures.

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(3 marks)

4.8.2.3 Test for carbon dioxide

Question 07 · continued

6 (b) Gas chromatography linked to a mass spectrometer (GC-MS) is used to identify substances found on Mars.

6 (b) (i) What is the purpose of gas chromatography?

.....

.....

(1 mark)

6 (b) (ii) What information do the molecular ion peaks from the mass spectrometer give about the substances?

.....

(1 mark)

6 (c) The atmosphere on Venus contains droplets of sulfuric acid solution.

6 (c) (i) Suggest a pH value for sulfuric acid solution.

pH = ...

(1 mark)

6 (c) (ii) Name the ion which makes sulfuric acid solution acidic.

.....

(1 mark)

6 (d) The atmosphere of Venus contains the isotopes $^{2}_{1}H$ and $^{1}_{1}H$

Describe the similarities and the differences in the isotopes $^{2}_{1}H$ and $^{1}_{1}H$

You should refer to the sub-atomic particles in each isotope.

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(3 marks)

10

4.8.2.3 Test for carbon dioxide

Question 08

June 2016 | CH1HP | Original Q3 | Legacy

3 Metals are extracted from ores in the Earth's crust.

Some ores contain metal carbonates and some ores contain metal oxides.

3 (a) (i) Name the type of reaction that happens when a metal carbonate is heated.

[1 mark]

_____

3 (a) (ii) Which solid product is formed when copper carbonate is heated?

[1 mark]

Tick (✓) **one** box.

copper ☐

copper nitrate ☐

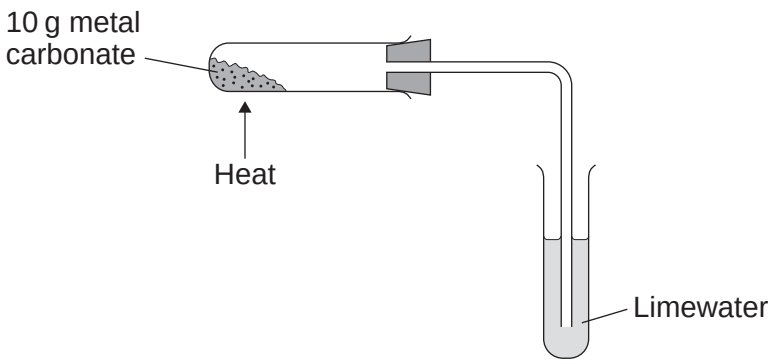
copper oxide ☐

copper sulfide ☐

3 (b) A student investigated heating four metal carbonates.

Figure 4 shows the apparatus used.

Figure 4



4.8.2.3 Test for carbon dioxide

Question 08 · continued

The student heated each metal carbonate for five minutes.

Table 3 shows the results.

Table 3

Metal carbonate	Mass of metal carbonate at start in g	Mass of solid after heating for 5 minutes in g	Observations
Copper carbonate	10.0	6.9	Limewater turns cloudy
Magnesium carbonate	10.0	9.1	Limewater turns cloudy
Potassium carbonate	10.0	10.0	Limewater does not turn cloudy
Zinc carbonate	10.0	8.3	Limewater turns cloudy

3 (b) (i) Explain the results for potassium carbonate.

[3 marks]

3 (b) (ii) Suggest how the reactivity series can be used to predict which metal carbonate reacts most easily when heated.

[2 marks]

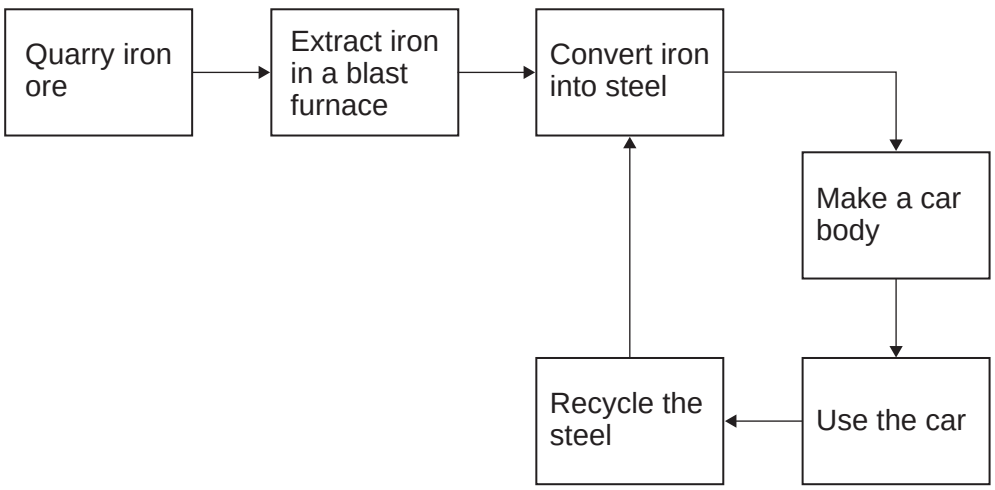
Question 3 continues on the next page

4.8.2.3 Test for carbon dioxide

Question 08 · continued

3 (c) **Figure 5** shows a simple life cycle of a car body.

Figure 5



3 (c) (i) Complete the sentence.

[1 mark]

Iron ores must contain enough iron to _____

_____

3 (c) (ii) Some iron ores contain iron oxide (Fe_2O_3).

Complete and balance the equation for a reaction to produce iron from iron oxide.

[2 marks]

_____ Fe_2O_3 + _____ C ⟶ _____ + _____ CO_2

3 (c) (iii) Give **two** reasons why iron produced in a blast furnace is converted into steel.

[2 marks]

_____

_____

_____

_____

4.8.2.3 Test for carbon dioxide

Question 08 · continued

3 (c) (iv) When a car reaches the end of its useful life, the car body can be:

- recycled
- reused
- sent to landfill.

Give **three** reasons why a steel car body should be recycled and **not** reused or sent to landfill.

[3 marks]

15

4.8.2.3 Test for carbon dioxide

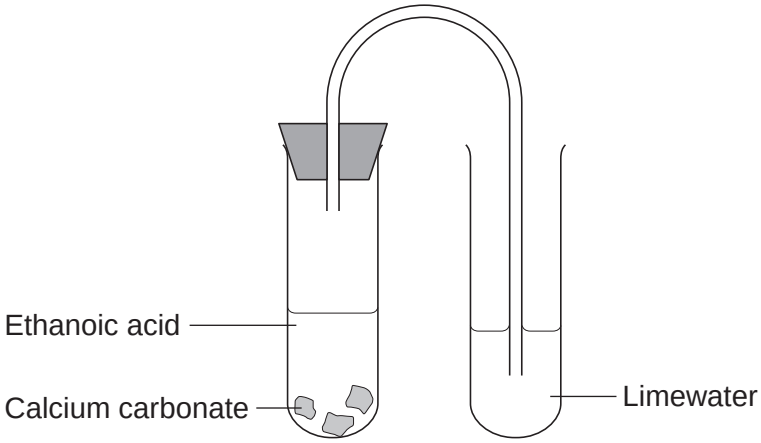
Question 09

June 2016 | CH3HP | Original Q1 | Legacy

1 This question is about reactions of ethanoic acid and the analysis of salts.

1 (a) **Figure 1** shows the apparatus used to investigate the reaction of ethanoic acid with calcium carbonate.

Figure 1



1 (a) (i) Describe a change that would be seen in each test tube.

Give a reason for each change.

[4 marks]

Test tube 1 _____

_____

_____

_____

Test tube 2 _____

_____

_____

_____

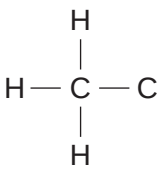
Question 1 continues on the next page

4.8.2.3 Test for carbon dioxide

Question 09 · continued

1 (a) (ii) Complete the displayed structure of ethanoic acid.

[1 mark]



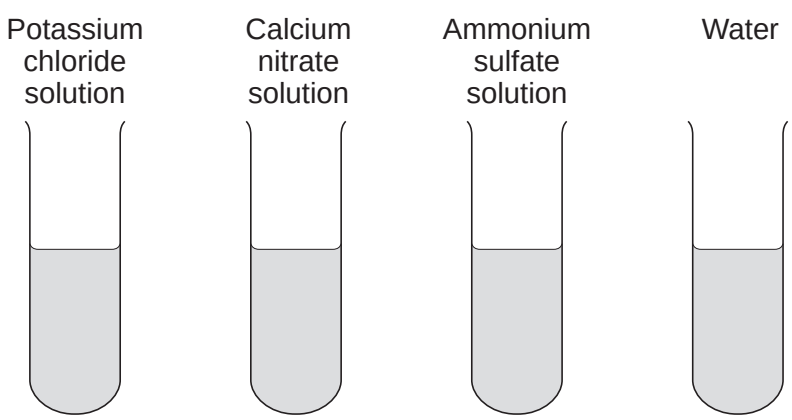
1 (a) (iii) Ethanoic acid is a carboxylic acid.
Complete the sentence.

[2 marks]

Carboxylic acids react with alcohols in the presence of an _____ catalyst to produce pleasant-smelling compounds called _____ .

1 (b) **Figure 2** shows four test tubes containing three different salt solutions and water.

Figure 2



Each solution and the water was tested with:

- silver nitrate in the presence of dilute nitric acid
- barium chloride in the presence of dilute hydrochloric acid.

4.8.2.3 Test for carbon dioxide

Question 09 · continued

Complete the table of results.

[2 marks]

	Potassium chloride solution	Calcium nitrate solution	Ammonium sulfate solution	Water
Test with silver nitrate in the presence of dilute nitric acid			no change	no change
Test with barium chloride in the presence of dilute hydrochloric acid		no change	white precipitate	

1 (c) Flame tests can be used to identify metal ions.

1 (c) (i) Complete the following sentences.

[2 marks]

The flame colour for potassium ions is _____ .

The flame colour for calcium ions is _____ .

1 (c) (ii) Give **one** reason why a flame test would **not** show the presence of both potassium ions and calcium ions in a mixture.

[1 mark]

_____

_____

_____

12

4.8.2.3 Test for carbon dioxide

Question 10

1 Elements are made of atoms.

1 (a) **Table 1** shows the atomic numbers and mass numbers of three atoms.

Table 1

Atom	Atomic number	Mass number
1	12	24
2	12	25
3	12	26

1 (a) (i) Suggest, in terms of the number of subatomic particles, why the atomic numbers of the three atoms are the same.

[1 mark]

_____

_____

1 (a) (ii) Explain, in terms of the number of subatomic particles, why the mass numbers of the three atoms are different.

[2 marks]

_____

_____

_____

1 (b) When elements react, their atoms join with other atoms to form compounds.

Sulfuric acid, H_2SO_4, is a compound.

1 (b) (i) How many elements are in the formula H_2SO_4?

[1 mark]

_____

1 (b) (ii) How many atoms are in the formula H_2SO_4?

[1 mark]

_____

4.8.2.3 Test for carbon dioxide

Question 10 · continued

1 (c) Sulfuric acid reacts with metal oxides.

$$\underset{\text{copper oxide}}{CuO} + \underset{\text{sulfuric acid}}{H_2SO_4} \longrightarrow \underset{\text{copper sulfate}}{CuSO_4} + \underset{\text{water}}{H_2O}$$

In a reaction, 159 g of copper oxide reacts with 196 g of sulfuric acid.

What is the mass of the products?

[1 mark]

Tick (✓) **one** box.

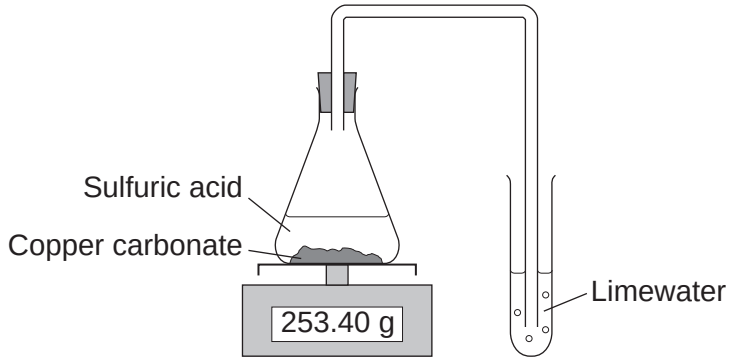
Mass of copper sulfate in g	Mass of water in g	Tick (✓)
30	7	
159	36	
196	18	
319	36	

4.8.2.3 Test for carbon dioxide

Question 10 · continued

1 (d) **Figure 1** shows apparatus used to investigate the reaction of sulfuric acid with copper carbonate.

Figure 1



Describe and explain the changes seen during the reaction.

[3 marks]

9

4.8.2.3 Test for carbon dioxide

Question 11

June 2019 | 8462/2H | Original Q2

0 2 This question is about lithium carbonate.

Lithium carbonate is used in medicines.

Figure 2 shows a tablet containing lithium carbonate.

Figure 2



0 2 . 1 Lithium carbonate contains lithium ions and carbonate ions.

A student tested the tablet for lithium ions and for carbonate ions.

The student used:

- a metal wire
- dilute hydrochloric acid
- limewater.

Plan an investigation to show the presence of lithium ions **and** of carbonate ions in the tablet.

You should include the results of the tests for the ions.

[6 marks]

4.8.2.3 Test for carbon dioxide

Question 11 · continued

0 2 . 2 The tablet also contains other substances.

The substances in tablets are present in fixed amounts.

What name is given to mixtures like tablets?

[1 mark]

0 2 . 3 The tablet has a mass of 1.20 g and contains 700 mg of lithium carbonate.

Calculate the percentage by mass of lithium carbonate in this tablet.

[3 marks]

Percentage by mass of lithium carbonate = _____ %

10

4.8.2.3 Test for carbon dioxide

Question 12

November 2020 | 8462/2H | Original Q9

0 9 This question is about algae.

A student:

- placed algae in water containing dissolved carbon dioxide
- shone bright light on the algae.

Gas bubbles were collected as the algae photosynthesised.

0 9 . 1 Describe a test that would identify the gas collected.

Give the result of the test.

[2 marks]

Test _____

Result _____

_____

0 9 . 2 Glucose is produced when algae photosynthesise.

Name **two** naturally occurring polymers produced from glucose.

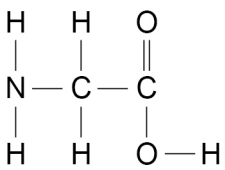
[2 marks]

_____ and _____

Question 9 continues on the next page

Figure 6 shows the displayed structural formula of an amino acid called glycine.

Figure 6



0 9 . 3 How many functional groups are there in the molecule in **Figure 6**?

[1 mark]

Tick (✓) **one** box.

1 ☐ 2 ☐ 3 ☐ 4 ☐

0 9 . 4 Glycine reacts by condensation polymerisation to produce a polypeptide and one other substance.

Name the other substance produced.

[1 mark]

_____

0 9 . 5 Scientists think that algae may have used gases in Earth's early atmosphere.

Algae need an element to produce the molecule in **Figure 6** which is **not** present in water or carbon dioxide.

Which **two** gases from Earth's early atmosphere could have provided this element?

[2 marks]

_____ and _____

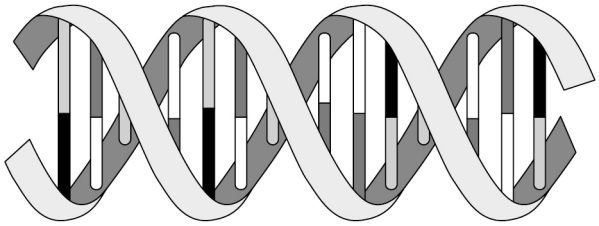
4.8.2.3 Test for carbon dioxide

Question 12 · continued

0 9 . 6 The development and function of algae are controlled by a naturally occurring polymer.

Figure 7 represents the shape and structure of this polymer.

Figure 7



Describe the shape and structure of this polymer.

[3 marks]

11

4.8.2.3 Test for carbon dioxide

Question 13

0 2 This question is about alcohols and carboxylic acids.

Alcohols are used as fuels.

A student burned 1.00 g of six alcohols and determined the energy released from each.

Table 2 shows the results.

Table 2

Alcohol	Formula of one molecule of the alcohol	Energy released in kJ/g
Ethanol	C_2H_5OH	29.6
Propanol	C_3H_7OH	33.6
Butanol	C_4H_9OH	36.1
Pentanol	$C_5H_{11}OH$	37.7
Hexanol	$C_6H_{13}OH$	38.9
Heptanol	$C_7H_{15}OH$	39.8

0 2 . 1 Calculate the mass of ethanol that must be burned to release the same amount of energy as burning 1.00 g of heptanol.

[2 marks]

Mass = _____ g

0 2 . 2 The energy released in kJ/g varies with the number of carbon atoms in one molecule of each alcohol.

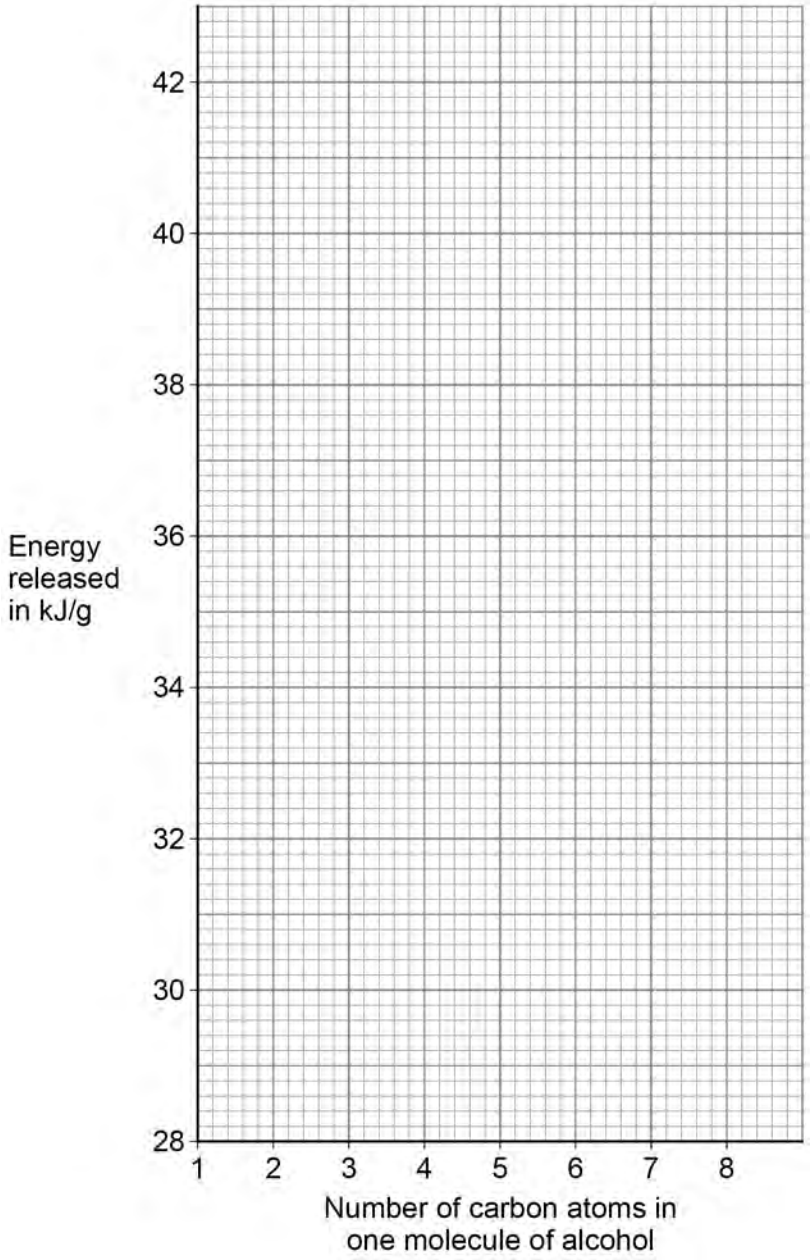
Plot the data from **Table 2** on **Figure 2**.

[2 marks]

4.8.2.3 Test for carbon dioxide

Question 13 · continued

Figure 2



0 2 . 3 Estimate the energy released in kJ when 1.00 g of octanol ($C_8H_{17}OH$) is burned.

Use **Figure 2**.

[1 mark]

Energy released = _____ kJ

4.8.2.3 Test for carbon dioxide

Question 13 · continued

Carbon dioxide is produced when alcohols are burned.

Carbon dioxide is identified by bubbling the gas through limewater.

0 2 . 4 Complete the sentence.

Choose the answer from the box.

[1 mark]

calcium chloride	**calcium hydroxide**	**calcium nitrate**	**calcium sulfate**

Limewater is an aqueous solution of _____.

0 2 . 5 Give the result of the test when carbon dioxide is bubbled through limewater.

[1 mark]

_____

_____

4.8.2.3 Test for carbon dioxide

Question 13 · continued

Ethanoic acid can be produced from ethanol.

0 2 . 6 What is reacted with ethanol to produce ethanoic acid?

[1 mark]

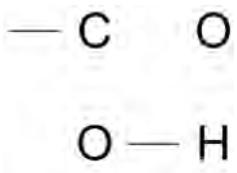
Tick (✓) **one** box.

- A halogen ☐
- An alkali metal ☐
- An oxidising agent ☐
- Water ☐

0 2 . 7 Ethanoic acid contains the functional group –COOH

Complete the displayed structural formula of this functional group.

[1 mark]



Question 2 continues on the next page

4.8.2.3 Test for carbon dioxide

Question 13 · continued

0 2 . 8 Ethanoic acid reacts with different compounds.

Draw **one** line from each compound to a product of the reaction of the compound with ethanoic acid.

[2 marks]

Compound	Product of the reaction with ethanoic acid
Ethanol	Carbon dioxide
Sodium carbonate	Ethene
	Ethyl ethanoate
	Hydrogen
	Poly(ethene)

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