AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.6.1.4

Catalysts

Past-paper questions

Tier	**Foundation**
Question groups	**6**
Available paper years	**2019–2024**

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.

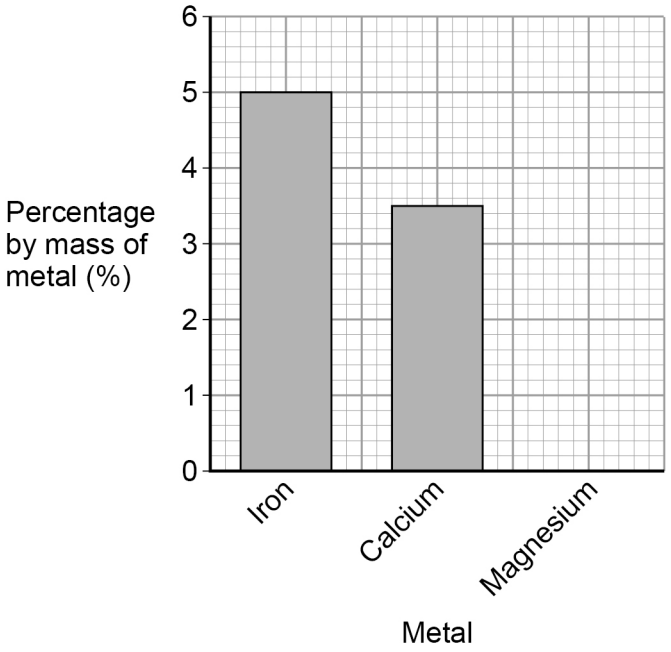
5.6.1.4 Catalysts

Question 01

June 2019 | 8464/C/2F | Original Q5

0 5 **Figure 6** shows the percentage by mass of some metals in the Earth's crust.

Figure 6



0 5 . 1 What is the percentage by mass of calcium in the Earth's crust?

[1 mark]

Tick (✓) **one** box.

3.25% ☐ 3.50% ☐ 4.50% ☐ 5.00% ☐

0 5 . 2 The percentage by mass of magnesium in the Earth's crust is 2.1%

Draw the bar for magnesium on **Figure 6**.

[1 mark]

Question 5 continues on the next page

5.6.1.4 Catalysts

Question 01 · continued

0 5 . 3 Copper sulfate is produced during the extraction of copper from the Earth's crust.

Copper is produced from copper sulfate solution using iron.

The word equation for the reaction is:

copper sulfate + iron → iron sulfate + copper

From the equation a company calculated that 648 kg of copper sulfate are needed to produce 617 kg of iron sulfate and 258 kg of copper.

Calculate the mass of iron needed to make 258 kg of copper.

[2 marks]

Mass = _____ kg

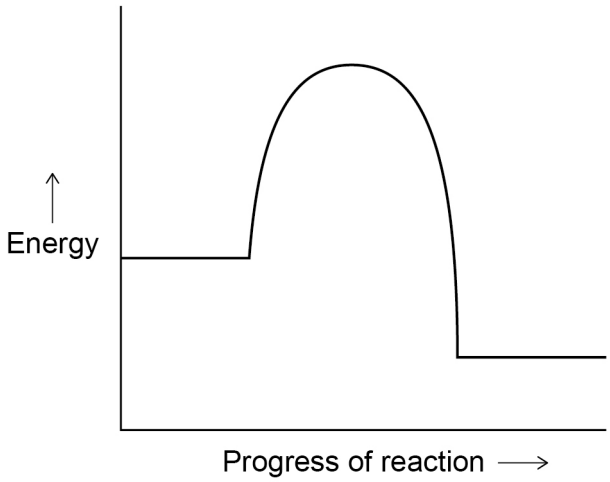
5.6.1.4 Catalysts

Question 01 · continued

Copper is used as a catalyst.

0 5 . 4 **Figure 7** shows the reaction profile for a reaction without a catalyst.

Figure 7

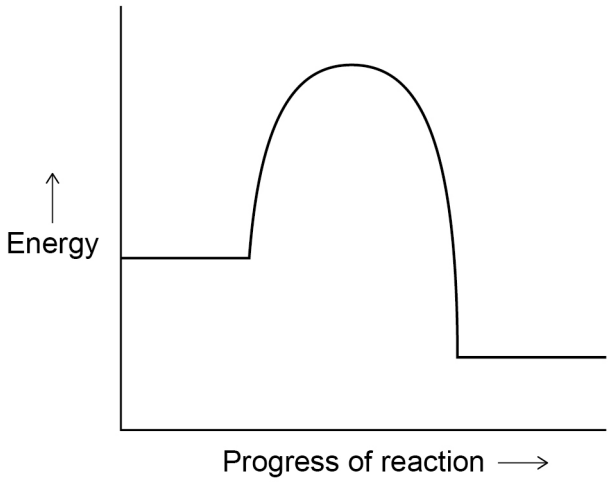


Draw an arrow on **Figure 7** to show the activation energy.

[1 mark]

0 5 . 5 The reaction profile for the reaction without a catalyst is shown again in **Figure 8.**

Figure 8



Draw a reaction profile on **Figure 8** for the same reaction with a catalyst.

[2 marks]

5.6.1.4 Catalysts

Question 01 · continued

0 5 . 6 What are catalysts in biological systems called?

[1 mark]

Tick (✓) **one** box.

- Detergents ☐
- Enzymes ☐
- Polymers ☐
- Solvents ☐

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5.6.1.4 Catalysts

Question 02

November 2020 | 8464/C/2F | Original Q4

0 4 This question is about hydrogen peroxide.

0 4 . 1 The symbol equation for the decomposition of hydrogen peroxide (H_2O_2) is:

$$2\ H_2O_2 \rightarrow 2\ H_2O + O_2$$

Complete the word equation for the decomposition of hydrogen peroxide.

[2 marks]

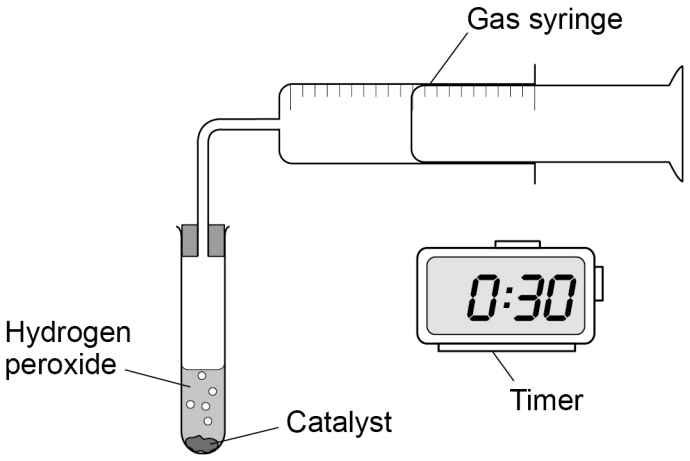
hydrogen peroxide → _____ + _____

A student investigated the effect of different catalysts on the decomposition of hydrogen peroxide.

The student measured the volume of gas collected every 30 seconds for 5 minutes.

Figure 5 shows the apparatus used.

Figure 5



Question 02 · continued

0 4 . 2 Which **two** variables should the student keep the same to make the investigation a fair test?

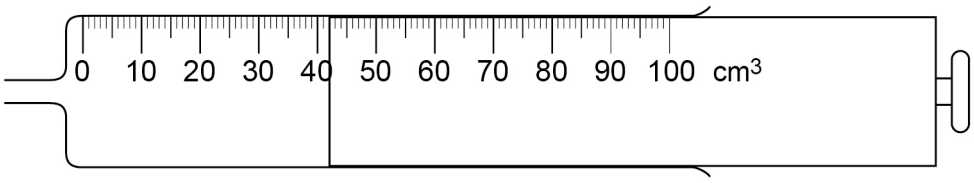
[2 marks]

Tick (✓) **two** boxes.

- Concentration of hydrogen peroxide ☐
- Mass of catalyst ☐
- Size of gas syringe ☐
- Type of catalyst ☐
- Volume of gas collected ☐

0 4 . 3 **Figure 6** shows a gas syringe.

Figure 6



What is the volume of gas in the syringe?

[1 mark]

Volume = _____ cm^3

Question 4 continues on the next page

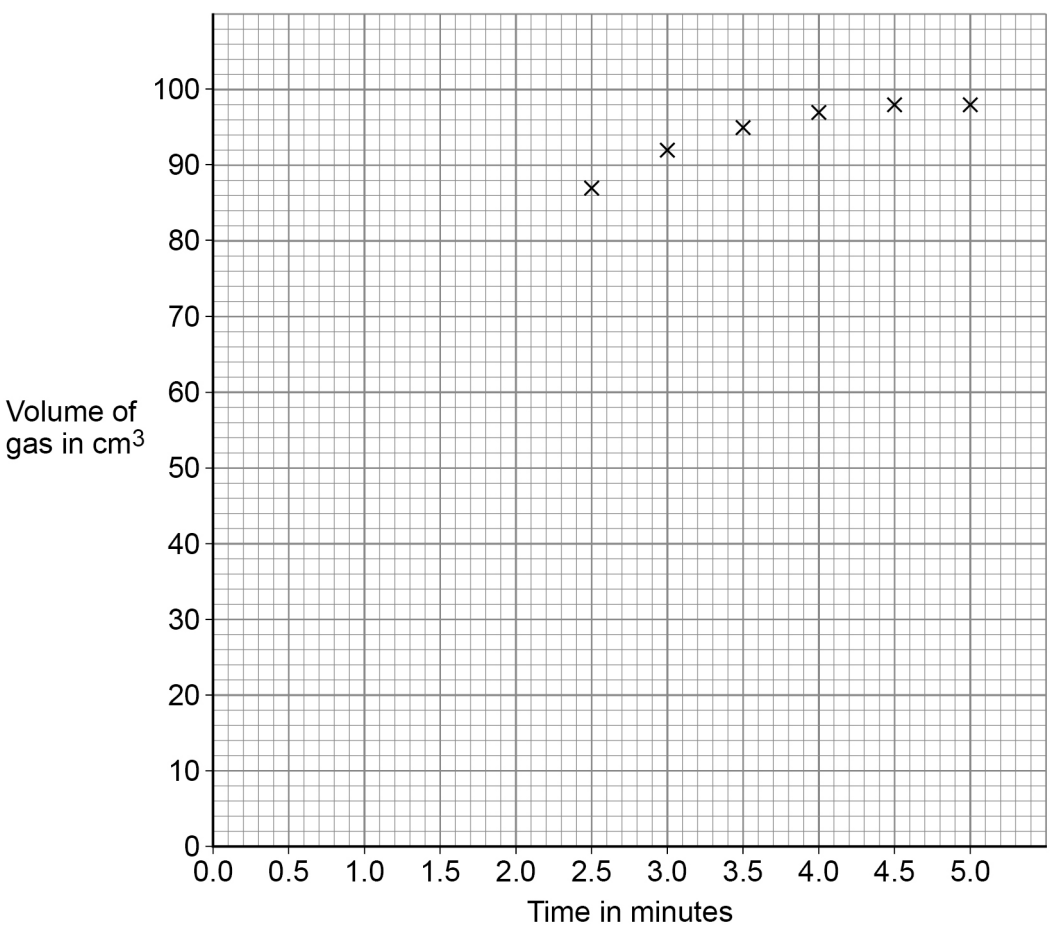
Table 3 shows the student's results for one catalyst.

Table 3

Time in minutes	0.0	0.5	1.0	1.5	2.0
Volume of gas in cm^3	0	34	54	68	78

0 4 . 4 Six of the other results have been plotted on **Figure 7**.

Figure 7



Complete the graph in **Figure 7**.

You should:

- plot the results from **Table 3**
- draw a line of best fit for all of the results.

[3 marks]

5.6.1.4 Catalysts

Question 02 · continued

The student repeated the experiment with other catalysts and plotted a graph for each of the catalysts used.

0 4 . 5 Suggest how the student could use these graphs to identify the best catalyst.

[1 mark]

0 4 . 6 All the graphs level off at the same volume of gas.

Suggest why.

[1 mark]

0 4 . 7 In another investigation, a student increased the temperature of the hydrogen peroxide.

Why is the rate of reaction faster when the temperature of the hydrogen peroxide is increased?

[2 marks]

Tick (✓) **two** boxes.

- The concentration of hydrogen peroxide decreases. ☐
- The particles are moving more slowly. ☐
- The particles have more energy. ☐
- There are more particle collisions per second. ☐
- There are more particles per unit volume. ☐

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5.6.1.4 Catalysts

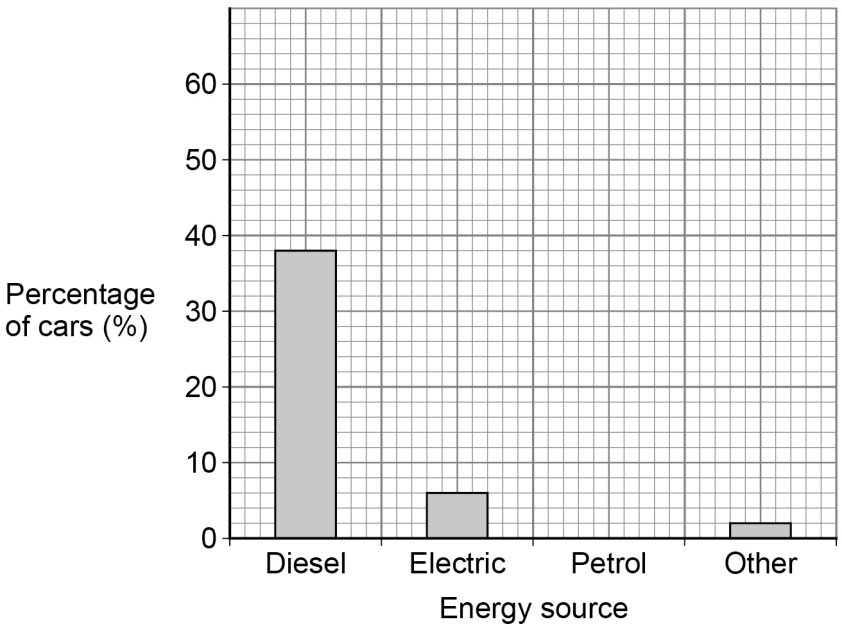
Question 03

November 2021 | 8464/C/2F | Original Q2

0 2 Cars cause atmospheric pollution.

0 2 . 1 **Figure 2** shows the percentage of cars in the UK using different energy sources.

Figure 2



The percentage of cars using petrol is 54%.

Draw the bar for petrol on **Figure 2**.

[1 mark]

Question 2 continues on the next page

Question 03 · continued

Some car emissions contain nitrogen dioxide.

Table 1 shows the concentration of nitrogen dioxide in the air in three different areas for 1 week.

Table 1

	Concentration of nitrogen dioxide in the air in arbitrary units		
Day	**City centre**	**Countryside**	**Motorway**
Monday	35	8	22
Tuesday	37	8	23
Wednesday	37	8	23
Thursday	34	8	23
Friday	37	8	23
Saturday	29	7	20
Sunday	22	6	17

0 2 . 2 Which column of data has the greatest range?

[1 mark]

Tick (✓) **one** box.

City centre ☐

Countryside ☐

Motorway ☐

5.6.1.4 Catalysts

Question 03 · continued

0 2 . 3 Explain why the concentration of nitrogen dioxide in the air is lower on Sunday.

[2 marks]

0 2 . 4 Calculate the mean value for the concentration of nitrogen dioxide in the air in the city centre for the days from Monday to Friday.

Use **Table 1**.

[2 marks]

Mean value for concentration of nitrogen dioxide = _____ arbitrary units

Question 2 continues on the next page

5.6.1.4 Catalysts

Question 03 · continued

Nitrogen dioxide is removed from car emissions by catalytic converters.

0 2 . 5 Which **two** of the following are correct statements about catalysts?

[2 marks]

Tick (✓) **two** boxes.

- Catalysts are included in the chemical equation for a reaction. ☐
- Catalysts are **not** used up in a reaction. ☐
- Catalysts decrease the surface area of the reactants. ☐
- Catalysts increase the concentration of the reactants. ☐
- Catalysts lower the activation energy of a reaction. ☐

0 2 . 6 The catalyst in catalytic converters contains platinum.

Platinum is an unreactive metal obtained from the Earth's crust.

Complete the sentence.

Choose the answer from the box.

[1 mark]

finite resource	**formulation**	**renewable resource**

Platinum is a _____ .

5.6.1.4 Catalysts

Question 03 · continued

0 2 . 7 Emissions from cars that burn fossil fuels contain carbon dioxide.

What is used to test for carbon dioxide?

[1 mark]

Tick (✓) **one** box.

Burning splint ☐

Glowing splint ☐

Limewater ☐

10

Turn over for the next question

5.6.1.4 Catalysts

Question 04

June 2022 | 8464/C/2F | Original Q3

0 3 This question is about ammonia and its compounds.

A student heated a sample of ammonium chloride.

The equation for the reaction is:

$$\underset{\text{ammonium chloride}}{NH_4Cl} \rightleftharpoons \underset{\text{ammonia}}{NH_3} + HCl$$

0 3 . 1 One product is ammonia.

What is the name of the product with the formula HCl?

[1 mark]

_____

0 3 . 2 Ammonia is a gas.

What is the state symbol for ammonia?

[1 mark]

Tick (✓) **one** box.

(aq) ☐ (g) ☐ (l) ☐ (s) ☐

0 3 . 3 How does the equation show that the reaction is reversible?

[1 mark]

_____

_____

0 3 . 4 Complete the sentence.

[1 mark]

The forward reaction is endothermic,

so the reverse reaction is _____ .

5.6.1.4 Catalysts

Question 04 · continued

0 3 . 5 Complete the sentence.

Choose the answer from the box.

[1 mark]

concentration	**rate**	**temperature**

Equilibrium is reached when the forward and reverse reactions happen at exactly the same _____ .

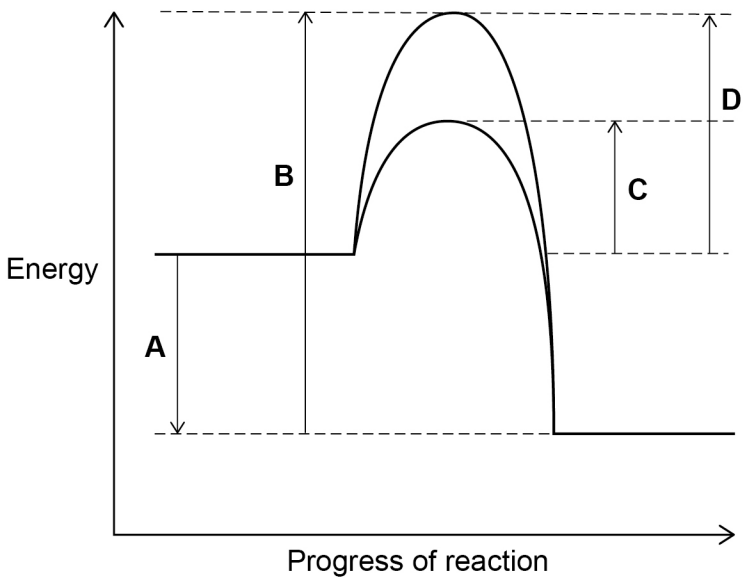
Question 3 continues on the next page

Question 04 · continued

The industrial process to produce ammonia uses a catalyst.

0 3 . 6 **Figure 5** shows the reaction profile for the reaction with and without a catalyst.

Figure 5



Which letter represents the activation energy for the reaction with a catalyst?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

5.6.1.4 Catalysts

Question 04 · continued

0 3 . 7 Give **one** reason why using a catalyst reduces costs.

Do **not** answer in terms of activation energy.

[1 mark]

0 3 . 8 Ammonia is in a mixture that is used as a household cleaner.

What is a mixture that has been designed as a useful product called?

[1 mark]

8

Turn over for the next question

5.6.1.4 Catalysts

Question 05

June 2023 | 8464/C/2F | Original Q4

0 4 A catalyst is used to increase the rate of decomposition of hydrogen peroxide.

0 4 . 1 Hydrogen peroxide decomposes to produce water and oxygen.

Write a word equation for the reaction.

[1 mark]

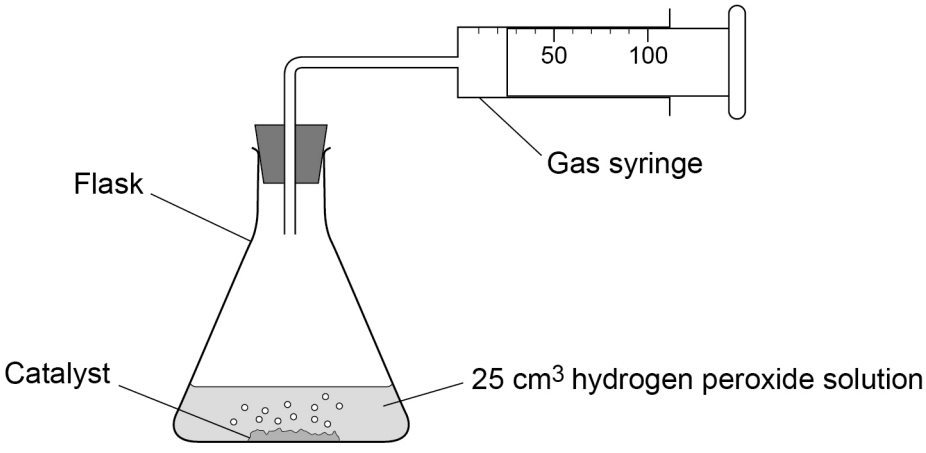
_____ → _____ + _____

A student investigated the rate of decomposition of hydrogen peroxide using three different catalysts:

- manganese dioxide
- copper oxide
- zinc oxide.

Figure 7 shows the apparatus.

Figure 7



5.6.1.4 Catalysts

Question 05 · continued

This is the method used.

1. Measure 25 cm^3 of hydrogen peroxide solution into a flask.
2. Add 0.5 g of manganese dioxide catalyst to the flask.
3. Attach a gas syringe to the flask.
4. Measure the volume of oxygen produced every 20 seconds for 120 seconds.
5. Repeat steps 1 to 4 two more times.
6. Repeat steps 1 to 5 using copper oxide catalyst.
7. Repeat steps 1 to 5 using zinc oxide catalyst.

0 4 . 2 Which **two** control variables are used in the investigation?

[2 marks]

Tick (✓) **two** boxes.

- Mass of catalyst ☐
- Shape of flask ☐
- Time of taking readings ☐
- Volume of hydrogen peroxide solution ☐
- Volume of oxygen produced ☐

Question 4 continues on the next page

Question 05 · continued

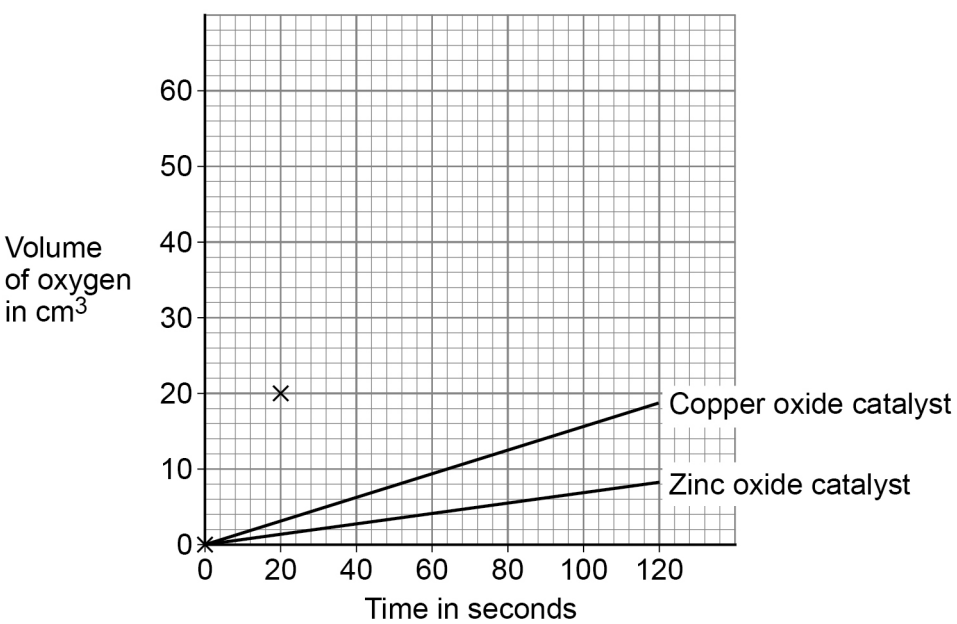
Table 3 shows the results with manganese dioxide catalyst.

Table 3

Time in seconds	0	20	40	60	80	100	120
Volume of oxygen in cm^3	0	20	32	40	45	49	50

Figure 8 shows a graph of the results with copper oxide catalyst and with zinc oxide catalyst.

Figure 8



0 4 . 3 Complete **Figure 8**.

You should:

- plot the data for the manganese dioxide catalyst from **Table 3**
- draw a line of best fit.

The first two points have been plotted for you.

[3 marks]

0 4 . 4 Which is the best catalyst?

Give **one** reason for your answer.

Use the completed **Figure 8**.

[2 marks]

Tick (✓) **one** box.

Copper oxide ☐

Manganese dioxide ☐

Zinc oxide ☐

Reason _____

_____

0 4 . 5 The student repeated the investigation with manganese dioxide catalyst.

The results were all close to the true value.

Complete the sentence.

Choose the answer from the box.

[1 mark]

accurate	**approximate**	**random**

Results that are close to the true value are _____.

Question 4 continues on the next page

5.6.1.4 Catalysts

Question 05 · continued

0 4 . 6 The student repeated the investigation using manganese dioxide catalyst at a higher temperature.

Complete the sentence.

Choose the answer from the box.

[1 mark]

decrease	**stay the same**	**increase**

At a higher temperature, the rate of reaction will _____.

10

5.6.1.4 Catalysts

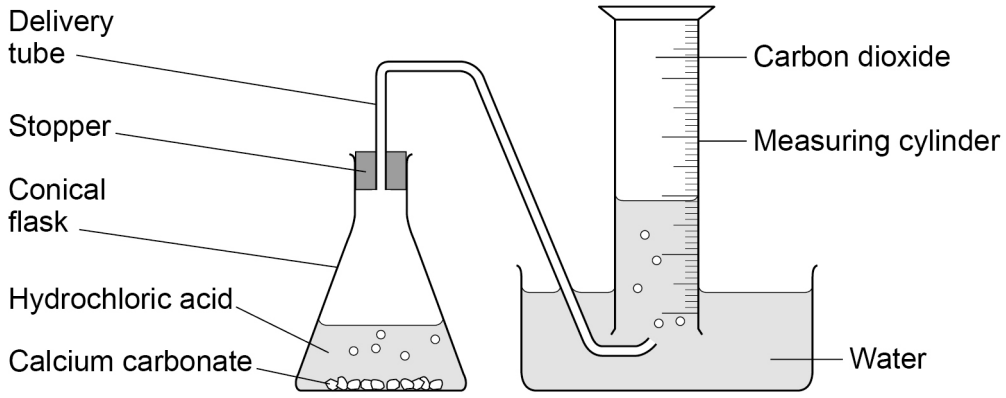
Question 06

0 7 Some factors affect the rates of chemical reactions.

0 7 . 1 A student investigated the effect of changing the particle size of calcium carbonate on the rate of reaction with hydrochloric acid.

Figure 6 shows the apparatus.

Figure 6



Describe a method the student could use to produce valid results.

[6 marks]

5.6.1.4 Catalysts

Question 06 · continued

0 7 . 2 The student investigated the effect of increasing the temperature on the rate of a reaction.

Explain the effect of increasing the temperature on the rate of a reaction.

Refer to particles and collisions in your answer.

[3 marks]

5.6.1.4 Catalysts

Question 06 · continued

Catalysts affect the rate of reactions.

0 7 . 3 What is meant by a 'catalyst'?

[2 marks]

0 7 . 4 What are catalysts in biological systems called?

[1 mark]

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