

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.

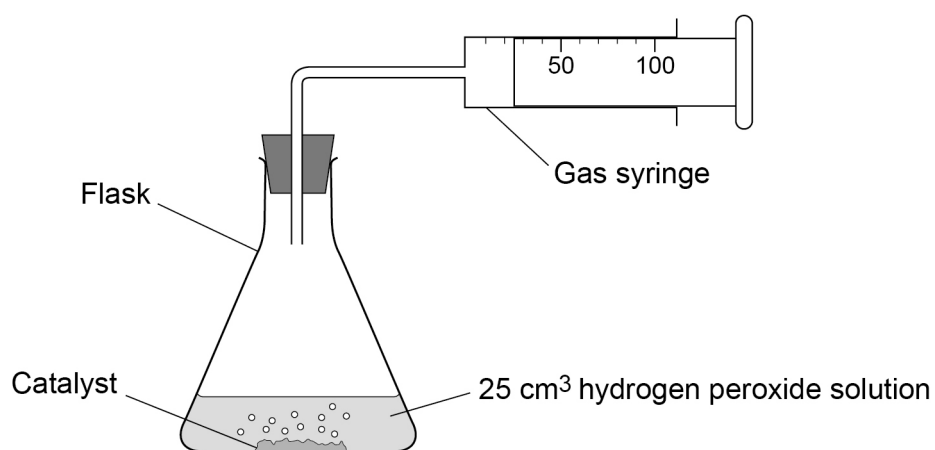
[1 mark]

_____ → _____ + _____

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

This is the method used.

1. Measure 25 cm³ 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

Turn over ►



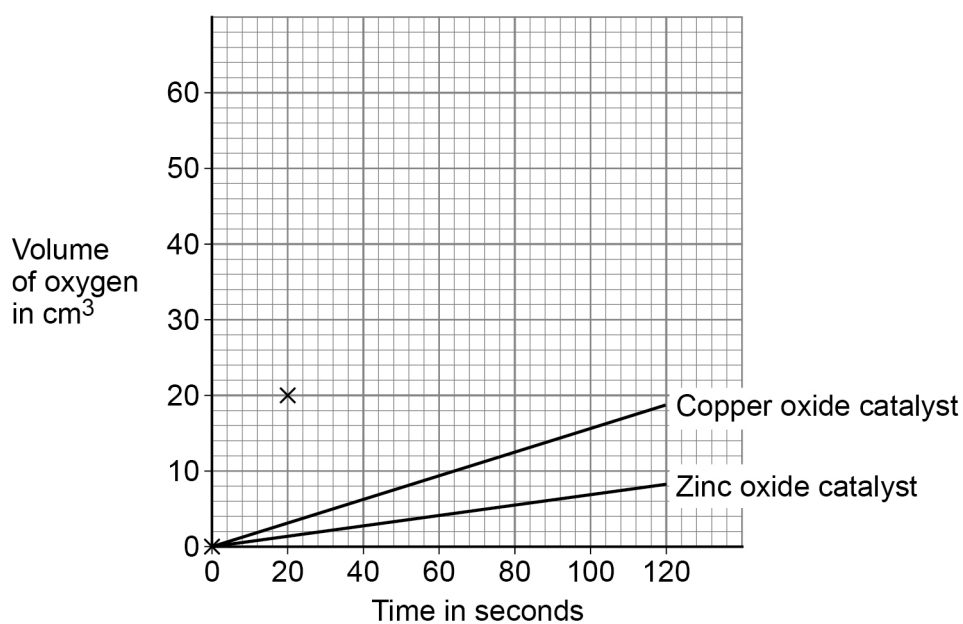
Table 3 shows the results with manganese dioxide catalyst.

Table 3

Time in seconds	0	20	40	60	80	100	120
Volume of oxygen in cm³	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

Turn over ►



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



Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	hydrogen peroxide → water + oxygen	allow H ₂ O ₂ for hydrogen peroxide allow H ₂ O for water allow O ₂ for oxygen	1	AO2 5.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	mass of catalyst		1	AO3 5.6.1.4
	volume of hydrogen peroxide solution		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	all points plotted correctly	allow a tolerance of ± ½ a small square allow at least 3 points plotted correctly for 1 mark	2	AO2 5.6.1.4
	line of best fit		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	manganese dioxide	allow ecf from question 04.3	1	AO3 5.6.1.4
	any one from: <ul style="list-style-type: none"> • steepest curve • reaction finishes first • greatest volume of oxygen (in given time) 		1	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	accurate		1	AO1 5.6.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	increase		1	AO1 5.6.1.2 5.6.1.3 5.6.1.4
Total Question 4			10	