

GCSE Combined Science: Trilogy

Worksheet: Catalysts

TIME 35 min	TOTAL 32 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Catalysts

NAME _____	CLASS _____	DATE _____
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- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0	1
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0	1	.	1
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 Which statement about catalysts is correct?

Tick (✓) **one** box.

A catalyst is used up during the reaction

☐

A catalyst changes the products of a reaction

☐

A catalyst provides a reaction pathway with a lower activation energy

☐

A catalyst increases the maximum amount of product that can be formed

☐

[1 mark]

0	1	.	2
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 What name is given to the catalysts found in living things (biological systems)?

.....

.....

.....

.....

[1 mark]

0 2

0 2 . 1

Complete the sentence.

A catalyst changes the rate of a chemical reaction, but is not changed _____
or used up by the reaction.

.....

.....

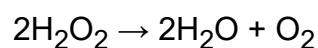
.....

.....

[1 mark]

0 2 . 2

Manganese(IV) oxide speeds up the decomposition of hydrogen peroxide:



What would you expect the mass of manganese(IV) oxide to be at the end of
the reaction, compared with the start?

.....

.....

.....

.....

[1 mark]

0 3

0 3 . 1

What is a catalyst?

.....

.....

.....

.....

[2 marks]

0 3 . 2

What name is given to the catalysts in living things?

.....

.....

.....

[1 mark]

0 3 . 3

How does a catalyst increase the rate of a reaction?

Tick (✓) **one** box.

It gives the particles more energy.

☐

It provides a different reaction pathway with a lower activation energy.

☐

It increases the temperature of the mixture.

☐

It increases the concentration of the reactants.

☐

[1 mark]

0 4

A student compared two catalysts for the decomposition of hydrogen peroxide solution. The student used the same volume and concentration of hydrogen peroxide solution and the same mass of powdered catalyst each time, and collected the oxygen produced in a gas syringe for 60 s.

- With manganese(IV) oxide: 48 cm³ of oxygen collected in 60 s.
- With copper(II) oxide: 4.0 cm³ of oxygen collected in 60 s.

0 4 . 1

Calculate the mean rate of reaction with each catalyst.

Give your answers in cm³/s.

.....

.....

.....

.....

[2 marks]

0 4 . 2

Calculate how many times faster the reaction was with manganese(IV) oxide than with copper(II) oxide.

.....

.....

.....

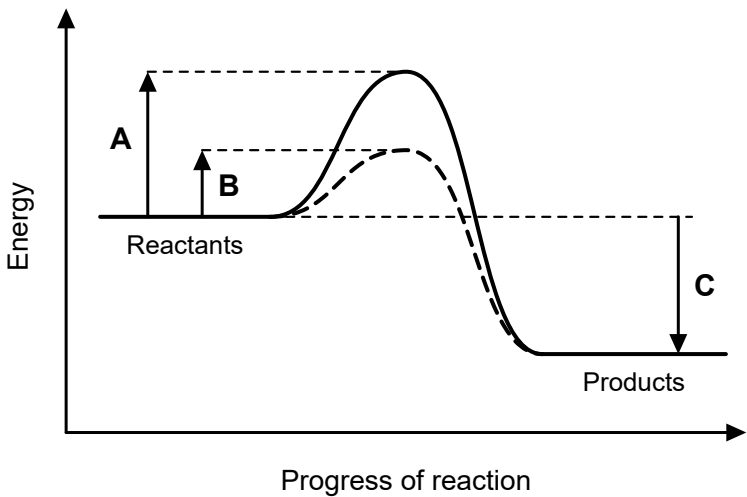
Factor = times

[1 mark]

0 5

Figure 1 shows the reaction profiles for a reaction with and without a catalyst. The dashed curve shows the catalysed reaction.

Figure 1



0 5 . 1

Which arrow shows the activation energy of the catalysed reaction?
Tick (✓) **one** box.

- A
- B
- C

☐

☐

☐

[1 mark]

0 5 . 2

Explain how the catalyst increases the rate of the reaction.

.....

.....

.....

.....

[2 marks]

0 5 . 3

What effect does the catalyst have on the overall energy change of the reaction?

Use Figure 1 to explain your answer.

.....

.....

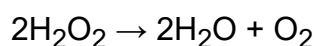
.....

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[2 marks]

0 6

Liver contains an enzyme called catalase. Catalase speeds up the decomposition of hydrogen peroxide:



0 6 . 1

How does the equation show that catalase is acting as a catalyst?

.....

.....

[1 mark]

0 6 . 2

Explain, in terms of activation energy, how catalase increases the rate of the reaction.

[2 marks]

0 6 . 3

A student adds a piece of liver to some hydrogen peroxide solution. When the fizzing stops, the student adds more hydrogen peroxide solution to the same piece of liver, and the fizzing starts again.
Explain what these observations show.

[2 marks]

0 7

A student wants to compare three different transition metal oxides to find out which is the most effective catalyst for the decomposition of hydrogen peroxide solution.

0 7 . 1

Identify the independent variable and the dependent variable for this investigation.

[2 marks]

0 7 . 2

Give **two** variables the student should control to make this a fair test.

.....

.....

.....

.....

[2 marks]

0 8

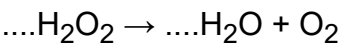
Hydrogen peroxide decomposes slowly to produce water and oxygen.
A student added 0.50 g of different solids to separate samples of the same hydrogen peroxide solution. The student measured the volume of oxygen produced in 60 seconds, then filtered, dried and weighed each solid.
Table 1 shows the results.

Table 1

Solid added	Volume of oxygen in 60 s in cm ³	Mass of solid after the reaction in g
none	1	—
copper(II) oxide	12	0.50
manganese(IV) oxide	58	0.50
solid Z	20	0.31

0 8 . 1

Complete the balanced equation for the decomposition of hydrogen peroxide.



.....

.....

[1 mark]

0 8 . 2

Which solid is the most effective catalyst?

Give **two** reasons for your answer.

.....

.....

.....

.....

.....

[3 marks]

0 8 . 3

Solid Z increased the volume of oxygen produced, but solid Z is **not** a catalyst.

Explain why.

.....

.....

.....

.....

[2 marks]

0 8 . 4

Why is a catalyst not shown in the equation for a reaction?

.....

.....

[1 mark]

END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

Mark scheme

GCSE Combined Science: Trilogy · Worksheet: Catalysts · 32 marks

Question 1 (2 marks)

01.1 [1 mark]

Correct: A catalyst provides a reaction pathway with a lower activation energy

01.2 [1 mark]

Answer: Enzymes

- enzymes (1)
-

Question 2 (2 marks)

02.1 [1 mark]

Answer: chemically

- chemically / permanently (1)
-

02.2 [1 mark]

Answer: The same.

- the same (it is not used up) (1)
-

Question 3 (4 marks)

03.1 [2 marks]

Answer: A substance that increases the rate of a reaction without being used up.

- a substance that increases / changes the rate of a reaction (1)
 - without being used up (in the reaction) (1)
-

03.2 [1 mark]

Answer: Enzymes

- enzymes (1)
-

03.3 [1 mark]

Correct: It provides a different reaction pathway with a lower activation energy.

Question 4 (3 marks)

04.1 [2 marks]

Answer: Manganese(IV) oxide: $0.80 \text{ cm}^3/\text{s}$; copper(II) oxide: $0.067 \text{ cm}^3/\text{s}$.

- manganese(IV) oxide: $48 \div 60 = 0.80 \text{ (cm}^3/\text{s)}$ (1)
- copper(II) oxide: $4.0 \div 60 = 0.067 \text{ (cm}^3/\text{s)}$ (1)

Notes: Allow 0.0667 for copper(II) oxide.

04.2 [1 mark]

Answer: 12 times

- $48 \div 4.0 = 12 \text{ (times)}$ (1)

Notes: Allow 11.9 to 12.1 from rounded rates.

Question 5 (5 marks)

05.1 [1 mark]

Correct: B

05.2 [2 marks]

Answer: It provides a different pathway with a lower activation energy, so more particles have enough energy to react when they collide.

- the catalyst provides a different pathway with a lower activation energy (1)
 - so more particles have enough energy to react / more collisions are successful (1)
-

05.3 [2 marks]

Answer: No effect: the energies of the reactants and of the products are the same with and without the catalyst.

- no effect / the overall energy change is the same (1)
 - the energies of the reactants and products are the same with and without the catalyst (arrow C is the same) (1)
-

Question 6 (5 marks)

06.1 [1 mark]

Answer: Catalase does not appear in the equation.

- catalase is not in the equation (it is not a reactant or a product) (1)

06.2 [2 marks]

Answer: Catalase provides a different reaction pathway with a lower activation energy, so a greater proportion of collisions are successful.

- catalase provides a different pathway with a lower activation energy (1)
- so more particles have enough energy to react when they collide / a greater proportion of collisions are successful (1)

06.3 [2 marks]

Answer: The fizzing stopped because all the hydrogen peroxide had been used up; the catalase was not used up, because it still catalysed the reaction when more hydrogen peroxide was added.

- the reaction stopped because the hydrogen peroxide was used up (1)
- the catalase was not used up (it still works / can be reused) (1)

Question 7 (4 marks)

07.1 [2 marks]

Answer: Independent: the metal oxide used; dependent: the rate of reaction (e.g. volume of oxygen collected in a fixed time).

- independent variable: the type of metal oxide (catalyst) used (1)
- dependent variable: the rate of reaction / the volume of oxygen produced in a fixed time (1)

07.2 [2 marks]

Answer: Mass of catalyst; concentration and volume of hydrogen peroxide solution.

- mass (and particle size) of the catalyst used each time (1)
- concentration of hydrogen peroxide solution (1)
- volume of hydrogen peroxide solution (1)
- temperature (1)

Any 2 of the points above.

Question 8 (7 marks)

08.1 [1 mark]

Answer: $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$

- $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$ (1)
-

08.2 [3 marks]

Answer: Manganese(IV) oxide: it produced the most oxygen in 60 s and its mass did not change.

- manganese(IV) oxide (1)
 - it produced the most oxygen in 60 s / gave the fastest rate (1)
 - its mass was unchanged, so it was not used up (1)
-

08.3 [2 marks]

Answer: Its mass decreased from 0.50 g to 0.31 g, so it was used up, but catalysts are not used up.

- the mass of solid Z decreased (from 0.50 g to 0.31 g) (1)
 - so it was used up / reacted, but a catalyst is not used up (1)
-

08.4 [1 mark]

Answer: It is not used up, so it is not a reactant or a product.

- it is not used up / it is not a reactant or product / it is chemically unchanged at the end (1)
-