

GCSE Combined Science: Trilogy

Worksheet: Calculating rates of reactions

TIME 35 min	TOTAL 32 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Calculating rates of reactions

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

The mean rate of a reaction can be calculated using:

mean rate of reaction = quantity of reactant used or product formed ÷ time taken

0 1 . 1

A reaction produces 45 cm³ of gas in 30 s.
Calculate the mean rate of reaction.

.....

.....

.....

Mean rate = cm³/s

[1 mark]

0 1 . 2

In a different reaction, carbon dioxide is produced at a mean rate of 0.015 g/s.
Calculate the mass of carbon dioxide produced in 120 s.

.....

.....

.....

.....

Mass = g

[2 marks]

0 1 . 3

Which of these is a correct unit for the rate of a reaction?

Tick (✓) **one** box.

cm³

☐

cm³/s

☐

s/cm³

☐

s

☐

[1 mark]

0 2

A student added a small amount of manganese(IV) oxide to hydrogen peroxide solution and collected the oxygen produced in a gas syringe.

Table 1 shows the results.

Table 1

Time in s	0	20	40	60	80	100	120
Volume of oxygen in cm ³	0	28	43	50	54	56	57

0 2 . 1

Calculate the mean rate of reaction between 0 s and 40 s.

.....

.....

.....

.....

Mean rate = cm³/s

[2 marks]

0 2 . 2

Explain how the results show that the rate of reaction decreased during the experiment.

.....

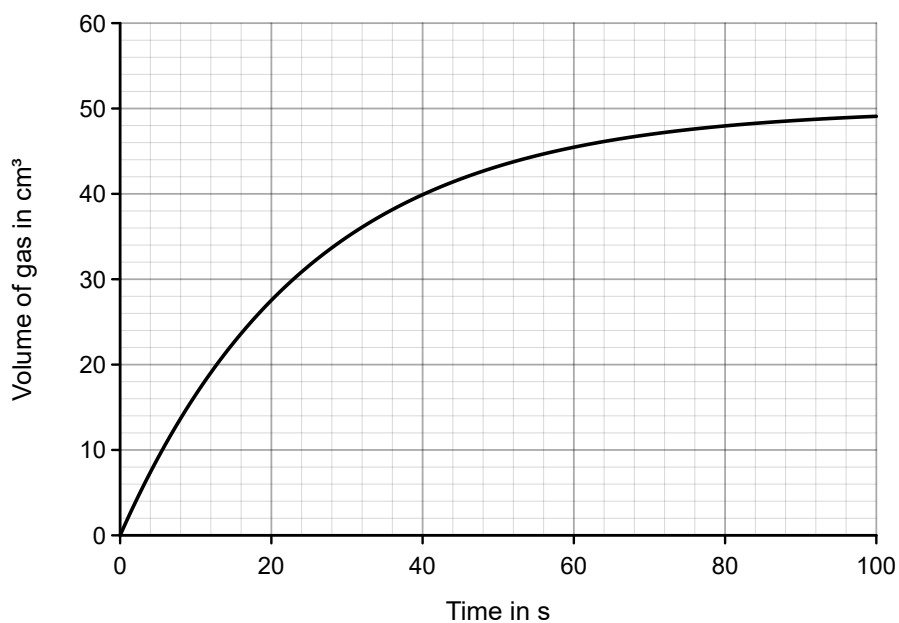
.....

[1 mark]

0 3

Figure 1 shows the volume of gas produced during a reaction.

Figure 1



0 3 . 1

During which time interval was the reaction fastest?

Tick (✓) **one** box.

0 s to 20 s

☐

20 s to 40 s

☐

60 s to 80 s

☐

80 s to 100 s

☐

[1 mark]

0 3 . 2

Explain how you can tell this from the graph.

.....

.....

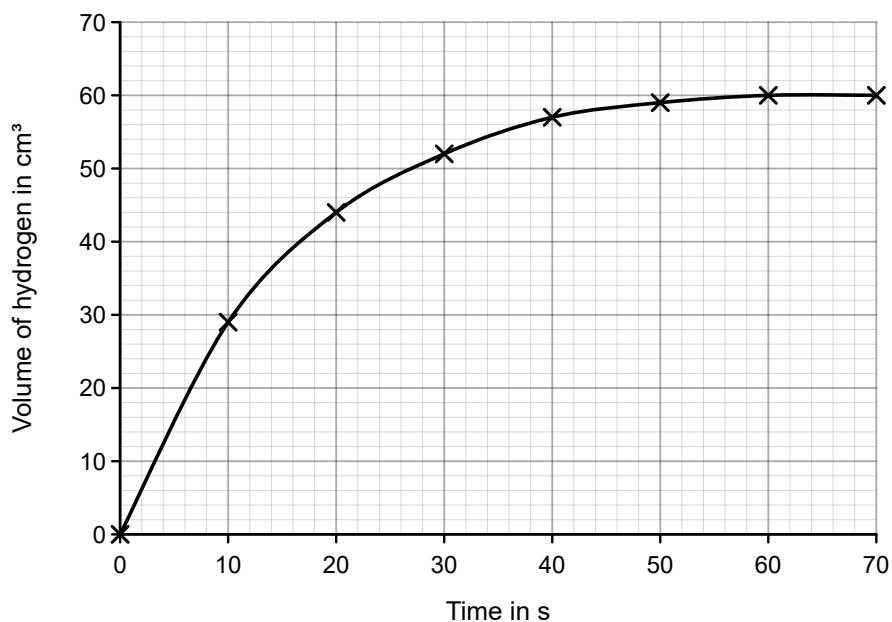
[1 mark]

0 4

A student reacted magnesium ribbon with dilute hydrochloric acid and collected the hydrogen produced.

Figure 2 shows the results.

Figure 2



0 4 . 1

Use Figure 2 to find the volume of hydrogen collected in the first 20 s.

.....

.....

.....

Volume = cm³

[1 mark]

0 4 . 2

Calculate the mean rate of reaction in the first 20 s.

Use the equation:

mean rate of reaction = quantity of product formed ÷ time taken

.....

.....

.....

.....

Mean rate = cm³/s

[2 marks]

0 4 . 3

How does Figure 2 show that the reaction had stopped by 70 s?

.....

.....

[1 mark]

0 4 . 4

Which unit could be used for the rate of this reaction?

Tick (✓) **one** box.

cm³

☐

cm³/s

☐

s/cm³

☐

g/cm³

☐

[1 mark]

0 5

A student added marble chips (calcium carbonate) to excess dilute hydrochloric acid in an open flask standing on a balance. The student recorded the total mass lost as carbon dioxide escaped.

Table 2 shows the results.

Table 2

Time in s	0	20	40	60	80	100	120
Total mass lost in g	0.00	0.61	0.90	1.04	1.11	1.14	1.16

0 5 . 1

Calculate the mean rate of reaction between 0 s and 20 s.
Give your answer in g/s to 2 significant figures.

.....

.....

.....

.....

.....

Mean rate = g/s

[3 marks]

0 5 . 2

Explain why the total mass lost stops increasing, however long the flask is left.

.....

.....

.....

.....

[2 marks]

0 6

A student added marble chips (calcium carbonate) to excess hydrochloric acid in a conical flask standing on a balance. A cotton wool plug was put in the neck of the flask.



Table 3 shows how the mass of the flask and contents changed.

Table 3

Time in s	Mass in g
0	152.60
30	152.12
60	151.80
90	151.60
120	151.48
150	151.42
180	151.40
210	151.40

0 6 . 1

Explain why the mass decreased.

.....

.....

[1 mark]

0 6 . 2

Suggest why a cotton wool plug was used.

.....

.....

[1 mark]

0 6 . 3

Calculate the mean rate of reaction in the first 60 s.
Give your answer in g/s to 2 significant figures.

.....

.....

.....

.....

.....

Mean rate = g/s

[3 marks]

0 6 . 4

Explain why the rate of reaction decreased as the reaction continued.

.....

.....

.....

.....

[2 marks]

0 6 . 5

Give the time at which the reaction had finished.

.....

.....

.....

Time = s

[1 mark]

.....

0 7

A student added excess calcium carbonate powder to 50 cm³ of dilute nitric acid in a flask on a balance, and recorded the total mass at intervals.

The mass of the flask and contents was 184.62 g at the start and 183.86 g after the reaction had finished.

0 7 . 1

Explain why the mass decreased during the reaction.

.....

.....

[1 mark]

0 7 . 2

The reaction took 240 s to finish.

Calculate the mean rate of reaction over this time.

Give your answer to 2 significant figures.

.....

.....

.....

.....

.....

Mean rate = g/s

[3 marks]

0 7 . 3

Suggest how the student could tell, without waiting and weighing, that carbon dioxide gas was still being produced.

.....

.....

[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: Calculating rates of reactions · 32 marks

Question 1 (4 marks)

01.1 [1 mark]

Answer: $1.5 \text{ cm}^3/\text{s}$

- $1.5 \text{ (cm}^3/\text{s) (1)}$
-

01.2 [2 marks]

Answer: 1.8 g

- $0.015 \times 120 \text{ (1)}$
 - 1.8 (g) (1)
-

01.3 [1 mark]

Correct: cm^3/s

Question 2 (3 marks)

02.1 [2 marks]

Answer: $1.1 \text{ cm}^3/\text{s}$

- $43 \div 40 \text{ (1)}$
- $1.1 \text{ (cm}^3/\text{s) (1)}$

Notes: Allow 1.08.

02.2 [1 mark]

Answer: The volume of gas collected in each 20 s interval got smaller.

- the volume of gas produced in each 20 s interval gets smaller (the volume increases by less each time) (1)
-

Question 3 (2 marks)

03.1 [1 mark]

Correct: 0 s to 20 s

03.2 [1 mark]

Answer: The curve is steepest (has the greatest gradient) during that interval.

- the curve is steepest / has the greatest gradient during that interval (1)
-

Question 4 (5 marks)

04.1 [1 mark]

Answer: 44 cm^3

- $44 \text{ (cm}^3\text{)} (1)$

Notes: Allow 43 to 45.

04.2 [2 marks]

Answer: $2.2 \text{ cm}^3/\text{s}$

- $44 \div 20 (1)$
- $2.2 \text{ (cm}^3/\text{s)} (1)$

Notes: Allow ECF from the previous part.

04.3 [1 mark]

Answer: The line is horizontal: no more hydrogen was produced.

- the line is horizontal / levels off (so no more hydrogen was produced) (1)
-

04.4 [1 mark]

Correct: cm^3/s

Question 5 (5 marks)

05.1 [3 marks]

Answer: 0.031 g/s

- mass lost = 0.61 (g) (1)
- $0.61 \div 20$ (1)
- 0.031 (g/s) (1)

Notes: An answer of 0.0305 (not to 2 significant figures) scores 2 marks.

05.2 [2 marks]

Answer: The hydrochloric acid (the limiting reactant) is all used up, so the reaction stops and no more carbon dioxide is produced.

- the hydrochloric acid is used up (it is the limiting reactant; the marble chips are in excess) (1)
 - so the reaction stops and no more carbon dioxide is produced (or lost) (1)
-

Question 6 (8 marks)

06.1 [1 mark]

Answer: Carbon dioxide gas was produced and escaped from the flask.

- carbon dioxide (gas) is produced and escapes from the flask (1)

06.2 [1 mark]

Answer: To let the gas out but stop acid spray escaping.

- to let the gas escape but stop acid spray / liquid escaping (1)

06.3 [3 marks]

Answer: 0.013 g/s

- $152.60 - 151.80 = 0.80$ (g) (1)
- $0.80 \div 60$ (1)
- 0.013 (g/s) (1)

Notes: An answer of 0.0133 (not given to 2 significant figures) scores 2 marks.

06.4 [2 marks]

Answer: The marble chips were being used up, so there were fewer collisions per second.

- the marble chips / the reactants are being used up (the concentration of acid decreases) (1)
- so there are fewer collisions per second / the frequency of collisions decreases (1)

06.5 [1 mark]

Answer: 180 s

- 180 (s) (1)

Notes: Allow any time between 150 s and 180 s.

Question 7 (5 marks)

07.1 [1 mark]

Answer: Carbon dioxide gas was produced and escaped from the open flask.

- carbon dioxide gas is produced and escapes from the (open) flask (1)
-

07.2 [3 marks]

Answer: 0.0032 g/s

- $184.62 - 183.86 = 0.76$ (g) (1)
- $0.76 \div 240$ (1)
- 0.0032 (g/s) (1)

Notes: An answer of 0.00317 (not to 2 significant figures) scores 2 marks.

07.3 [1 mark]

Answer: Bubbles (effervescence) would still be seen in the flask.

- bubbles / fizzing (effervescence) can still be seen in the flask (1)
-