

GCSE Chemistry

Worksheet: Factors which affect the rate of reaction

TIME 35 min	TOTAL 31 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Factors which affect the rate of reaction

NAME _____ **CLASS** _____ **DATE** _____

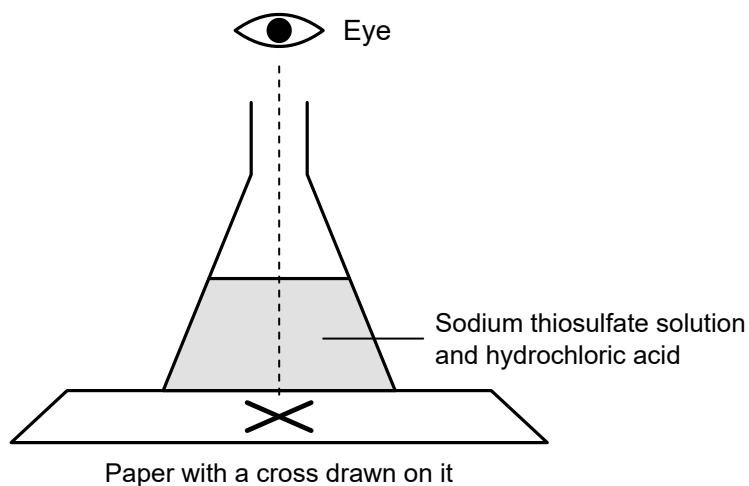
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

A student investigated the reaction between sodium thiosulfate solution and dilute hydrochloric acid. The mixture slowly becomes cloudy.

Figure 1 shows the apparatus. The student timed how long it took for the cross to disappear.

Figure 1



0 1 . 1

The student used different concentrations of sodium thiosulfate solution. What was the independent variable?

.....

.....

[1 mark]

0 1 . 2

What was the dependent variable?

.....

.....

[1 mark]

0 1 . 3

Give **one** control variable.

.....

.....

[1 mark]

0 1 . 4

The mixture becomes cloudy because a solid forms.
Name the solid.

.....

.....

.....

.....
[1 mark]

0 1 . 5

Sulfur dioxide gas is also produced. Sulfur dioxide is toxic.
Give **one** safety precaution.

.....

.....

[1 mark]

0 2

A student investigates how the concentration of hydrochloric acid affects the rate of its reaction with marble chips (calcium carbonate). The student puts the acid in a conical flask on a balance, adds the marble chips and loosely plugs the neck of the flask with cotton wool. The student records the mass of the flask and its contents every 30 seconds.

0 2 . 1

Complete the word equation for the reaction.

calcium carbonate + hydrochloric acid → calcium chloride + water +

.....

.....

.....

[1 mark]

0 2 . 2

Explain why the mass of the flask and its contents decreases.

.....

.....

[1 mark]

0 2 . 3

Suggest why the flask is plugged with cotton wool rather than left open.

.....

.....

[1 mark]

0 2 . 4

Which variable must the student keep the same to make this a fair test?

Tick (✓) **one** box.

The concentration of hydrochloric acid

☐

The loss in mass

☐

The size of the marble chips

☐

The rate of reaction

☐

[1 mark]

0 2 . 5

Give **one** other variable the student must keep the same.

[1 mark]

0 3

A student is about to investigate the reaction between sodium thiosulfate solution and dilute hydrochloric acid, using the disappearing-cross method.

0 3 . 1

Suggest why the same person should decide when the cross has disappeared in every experiment.

[1 mark]

0 3 . 2

The reaction produces sulfur dioxide gas, which is toxic.
Give **one** control measure the student should use.

[1 mark]

0 3 . 3

Suggest why the student should wear eye protection during this experiment.

[1 mark]

0 4

A student investigated how the concentration of sodium thiosulfate solution affects the rate of its reaction with hydrochloric acid. The student timed how long it took for a cross under the flask to disappear.

Table 1 shows the results.

Table 1

Concentration of sodium thiosulfate in g/dm ³	Time 1 in s	Time 2 in s	Time 3 in s	Mean time in s
40	21	22	21	21.3
32	27	26	26	26.3
24	34	45	36	X
16	53	51	52	52.0
8	104	106	105	105.0

0 4 . 1

Identify the anomalous result in Table 1.

.....

.....

.....

.....
[1 mark]

0 4 . 2

Calculate the mean time **X**.

Do not include the anomalous result.

.....

.....

.....

X = s

[1 mark]

0 4 . 3

Describe the relationship between the concentration of sodium thiosulfate and the time taken for the cross to disappear.
Use data from Table 1.

.....

.....

.....

.....

[2 marks]

0 4 . 4

The rate of reaction can be found using: rate = $1 \div \text{mean time}$
Calculate the rate for 40 g/dm³. Give your answer to 2 significant figures.

.....

.....

.....

Rate = /s

[1 mark]

0 4 . 5

Suggest **one** way the student could improve the method to reduce errors in deciding when the cross has disappeared.

.....

.....

[1 mark]

.....

0 5

A student uses the mass-loss method to measure the mass lost in the first 60 s when marble chips react with hydrochloric acid. The student does the experiment three times with acid of the same concentration. The balance has a resolution of 0.01 g. The mass losses were 0.32 g, 0.36 g and 0.34 g.

0 5 . 1

Calculate the mean mass lost in the first 60 s.

.....

.....

.....

Mean mass lost = g

[1 mark]

0 5 . 2

Calculate the uncertainty in the mean. Use half the range of the three results.

.....

.....

.....

Uncertainty = g

[1 mark]

0 5 . 3

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

.....

.....

.....

.....

Mean rate = g/s

[2 marks]

0 5 . 4

Explain why a balance with a resolution of 0.01 g is suitable for measuring these mass losses.

.....

.....

.....

.....

[2 marks]

0 5 . 5

Another student did the same experiment with a different balance and obtained a mass loss of 0.33 g in the first 60 s.
What does this show about the first student's results? Give a reason for your answer.

.....

.....

.....

.....

[2 marks]

0 6

Two students investigated how the concentration of sodium thiosulfate solution affects the time for a black cross to disappear, viewed through the solution from above.

- Student A repeated the experiment three times with 40 g/dm³ solution and got times of 21 s, 22 s and 21 s.
- Student B, using a different batch of the same concentration of sodium thiosulfate solution and a different stopwatch, got a time of 23 s.

0 6 . 1

What is meant by a result being repeatable?

.....

.....

[1 mark]

0 6 . 2

What is meant by a result being reproducible?

.....

.....

[1 mark]

0 6 . 3

Use the data to explain why student A’s results are repeatable and the investigation is reproducible.

.....

.....

.....

.....

[2 marks]

END OF QUESTIONS

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

Mark scheme

GCSE Chemistry · Worksheet: Factors which affect the rate of reaction · 31 marks

Question 1 (5 marks)

01.1 [1 mark]

Answer: The concentration of sodium thiosulfate solution.

- concentration of sodium thiosulfate (solution) (1)
-

01.2 [1 mark]

Answer: The time taken for the cross to disappear.

- time (taken) for the cross to disappear (1)
-

01.3 [1 mark]

Answer: The volume of hydrochloric acid.

- volume of sodium thiosulfate solution / volume or concentration of hydrochloric acid / temperature / same cross or paper / same person watching the cross (1)
-

01.4 [1 mark]

Answer: Sulfur

- sulfur (1)
-

01.5 [1 mark]

Answer: Work in a well-ventilated room.

- work in a well-ventilated room / avoid breathing in the gas / people with asthma should not do the experiment / pour the mixture away as soon as the experiment ends (1)
-

Question 2 (5 marks)

02.1 [1 mark]

Answer: carbon dioxide

- carbon dioxide (1)

02.2 [1 mark]

Answer: Carbon dioxide gas is produced and escapes from the flask.

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

02.3 [1 mark]

Answer: The cotton wool lets the gas escape but stops acid spray escaping.

- it lets the carbon dioxide escape but stops acid spray / droplets escaping (so only the gas is lost) (1)

02.4 [1 mark]

Correct: The size of the marble chips

02.5 [1 mark]

Answer: The volume of hydrochloric acid.

- volume of acid / mass of marble chips / temperature (1)

Question 3 (3 marks)

03.1 [1 mark]

Answer: Different people may judge the moment the cross disappears differently, so using the same person makes the results more comparable.

- different people may judge when the cross disappears differently (it is a judgement by eye), so the results are more comparable / more repeatable (1)

03.2 [1 mark]

Answer: Work in a well-ventilated room (or use a fume cupboard).

- work in a well-ventilated room / use a fume cupboard / avoid breathing in the gas (1)

03.3 [1 mark]

Answer: Dilute hydrochloric acid can irritate or damage the eyes.

- dilute hydrochloric acid could splash into the eyes and cause irritation or damage (1)
-

Question 4 (6 marks)

04.1 [1 mark]

Answer: 45 s (at 24 g/dm³)

- 45 (s) at 24 g/dm³ (1)
-

04.2 [1 mark]

Answer: 35 s

- 35 (s) (1)
-

04.3 [2 marks]

Answer: As the concentration increases the time decreases; halving the concentration doubles the time (16 g/dm³: 52 s; 8 g/dm³: 105 s), so time is inversely proportional to concentration.

- as the concentration increases, the time decreases (1)
 - halving the concentration (about) doubles the time, e.g. 16 g/dm³ → 52 s and 8 g/dm³ → 105 s / time is inversely proportional to concentration (1)
-

04.4 [1 mark]

Answer: 0.047 /s

- 0.047 (/s) (1)
-

04.5 [1 mark]

Answer: Use a light sensor and data logger.

- use a light sensor / data logger / the same person judges the cross every time (1)
-

Question 5 (8 marks)

05.1 [1 mark]

Answer: 0.34 g

- $(0.32 + 0.36 + 0.34) \div 3 = 0.34$ (g) (1)

05.2 [1 mark]

Answer: ± 0.02 g

- $(0.36 - 0.32) \div 2 = (\pm) 0.02$ (g) (1)

05.3 [2 marks]

Answer: 0.0057 g/s

- $0.34 \div 60$ (1)
- $= 0.0057$ (g/s) (1)

Notes: An unrounded answer (0.00567 g/s) scores 1 mark. Allow ECF from part (a).

05.4 [2 marks]

Answer: The mass losses (about 0.34 g) are much larger than 0.01 g, so the reading uncertainty is only a small percentage (about 3%) of the mass lost.

- the mass losses (about 0.34 g) are much larger than the resolution (0.01 g) (1)
- so the uncertainty in reading the balance is only a small fraction (about 3%) of the mass lost / differences between results can be detected (1)

05.5 [2 marks]

Answer: They are reproducible: a different person with different equipment obtained a similar result, within 0.32–0.36 g.

- the results are reproducible (1)
- a different person using different equipment obtained a similar result (0.33 g is within the range 0.32–0.36 g) (1)

Notes: Do not accept 'repeatable' for the first mark.

Question 6 (4 marks)

06.1 [1 mark]

Answer: The same experimenter repeats the method with the same equipment and gets very similar results.

- the same experimenter repeats the investigation using the same method and equipment and gets very similar results (1)

06.2 [1 mark]

Answer: A different person, or different equipment, gets very similar results.

- a different person, or different equipment, obtains very similar results (1)

06.3 [2 marks]

Answer: Student A's three repeats (21, 22, 21 s) are all close together, showing repeatability; student B's result (23 s), with different equipment, is close to student A's results, showing reproducibility.

- student A's repeated results are all close together (within 1 s of each other), showing repeatability (1)
 - student B's result (23 s), obtained with different equipment, is close to student A's results, showing reproducibility (1)
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