

GCSE Combined Science: Trilogy

Worksheet: Factors which affect the rates of chemical reactions

TIME 30 min	TOTAL 28 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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Topics: Factors which affect the rates of chemical reactions

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

0 1 . 1

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

[1 mark]

0 1 . 2

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

[1 mark]

0 1 . 3

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

[1 mark]

0 2

Marble chips react with dilute hydrochloric acid.

0 2 . 1

Which **two** changes would increase the rate of the reaction?

Tick (✓) **two** boxes.

Use larger marble chips

☐

Use powdered marble

☐

Use more dilute acid

☐

Increase the temperature

☐

Use a bigger flask

☐

[2 marks]

0 2 . 2

Give **one** other factor that affects the rate of a chemical reaction.

.....

.....

[1 mark]

0 2 . 3

A student says:

'Using powdered marble instead of the same mass of marble chips will produce more carbon dioxide.'

Is the student correct? Explain your answer.

.....

.....

.....

.....

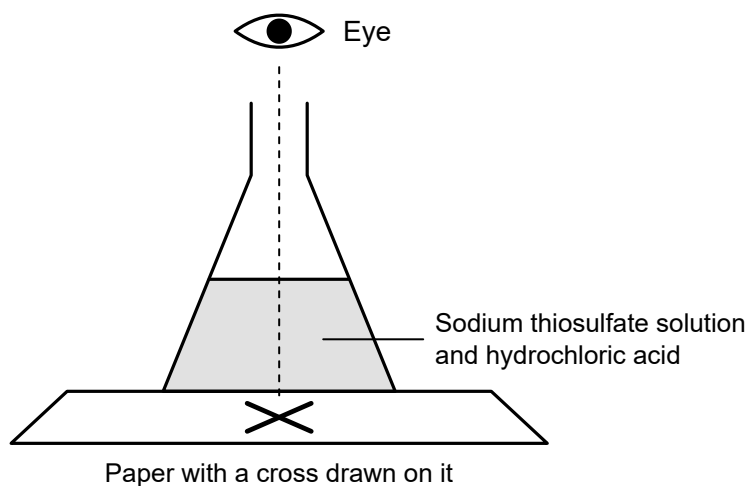
[2 marks]

0 3

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 3 . 1

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

.....

.....

[1 mark]

0 3 . 2

What was the dependent variable?

.....

.....

[1 mark]

0 3 . 3

Give **one** control variable.

.....

.....

[1 mark]

0 3 . 4

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

.....

.....

.....

.....
[1 mark]

0 3 . 5

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

.....

.....

[1 mark]

0 4

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/dm^3 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 4 . 1

What is meant by a result being repeatable?

.....

.....

[1 mark]

0 4 . 2

What is meant by a result being reproducible?

.....

.....

[1 mark]

0 4 . 3

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

.....

.....

.....

.....

[2 marks]

0 5

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 5 . 1

Identify the anomalous result in Table 1.

.....

.....

.....

.....

[1 mark]

0 5 . 2

Calculate the mean time **X**.
Do not include the anomalous result.

.....

.....

.....

$X =$ s

[1 mark]

0 5 . 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 5 . 4

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

.....

.....

.....

Rate = /s

[1 mark]

0 5 . 5

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

.....

.....

[1 mark]

0 6

A student used the disappearing-cross method to investigate the effect of concentration on the rate of reaction between sodium thiosulfate solution and dilute hydrochloric acid. The student repeated each concentration three times.

Table 2 shows the results.

Table 2

Concentration of sodium thiosulfate in g/dm ³	Time 1 in s	Time 2 in s	Time 3 in s	Mean time in s
50	16	15	16	15.7
40	19	20	31	X
30	27	26	28	27.0
20	41	40	42	41.0

0 6 . 1

Identify the anomalous result in Table 2.

.....

.....

.....

Anomalous result = s

[1 mark]

0 6 . 2

Calculate the mean time **X**, ignoring the anomalous result.

.....

.....

.....

X = s

[1 mark]

0 6 . 3

The stopwatch used has a resolution of 0.01 s, but the student recorded times only to the nearest whole second.

Suggest why judging the disappearing cross, rather than the stopwatch, limits the precision of these results.

.....

.....

[1 mark]

0 6 . 4

Describe the relationship between concentration and rate of reaction shown by these results.

.....

.....

.....

.....

[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 Combined Science: Trilogy · Worksheet: Factors which affect the rates of chemical reactions · 28 marks

Question 1 (3 marks)

01.1 [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)
-

01.2 [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)
-

01.3 [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 2 (5 marks)

02.1 [2 marks]

Correct: Use powdered marble; Increase the temperature

02.2 [1 mark]

Answer: Concentration of a reactant in solution (or a catalyst, or pressure of gases).

- concentration (of a reactant in solution) / adding a catalyst / pressure (of reacting gases) (1)

Notes: Do not accept surface area or temperature.

02.3 [2 marks]

Answer: No: the same masses of marble and acid react, so the same volume of gas forms; the powder only makes the reaction faster.

- no (1)
 - the same mass of marble reacts (with the same acid) so the same volume of gas is produced; the powder only increases the rate (1)
-

Question 3 (5 marks)

03.1 [1 mark]

Answer: The concentration of sodium thiosulfate solution.

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

03.2 [1 mark]

Answer: The time taken for the cross to disappear.

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

03.3 [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)
-

03.4 [1 mark]

Answer: Sulfur

- sulfur (1)
-

03.5 [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 4 (4 marks)

04.1 [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)

04.2 [1 mark]

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

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

04.3 [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)
-

Question 5 (6 marks)

05.1 [1 mark]

Answer: 45 s (at 24 g/dm³)

- 45 (s) at 24 g/dm³ (1)
-

05.2 [1 mark]

Answer: 35 s

- 35 (s) (1)
-

05.3 [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)
-

05.4 [1 mark]

Answer: 0.047 /s

- 0.047 (/s) (1)
-

05.5 [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 6 (5 marks)

06.1 [1 mark]

Answer: 31 s (at 40 g/dm³)

- 31 (s) at 40 g/dm³ (1)
-

06.2 [1 mark]

Answer: 19.5 s

- 19.5 (s) (1)
-

06.3 [1 mark]

Answer: The uncertainty in judging exactly when the cross disappears is much larger than 0.01 s, so a more precise stopwatch would not improve the results.

- the uncertainty in judging by eye exactly when the cross disappears is much larger than the stopwatch's resolution (0.01 s), so the stopwatch is not the limiting factor (1)
-

06.4 [2 marks]

Answer: As the concentration increases, the time decreases, so the rate of reaction increases.

- as the concentration of sodium thiosulfate increases, the time (for the cross to disappear) decreases (1)
 - so the rate of reaction increases as concentration increases (1)
-