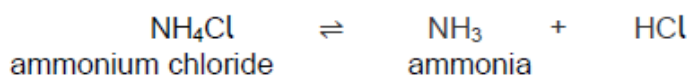**AQA – The rate and extent of chemical reaction – GCSE 2022 CS Chemistry**

1. June/2022/Paper_8464/C/2F/No.3

| 0 | 3 |

This question is about ammonia and its compounds.

A student heated a sample of ammonium chloride.

The equation for the reaction is:

$$NH_4Cl \rightleftharpoons NH_3 + HCl$$
ammonium chloride   ammonia

| 0 | 3 |.| 1 |

One product is ammonia.

What is the name of the product with the formula HCl?

[1 mark]

_____

| 0 | 3 |.| 2 |

Ammonia is a gas.

What is the state symbol for ammonia?

[1 mark]

Tick (✓) **one** box.

(aq) ☐   (g) ☐   (l) ☐   (s) ☐

| 0 | 3 |.| 3 |

How does the equation show that the reaction is reversible?

[1 mark]

_____

_____

| 0 | 3 |.| 4 |

Complete the sentence.

[1 mark]

The forward reaction is endothermic,

so the reverse reaction is _____ .

0 3 . 5 Complete the sentence.
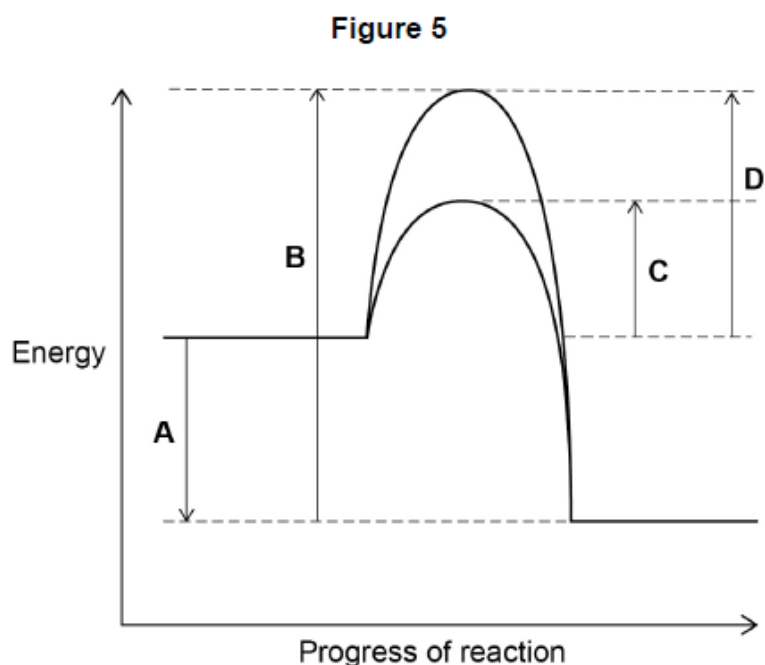
Choose the answer from the box.

[1 mark]

concentration	rate	temperature

Equilibrium is reached when the forward and reverse reactions happen at exactly the

same _____ .

The industrial process to produce ammonia uses a catalyst.

0 3 . 6 **Figure 5** shows the reaction profile for the reaction with and without a catalyst.

Figure 5

Which letter represents the activation energy for the reaction with a catalyst?

[1 mark]

Tick (✓) **one** box.

A ☐   B ☐   C ☐   D ☐

2

| 0 | 3 |.| 7 | Give **one** reason why using a catalyst reduces costs.

Do **not** answer in terms of activation energy.

[1 mark]

_____

_____

| 0 | 3 |.| 8 | Ammonia is in a mixture that is used as a household cleaner.

What is a mixture that has been designed as a useful product called?
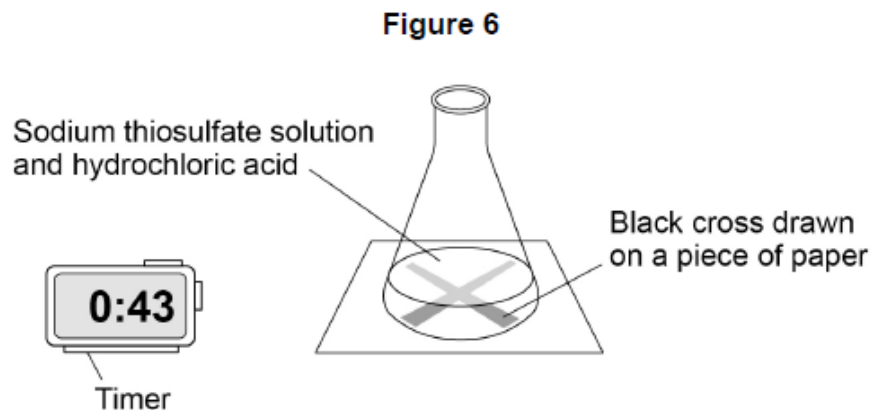
[1 mark]

_____

2. June/2022/Paper_8464/C/2F/No.4

| 0 | 4 |

A student investigates the effect of concentration on the rate of the reaction between sodium thiosulfate solution and hydrochloric acid.

Figure 6 shows the experiment.

The experiment was done in a fume cupboard.

Figure 6

This is the method used.

1. Pour 50 cm³ of sodium thiosulfate solution into a conical flask.

2. Put the conical flask on a black cross drawn on a piece of paper.

3. Pour 10 cm³ of hydrochloric acid into the conical flask and start a timer.

4. Stop the timer when the cross can no longer be seen.

5. Repeat the experiment with different concentrations of sodium thiosulfate solution.

0 4 . 1 Draw **one** line from each type of variable to the correct example of the variable in this investigation.

[2 marks]

Type of variable   **Example of variable**

Concentration of sodium thiosulfate solution

Dependent

Temperature of reaction mixture

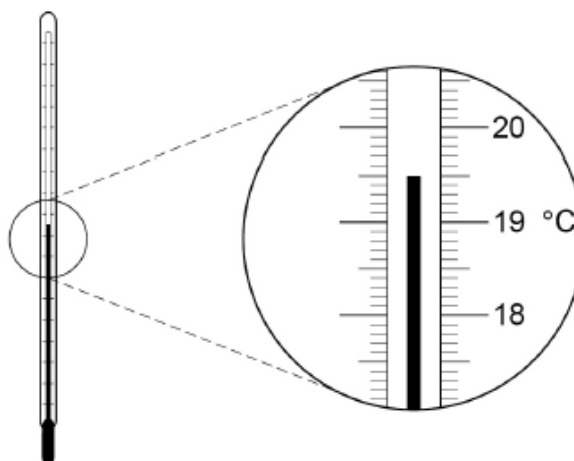Time taken for the cross to no longer be seen

Independent

Volume of acid

Volume of the flask

0 4 . 2 The experiment is done at room temperature.

Figure 7

What is the temperature shown on the thermometer in **Figure 7**?

[1 mark]

Temperature = _____ °C
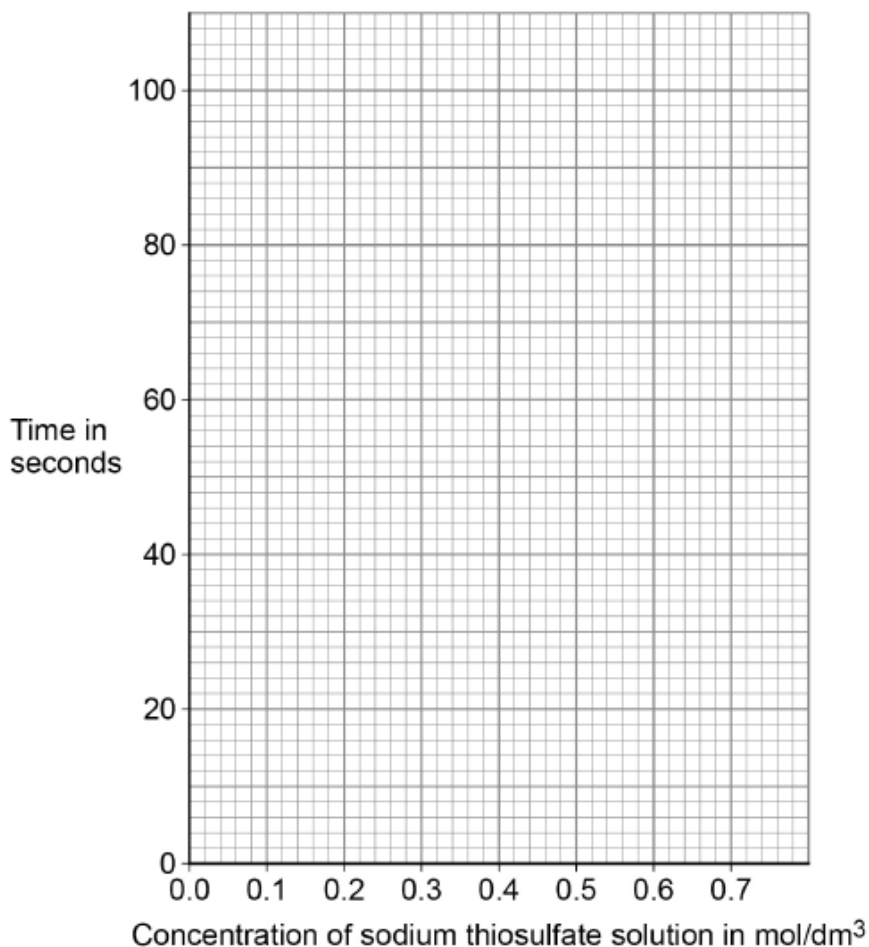
Table 1 shows the student's results.

Table 1

Concentration of sodium thiosulfate solution in mol/dm^3	Time in seconds
0.1	82
0.2	40
0.3	20
0.4	13
0.5	10
0.6	8

0 4 . 3 Plot the data from **Table 1** on **Figure 8**.

Draw a line of best fit.

[3 marks]

Figure 8

0 4 . 4 Predict the time taken for the cross to no longer be seen at a concentration of 0.7 mol/dm^3

Use your graph in **Figure 8**.

[1 mark]

Time = _____ s

0 4 . 5 Complete the sentence.

[1 mark]

As the concentration of sodium thiosulfate solution increases, the time taken for the

cross to no longer be seen _____ .

0 4 . 6   In one experiment 0.725 g of sulfur is produced in 20 seconds.

Calculate the mean rate of the reaction from 0 to 20 seconds.

Use the equation:

$$\text{mean rate of reaction} = \frac{\text{mass of sulfur produced in grams}}{\text{time in seconds}}$$

[2 marks]

_____

_____

Mean rate of reaction = _____

0 4 . 7   What is the unit for the mean rate of reaction calculated in Question **04.6**?

[1 mark]

Tick (✓) **one** box.

g ☐   g/s ☐   s ☐   s/g ☐

0 4 . 8 The student did the experiment with 0.15 mol/dm^3 sodium thiosulfate solution and repeated the experiment three more times.

Table 2 shows the results.

Table 2

	Test 1	Test 2	Test 3	Test 4
Time in seconds for the cross to no longer be seen	60.5	63.2	82.3	65.7

Calculate the mean time for this reaction.

Do **not** include the anomalous result in your calculation.

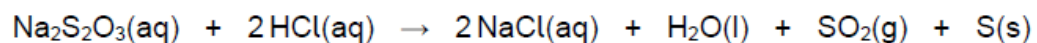Give your answer to 3 significant figures.

[3 marks]

_____

_____

_____

_____

_____

_____

Mean time for the reaction (3 significant figures) = _____ s

3. June/2022/Paper_8464/C/2H/No.3

| 0 | 3 |

This question is about the reaction between sodium thiosulfate solution and hydrochloric acid.

The equation for the reaction is:

$$Na_2S_2O_3(aq) \ + \ 2\,HCl(aq) \ \rightarrow \ 2\,NaCl(aq) \ + \ H_2O(l) \ + \ SO_2(g) \ + \ S(s)$$

| 0 | 3 |.| 1 |

The mass of the conical flask and contents was greater at the start of the reaction than at the end.
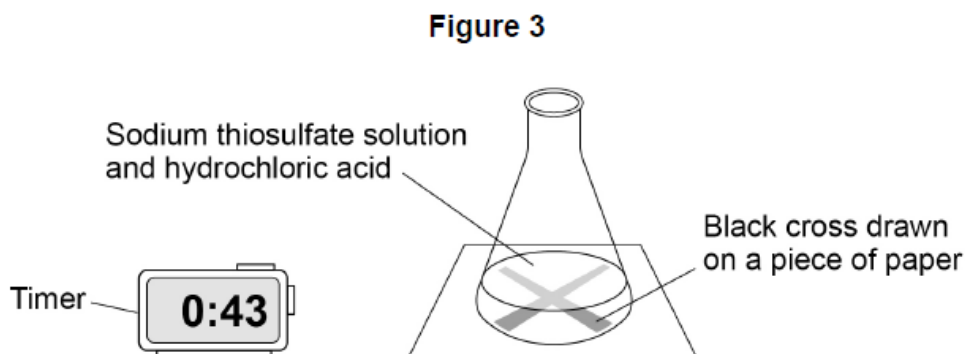
Explain why.

[2 marks]

_____

_____

_____

_____

A teacher demonstrated the reaction between sodium thiosulfate solution and hydrochloric acid.

Figure 3 shows the experiment.

The experiment was done in a fume cupboard.

Figure 3

This is the method the teacher used.

1. Pour 50 cm^3 of sodium thiosulfate solution into a conical flask.

2. Put the conical flask on a black cross drawn on a piece of paper.

3. Pour 10 cm^3 of hydrochloric acid into the conical flask and start a timer.

4. Stop the timer when the cross can no longer be seen.

5. Repeat the experiment at different temperatures.

| 0 | 3 |.| 2 | What type of variable is time in this reaction?

[1 mark]

Tick (✓) **one** box.

Control ☐

Dependent ☐

Independent ☐

0 3 . 3 **Table 1** shows the results.

Table 1

Temperature in °C	Time in seconds
19	82
32	48
45	43
52	15
63	7
73	3

Complete **Figure 4**.

You should:

- plot the data from **Table 1** on **Figure 4**
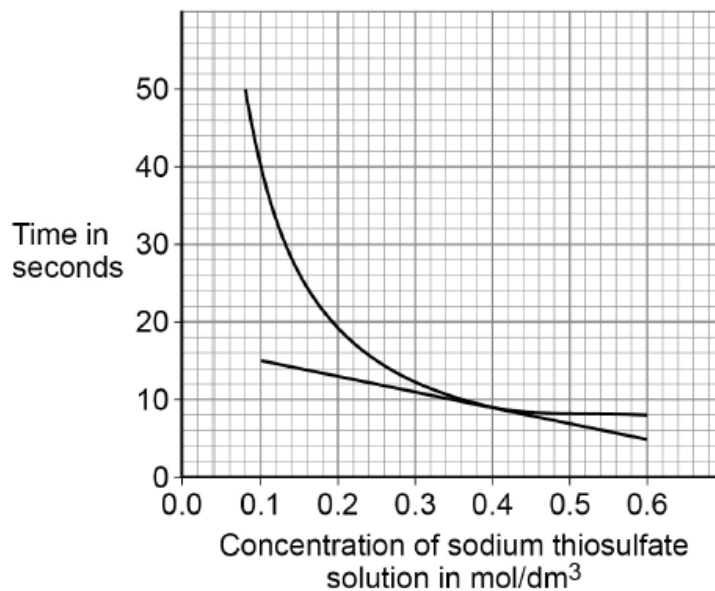- draw a line of best fit.

[3 marks]

Figure 4

12
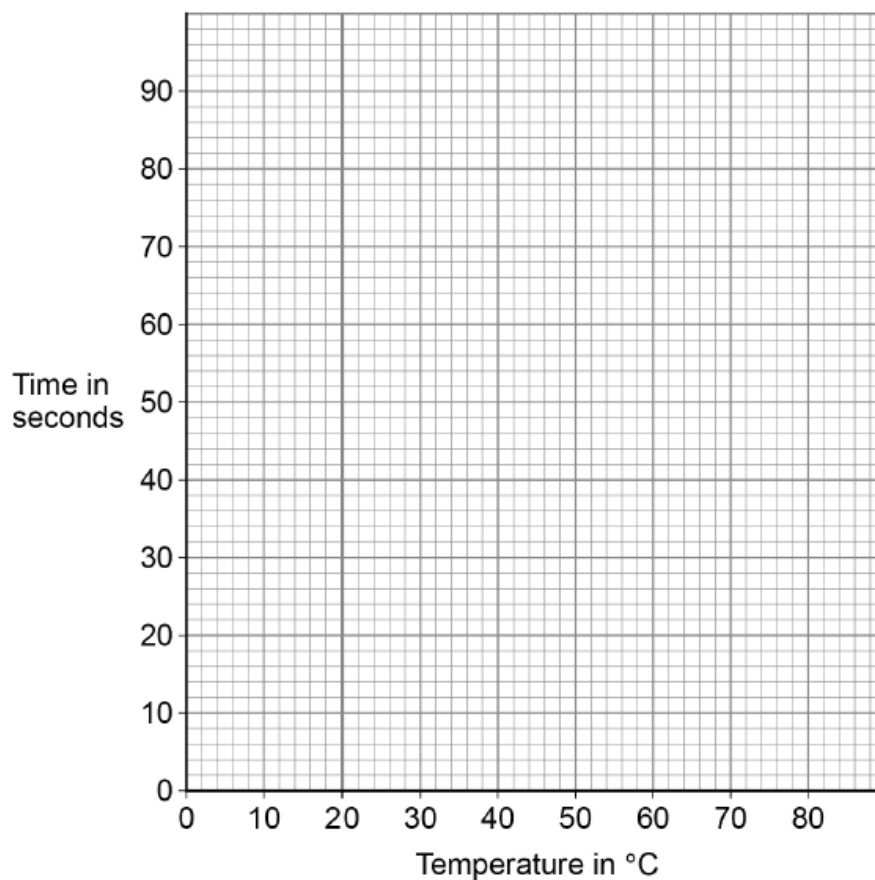
0 3 . 4 A student investigated the effect of concentration of sodium thiosulfate on the time taken for the reaction at room temperature.

Figure 5 shows the results with a tangent drawn at 0.4 mol/dm^3

Figure 5

Calculate the gradient (slope) of the tangent at 0.4 mol/dm^3

Give the unit.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

Gradient = _____

Unit = _____

0 3 . 5   The student determined the **rate** of the reaction at regular time intervals during an experiment.

Explain why the **rate** decreased during the reaction.

You should give your answer in terms of particles.

[2 marks]

_____

_____

_____

_____

4. June/2022/Paper_8464/C/2H/No.6

| 0 | 6 |

This question is about catalysts and equilibrium.

| 0 | 6 |.| 1 |

What type of substance is a catalyst in biological systems?
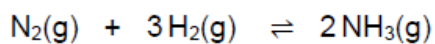
[1 mark]

Tick (✓) **one** box.

Algae ☐

Alkene ☐

Enzyme ☐

Formulation ☐

| 0 | 6 |.| 2 |

Explain how a catalyst increases the rate of a reaction.

[2 marks]

_____

_____

_____

_____

The reversible reaction for the production of ammonia is:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

0 6 . 3   What can scientists predict using Le Chatelier's Principle?

[1 mark]

_____

_____

0 6 . 4   Describe how a reversible chemical reaction is able to reach equilibrium.

[2 marks]

_____

_____

_____

_____

0 6 . 5   Explain the effect of increasing the pressure on the yield of ammonia.

[2 marks]

_____

_____

_____

_____

0 6 . 6   The forward reaction to produce ammonia is exothermic.

Explain the effect of increasing the temperature on the yield of ammonia.

[2 marks]

_____

_____

_____

_____