

Rate of Reaction

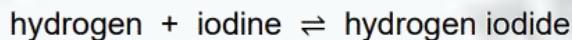
Total mark - 17

Q1.

This question is about reactions between gases.

When hydrogen gas is heated with iodine gas, hydrogen iodide gas is produced.

The equation for this reversible reaction is:



This reversible reaction reaches equilibrium in a sealed container.

(a) How does the equation show that the reaction is reversible?

(1)

(b) Which **two** statements are correct when the reaction reaches equilibrium?

Tick (✓) **two** boxes.

The forward reaction and reverse reaction are both exothermic.

The gases have escaped from the container.

The hydrogen no longer reacts with iodine.

The mass of each substance does not change.

The rates of the forward reaction and reverse reaction are equal.

(2)

(c) The initial mixture of hydrogen and iodine in the sealed container is purple.

Hydrogen iodide is colourless.

How will the colour of the mixture in the sealed container have changed when equilibrium is reached?

Tick (✓) **one** box.

The mixture will have become a deeper purple.

The mixture will have become a paler purple.

The mixture will have become colourless.

(1)

(d) The rate of reaction between gases is affected by changing the pressure.

Complete the sentences.

When the pressure of the reacting gases is increased,

the rate of reaction _____.

This is because at higher pressures the distance

between the particles _____.

This means that the frequency of collisions _____.

(3)

(e) Give **one** other way of changing the rate of reaction between gases.

You should **not** refer to pressure in your answer.

(1)

Mark Scheme

Q1.

(a) (equation contains the symbol) \rightleftharpoons
allow description of arrow / symbol

1

(b) the mass of each substance does not change

1

the rates of the forward reaction and reverse reaction are equal

1

(c) the mixture will have become a paler purple

1

(d) increases

must be in this order

1

decreases

1

increases

1

(e) change the temperature

or

add a catalyst

ignore references to pressure

1

Q2.

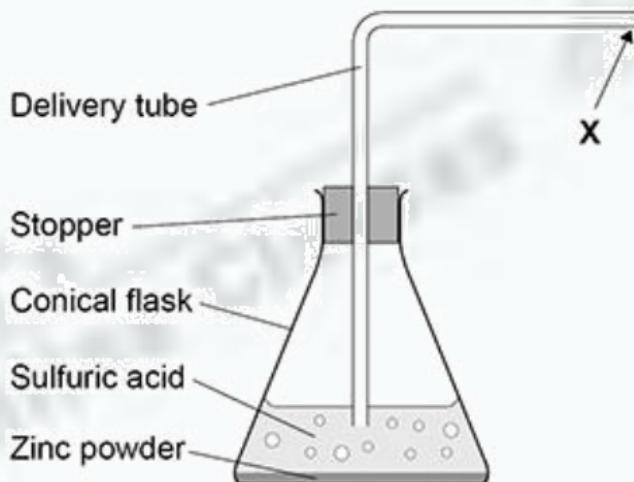
A student investigated the rate of the reaction between zinc and sulfuric acid.

This is the method used.

1. Pour 40 cm³ of sulfuric acid into a conical flask.
2. Add 2.0 g of zinc powder to the conical flask.
3. Put the stopper in the conical flask.
4. Measure the volume of hydrogen gas collected every 30 seconds for 5 minutes.

Figure 1 shows part of the apparatus used.

Figure 1



(a) X shows where a piece of equipment is connected to measure the volume of hydrogen gas collected.

Complete **Figure 1** to show the equipment used.

(1)

(b) The student made an error setting up the delivery tube shown in **Figure 1**.

Describe the error **and** the problem this error would cause.

Error made _____

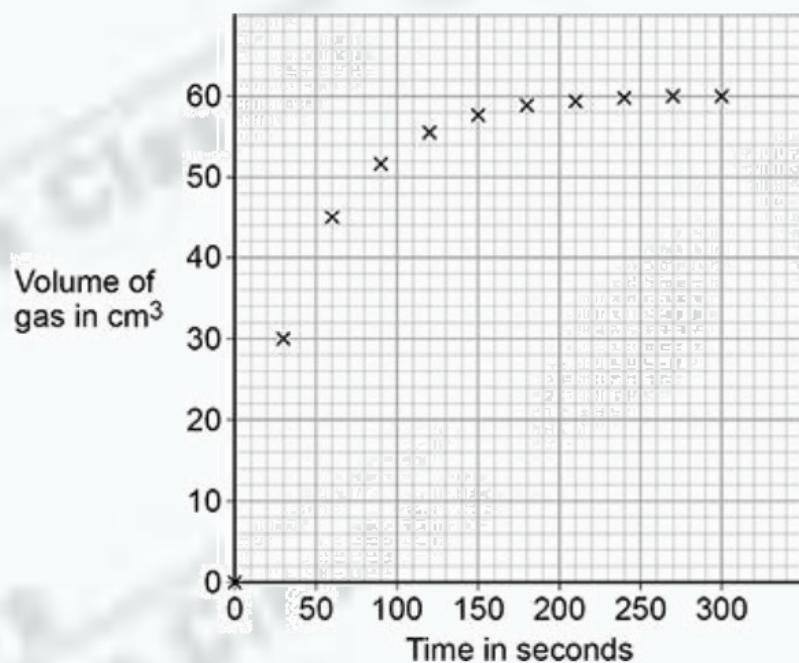
Problem caused _____

(2)

The student then set up the apparatus correctly.

Figure 2 shows the student's results.

Figure 2



(c) Complete **Figure 2** by drawing a line of best fit.

(1)

(d) Determine the mean rate of reaction between 0 seconds and 60 seconds.

Use the equation:

$$\text{mean rate of reaction} = \frac{\text{volume of gas formed}}{\text{time taken}}$$

Use data from **Figure 2**.

Give the unit.

Choose the answer from the box.

cm³ / s	g / s	s / cm³	s / g
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Mean rate of reaction = _____ Unit _____

(4)

(e) The student repeated the investigation using sulfuric acid of a higher concentration.

The student plotted the results and drew a line of best fit.

How would the line of best fit for higher concentration compare with the line of best fit for lower concentration?

Tick (✓) **one** box.

The line of best fit for higher concentration would have a less steep slope.

The line of best fit for higher concentration would have a steeper slope.

The lines of best fit would have slopes with the same steepness.

(1)

Mark Scheme

Q2.

(a) (diagram)
gas syringe
or
inverted measuring cylinder over water 1

(b) (error)
(delivery) tube is in (sulfuric) acid 1

(problem)
(sulfuric) acid will travel up tube
or
no hydrogen / gas will be collected 1

(c) line of best fit
must include 0, 0 1

(d) (volume of gas =) 45 (cm³)
allow a tolerance of $\pm \frac{1}{2}$ a small square
allow volume from drawn curve 1

(rate =) $\frac{45}{60}$
allow correct use of incorrectly determined volume at 60 seconds 1

= 0.75 1

cm³/s 1

(e) the line of best fit for higher concentration would have a steeper slope 1