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:

$$\text{hydrogen} + \text{iodine} \rightleftharpoons \text{hydrogen iodide}$$

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)

Q2.

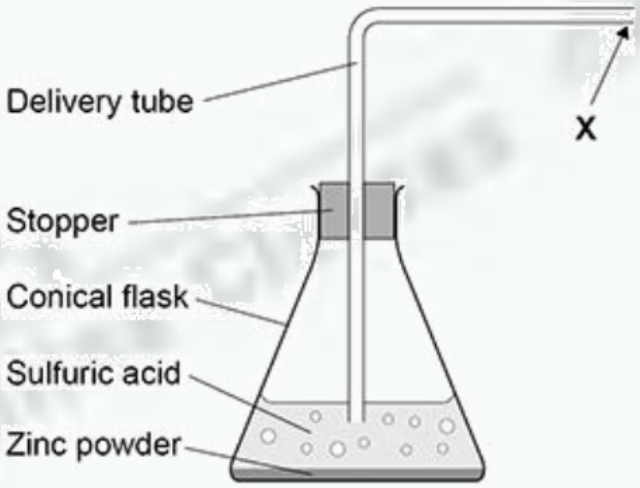
A student investigated the rate of the reaction between zinc and sulfuric acid.

This is the method used.

1. Pour 40 cm^3 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 _____

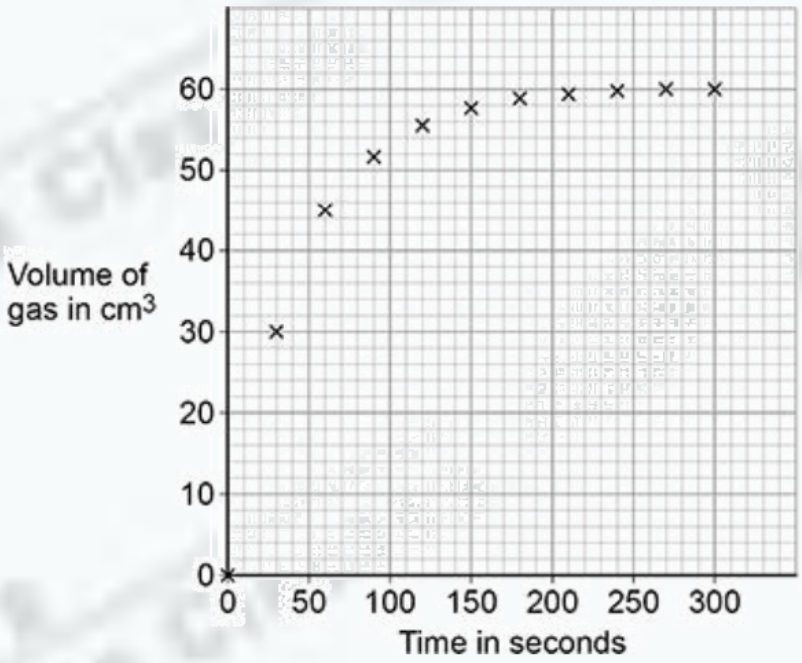
_____

(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.

cm^3/ s	**g / s**	**s / cm^3**	**s / g**

_____

_____

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)