AS level Chemistry A

H032/02 Depth in chemistry

Question Set 17

1. Zinc reacts with hydrochloric acid, HCl(aq), as shown in the following equation.

$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$

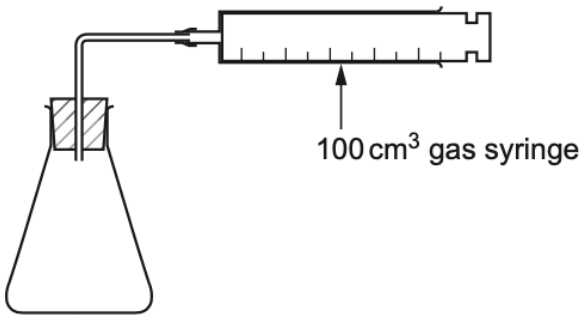
A student investigates the rate of this reaction.

(a) The student plans to react 50.0 cm^3 of 0.100 mol dm^{-3} HCl with 0.200 g of zinc (an excess).

Calculate the volume, in cm^3, of hydrogen that should be produced at RTP.

[3]

(b) The student uses the apparatus in the diagram.



The student's method is outlined below:

- Pour 50.0 cm^3 of 0.100 mol dm^{-3} HCl into the conical flask.
- Add 0.200 g of zinc (an excess), and quickly attach the delivery tube and gas syringe.
- Measure the volume of gas collected every 20 seconds until the reaction stops.

The student obtains the results shown in **Table 4.1**.

Time / s	0	20	40	60	80	100	120	160	200
Volume of gas / cm^3	0	16	27	37	39	50	53	58	58

Table 4.1

(i) On the graph paper in **Fig. 4.1**, label the x axis **and** plot the results in **Table 4.1**.

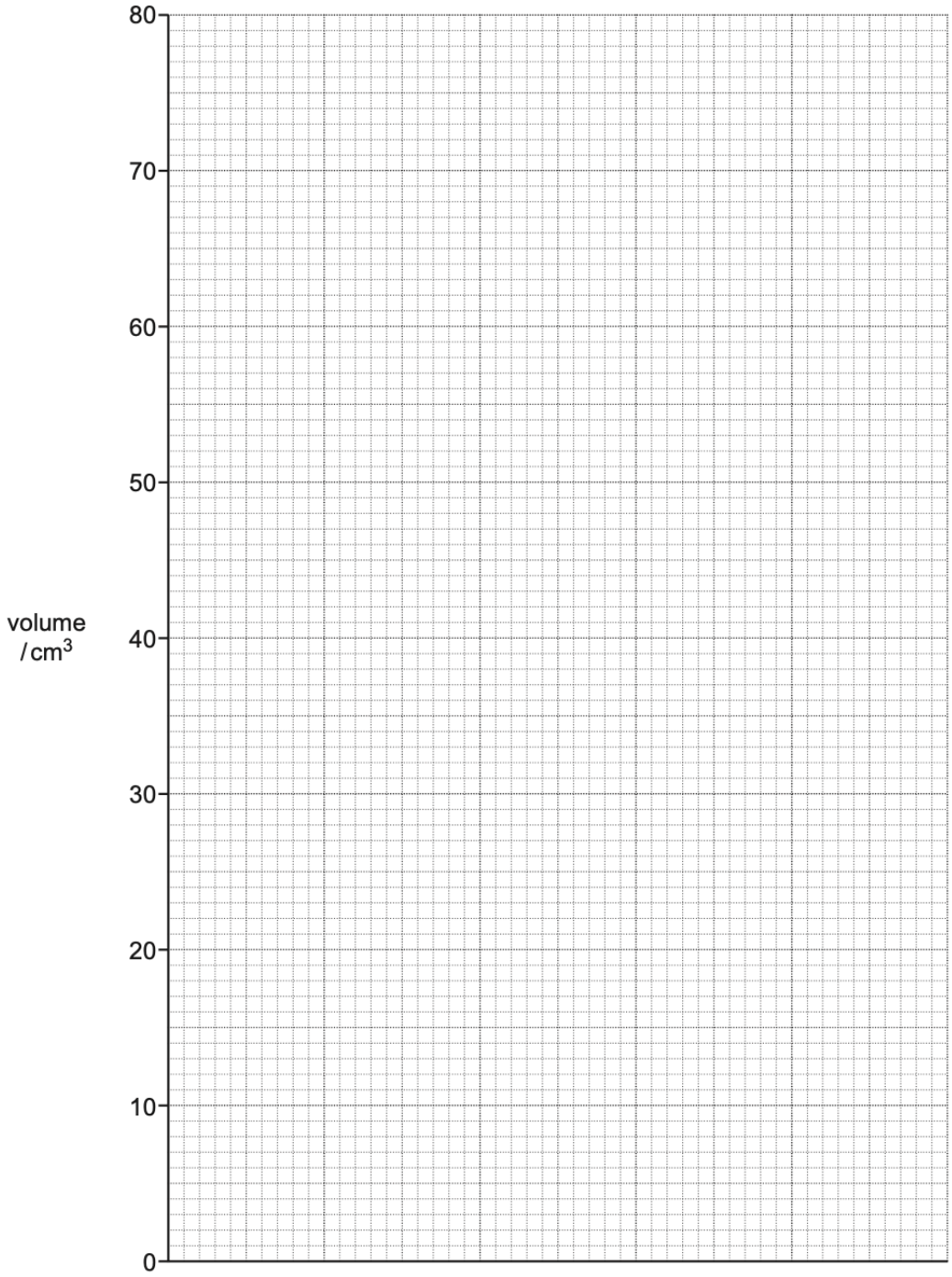


Fig 4.1

[1]

(ii) Circle any anomalous results present in the graph you have drawn in **Fig. 4.1**.

[1]

(iii) Draw a best-fit smooth curve on the graph you have drawn in **Fig. 4.1**.

[1]

(c) The student repeats the experiment using:

- zinc with the same mass (0.200 g) and same surface area
- the same temperature and pressure
- 40.0 cm^3 of 0.125 mol dm^{-3} HC*l*, instead of 50.0 cm^3 of 0.100 mol dm^{-3} HC*l*.

On your graph in **Fig. 4.1** sketch the curve you would expect in this experiment.

[2]

(d) The graph shows that rate of reaction decreases over time.

Explain why, in terms of collision theory.

[2]

(e) **(i)** The rate of the reaction between zinc and hydrochloric acid can be increased using a solution of copper(II) sulfate as a catalyst.

Explain how a catalyst increases the rate of reaction.

[2]

(ii) Why is it difficult to classify the solution of copper(II) sulfate as a homogeneous or heterogeneous catalyst in this reaction?

[1]

Total Marks for Question Set 4: 13