

AQA – Rate equations – A2 2023 Chemistry P2**1. June/2023/Paper_7405/2/No.1**

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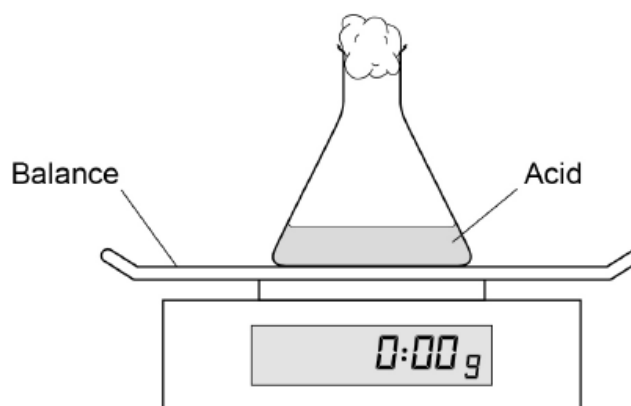
This question is about rates of reaction.

Figure 1 shows apparatus used to measure the rate of reaction when an acid reacts with an excess of solid sodium hydrogencarbonate, NaHCO_3

When different monoprotic organic acids are used, the rates at which gas escapes can be used to compare the strengths of the acids.

A timer is started when the NaHCO_3 is added to the acid and the mass of CO_2 gas lost is recorded at regular intervals.
(It is assumed that any change in mass is due to the loss of CO_2)

Figure 1



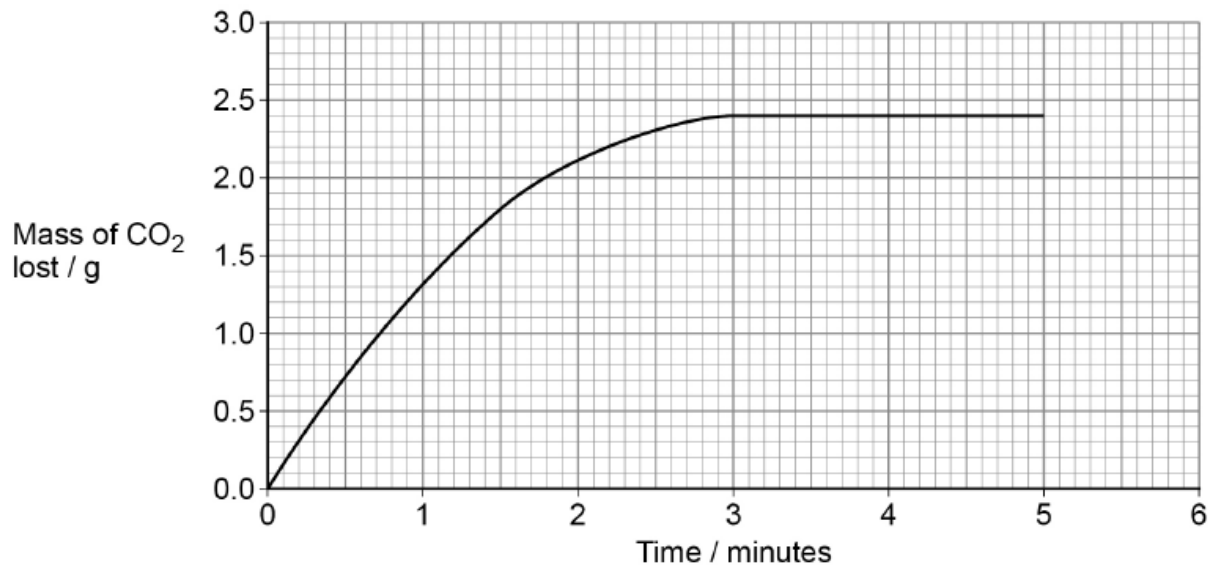
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Suggest a reason why using a conical flask instead of a beaker would give more accurate results in this experiment.

[1 mark]

Figure 2 shows the results of this experiment when 25.0 cm^3 of a 2.23 mol dm^{-3} solution of ethanoic acid reacts with an excess of NaHCO_3

Figure 2



0 1 . 2 Use **Figure 2** to calculate the rate of reaction at 2 minutes.

Deduce the units of your calculated rate.

[3 marks]

Rate _____ Units _____

0 1 . 3 Chloroethanoic acid is a stronger acid than ethanoic acid.

Sketch, on **Figure 2**, the curve you would expect when 25.0 cm^3 of a 2.23 mol dm^{-3} solution of chloroethanoic acid reacts with an excess of NaHCO_3

Suggest why chloroethanoic acid is a stronger acid than ethanoic acid.

[3 marks]

2. June/2023/Paper_7405/2/No.2

0 2

A and B react together in the presence of an acid catalyst.



The rate equation for this reaction is

$$\text{rate} = k[\text{B}]^2[\text{H}^+]$$

Table 1 shows how the values of the relative initial rate vary with different concentrations of each reagent at the same temperature.

Table 1

Experiment	[A] / mol dm ⁻³	[B] / mol dm ⁻³	[H ⁺] / mol dm ⁻³	Relative initial rate
1	0.40	0.20	0.10	1.00
2	0.50	0.20	0.10	
3	0.40		0.10	0.64
4	0.50	0.30	0.06	

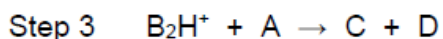
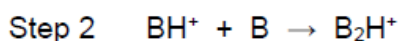
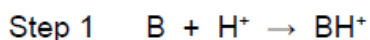
0 2 . 1

Complete **Table 1** by calculating the missing values.

[3 marks]

0 2 . 2

A suggested mechanism for the reaction is shown.



Deduce the rate-determining step for this reaction.

Give a reason for your answer.

[2 marks]

Rate-determining step _____

Reason _____
