

Collision Theory

Q1. (2018) – 9c

- *(c) Two substances, **A** and **B**, each form a colourless solution. If the solutions are mixed in a beaker, **A** and **B** react to form a coloured product. The rate of the reaction between **A** and **B** can be investigated by placing the beaker containing the mixture on a cross on a piece of paper and timing how long it takes for enough coloured product to be produced to make the cross invisible when viewed from above, through the solution.

	experiment 1	experiment 2	experiment 3
concentration of A in solution in g dm ⁻³	10	10	40
temperature in °C	20	40	40
time for cross to become invisible in s	320	80	20

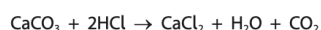
Figure 13

Use the results of these experiments to explain, in terms of the behaviour of particles, the effect of changing temperature and the effect of changing the concentration of **A** in solution on the rate of this reaction.

(6)

Q2. (2019) – 8c

- 8 Calcium carbonate reacts with dilute hydrochloric acid to produce calcium chloride, water and carbon dioxide.



- *(c) An investigation was carried out into the rate of reaction of calcium carbonate with dilute hydrochloric acid.

5.0g of small lumps of calcium carbonate were reacted with 50 cm³ of 0.50 mol dm⁻³ hydrochloric acid.

Another 5.0g of the same sized lumps of calcium carbonate were reacted with 50 cm³ of 1.0 mol dm⁻³ hydrochloric acid.

The volume of gas collected in two minutes was recorded for each experiment.

The two experiments were then repeated, each using 5.0g of large lumps of calcium carbonate.

Figure 5 shows the results.

concentration of hydrochloric acid in mol dm ⁻³	volume of gas collected in cm ³	
	small lumps of calcium carbonate	large lumps of calcium carbonate
0.50	17.2	3.1
1.0	35.1	5.6

Figure 5

Explain, in terms of collision of particles, how these results show the effect of the size of the lumps of calcium carbonate and the effect of the concentration of the acid on the rate of this reaction.

(6)

Q3. (2019) – 3c

- 3 Calcium carbonate reacts with dilute hydrochloric acid to produce carbon dioxide gas.

The rate of reaction between calcium carbonate and dilute hydrochloric acid at room temperature was investigated.

- (c) The experiments were repeated at a higher temperature. The rate of reaction for each experiment increased.

Explain, in terms of particles, why the rate of reaction increased when the temperature was increased.

(3)

Q4. (2021) – 6c (iv)

- (c) The reaction between calcium carbonate and dilute hydrochloric acid was investigated at different temperatures.
- (iv) Explain, in terms of particles, how decreasing the temperature affects the rate of this reaction.

(3)

Q5. (2022) – 2b

- 2 A student used the apparatus in Figure 3 to investigate the rate of the reaction between a metal and dilute hydrochloric acid.
- Pieces of the metal were placed in dilute hydrochloric acid in the flask, and the total volume of gas produced was measured every minute.

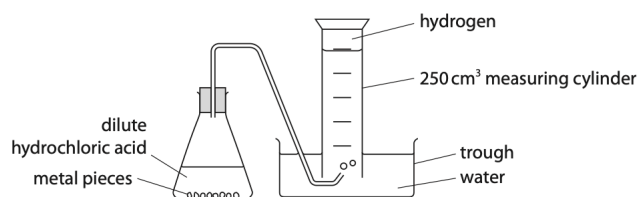


Figure 3

- (b) The experiment was repeated, but with acid of a higher concentration.
- The rate of reaction was faster.
- (i) Explain why the rate of reaction increases when the concentration of acid is increased.

(2)

Q6. (2023) – 2b (ii)

- 2 A student used the apparatus shown in Figure 3 to investigate the reaction between marble chips and dilute hydrochloric acid.

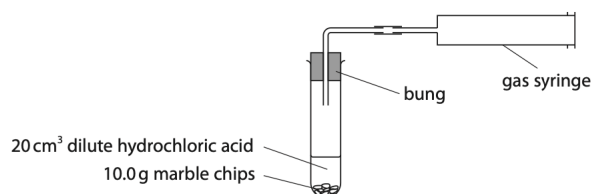


Figure 3

The student recorded the volume of gas every minute as shown in Figure 4.

time in minutes	0	1	2	3	4	5	6
volume of gas in cm ³	0	52	78	91	97	100	100

Figure 4

- (b) Rate of reaction can be calculated using

$$\text{rate of reaction} = \frac{\text{volume of gas produced in 1 minute}}{1 \text{ minute}}$$

Figure 5 shows the rates of reaction calculated from the results of this experiment.

The rate of reaction for the time interval 2 to 3 minutes is missing.

time interval	0 to 1 minute	1 to 2 minutes	2 to 3 minutes	3 to 4 minutes	4 to 5 minutes
rate of reaction in cm ³ min ⁻¹	52	26		6	3

Figure 5

- (ii) State and explain what happens to the rate of reaction as the acid reacts with the marble chips in this experiment.

(3)