WJEC (Wales) Chemistry GCSE

SP 1.5a - Investigation of the Factors that affect the Rate of a Reaction using a Gas Collection Method

Flashcards

Define rate of reaction

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The rate of reaction is the speed at which reactants are changed into products.

Give the equation to calculate rate of reaction

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$$\text{Rate of reaction} = \frac{\text{Amount of reactant used or product formed}}{\text{Time (s)}}$$

Give the chemical equation for the reaction which takes place between hydrochloric acid and magnesium

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Hydrochloric acid + Magnesium → Magnesium Chloride + Hydrogen

$$HCl_{(aq)} + Mg_{(s)} \rightarrow MgCl_{2(aq)} + H_{2(g)}$$

How can the rate of reaction of Hydrochloric acid with Magnesium be investigated?

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Since hydrogen gas is produced, the volume of gas can be collected in an upside down measuring cylinder submerged in a water trough. The amount of gas collected can be measured at regular intervals to investigate the rate of reaction.

What apparatus is required to investigate the rate of reaction of Hydrochloric acid with Magnesium?

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- 250 cm^3 conical flask
- Gas syringe with delivery tube
- Measuring cylinder
- Water trough
- Stopwatch
- Clamp and Stand

Outline the experimental procedure to investigate the effect of concentration of HCl on the rate of reaction of HCl with Mg

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1. Measure 50 cm^3 of HCl of known concentration into the conical flask.
2. Cut a 3 cm strip of Mg ribbon.
3. Set up the upside down measuring cylinder in a water trough. Attach the delivery tube.
4. Put the Mg ribbon into the conical flask and immediately attach the rubber stopper and delivery tube to the conical flask. Simultaneously, start the stopwatch.
5. Record the volume of hydrogen gas collected at every 10 second interval. Stop when no more gas is being collected.
6. Now repeat steps 1-5 using a different concentration of HCl.
7. Plot the results on a graph.

Why must the rubber stopper with the delivery tube be placed on the conical flask immediately after the magnesium is added to the acid?

Why must the rubber stopper with the delivery tube be placed on the conical flask immediately after the magnesium is added to the acid?

The reaction will start straight away and H_2 gas will be produced immediately. The rubber stopper must be fitted as quickly as possible to avoid losing too much H_2.

What trend would you expect to see on the graph when the rate of reaction is plotted against concentration of HCl?

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As the concentration of HCl increases, the rate of reaction will increase.

Explain how the increase in concentration of HCl will affect the rate of reaction

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Increasing the concentration of HCl will increase the number of reactant particles in the same volume. This means the particles will be closer together, so there will be more frequent collisions. This will lead to more successful collisions, increasing the rate of reaction.

Explain why it is important that the reactions with different concentrations of HCl are carried out at the same temperature

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Temperature also has an effect on the rate of reaction. An increase in temperature will cause an increase in the rate of reaction. Therefore, it is important that temperature is controlled during the reactions, to ensure that any trends in the results are only as a result of the changing concentration of HCl.

How could you adapt the experiment to investigate the effect of surface area on the rate of reaction?

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The effect of surface area could be investigated by carrying out the same experiment between magnesium and hydrochloric acid - but keep the concentration of hydrochloric acid constant and change the surface area of magnesium. The surface area of magnesium can be increased by cutting the 3 cm ribbon into smaller pieces.

Why is the underwater gas collection method not suitable for the reaction between $CaCO_3$ and HCl?

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CO_2 is the gas produced in the reaction between $CaCO_3$ and HCl. CO_2 is soluble in water so it will not effectively fill the measuring cylinder.

What piece of apparatus can be used to effectively measure the volume of gas produced if the gas is soluble in water?

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Gas syringe with delivery tube and bung.

Apart from the effect on the reaction rate, why is it important that the reaction temperature is kept constant during the experiment?

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A change in temperature will affect the volume of the gas. An increase in temperature will cause the gas to expand, causing the volume recorded to be larger than it should be.

What are the units for the rate of reaction when a volume of gas produced is measured over time?

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cm^3/s