

WJEC (Wales) Chemistry A-level

SP 2.2a - Investigation of a Rate of Reaction by a Gas Collection Method

Flashcards

This work by [PMT Education](https://www.pmt.education) is licensed under [CC BY-NC-ND 4.0](https://creativecommons.org/licenses/by-nc-nd/4.0/)



Give the chemical equation for the reaction which takes place between HCl and CaCO_3



Give the chemical equation for the reaction which takes place between HCl and CaCO₃



How can the rate of reaction of hydrochloric acid with calcium carbonate be investigated?



How can the rate of reaction of hydrochloric acid with calcium carbonate be investigated?

Since carbon dioxide gas is produced, the volume of gas can be collected in a gas syringe. 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 calcium carbonate?



What apparatus is required to investigate the rate of reaction of hydrochloric acid with calcium carbonate?

- Digital mass balance
- 250 cm³ conical flask
- Gas syringe with delivery tube
- 50 cm³ measuring cylinder
- Weighing boat
- Spatula
- Stopwatch
- Clamp and stand



Outline the experimental procedure to investigate the effect of concentration of HCl on the rate of reaction of HCl with CaCO_3



Outline the experimental procedure to investigate the effect of concentration of HCl on the rate of reaction of HCl with CaCO_3

1. Measure 50 cm^3 of HCl of known concentration into the conical flask.
2. Measure out 2.0 g of CaCO_3 powder.
3. Set up the gas syringe in a clamp and stand.
4. Put the CaCO_3 powder into the conical flask and immediately attach the rubber stopper and delivery tube to the conical flask. Simultaneously, start the stopwatch.
5. Stop the stopwatch when the volume of gas in the syringe reaches 100 cm^3 .
6. Record this result in a table and calculate the average rate for this reaction.
7. Repeat steps 2 through to 6 using a different concentration of HCl solution.
8. Use your data to plot a graph of rate ($1/t$) against concentration of HCl solution.



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



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

The reaction will start straight away and CO_2 will be produced immediately. The rubber stopper must be fitted as quickly as possible to avoid losing too much CO_2 .



What is the weighing by difference technique?



What is the weighing by difference technique?

Weighing by difference ensures that the mass of a solid is measured as accurately as possible.

The calcium carbonate is weighed in a weighing boat before it is added to the acid. The empty weighing boat is then reweighed after the calcium carbonate is added to the acid, to calculate exactly how much solid was added to the reaction mixture.



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



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

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



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

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 reaction 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



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

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?



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

The effect of surface area could be investigated by carrying out the same experiment between CaCO_3 and HCl - but keep the concentration of HCl constant and change the surface area of CaCO_3 . The surface area of CaCO_3 can be increased by grinding it up into a fine powder.



What is the equation to calculate rate of reaction?



What is the equation to calculate rate of reaction?

Rate of reaction =

Amount of reactant used or product formed

Time (s)



The collection of gas could also be measured in an underwater inverted measuring cylinder. Why is this not suitable for the reaction between CaCO_3 and HCl ?



The collection of gas could also be measured in an underwater inverted measuring cylinder. Why is this not suitable for the reaction between CaCO_3 and HCl ?

Carbon dioxide is soluble in water so it will not effectively fill the measuring cylinder.



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



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

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.



Why is it important that the quantities of reactants are carefully calculated before the experiment?



Why is it important that the quantities of reactants are carefully calculated before the experiment?

The gas syringe will only hold 100 cm^3 of gas. It is important that the expected volume of CO_2 produced does not exceed this value because any volume above 100 cm^3 will not be measured accurately.

