Year 11 Chemistry NAME_____
Practical Investigation

Rate of Reaction of HCl with $CaCO_3$

Aim:

To investigate how the rate of a chemical reaction changes over time by observing a reaction between hydrochloric acid and calcium carbonate.

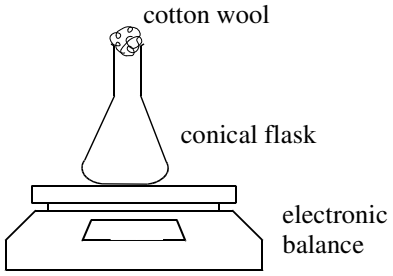
$$2HCl + CaCO_3 \rightarrow H_2O + CaCl_2 + CO_2$$

Equipment:

- 1g calcium carbonate, powdered
- 50 mL HCl solution, 0.1 mol L^{-1}
- conical flask
- 100 mL beaker
- electronic balance
- cotton wool

Procedure:

1. Pull at a ball of cotton wool until it is large enough to rest in the mouth of the conical flask without falling in.
2. Add 1g $CaCO_3$ powder to a conical flask. Leave the conical flask on the electronic balance.
3. Measure 50 mL of 0.1 mol L^{-1} HCl into a 100 mL beaker.
4. Pour the HCl to the conical flask and place the cotton wool in the mouth of the conical flask. Immediately record the weight and start the stopwatch.
5. Whenever you are not measuring the weight of the flask, swirl it to unsure the reactants are evenly mixing together.
6. Record the weight every 30 seconds until there is no longer any $CaCO_3$ visible in the conical flask.



Results:

Make a copy of this table to record results. This table does not have enough rows.

Time (seconds)	Mass of flask (g)

Analysis and Evaluation:

1. Plot a graph of the mass of the flask against the time of reaction.
2. State whether the rate of reaction is faster at the beginning or end of the reaction. Describe how the graph shows this.
3. Explain, in terms of particle collisions, why the rate of reaction changes over the course of the reaction.
4. Using different colours, draw lines on the graph to show the expected results if the experiment was repeated and one change was made each time:
   (a) Half the amount of $CaCO_3$ was used
   (b) The $CaCO_3$ was in lumps instead of powder
   (c) The acid had been preheated to 50°C
   (d) 50 mL of water had been added to the acid prior to tipping into the flask
5. Explain one possible source of random error in this experiment, and describe evidence for it in the results.
6. Suggest one possible improvement to the experiment that would improve the accuracy of the results. Explain why it would improve accuracy.

Stoichiometric Analysis (Bonus):

The amount of CO_2 released is an indication of the amount of $CaCO_3$ consumed in the reaction.

1. Use the first and last points of data in your results to calculate the mass lost from the flask.
2. This mass is CO_2 gas. Calculate the number of moles of CO_2 released.
3. Use the balanced equation given on the previous page to determine the number of moles of $CaCO_3$ used up during the reaction.
4. Hence calculate the mass of $CaCO_3$ that reacted.
5. Compare the calculated mass to the mass of $CaCO_3$ originally measured. Suggest reasons for any differences.