

Making reactions go fast. (junior Science)

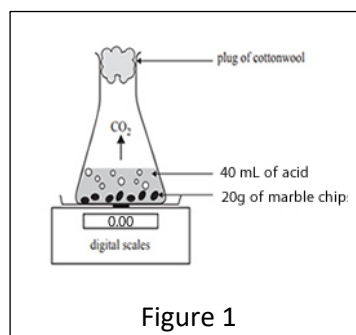
When adding an acid, such as hydrochloric acid, to marble chips carbon dioxide gas is produced according to the word reaction below.

Hydrochloric acid + calcium carbonate (marble) $\rightarrow$ calcium chloride + carbon dioxide + water

This word equation can be written as a chemical equation, as shown below.



By measuring how quickly this gas is formed we can measure the speed or rate of the reaction taking place. The setup shown in fig. 1 will be used to record the total mass of carbon dioxide lost at each time interval. The cotton wool plug simply stops acid from splattering out of the flask as gas bubble pop at the surface. Gas can still easily escape from the flask.



1. What is the dependent variable for this investigation?

2. What is the independent variable for this investigation?

3. Give three controlled variables.

4. Using your knowledge of collision theory and the dependent and independent variables listed above write a hypothesis for this investigation.

If _____

then the _____

because _____

Measuring the rate of a chemical reaction

Aim - to measure the rate of a chemical reaction with different size reactant particles.

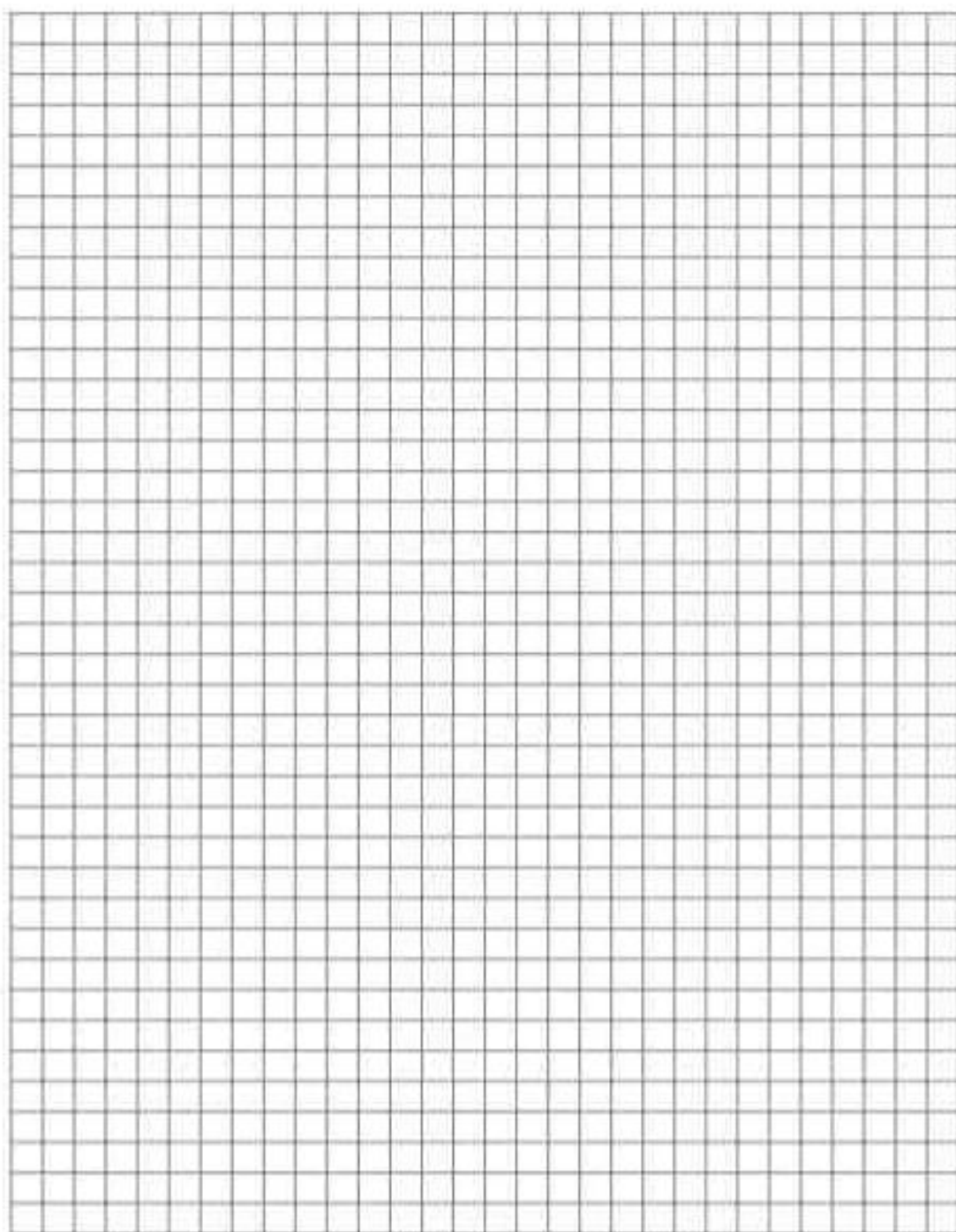
Method

- Step 1 - You have been supplied with two different sized marble chips, fig 2.
- Step 2 - Place a 50 mL flask on an electronic balance and place 20 g of large sized chips into the flask.
- Step 3 - Using a measuring cylinder measure 40 mL of the 0.1 M HCl solution.
- Step 4 - Pour the 40 mL of HCl into the flask that is currently placed on the electronic balance with the 20 g of marble chips, place the cotton wool plug into the opening of the flask and quickly press the tare button to zero the display.
- Step 5 - The reaction will start immediately and you will notice that the mass of the flask and its contents will start to decrease as gas is formed and escapes from the flask into the air. Record the mass of the flask and its contents every minute until no more gas is seen to form. Place your results in the table below.
- Step 6 - Repeat steps 2 to 5 for the smaller size chips.
- Step 7 - Plot the results of mass loss vs time using the graph paper on the next page.



Figure 2 – shows two different sized marble chips

Time (min)	Total mass lost (g) (large chips)	Total mass lost (g) (small chips)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		



5. Explain, with reference to your graphs, drawn above, how the size of the marble chips affected the rate of reaction with hydrochloric acid.

6. Explain the results using collision theory

7. A student accidentally misread the instructions and added 20 ml of water to the flask prior to adding the 40 ml acid solution.

a. Discuss how the speed or rate of the reaction would change if 20 mL of water was added to the acid solution prior to the marble chips being placed in the flask.

b. Explain your answer to a. above with reference to collision theory. Use the image in fig 3 to assist you in your explanation.

