

# Rates of reaction



\* Change of temperature: – Increased temperature will speed up the reaction because the particles will gain kinetic energy and are more likely to collide and react. Decrease in temperature will result in fewer collisions because the particles lose kinetic energy.

\* Altering the concentration: – Will affect the speed of the chemical reaction. The higher the concentration the more likely the particles are to collide.

\* Catalyst: – Speeds up a chemical reaction without actually taking part in the reaction.

\* Shaking or Stirring: – Stirring the reactants causes them to move more and so they are more likely to collide with the other particles.

\* Surface area: – The larger the surface area the faster the rate of reaction. This is because the particles have a larger area to collide and react with.

The reaction: –

Sodium thiosulphate + Hydrochloric acid Sodium chloride + Sulphur +

We will use three different concentrations to investigate how the concentration affects the rate of this reaction.

Strong acid – 2 Molar

Medium acid – 1 Molar

Weak acid – 0.5 Molar

Apparatus: –

- \* Conical flasks
- \* Piece of paper with a cross on it
- \* Hydrochloric acid (3 strengths) – see above
- \* Measuring cylinder
- \* Stop-watch
- \* Sodium thio-sulphate
- \* Paper marked with X

Method: –

- \* Be aware of all safety issues
- \* Put a X on a piece of paper with a marker pen
- \* Put conical flask over cross
- \* Put 50cm<sup>3</sup> of Sodium thio-sulphate (1 Molar) in the flask
- \* While pouring acid (100mls) start stop-watch
- \* Stir the mixture as it will aid in the reaction
- \* Stop the stop-watch when the X has disappeared
- \* Record the result
- \* Repeat experiment another two times so it is accurate

\* Repeat last eight steps for the other two concentrations

Fair Test: –

To make this experiment fair we must keep some factors the same. Firstly the concentration and volume of the Sodium thio-sulphate must be kept the same. The volume of the acid must be kept the same. The environment and the temperature must be kept the same. We must also stir all the mixtures. We have to keep all the factors the same as it may speed up or slow down the experiment.

We are only going to vary the concentration of the Hydrochloric acid.

Prediction: –

I predict that the 2 molar acid will react the fastest as it has more acid particles which are concentrated in a small space so they will collide with the Sodium thio-sulphate react. Next will be the 1 molar acid as the particles are a slightly more spread out and they are a bit less likely to collide with the Sodium thio-sulphate particles. After this it will be the 0.5 molar acid. As the acid particles are less concentrated so there are less acid particles and it will be less likely for the acid particles to collide with the Sodium thio-sulphate particles.

TEST

Concentration

1st

2nd

3rd

Average

Strong (2M)

2 min 39 sec

2 min 19 sec

2 min 28 sec

2 min 28sec

Medium (1M)

2 min 44 sec

2 min 48 sec

2 min 41 sec

2 min 44 sec

Weak (0.5M)

3 min 05 sec

3 min 20 sec

3 min 09 sec

3 min 11 sec

Concentration

Average results from each group

Average of class results

Strong (2M)

2. 28, 2. 06, 2. 53, 1. 38, 2. 36

2. 12

Medium (1M)

2. 44, 4. 05, 3. 40, 1. 58, 3. 24

2. 56

Weak (0. 5M)

3. 11, 5. 01, 2. 36, 2. 32, 4. 05

3. 37

Conclusion: -

My results show that the stronger the acid the faster the rate of reaction. I can see that both graphs have a curved line. This tells me that there is a relationship when the concentration of the hydrochloric acid increased. As it takes time for the reaction to take place it is not have a linear relationship. I can see that when the concentration of the acid is increased the reaction

happens quicker. The quickest reaction was when the 2 molar acid was added and the slowest was the 0.5 acid this strongly supports my prediction.

There is a curved line as in the 0.5 molar acid there are only a few particles so therefore the particles are less likely to collide but like the 2 molar acid there are a lot of particles there is more chance of a collision taking place.

The graph supports my prediction and it shows that as the concentration of the acid increases the quicker the reaction.

Discussion/ Evaluation: –

This method was quite easy except the part where you have to judge the exact moment when the X disappeared. There was an anomalous result (marked as RED) it may be because we did it over two days and the temperature may be different. We may have stirred it faster so the acid particles collided faster with the Sodium thio-sulphate particles. To get the average we did not include the anomalous result. Next time to make this experiment more accurate a data logger and a light sensor can be used. Also to do this experiment within one day will improve the accuracy and reliability of the experiment. Another way to make the experiment more reliable is to measure a wide range of readings and also would repeat the experiment another time to improve the accuracy of the results. The positive points of our experiment were that we measured the volume of each acid and the Sodium thio-sulphate. Also we washed each apparatus thoroughly so the reactants were not reacting before the test took place.

To take this experiment I would keep the concentration of the acid the same but I would alter the concentration of the Sodium thio-sulphate or I could keep the concentrations of the reagents the same but change the temperature to see if there was any difference.