Ivor's Problem

Introduction

In this investigation I am going to try and increase the rate of reaction when creating Carbon Dioxide, we will be using 1 gram of Sodium Carbonate and 20cm3 of 1.0 mole dm-3 Sulphuric Acid at 20 degrees centigrade. I will try to improve the rate of reaction by heating up the acid, in turn this will increase the acid molecules speed, making them move around more quickly and have more collisions with the Sodium Carbonate's base area, during a certain amount of time. But if the acid is not heated the molecules are not going to be as violent, so there would not be as many collisions in the same amount of time, so the speed of the reaction would be slower. To heat the acid I will first put it into a test tube and then I will put the test tube into a water bath, the water bath will be heated from a Bunsen burner underneath it (Fig 1). I will be heating the Sulphuric acid up to 5 different temperatures. 20, 40, 60, 80 and 100 degrees centigrade. I will put my results that I have found out into a table, I predict that as the temperature increases so will the rate of reaction. Also as well as doing a test to see if temperature changes the rate of reaction I will do a test to see if the concentration of the acid determines the rate of reaction this is what the different concentration of acid looks like (Fig 2), I am going to do this experiment in my spare time because I wanted to find out if a difference in concentration in the acids could affect the rate of reaction, if this is true then there is a possibility that the test could be unfair which would make it useless. I predict that the higher the concentration/stronger the acid is, the more it will increase the rate of reaction.

Fig 1

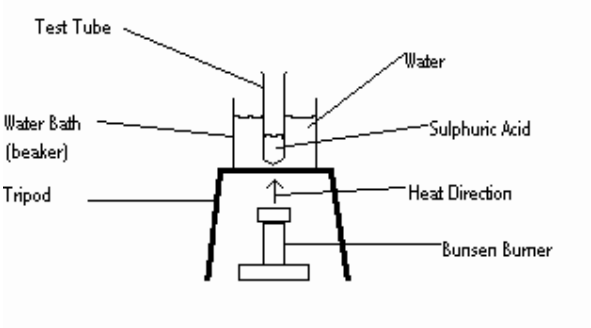
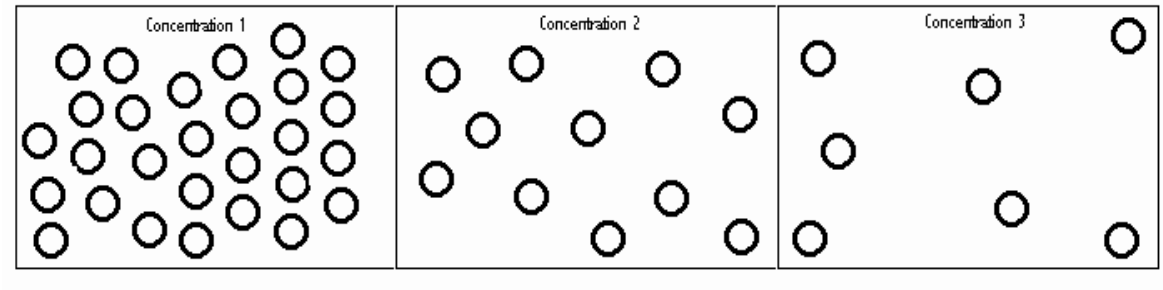


Fig 2



What equipment I will use

In this experiment I will be using a Bunsen burner to heat up the acid, a Beaker to be used as the water bath, a Test Tube to hold the Sulphuric Acid and Sodium Carbonate when the reaction takes place, a tripod to raise the equipment over the Bunsen burner, a gauze to put on top of the tripod to stop the equipment from falling though the hole, a mat to protect the table and a pair of Safety goggles to protect my eyes.

Safety

In both experiments I did, I used goggles because they protect your eyes. I needed to protect my eyes because I was using acids and there was a reaction that I did not know what would happen. In the temperature experiment I also had to use a pair of test tube holders and a heatproof mat, I used the test tube holders to pick up the test tubes containing the acid, after the experiment. I needed to pick up the test tubes with these because they were hot and I did not want to hurt myself or anyone else. I used a heatproof mat because it is fire retardant, I needed something fire retardant because, if my Bunsen burner fell over it wouldn't create a fire which is a danger.

How I did the experiment

Temperature Change

First I wrote out a table to record my results, then I used a thermometer to test the temperature of the acid while it was being warmed up in the water bath, as soon as the temperature reached the temperature I wanted it to reach I put the Sodium Carbonate into the acid and turned the Bunsen burner off, as soon as the Sodium Carbonate touched the acid I began the timer, and I stopped the timer when all of the Sodium Carbonate had dissolved, these are my results.

Temperature	Time to dissolve (seconds)
20°c	64.68
40°c	25.53
60°c	9.19
80°c	9.75
100°c	9.24

As you can see as the temperature increased the time it took to dissolve decreased, my prediction was correct, I think that the experiment could have been a lot more precise if we had measured the rate of reaction every 10°c instead of every 20°c, this would make it easier for me to see the increase in speed, it would also allow me to narrow down the experiments optimum temperature, the optimum temperature is the temperature in which the reaction takes place the quickest, I found that this was around 60°c. I found out that increasing the temperature not only makes the particles move faster which in turn makes them collide more frequently, but it also increases the energy of the collisions, so there will be more particles being exchanged in a shorter amount of time.

What happened

When the Sodium Carbonate was added to the acid, the acid particles collided with the Sodium Carbonate particles, normally the acid particles collide with the Sodium Carbonate particles quite slowly, but when heated up the acid particles get more energy and move around more, so they collide more frequently with the Sodium Carbonate particles. Also when the acid particles are heated up the activation energy is increased, this is the energy that that is used during successful collisions where a reaction takes place, if there is not enough of this energy then the particles will just bounce off each other. During the reaction the compound Sodium Carbonate's particles collide with the acid, because the particles of acid are more reactive than the Sodium atoms that make up the compound Sodium Carbonate, so the Sodium atoms are taken from the Carbon atoms, leaving the carbon atoms on their own, where they react with the surrounding oxygen particles to create Carbon Dioxide, I could tell that Carbon Dioxide was made because when I put a lighted splint into the test tube it went out. During the reaction the test tube got colder, this was an endothermic reaction, an endothermic reaction is where heat is taken in from the surroundings during a reaction.

Concentration Change

First I wrote out a table where I could write down the reaction times. Then I got three different types of acid, one was a high concentration acid, one was a medium concentration acid and one was a low concentration acid. I set up the scales so that when the paper was lying on top of them, they read 0, then I put on the sodium carbonate till it measured 1 gram, then I did the same two more times, till I had 3 piles of sodium carbonate all weighing 1 gram. Then I got a measuring tube and measured 20cm3 of the highest concentration (strongest) and poured it into a beaker, and then I put the first pile of sodium carbonate into the acid, without the paper. I measured the time it took to dissolve, and then I put it the result into a table. After I had written the result down I cleaned out the beaker I measured out 20cm3 of the medium (middle/in-between) concentration acid then I did exactly the same as above and wrote down that result in the table. Finally I did the same experiment except using the weakest concentration acid and wrote the result down. Here are my results…

Acid Strength	Time Taken to dissolve (seconds)
Weak	64.68
Medium	47.54
Strong	19.67

As I predicted, the stronger the acid, the less time it takes for the sodium carbonate to dissolve, I find this information useful because it tells me that if any of the acids were

stronger than another, they would dissolve the sodium carbonate quicker than a weaker acid which in turn could make the experiment unfair.

What could have been done to make the tests more accurate

When I was doing the temperature experiment I only had time to do 5 different tests, these tests were fair because I kept everything the same apart from the temperature; I even used the same apparatus to measure the chemicals I used. I would have liked longer to perform the experiments because I would have had time to increase the accuracy and fairness of the experiment, I would have done this by doing things like putting a lid over the tops of the test tubes maybe, this would stop some of the acid from getting out when the water evaporates, and even if the acid atoms do not evaporate, some of the liquid may evaporate leaving the acid atoms behind, this could also make the experiment unfair because the acid would be more concentrated. I could also have tested the ph/strength of the acid before I put the sodium carbonate in to make sure that one of the acids I used was not stronger than any of the others, if any acid was stronger than any other acid we used the experiment would be unfair. When doing the experiment that used more concentrated acid I would like to have been able to test the temperatures more accurately before I put the Sodium Carbonate in it, if the acids were all different temperatures then my results would be incorrect, a less concentrated acid is hotter than a more concentrated acid, it could have dissolved the Sodium Carbonate quicker than a more concentrated acid.

Evaluation

I thought that overall the experiment was successful, the tests were fair and a digital timer timed them quite accurately. I got the results I expected to see, I expected too see the rate of reaction increase as the temperature increased. I am pleased with the outcome because it proves that when creating Carbon Dioxide heat can effect it a lot, it speeds up collisions between particles which means more reactions in a shorter time