Aim: As I start the experiment, I am going to see how an increase in temperature at a steady rate on a waterbath, will affect the time of how long it will take an alka-seltzer tablet to dissolve in a steadily heated water-bath. This will be done by me first heating a large beaker, full of water, which contains another smaller beaker, half filled with water inside. Once the temperature is right, by me checking on a thermometer, I will remove the heat and quickly place the tablet inside and start timing how long it takes to dissolve or stop fizzing, using a stop clock.

Input Variables:

Temperature – I will increase the temperatures by 5^0C from the room temperature, which is around 20^0C, until I reach 85^0C and I will see how the increase in temperature, will affect the rate of which tablet dissolves, in the entire range. It is most likely you will see the greatest differences in times between 20^0C and 35^0C, which is at the start of the experiment and I think there will be a slow decline in spread of times from there on, until you reach the higher temperatures like 65^0C onwards, where from there only a matter of seconds will effect the rate at which the tablet dissolves.

Output Variables:

The variable I want to increase or use is temperature. This will be done by me using a busen burner and heating a 200ml beaker of water, which has a 50ml beaker of water, clamped tightly inside the centre. Once this is set to the heat temperature I want, I will place the tablet in carefully and time with a stop clock how long it takes to dissolve fully or until the bubbling is almost nonexistent. From then on, I will increase the temperature by 5 or 10^0C at a go and then time how long the tablet takes to dissolve in the 50ml of water. I will make sure when I put the tablet in the small beaker of water, it isn't chipped or broken as this will alter my results, if the sizes are different. Also as the experiment takes place, or as the tablet starts to dissolve, I have to make sure that the heat from the Bunsen burner is not running as this will mean the temperature will keep on increasing and so I won't have an accurate result, and so this will clearly show as the

reading will be much faster compared to the overall average of that certain temperature.

Preliminary Experiment:

At the start of the experiment, I will put on my safety goggles and make sure the working area is clear and so ready for me to start.

I got my film tube, which had around 10 alkaseltzer tablets inside, which were roughly 3cm in diameter and weighed around 100g. I now got my 200ml beaker, my 50ml beaker, retort stand, clamp and boss, Bunsen, heat pad, gauze, tripod, measuring cylinder, thermometer and stopwatch.

I now set up my retort stand, boss and clamp. Next, I took my gauze, tripod and Bunsen and set that up next to the retort stand, on a heat pad. I took my 200ml beaker and filled that with water, measuring it with a measuring cylinder. I now did the same with the 50ml beaker.

I put the large beaker on the gauze and I placed the small one inside the centre of it and that was held firmly by the clamp. This was to ensure that the small beaker got an equal amount of heat allround.

Once everything was set up, I took one tablet and I placed it inside the small beaker and timed how long it took to dissolve with a stop clock. I used a thermometer to measure the room temperature.

I next cleaned the small beaker with water and I refilled 50ml of water and clamped it firmly in the centre. I now took a split and heated the Bunsen. I altered the heat, so it was on a blue flame and I heated the water until it reached the correct temperature I wanted. I stopped the heating and I took a tablet and timed how long it would take to dissolve in the water. The reason, why I used two beakers, was because once I stopped the heating, the larger beaker acts as a water bath, so the temperature of the water stays constant for longer at the temperature I need. This helps stabilise the results.

I repeated the experiment at an increase of 5^0C each time (using a thermometer) and so I continued this until I reached around 85^0C. I timed how long the tablet took to dissolve in the 50ml of water and I recorded my results. Once I finished, I cleared away my apparatus.

From these results, you van see that as the temperature increases by 5^0C, there is a substantial drop in the time it takes to dissolve the tablet. This is because the more heat produced, the more collisions there are and so more molecules to dissolve the tablet and faster. I saw as each attempt went on, more and more froth was produced and I saw more spitting out of liquid as a byproduct.

Background Knowledge

Collision theory: When particles in a chemical substance, i.e. in this case water are heated, reactions are sparked between molecules and different particles. As more heat is placed on these molecules and particles, they gain more energy and so collisions occur between them. The more energy they get, the more collision occur and in more force.

Planned Method

Apparatus:

Safety Spectacles

Heat Pad

Tripod

Gauze

Bunsen Burner

200ml Beaker

50ml Beaker

100ml Measuring Cylinder

Thermometer

Stop Watch

AlkaSeltzer Tablets x40

Boss

Clamp

Retort Stand

Planned Method

At the start of my experiment, I am going to put on my safety spectacles for protection from the hot water. Next I will take my 200ml beaker of water and fill that up with water. Next I will take my second beaker, which is 50ml and I will fill that up with water.

Next I am going to take my tripod, gauze and Bunsen burner and set that up on a heat pad. I will now collect my alkaseltzer tablets and thermometer. I will now take my 50ml beaker and place one tablet inside it and I will straight away start the timer on my watch running. I will stop it when the bubbling is minute or non-existent. I will record the reading at room temperature.

After that, I will turn on my Bunsen on a blue flame and place my large beaker on the gauze above it. I will next take my clamp, boss and stand and set that up next to the beaker. I will now take the small beaker and clamp that in firmly in the centre of the large beaker. The large beaker, now acts as a water bath to keep the temperature I need constant for longer after the heating stop and I dissolve the tablet. Once I have reached the temperature I am looking for, I will immediately stop the heating and quickly place the tablet in the small beaker and start the time. I will stop it when the tablet has almost dissolved.

After each attempt, I rinse out the small beaker as it has the white powdery remains from the previous attempt, and I set up the apparatus again. I refill the water and start the heating until it has to be stopped and I dissolve the tablet and time how long it takes at each increasing temperature. I will continue this pattern until I finish all my reading that I need up to 85^0C.

I will record all my readings in a table and then calculate the average times for each temperature for the tablet to dissolve in the water. Once I have finished that, I will do several graphs for that, comparing the times and temperatures.

Obtaining Evidence(Skill O)

As you can see from my graphs, there is a consistent curve, top to bottom each time, showing me that I have fairly accurate results with perhaps some slight miner anomalies. So now I can comment on my results more accurately knowing that I have not made mistakes in my results. If I did it would be very noticeable as it would be an anomalous result and stick out (like a sore thumb).

All my graphs represent each week that I have done the experiment, so in my evaluation, I can comment on the accuracy of them as generally they should be the same, but if there is any noticeable difference, I can comment on why that occurred, perhaps due to an error of my doing, or a mistake in the set up. Each time I did the experiment, it was tricky to get everything in place and keeping the clamp on the small beaker still, so that it was partially in the larger (waterbath) beaker. I have used a fairy larger scale, so this should also help point out any mistakes and improve the general accuracy.

Throughout the experiment, I used a suitable range of temperature and a suitable amount of water, so that I had fair and accurate results throughout each week.

All my tables are systematic and are in seconds **(sec)** for the temperature and

in ^{0}**C**for the temperature. Finally, as I did the experiment and I recorded the results, I had to make sure that they made sense and so that as the temperature increased, the timing decreased. I realised that as I reached the very high temperatures, the average timing would be very similar and so I took that into mind.

Conclusion(Skill A)

In my results, I can see that as the temperature increases, the time taken for the tablet to dissolve in the water decreases. At the very start of the experiment, you can see on the graphs that there are large gaps. This is because as the temperatures are fairly low, the rates of reaction or time taken for the tablet to dissolve are low as well.

As my data is fairly consistent with no real big gaps in the readings, when I plotted my graph I got a fairly accurate curve. As I expected in the beginning of the experiment, the times takes for the tablet to dissolve took much longer than when I did the experiment in the end.

In this experiment, there is no optimum temperature, for where the tablet dissolves the fastest, but sometimes in the middle and end of the experiment, you managed to see the best readings as they were very quick.

Due to me doing the experiment three times, I found that as graph was the same, my results became reliable and so they could be used. If there were any mistakes, they would easily be shown and so I know where they would have occurred and so I know how to rectify them, for the next time I do the experiment.

I found that there was no real need to go to the very high temperatures as that doesn't really help you that much as the results become very similar and predictable.

In my experiment, I found that I did not have any anomalous or suspicious readings. You could have said that at the beginning of my experiment, my readings didn't fit in with the general pattern and results of the whole experiment, but once again using the theory of rates of reactions, you can say that at low temperatures, the time taken for the tablet to dissolve would take much longer than at higher temperatures.

As my main variable is temperature, I also draw a graph of 1/t. I found that after drawing that graph, I found I got a straight line, meaning that I found a positive correlation between temperature and time.

Evaluation (Skill E)

In my method, I made sure that I had followed all the safety procedures. I made sure that I wore my safety spectacles to stop any hot water or alkaseltzer tablet by products (foam) touching my face or eyes, whilst reacting with the higher temperatures. I also made sure that I had a safe and clean working area and that my set up was secure, so that the hot water or my stand didn't fall on the bench, which would have ruined my work and my neighbours work (set up). I also made sure nothing got mixed up in the set up.

I found that as the temperature increases, the timings decrease for the tablet to dissolve. I also found that as the temperature increases, the curve on the graph gets much steeper.

This continues until the temperatures get quite hot, so once I reach 55^0C, the graph starts to flatten out.

The reaction times do get quicker, but the difference in time between each temperature aren't so great anymore, so that is why the results are seen as being so close to each other.

The graph seemed fairly reliable and accurate, therefore showing me that I hadn't made any serious errors in the experiment itself, so I could comment on it more accurately. I found the pattern of it to be as I predicted in my prediction.

As there was a lack of anomalous results, it helped me because this showed that my experiment was fair throughout each attempt and so I didn't make any errors that could have altered my results and experiment set up. As there were longer gaps in the beginning than the end, it showed that the tablet took longer to dissolve at the start than at the end as the temperatures were lower. Even at the higher temperatures, I saw very little change in results wit only about 10 – 12 seconds separating the last six readings.

Here is a list of the changes that could have been made to improve the experiment.

Thermostatic Waterbath: Instead of using a Bunsen burner and two beakers of water, which the 200ml one acts as the water bath, we could have used an electronic waterbath, which would have been more faster and accurate in giving the correct temperatures. Your results would have been more accurate as the temperature stays constant and exact for longer. Also it would have been much safer as you wouldn't have too touch any hot beakers. If the racks inside could hold these large beakers, then it would be no problem and this would make the experiment much easier and safer, though with the apparatus we have now, it presents a challenge in getting the set up all right, which is why we do the experiment.

Amount of Water used: If we could have experimented for a little longer, we could have found a suitable amount of water to use to dissolve the tablet in. This would improve the accuracy of the experiment and would also give a more suitable answer range.

Replicating the experiment:I was glad I did all the temperatures I needed at least three times as this showed me if any of my results were inaccurate or totally wrong. I felt if we had more time and perhaps better heating equipment, we could have done more results at different temperatures and so this would help further as I would have more results to use and so I can comment on more in my conclusion and graph.