Plan

We are going to be studying the reaction between zinc and copper (2) sulphate solution. As Zinc is higher up in the reactivity series this shall be a displacement reaction in which zinc will take something away from the copper (2) sulphate solution.

To do this we will be measuring the temperature rise when using different amounts of zinc. We will be reacting the zinc and copper(2) sulphate solution in a polystyrene cup as the preliminary experiment showed this to be superior to a plastic cup. Then we will measure the temperature rise of the solution. We will be using 0.5,1.0,1.25,1.50,1.75,2.00,2.25,2.50 amounts of zinc in grams.

As Zinc is higher up in the reactivity series this will be a displacement reaction in which it takes something away from the copper solution. The symbol equation for this is:

+ $\longrightarrow$ +

Therefore the products of this reaction are zinc sulphate + copper
This is also going to be an exothermic reaction which means it gives out heat.

During this experiment we shall be keeping constant the;
Polystyrene cup used (cleaned after each experiment)
Mass and type of zinc use (and the same sized pieces)
Equipment used (e.g. thermometer)
Concentrations of copper (2) sulphate solution used
Time we leave for the reaction.
The only thing that we shall be varying in this experiment is the amounts of zinc we use.

The mass of zinc we use each time is our variable, and we shall be increasing the mass used for the reaction by .25g each time starting from 0.5g up to 2.50g. this should ensure that when the reaction is completed we will have a large amount of data which we can easily put into a graph and evaluate easily.

I think that as the amount of zinc is increased so will the temperature rise increase. I also believe that when the temperature rise reaches a certain temperature the solution will not get any greater no matter how much zinc is used.

Before we started the experiment we needed to carry out a preliminary experiment which was used to determine what type of cup would be best for the experiment we are going to do. We used two different cups, one polystyrene and one plastic. We then carried out the experiment we were going to do for real just once in each of the cups. Then when we have the results we can determine which is best at retaining heat and overall which had the best results. We found out that it was the polystyrene cup which was best for the experiment and so this is the one which we shall be using.

Obtaining Evidence

To carry out the experiment we first had to clean out all of the equipment we are going to use to be sure it is a fair test. We already had the predetermined amounts of zinc measured out for us so that wasn't problem. For safety I tucked away my tie put on the protective goggles and put away the stools. I used a measuring cylinder to measure out 40ml of 0.5m CuS0 after checking the cylinder was completely clean and empty. Then I poured the CuS0 into the polystyrene cup and used the thermometer to measure the start temperature. I then wrote in the start temperature into the table I had drawn in my book. Next I started with the main part of the experiment, I emptied the contents of the first test tube which contained 0.5g of zinc into the polystyrene cup. Then I stirred the solution with the thermometer and made sure that whilst I did this my hand heat was not transferring onto the cup by holding at the top. I constantly measured the temperature of the solution, then when the temperature had stopped rising I marked down the maximum temperature reached. I could then work out the temperature rise using the maximum and minimum temperatures and put the results into the table. I then emptied the contents of the cup into the containers provided as it was dangerous to pour it down the sink. The I cleaned out all of the equipment and made sure the themometer had returned to its original temperature. Now I was ready to repeat the experiment for the remaining amounts of zinc. I had to repeat this same procedure for each of the masses of zinc.

Overall I think that the whole experiment went very well

With no real anomalies and the results following mainly what I had said in my prediction. With the maximum temperature increase at 24. The results of my experiment are shown in the table below.

Mass of Zinc	Tube Colour	Start Temp	Max Temp	Temp increase
0.50g	Blue	24	35	9
1.00g	Red	22	39	12
1.25g	Orange	23	45	22
1.50g	Green	25	48	23
2.00g	Pink	25	49	24
2.25g	Brown	25	48	23
2.50g	Colourless	23	47	24

The test tubes we used had different colours this was so that we could tell easily which mass of zinc they contained.

Here is a list of all the equipment we used during the experiment:

Measuring Cylinder
Test Tubes containing different masses of zinc
Thermometer
Polystyrene cup
Copper (ii) sulphate solution
Pen and book for the taking of results

Safety in this experiment was quite basic as it wasn't a very dangerous reaction. Even so the basic safety rules still had to be undertaken. These include tucking away ties, wearing protective goggles, clearing away any stools or anything else which may get in the way or become a hazard.

Analysing Evidence

This graph clearly shows how the temperature gradually increases as the mass of zinc increases. It shows how the temperature increase levels off at around 23 degrees. It has reached its full peak when the mass of zinc is 2.0g. As this is a displacement reaction it means that the whole purpose of it is that Zinc is trying to take something away ffrom the copper (ii) sulphate solution. The products of it are zinc sulphate + copper which means that it is the sulphur which the zinc has taken away from the copper. The reason which the graph levels out at 2.0g of zinc may be explained because the more zinc there is the quicker it will be at reacting with the copper, it does also mean that it gives out more heat but it does this faster than when there is less zinc reacting. The reason the temperature does not continue to grow is because the zinc has already taken the sulphur away from the copper and the reaction has stopped so nothing is happening. When there is very little zinc reacting there is not a very high temperature increase, this may be because there is less zinc so therefore there is less to react with the copper so it will give out less heat. This however does not mean that the reaction does not take place the products are still the same but the reaction may just take longer.

Overall these experiments have shown us exactly what happens when copper (ii) sulphate and Zinc react. It has shown us the amount of heat that is given off when these two react and how this changes with the amount of zinc which is used. It gives us a clear understanding of what happens with a displacement and an exothermic reaction. The smallest temperature increase was just 9 whereas the largest increase was 24 that's a total range of 15 between the biggest and smallest results.

Evaluating Evidence

Overall I think the experiments were a complete success, I also think this is shown in the accurate set of results which have been obtained from the experiments. Although these results appear to be perfect they cannot be completely reliable as they were not performed under exact conditions which it would need to be for them to be perfect. All of the zinc which we used was premeasured which meant that it was

not completley accurate as it would have been if I had measured the same amount out each time using a top pan balance. The concentration of the CuSo was another thing which cannot be completely trusted because for some experiments we used a solution from a different container which may have meant that it was not the exact same concentration as before. We could have rectified this problem by checking the concentration before each experiment or to have simply used the same solution each time. The zinc which was used was not as fine as it could have been which would have meant for a larger surface area and therefore more reactivity and better results. Using the same polystyrene cup was another thing which may have contributed to not entirely trustworthy results as although the cup was cleaned after each experiment it would have been more reliable to use a new cup each time, as it may not have been completely cleaned out of all traces of zinc. The thermometer we used could also have improved the results we got if it had been more accurate and precise. It was impossible for us to complete all of the experiments on the same day but this is another thing which may improve the results because it would have meant a more constant R.T.P (room temperature and pressure). The main thing which could have been done to be sure of a more precise outcome of results would have been to simply do more repeats, the more repeats which are done the better the end results will be.

I think that my prediction is very well backed up by my results and the graph as it reinforces everything I have said about what I expected my results to show. The graph rises and peaks off where I expected it to and overall I think the whole experiment was a complete success.

If I wanted to extend my study then I could have carried out experiments involving different concentrations or amounts of CuSO . I could also do another experiment but timing it to test how fast it takes for the temperature to reach its peak when using different masses of zinc. I could also have carried out the experiment in a different type of cup and see how that changes the results.

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