AQA Chemistry A-level

Required Practical 2

Measurement of an enthalpy change

Method 1: Collecting data for the determination of ΔH1

[Anhydrous copper sulfate + aq -> copper sulfate solution]

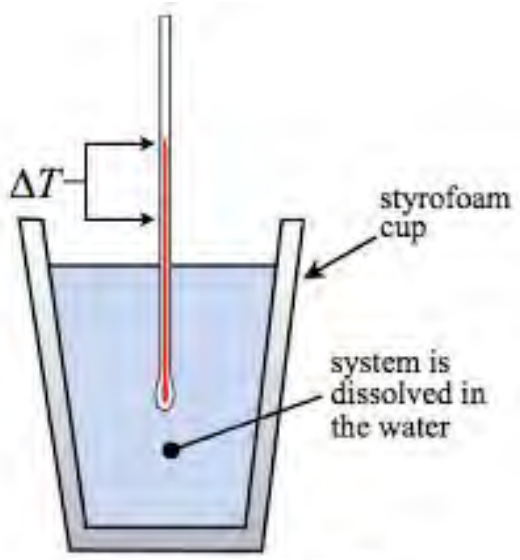
Method	Accuracy	Explanation
1. Weigh out between 3.90-4.10 g of anhydrous copper(II) sulfate in a dry, stoppered weighing bottle. Keep the stock of solid in a closed container during weighing. The precise mass should be recorded.	• Wash the containers with the solution to be used. • Dry the cup after washing.	
2. Construct a suitable table of results to allow you to record temperatures at minute intervals up to 15 minutes.		
3. Using a measuring cylinder, place 25 cm^3 of deionised (or distilled) water into a polystyrene cup and record its initial temperature (t=0). Start the timer and then continue to record the temperature each minute, for three minutes.	• Allow the water to stand for some time. • Stir the liquid continuously. • Place the polystyrene cup in a beaker for extra insulation and support. • Clamp thermometer into place ensuring that the bulb is immersed in liquid. (see diagram) • If the two reactants are solutions then the temperature of both solutions need to be measured before addition and an average temperature is used.	This ensures they all reach room temperature, allowing a better average temperature to be obtained. Polystyrene beakers make good calorimeters because they are good insulators and have high specific heat capacities.
4. At the fourth minute, add the powdered anhydrous copper(II) sulfate to the water in the polystyrene cup and but **do not** record the temperature. At the fifth minute continue the temperature readings at minute intervals, up to fifteen minutes. Stir the solution in the polystyrene cup as this is done.	• Add the powdered anhydrous copper(II) sulfate rapidly. • Using a lid on the polystyrene cup can help to minimise heat loss and maximise change in temperature.	

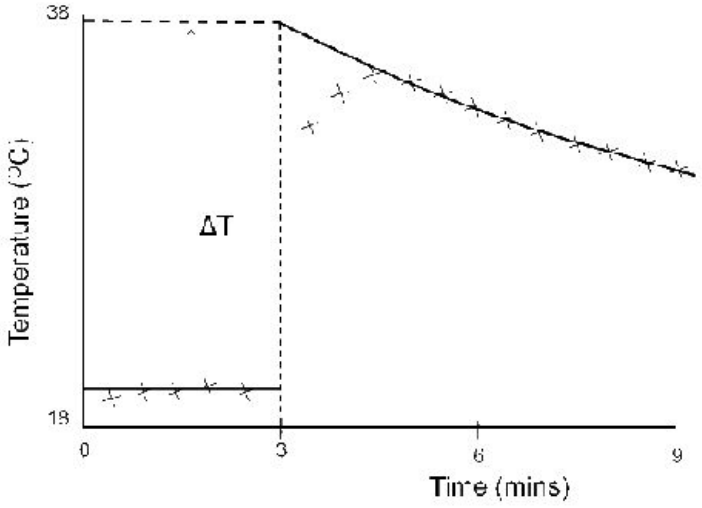
5. Plot a graph of temperature (on the y-axis) against time. Draw two separate best fit lines; one, which joins the points before the addition, and one, which joins the points after the addition. Extrapolate both lines to the fourth minute. (see diagram)	• Use a large scale on the graph.	
6. Use your graph to determine the temperature change at the fourth minute, which theoretically should have occurred immediately on addition of the solid.		

Safety precautions:

- Take care to avoid skin contact

Diagrams:





Errors:

- Heat transfer to or from surroundings (usually heat loss).
- The method assumes all solutions have the heat capacity of water.
- Neglecting the specific heat capacity of the calorimeter, any heat absorbed by the apparatus is ignored.
- Reaction or dissolving may be incomplete or slow.
- Density of solution is taken to be the same as water.
- Some of the water could have evaporated.
- Room temperature could have changed.
- Incomplete combustion if using a fuel.

To improve accuracy:

- An electronic temperature sensor and data logging software could be used to plot the graph accurately.
- A flame calorimeter could be used to improve accuracy:
    - Spiral chimney is made of copper.
    - Flame is enclosed.
    - Fuel burns in pure oxygen rather than air.