As Level Chemistry Coursework

PLANNING
INRODUCTION

For this experiment I have been given a task to determine which is the best Alcohol from its Homologous series. I can determine this by finding the Enthalpy change of Combustion for Alcohols. I know th at 4.2J of energy is required to raise the temperature of 1g of water by 1°C and to find the Enthalpy change for the Alcohols, I will use the formula D = M/V. The density of water is 1 and therefore 1g is equivalent to 1 ml.

APPARATUS

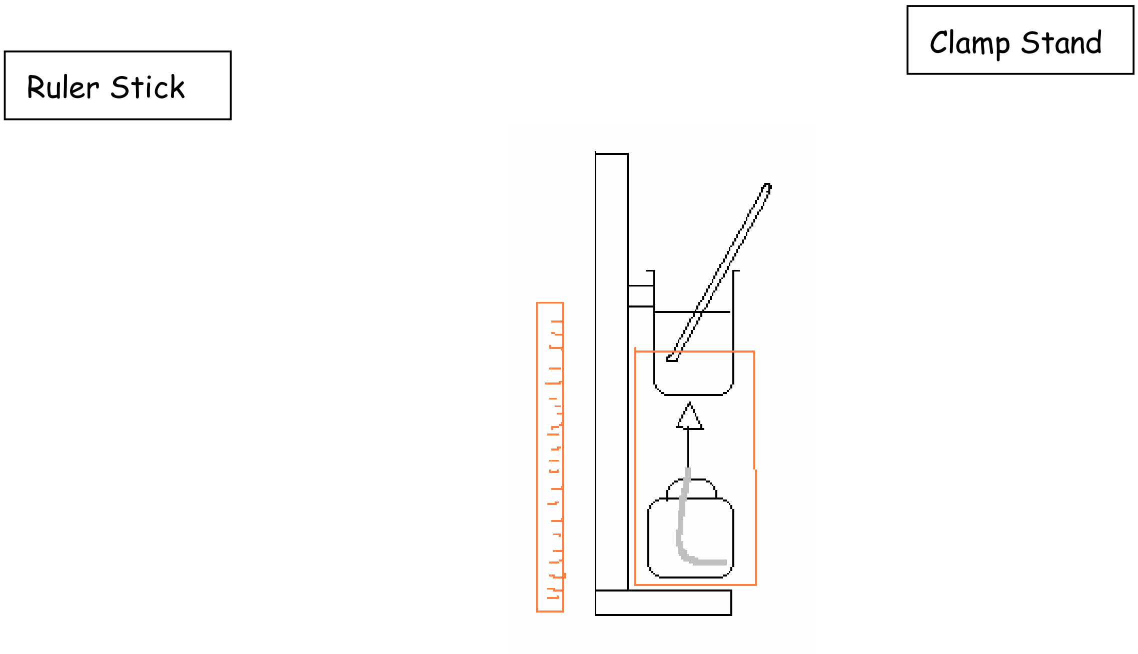
The apparatus that I will use within this experiment will consist of:

- 6 * 250ml Steel Crucibles
- 2 * 100ml measuring cylinders
- 6 * 250ml Sprit burners
- Clamp + Clamp stand
- 2 * Cardboard shields
- Stopwatch
- 30cm Ruler stick
- Electrical weigh

I will also include 100ml of six Alcoh ols from their functional groups.

ALCOHOLS BEING USED

DIAGRAM



FAIR TEST & FACTORS THAT I NEED TO CONTROL

For this experiment to proceed successfully, I have to consider some key factors that need to be controlled in order for this experiment to be a fair test. Firstly, the quantity of the Alcohols needs to be the same throughout the experiment. This is because if the quantity is varied, then the results that I receive at the end of the experiment will also be affected. Secondly, the temperature of the water also needs to be kept the same as well as the distance between the Crucible and the Sprit Burner. If the factors are not controlled then it will lead to the experiment being bias. The process in which I intend to avoid this from occurring is by controlling the temperature of the water using a thermometer and controlling the distance between the Crucible and Sprit Burner by measuring the distance using a 30cm ruler stick. This factor needs to be controlled or the results that I receive in the end will effected and the experiment would not be fair test.

SAFETY

There are a number of Safety Precautions that I will have to consider during this experiment:

I will have to wear eye protection (goggles) because I will be handling corrosive materials. I will be cautious on keeping then equipment I am using, away from the edges to avoid any breakages or spills.

PREDICTIONS

From my knowledge of Chemistry and Enthalpy Change of Combustion, I know that for example Methanol will need a

Total of 2039 KJ mol^{-1} to break the bonds and form new ones. I predict that 2-Methyl-Propan-1-ol will have the largest Enthalpy change because it has more bonds, which needs more energy to break and form new bonds. It will need around 5558 KJ mol^{-1}

METHOD

I will start this experiment by collecting the apparatus that I will be using. Using the measuring cylinder, pour 100ml of water into steel cubicle and record the temperature of the water. Join the cubicle to the clamp stand at a distance of 17cm from the base. The distance will need to be kept the same in all the experiments or it will not a fair test. Secondly, using the second 100ml-measuring cylinder, measure 100ml of the specific Alcohol being used and pour it into a sprit burner. For safety, make sure this procedure is operated within a fume cupboard to prevent fumes from escaping out into the classroom. Alcohols are known to be dangerous chemicals, so it is important that they are not it contact with the user. Thirdly, place the sprit burner beneath the cubicle and light the wick using a light from the Bunsen. While the wick is still burning, Start the stopwatch and using both cardboard shields, grasp them around the sprit burner tightly similarly to a cubical shape to prevent heat loss. This is because the experiment will be affected if most of the heat energy escapes and suffienct amounts of heat energy can only be used to heat the water. Keep the shields held tightly together until 3 minutes are over. I decided to time the experiment for a specific time length because then it helps in comparing the Alcohols. Repeat the experiment for all the alcohols until left with 2 sets of results for each Alcohol. This helps in identifying any mistakes.

ANNALYSING

RESULTS 1

ALCOHOL	Weight of bottle (g)	Weight of bottle&fuel	Temperature of water (start)(°C)	Temperature of water (end)	Weight of sprit burner(end)
Methanol	238.9	257.2	21	49	256.1
Ethanol	223.6	251.7	21	46	246.0
Propan-1-ol	201.3	223.6	21	51	222.8
Butan-1-ol	239.6	289.7	21	60	288.1
Butan-2-ol	198.7	233.9	21	62	232.0
2-Methyl-Propan-2-ol	204.1	247.3	21	40	245.6

RESULTS 2

ALCOHOL	Weight of bottle (g)	Weight of bottle&fuel	Temperature of water (start)(°C)	Temperature of water (end)	Weight of sprit burner(end)
Methanol	238.9	260.2	21	49	258.1
Ethanol	223.6	251.8	21	47	248.3
Propan-1-ol	200.4	224.6	21	53	222.8
Butan-1-ol	238.6	289.9	21	61	286.3
Butan-2-ol	198.7	233	21	59	233.3
2-Methyl-Propan-2-ol	208	246	21	40	246.6

AVERAGES RESULTS 1+ RESULTS 2/2

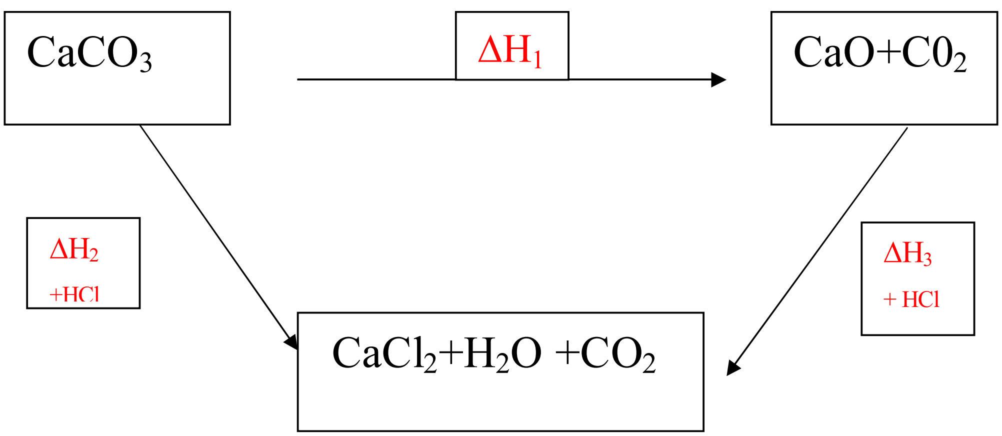
ALCOHOL	Weight of bottle (g)	Weight of bottle&fuel	Temperature of water (start)(°C)	Temperature of water (end)	Weight of sprit burner(end)
Methanol	238.9	258.7	21	49	257.1
Ethanol	223.6	251.75	21	46.5	247.15
Propan-1-ol	200.85	224.1	21	52	228.89
Butan-1-ol	239.1	289.8	21	60.5	281.2
Butan-2-ol	198.7	233.45	21	60.5	232.65
2-Methyl-Propan-2-ol	206.05	246.65	21	40	246.1

The results show that Butan-1-ol and 2-Methyl-Propan-2-ol weighed the highest whereas Methanol weighed the lowest. This point connects to the chemistry of the Alcohols which also state that Butan-1-ol weights 74.1 g mol^{-1} and 2 Methyl Propan-2-ol also weights around 74.1 mol^{-1}. The temperature of the water in the experiments using Alcohols, Butan-1-ol and Butan-2-ol had the largest increase.

The results also show that most of the Butan-1-ol Alcohol fuel was burned compared to the other alcohols. An anomalous result appeared in the weight of fuel burned for Propan-1-ol because at the end, the sprit burner had gained weight, which somehow affects my results.

Expt 3(Evaluation)- Determining the Enthalpy change of a reaction

Finding the Enthalpy change of a reaction when Sodium Carbonate decomposes after being heated to form Calcium oxide and Carbon Dioxide is difficult to measure directly. The enthalpy change could be measured through a simple approach through Hess's Law. In this experiment, Calcium Carbonate and Calcium oxide were reacted separately with hydrochloric acid. An enthalpy cycle could then be used to determine the enthalpy change of the reaction.



$\Delta H_1=\Delta H_2+\Delta H_3$

To find the mass, the density needs to be multiplied by the volume to find ΔH_2 and ΔH_3.

Enthalpy change for ΔH_2:

Specific Heat Capacity

$$\text{Heat} = M \times C \times \Delta T$$

Mass

Change in Temperature

HEAT = 50 x 4.2 x 4 = 840 kJ

50 * 2 /1000 = 0.1 Mol

ΔH_2 = 840 KJ/ 0.1 Mol = 8400KJ $^{-1}$

Enthalpy chnge for ΔH_3:

HEAT = 50 x 4.2 x 9 = 1890 kJ

50 x 2 /1000 = 0.1 Mol

ΔH_3 = 1890 KJ/ 0.1 Mol = -18900KJ $^{-1}$

ΔH_1 = 8400 KJ Mol^{-1} (ΔH_2) – -18900 KJ Mol $^{-1}$ (ΔH_3)

= -10500 KJ Mol $^{-1}$

The experiment proceeded successfully but there w ere some key factors that may have affected the results.

<u>Suitability of experimental procedures</u>

There are some factors in the experiment that can be improved if the experiment was repeated. Firstly, the weigh in machine was not suitable for this experiment because it weighed substances to one decimal point (e.g. 2.5) and can be made more accurately by using a weigh that weighs up to four decimal places. Secondly, the experiment was performed in a container with poor insulation and therefore some of the heat may have escaped. If I had the chance to repeat the experiment, I would perform the experiment in a closed insulated container such as a Bomb Calorimeter. This could then minimise the chance of any errors occurring within the experiment.

Anomalous Results

According to the results that I received, there were no anomalous results but I would repeat the experiment just to be sure that there were no anomalous results.

Sources of error

There may have been a number of errors within this experiment that could have been avoided. Firstly, the mass of Calcium Oxide and Calcium Carbonate should have been kept the same to allow the experiment to be a fair test. Also, a more accurate thermometer could have been used to determine the temperature change