ENTHALPY OF VARIOUS REACTIONS

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Date: 9th October 2018

Introduction:

The law of conservation of energy states that the total amount of energy in an isolated system remains constant. This means that energy can neither be created nor destroyed but can only be converted from one form to another. Therefore, in a closed system the total amount of energy is always the same at any point. In a closed system the magnitude of the heat loss is equal to the heat gained.

The specific heat capacity of an object is the amount of heat per unit mass required to raise the temperature that object by one degree Celsius (℃). The energy lost or gain in system can be determined by using the following equation.

$$q = m \times c \times \Delta t$$

Where q= energy in joules

m= mass in Kg, Δt= change in temperature

c= specific heat capacity of substance in J/Kg℃

Enthalpy of a solution

Enthalpy of a solution can be exothermic or endothermic and if it depends on lattice energy and enthalpy of hydration.

Procedure:

1. Make theoretical calculation.
2. Place 100 mL of water in the aluminum can and 125 mL of distilled water in the Calorimeter.
3. Add calculated amounts of NH_4Cl to the of water surrounding the aluminum can.
4. Quickly stir the solution and close calorimeter.
5. Ensure the calorimeter remains firmly closed throughout experiment.
6. Place temperature sensor in the aluminum can to measure the change in temperature over time.
7. Record the initial temperature and final temperature of water
8. Repeat experiment.

Theoretical Calculation:

Heat loss= heat of water + heat of aluminum can

$$=[mass \times \Delta t \times c]water + [mass \times \Delta t \times c]aluminium$$

$$=[225 \times 4.186 \times -5] + [8.53 \times 0.9 \times -5]$$

$=[-4709.25] + [-38.385]$

$=4747.635 Joules = 4.747 Kj$

Heat of solution for NH_4CL is 17.7kj/mol

Number of moles= $\frac{4.747}{17.7}$

$=0.26717 mol \quad mass = mol \times molecular\ mass$

$=0.26717 \times 53.491$

$=14.291 g$

Discussion:

The aim of this experiment was to cool a chosen volume of substance by employing the laws of conservation of energy. The heat of solution dissociation of ammonium chloride-the salt used-is positive meaning the reaction is endothermic therefore it absorbs heat to start the its dissociation. So, the heat of the substance within the aluminum can is being transferred to the reaction. In my data the temperature of the water inside the aluminum reduced over time which means that the reaction was progressing. Over a period of time the temperature stopped reducing and the maintain a steady value which meant that the system was at equilibrium. The design worked because it was able to keep the system closed and not allow lost of heat to the surrounding. In my result I was not able to reach the required temperature drop for the substance, but I was able to reduce the temperature of the substance. The design would have been more efficient if the solution outside the can could cover the whole surface area of the aluminum. This would make the reaction faster, also if there was accommodation for stirring without opening the system. The reason of selection of Ammonium chloride over Ammonium nitrate was because it is more cost-effective for mass production. We also chose Ammonium chloride because it has a low potential for poisoning compared to Ammonium nitrate which has nitrates that can lead to the methemoglobinemia-a blood disorder-in humans.

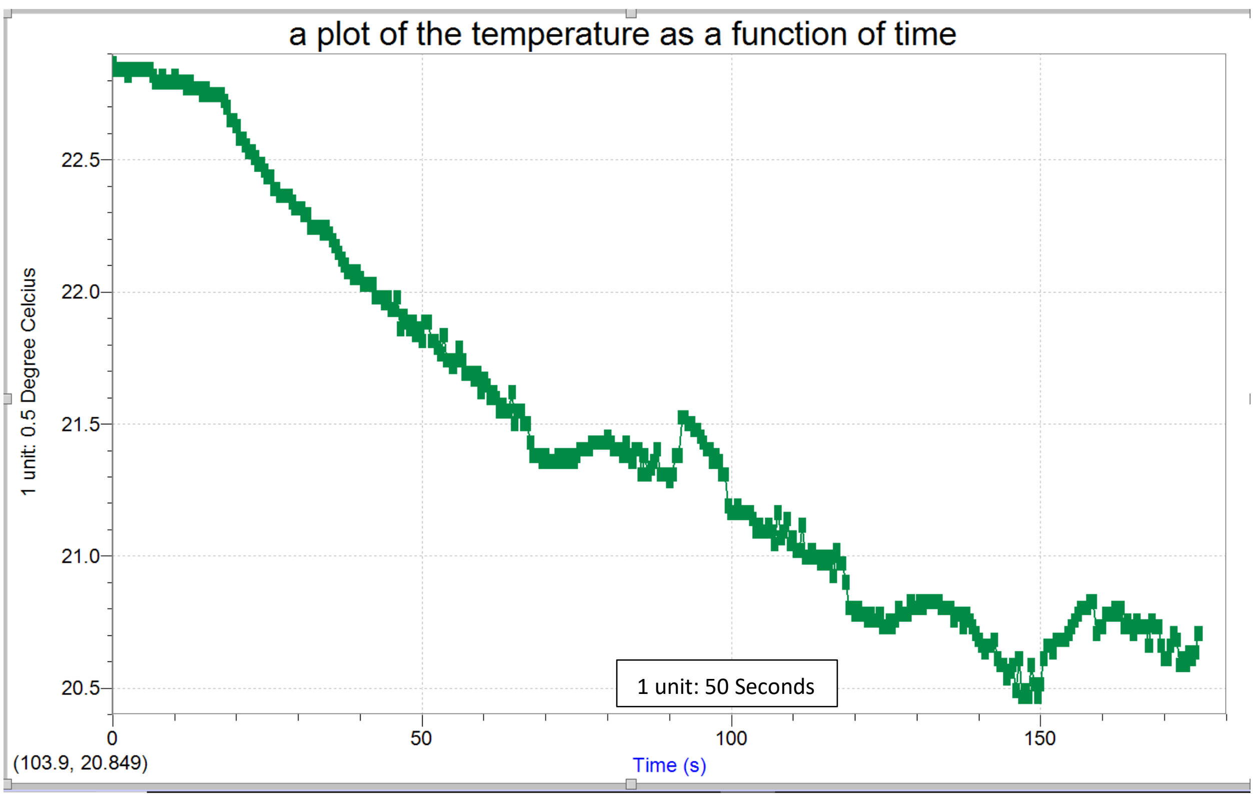
Observation:

While conducting the experiment we observed that upon adding NH_4Cl the temperature of the system dropped to a point and became stable which meant the system was now at equilibrium. We observed that any slight opening of the calorimeter will cause a change in temperature. This will lead to error in temperature reading. I also observed that the system couldn’t remain closed on its own without being firmly held.

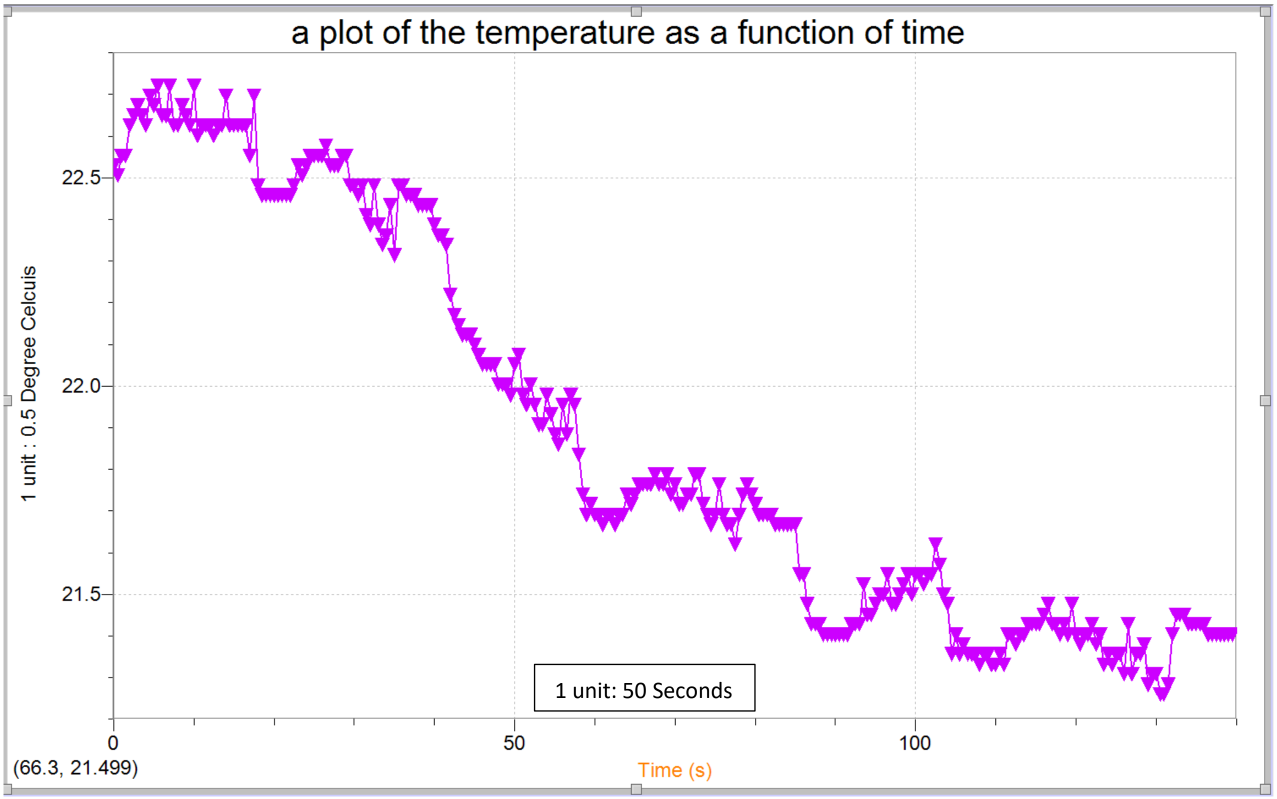
Table 1

s/n(Trail)	Mass of Salt(g)	Initial Temperature(°C)	Lowest Temperature (°C)	Δt(°C)
1	14.93	23.00	20.50	-2.50
2	15.93	22.50	20.20	-2.30
3	15.43	22.60	20.70	-1.90
4	20.00	22.50	19.90	-2.60
5	14.93	22.60	19.10	-3.50
6	16.00	22.10	19.90	-2.20

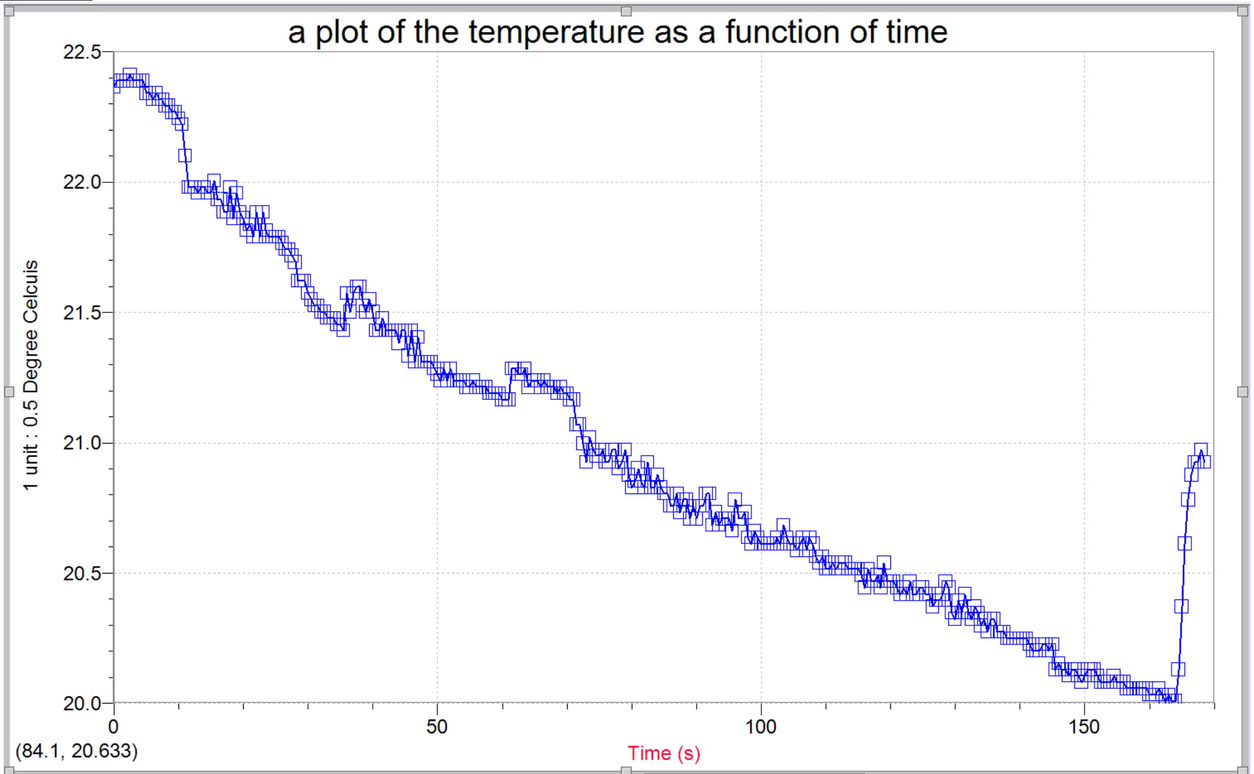
Trial 1



Trial 2

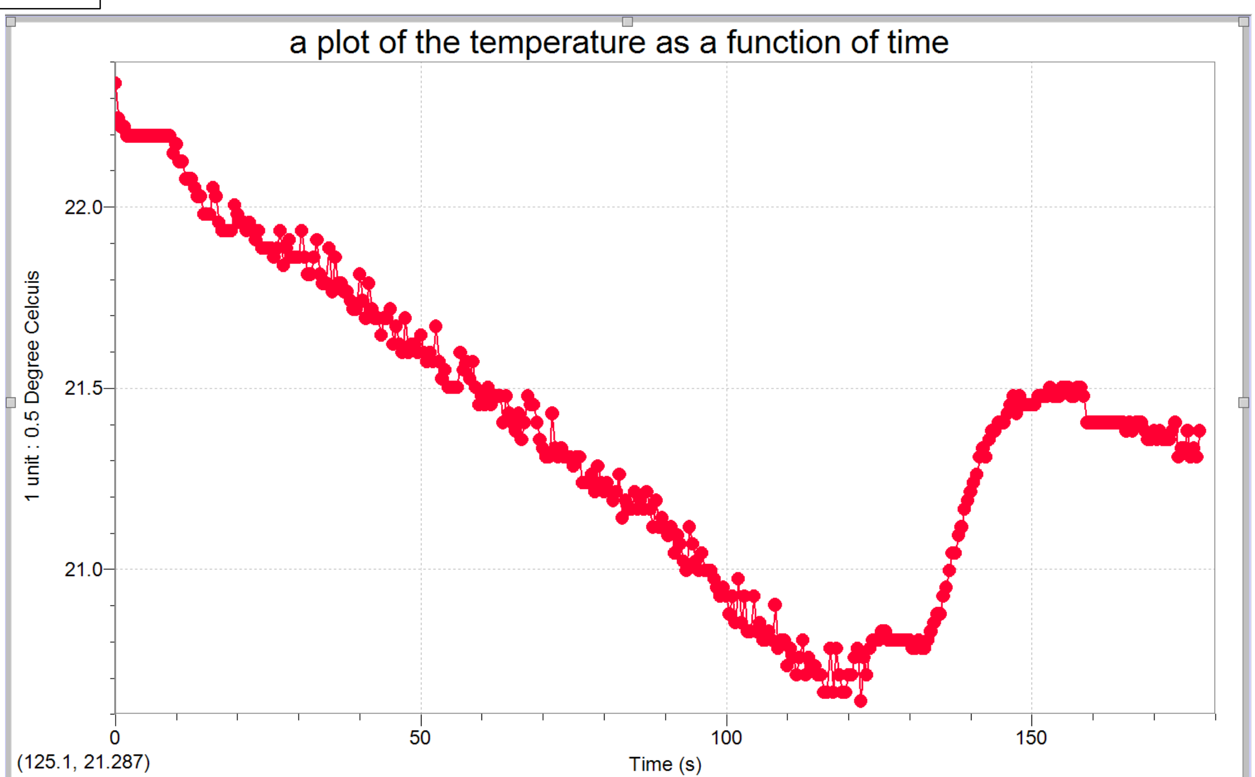

a plot of the temperature as a function of time
1 unit : 0.5 Degree Celcuis
22.5
22.0
21.5
1 unit: 50 Seconds
0
50
100
(66.3, 21.499)
Time (s)

Trial 3



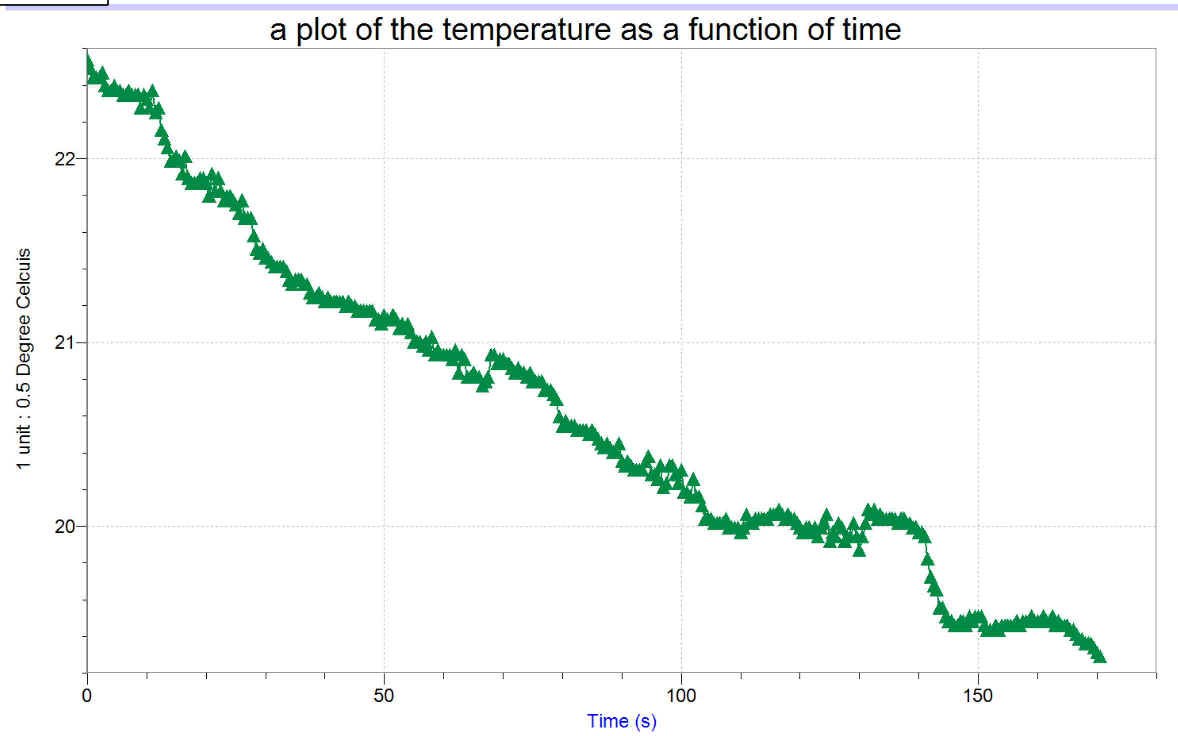
1 unit: 50 Seconds

Trial 4



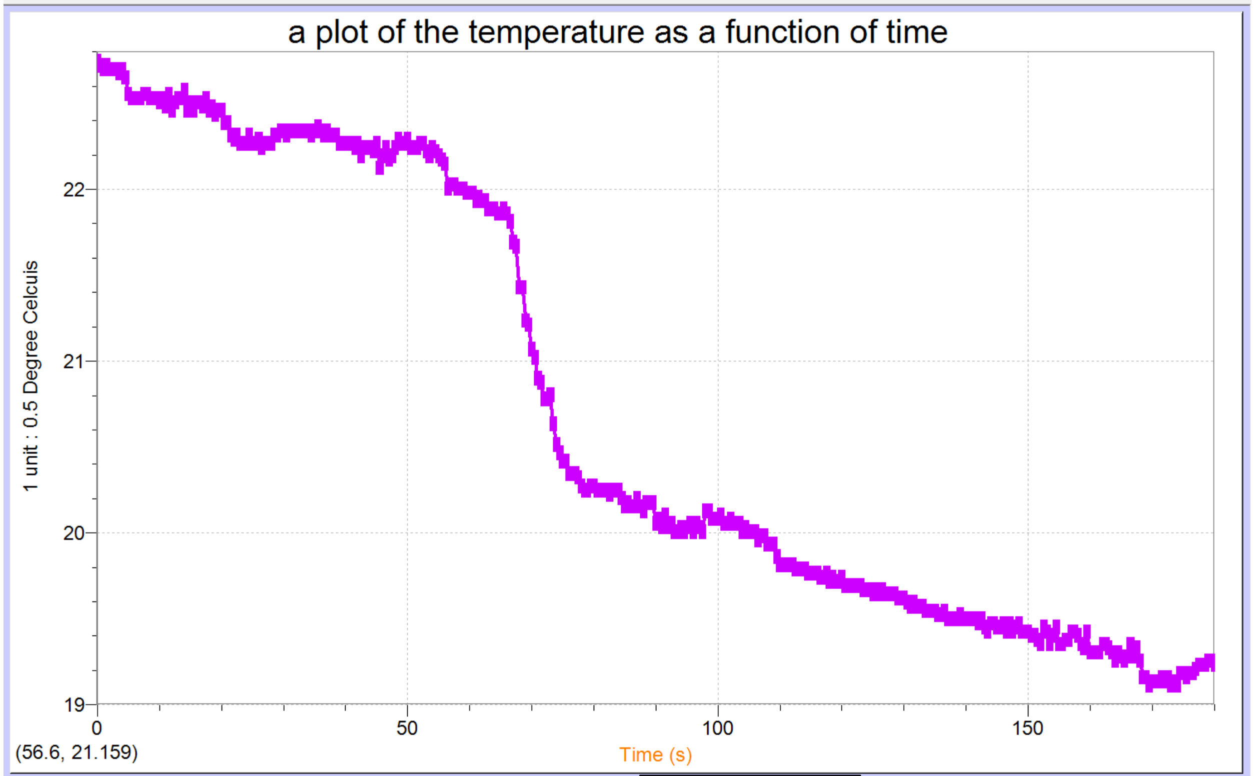
1 unit: 50 Seconds

Trial 5



1 unit: 50 Seconds

Trial 6



1 unit: 50 Seconds

Conclusion:

In all the experiment was not a success as we could not achieve the desired temperature drop for the content of the can. The experiment showed that there was a change in heat of the system because the temperature decreased after the addition of the salt.

Bonus:

Name of Product: Insta Chill Cooling Flask. (Chill with ease)

Reference:

Dr. Rashmi, Venkateswaran. "*But A Hot Temper Leaps O'er A Cold Decree*".Enthalpy of Various Reactions.

"Nitrates in ground water", What Methemoglobinemia, https://www.healthline.com/health/methemoglobinemia#prevention.


INSTA
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CHILL

Volume in Can : 100mL
Volume out of Can: 125mL

	Ti(°C)	Tf (°C)	Δt (°C)	mass (g)
Trial 1	~~100~~ 23.0	20.5	-2.5°C	14.93
Trial 2	22.5	20.2	-2.3°C	15.93
Trial 3	22.6	20.7	~~20.7~~ -1.9°C	15.43
Trial 4	22.5	19.9	-2.6	20.00
Trial 5	22.6	19.1	-3.5	14.93
Trial 6	22.1	19.9	-2.2	16 g

Energy loss

$[(100+125) \times 4.186 \times -5] + (8.53 \times 0.9 \times -5)$

$= 4709.25 + 38.385$

$= 4747.635$

$= mol = 4.747 \text{ kJ}$

$mol = \frac{4.747 \text{ kJ}}{17.7}$

$mol = 0.26717$

$mass = n \times M_m$

$= 14.291 \text{ g of } NH_4Cl$

Hammond Odibo-satu

Ebiarede

Procedure

1 ~~Obtain a~~ Make theoretical calculation

2) Obtain 100ml and 125ml samples of water

3) Add required masses of NH_4Cl

4) Stir

5) Record Initial and final temp

6) Calculate Δt

trial 1	Volume in can	out can	temp initial (°C)	final temp (°C)	mass (g)
1	100	125	23.0	20.5	14.93
2	100	125	22.5	20.2	15.93
3	100	125	22.6	20.7	~~20.0~~ 15.43
4	100	125	22.5	19.9	20.0
5	100	125	22.6	19.1	14.93
6	100	125	22.1	19.2	16.0

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Energy loss

$[(100+125) \times 4.186 \times -5] + [8.53 \times 0.9 \times -5]$

4709.25 + 38.385

= 4747.635

= 4.747kJ

$g/L \times mol/g =$

mol = $\frac{4.747\ kJ}{17.7}$

$\frac{g/L}{g/mol} = mol/L$

mol = ~~267177~~ 0.26717

mass = n × Mm

= 14.291g of NH_4Cl

Procedure

1. Make theoretical values of the experiment (calculations

2) collect required of water and drink

3) stir

4) Prepare lab quest

5) monitor reading

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