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Date:

Topic: Energetics

Title: Heat of Solution

Aim: To investigate the Heats of Solution of NH_4NO_3 and NaOH

Apparatus and Materials: beaker, thermometer, insulated cup, measuring cylinder, stirring rod, balance, NH_4NO_3 and NaOH crystals

Background: The enthalpy of solution of a salt is the energy change which occurs when 1mol of a salt dissolves completely in a given amount of solvent under standard conditions. The enthalpies of solution of NH_4NO_3 and NaOH are $+25.69 kJmol^{-1}$ and $-44.51 kJmol^{-1}$ respectively. This indicates that the dissolution of NH_4NO_3 is endothermic and that of NaOH is exothermic.

Method:

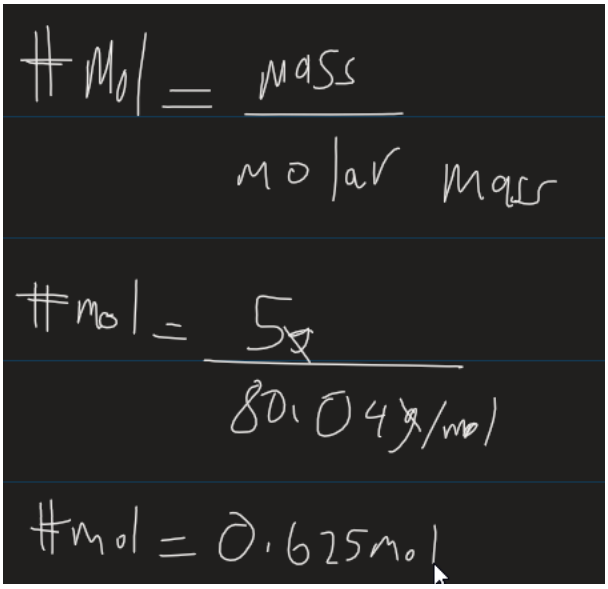
1. 5g of NH_4NO_3 was weighed on a balance.
2. $25cm^3$ of water was measured and poured in an insulated cup.
3. A thermometer was used to measure the initial temperature of the water.
4. The 5g of NH_4NO_3 was added to the insulated cup all at once and stirred to dissolve the solute as quickly as possible.
5. The final temperature on dissolution was recorded.
6. Steps 1-5 were repeated using NaOH instead of NH_4NO_3

Observations:

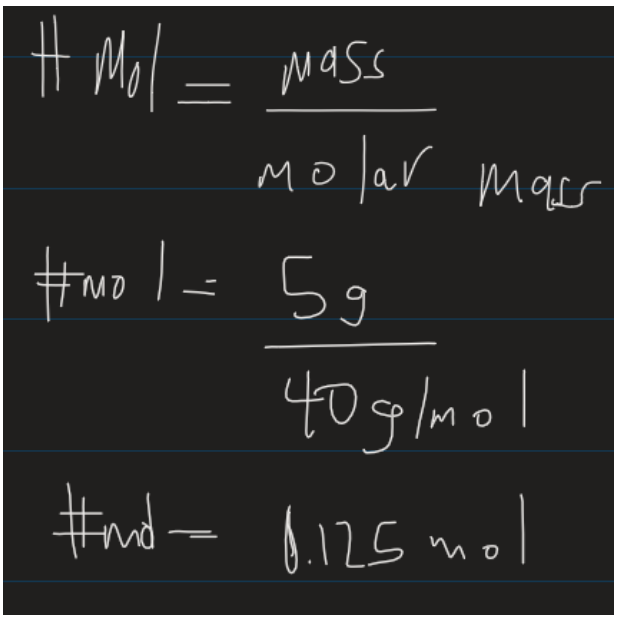
Salt	Mass of Salt (g)	Initial Temperature (°C)	Final Temperature (°C)	ΔT (°C)
NH_4NO_3	5g	26.5	15.5	-11
NaOH	5g	26.5	68.7	42.2

Discussion: Answer the following questions.

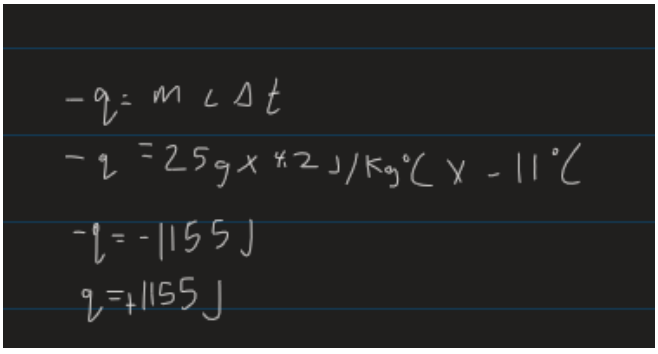
1. Calculate the number of moles of NH_4NO_3.



2. Calculate the number of moles of NaOH.



3. Calculate the heat change for the dissolution of NH_4NO_3.



4. Calculate the heat change for the dissolution of NaOH.

$-q = mc\Delta t$

$-q = 25g \times 4.2J/gC \times 42.2C$

$-q = 4431J$

$q = -4431J$

5. Calculate the enthalpy of solution of NH_4NO_3.

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

$-q = 25g \times 4.2J/Kg°C \times -11°C$

$-q = -1155J$

$q = +1155J$

$\#mol = \frac{Mass}{molar\ mass}$

$\#mol = \frac{5g}{80.04\ g/mol}$

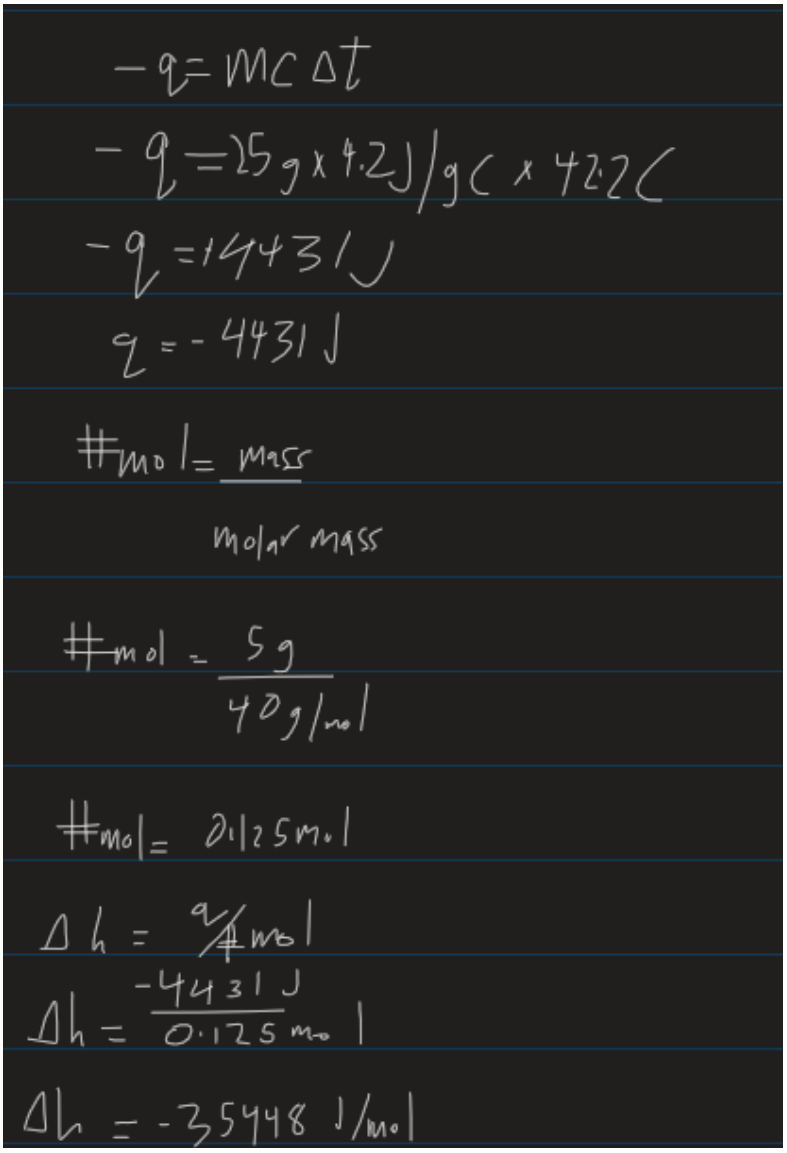
$= 0.0625 mol$

$\Delta h = \frac{q}{\#mol}$

$\Delta h = \frac{+1155J}{.0625\ mol}$

$\Delta h = +18480\ J/mol$

6. Calculate the enthalpy of solution of NaOH.



7. Why was an insulated cup used instead of a beaker?

   An insulated cup was used so that little to no heat escaped.

8. Why did the values obtained in questions 5 and 6 differ from those stated in the background?

   The values obtained were different due to a different in the temperature. The formula to calculate q is MCΔt, and there would be a different temperature in the room which the experiment took place in, which would make Δt higher or lower.

9. **Conclusion:** **In conclusion, the heat of solution of** NH_4NO_3 was +1155J, and the enthalpy of solution was +18430 joules per mole. It was an endothermic reaction. The heat of solution and enthalpy of NaOH was -4431J and -35488 joules per mole respectively and it was an exothermic reaction.