Tobias Blom
IB III

Lab-report

Date: 98-10-05

Hess' Law:

Work to be done:

Find enthalpy change by measuring temperature change of a reaction.

Chemicals and apparatus:

Thermometer
Scale
Isolator
NaOH, solid
NaOH, 0.50M solution
Acetic acid, 0.50M and 0.25M

Lab:

Reaction 1)

The temperature of 200ml water that I poured into the isolator was 23.0°C. To that I added 1.97g solid NaOH and let the reaction take place. After a while I measured the temperature to 24.9°C → $\triangle$T = 1.9°C. The number of mole NaOH is 1.97 / 40 = 0.049 mol.

Reaction 2)

In this experiment I used 100ml 0.50M acetic acid, and to that I added 100ml 0.50M liquid NaOH. The temperature of the acetic acid was 23°C and the temperature of the NaOH was 22°C. So the average, and the number I use will be 22.5°C. After the reaction the temperature of the solution was 25°C, so $\triangle$T = 2.5°C. The number of mole NaOH is 0.50 * .100 = 0.050 mol.

Reaction 3)

In the third reaction I used 200ml 0.25M acetic acid with a temperature of 22.5°C, that I added to 2.00g NaOH. The temperature after the reaction was 27°C, so $\triangle$T = 4.5°C. And the number of mole NaOH in the reaction was 2.00 / 40 = 0.05 mol.

The same amount NaOH has been used in all three reactions, and the same amount of liquid also, 200ml. In reaction two and three is also the amount acetic acid the same.

I can now calculate the enthalpy changes in each case:

H = c m T, and since the same mass has been used, and since I can use the same c in all three cases H = 0.84 T (c = 4.2, m = 0.200g)

$\triangle H_1 = 1.596$
$\triangle H_2 = 2.1$
$\triangle H_3 = 3.78$

According to Hess' Law you should be able to calculate the enthalpy change for a reaction which is the sum of two (or more) reactions with known enthalpy change, so:

$NaOH_{(s)} \rightarrow NaOH_{(aq)}$ (1)
$NaOH_{(aq)} + HCl \rightarrow NaCl + H_2O$ (2)
$NaOH_{(s)} + HCl \rightarrow NaCl + H_2O$ (3)

(3) – (2) = (1)

and we can also see that $\triangle H_3 - \triangle H_2 \approx \triangle H_1$

Other results in class:

Group	**H_1**	**H_2**	**H_3**	**H_3-H_2**
1	1.26	2.1	3.36	1.26
2	1.67	2.3	3.27	1.47
3	6.82	1.89	8.4	6.51
4	1.26	2.94	4.2	1.26
5	1.60	2.1	3.78	1.68
6	1.596	2.1	3.36	3.36
7	2.5	2.1	4.2	2.1

(The results of group 3 was probably because they isolated more.)