**REPORT**

**EXERCISE 6**

**THERMODYNAMICS**

**NAME:** **GROUP:**

**DATE OF EXERCISE:**

**EXERCISE TOPIC:** Enthalpy of dissolution and neutralization of NaOH.

**OBJECTIVE OF THE EXERCISE:** To determine the enthalpy of dissolution of 1 mole of sodium hydroxide depending on the molar ratio of hydroxide to water and to measure and compare the enthalpy of neutralization of sodium hydroxide with a strong and weak acid.

**1. Table 1 – Results obtained during the exercise.**  
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**2. Table 2 – NaOH dissolution process**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **No.** | |  | | --- | | **Amount of NaOH (moles)** | | |  | | --- | | **Total Amount of NaOH (moles)** | | |  | | --- | | **Temperature increase ΔT** | | |  | | --- | | **Enthalpy of NaOH dissolution (kJ/mol)** | | |  | | --- | | **Total molar enthalpy of NaOH dissolution (kJ/mol)** | | |  | | --- | | **Calorimeter constant K (kJ/deg)** | | |  | | --- | | **Mean K value (kJ/deg)** | |
| **1** |  |  |  |  |  |  |  |
| **2** |  |  |  |  |
| **3** |  |  |  |  |

The enthalpy of dissolution is calculated using the formula:  
ΔHr = -Qr

Qr = (mkalckal+mrcr)ΔT

where:

* mkal – mass of the inner beaker of the calorimeter [g]
* ckal – specific heat of the calorimeter (assumed to be 0.88 J/(g∙deg))
* mr – mass of the sodium hydroxide solution [g]
* cr – specific heat of the solution (assumed to be 4.18 J/(g∙deg))

The calorimeter constant is determined for each NaOH portion using the formula:  
K = Qr/∆T

**Example calculations**

…

**3. Table 3 – NaOH neutralization process**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Acid** | |  | | --- | | **Amount of acid (moles)** | | |  | | --- | | **Temp. increase ΔTacid** | | |  | | --- | | **Temp. increase ΔTbase** | | |  | | --- | | **Enthalpy of neutralization (kJ)** | | |  | | --- | | **Molar enthalpy of neutralization (kJ/mol)** | |
| **CH3COOH** |  |  |  |  |  |
| **HCl** |  |  |  |  |  |

The enthalpy of neutralization is calculated using the formula:

ΔHz = -Qz

Qz = (mkalckal+mrcr)ΔTbase + macidcacidΔTacid

where:

* macid – mass of the acid solution
* dacid – density of acetic acid = 1.02 g/cm³; density of hydrochloric acid = 1.03 g/cm³
* cacid – specific heat of the acid (acetic acid = 2.043 J/gK; hydrochloric acid = 4.200 J/gK)

**Example calculations**

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**4. Conclusions**

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**EXERCISE TOPIC:** Determining the heat of dissolution based on the calorimeter constant.

**OBJECTIVE OF THE EXERCISE:** To determine the heat of dissolution of substances with endothermic and exothermic characteristics using the calculated calorimeter constant K.

**1. Table 4 – Results obtained during the exercise.**  
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**2. Table 5 – Summary of the results**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Substance** | **Measurement** | **Amount of moles** | **Temperature change ΔT** | **Enthalpy of Dissolution (kJ)** | **Molar enthalpy of dissolution (kJ/mol)** | **Mean molar enthalpy of dissolution (kJ/mol)** |
| **CaCl2** | **1** |  |  |  |  |  |
| **2** |  |  |  |  |
| **3** |  |  |  |  |
| **NaNO3** | **1** |  |  |  |  |  |
| **2** |  |  |  |  |
| **3** |  |  |  |  |
| **oxalic acid** | **1** |  |  |  |  |  |
| **2** |  |  |  |  |
| **3** |  |  |  |  |
| **methanol** | **1** |  |  |  |  |  |
| **2** |  |  |  |  |
| **3** |  |  |  |  |

The enthalpy of dissolution is calculated using the formula:  
ΔHr = -K∙ ΔT

where:

* K – calorimeter constant calculated in section 6.1

**Example calculations**

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**3. Conclusions**

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