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civil engineering

lab Chemistry 108

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Exp. 9 Calorimetry

* Purpose: To Measure Heat of [redacted] rxn.

* Calorimetry: It's the Measurment of Heat Change.

* Calorimeter: It's a device that used to Measure the heat of the rxn.

* ΔH : is quantitative property

⇒ depends on Amount not Nature

② *Heat of rxn $\Delta H_{rxn.}$ have several kinds, such:

[1] Heat of soln.: Amount of Heat required OR released when a certain amount of solute is dissolved in Certain amount of solvent.

OR Heat flows during a process of soln.

[2] Heat of Neutralization: Amount of heat that is released from the Neutr. of at acids by bases at Constant Pressure.

OR Amount of Heat required or released to make a Neutre.

③

* ΔH_{rxn} & $\Delta H_{soln.}$: Can be determined experimently.

* $\Delta H_{neut.}$: Can not be determined experimently, It can be determined from the difference between the combined heat of soln. & Neutr. and Heat of soln. : $\Delta H_{Nut.} = \Delta H_{rxn.} - \Delta H_{soln.}$

$\Rightarrow \Delta H_{rxn.} = \Delta H_{Nut.} + \Delta H_{sdn.}$

* $\Delta H_{rxn.} > \Delta H_n$
  $\Delta H_{rxn.} > \Delta H_{soln.}$

$\Delta H_{rxn.} =$ { حرارة المحلول + حرارة تفاعل التعادل

(4)

* $\Delta H = (-)$ Mass soln. * S.p.Heat * $\Delta T = (-)$ J

Mass (solvent + solute) (g) $\left(\frac{J}{g \cdot C^\circ}\right)$ (C°)

* Specific Heat: Amount of Heat required to raise the Temp. of 1 g of sample by 1 C°

* $\Delta T = T_f - T_i$:←

* هي التي تحدد إشارة ΔH

⑤

* $T_f > T_i$: increasing in Temp. ⇒ Exothermic (طارد للحرارة)

⇒ flows out of the system.

⇒ (-ve) sign should be added to the value of ΔH that is calculated.

* $T_f < T_i$: decreasing in Temp. ⇒ Endothermic (ماص للحرارة)

⇒ flows into the system.

⇒ (+ve) sign should be added to the value of ΔH that is calculated.

$(\pm \Delta T) \rightleftharpoons (\mp \Delta H)$

⑥ * The Heat of the soln. should be calculated while the Calorimeter is closed tightly.
مغلق بإحكام

* [NaOH]: that used in the exp. is hygroscopic So that it should be weighted & use it fast.

* Hygroscopic : مادة اسفرطابية وهي تجذب الماء بسهولة من محيطها من خلال الاستقطاب

(٢)

* Heat Per mole of A $\Rightarrow \frac{\Delta H}{\text{mole of A}} = \text{J/mol}$

* Heat Per gram of A $\Rightarrow \frac{\Delta H}{\text{Mass of A}} = \text{J/g}$

* Heat in kJ/mol $= \frac{\Delta H}{n_A} * 10^{-3} = \text{kJ/mol}$

OR kJ/g $= \frac{\Delta H}{M_A} * 10^{-3} = \text{kJ/g}$

1000 نقسم على

OR 10^{-3} نضرب بـ

Yazan

(8)

* ΔH_{sol} (kJ):

$$NaOH_{(s)} \xrightarrow{H_2O} H_2O \Longrightarrow \underbrace{Na^+ + OH^-}_{\text{محلول}} + \underbrace{Heat}_{\Delta H_{soln.}}$$

* ΔH_{rxn} (kJ):

$$NaOH + \underbrace{H^+_{(aq)} + Cl^-_{(aq)}}_{\text{محلول حمض}} \rightarrow H_2O + Na^+_{(aq)} + Cl^-_{(aq)} + \underbrace{Heat}_{\Delta H_{rxn}}$$

9)

Q1 A 2 g Sample of solid $CsOH$ is dissolved in 200 mL of water in a Calorimeter. The Temp. of the water was raised from 22.3 To 23.4 °c, Calculate the Heat of ΔH_{sol} the soln in kJ/mol. [Assume the s.p.H of the soln to be 4.184 J/g c° & The density of the soln to be 1 g/mL] ?!

$M.m_{CsOH} = 149.9$ g/mol

$n_{CsOH} = \frac{2}{149.9} = 0.0133$ mol .

Yazan

(10)

Sol $\Delta H = (-)\, Mass_{soln.} * S.p.H * \Delta T$

* Mass solute = 2 g * Mass solvent = M_w

$\Rightarrow D = \frac{m}{V} \Rightarrow m = D\,V = 1 * 200 = 200$ g

* $\Delta T = T_2 - T_1 = 23.4 - 22.3 = 1.1\ C^\circ$

* $Mass_{soln} = 2 + 200 = 202$ g

$\Rightarrow \Delta H_{soln} = (-)(202) * 4.184 * (1.1) = -929.7$ J

$\Rightarrow \frac{-929.7}{0.0133} * 10^{-3} = -69.9$ KJ/mol

$\Delta H_{soln.}$

(11) Q2| A 2 g Sample of CsOH reacted with 200 mL of aqueous soln. of (HCl) in a Calorimeter, The Temp. of the soln. increased from 22.3 To 24.3 °C. Calculate The Heat of the reaction (ΔH_{rxn}) in kJ/mol ?

[Assume The Sp.H of the soln. to be 4.184 J/g°C & The density of the soln to be 1 g/mL]

$n_{CsOH} = \frac{2}{149.9} = 0.0133$ mol

(12) Sol * ΔH_{rxn} = (−) Mass $_{soln.}$ * Sp. H * ΔT

* $\Delta T = 24.3 - 22.3 = 2\ C^{\circ}$

* Mass $_{solute}$ = 2g * Mass solvent = 200 g

* Mass soln. = 2 + 200 = 202 g

⇒ $\Delta H_{rxn} = -202 * 4.184 * 2 = -1690.3$ J

⇒ $\frac{-1690.3}{0.0133} * 10^{-3} = -127.1$ kJ/mol

ΔH_{rxn}

(13) from 2 Qus. before:

Q2] $\Delta H_{rxn} = -127.1$ kJ/mol Yazan.

Q1] $\Delta H_{soln.} = -69.9$ kJ/mol .

Calculate ΔH_n ?

$\Delta H_n = \Delta H_{rxn} - \Delta H_{soln.} = -127.1 - (-69.9)$

$\Delta H_n = -57.2$ kJ/mol Yazan.