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civil engineering

lab Chemistry 108

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^① Exp. 9 | Calorimetry

- * Purpose: To Measure Heat of rxn .
- * Calorimetry: It's the Measurement of Heat Change.
- * Calorimeter: It's a device that used to Measure the heat of the rxn .
- * ΔH : is quantitative property
 $\Rightarrow$ depends on Amount not Nature

② * Heat of rxn ΔH_{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 acids by bases at constant Pressure.

OR Amount of Heat required or released to make a Neutr. — A.

③ * ΔH_{rxn} & $\Delta H_{soln.}$: Can be determined experimentally.

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

$$\Rightarrow \Delta H_{rxn.} = \Delta H_{neut.} + \Delta H_{soln.}$$

$$\Delta H_{rxn.} > \Delta H_{neut.} \\ \Delta H_{rxn.} > \Delta H_{soln.} \quad \left\{ \begin{array}{l} \Delta H_{rxn.} = \left\{ \begin{array}{l} \text{حرارة المخلول} \\ + \\ \text{حرارة تفاعل المعادل} \end{array} \right. \end{array} \right.$$

$$④ \quad * \Delta H = \underbrace{(-) \text{Mass soln.}}_{\text{Mass (solvent + solute)}} * \underbrace{\text{S.p. Heat}}_{\left(\frac{\text{J}}{\text{g} \cdot \text{C}^\circ}\right)} * \underbrace{\Delta T}_{(\text{C}^\circ)} = \underline{\underline{(-) \text{J}}}$$

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

$$* \Delta T = T_f - T_i \quad \rightarrow$$

* ΔH هي التي تحدد اتجاه التفاعل

⑤ * $T_f > T_i$: increasing in Temp. $\Rightarrow$ **Exothermic**
(طارد الحرارة)
 $\Rightarrow$ flows out of the system.

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

* $T_f < T_i$: decreasing in Temp. $\Rightarrow$ **Endothermic**
(ماص للحرارة)
 $\Rightarrow$ flows into the system.

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

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

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

* $[NaOH]$: that used in the exp. is hygroscopic

So that it should be weighted & use it fast.

* Hygroscopic : مادة شقرطابية وهي تجذب الماء بسهولة من محيطها من خلال الأوسمات في ج.

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

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

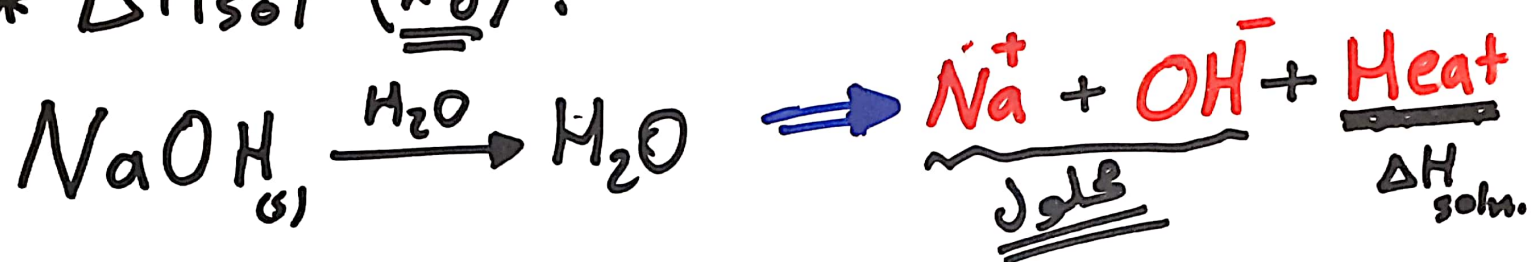
* Heat in kJ/mol $= \frac{\Delta H}{n_A} \times 10^{-3} = \text{kJ/mol}$
 OR kJ/g $= \frac{\Delta H}{m_A} \times 10^{-3} = \text{kJ/g}$

نقسم على 1000
 OR تقرب بـ 10^{-3}

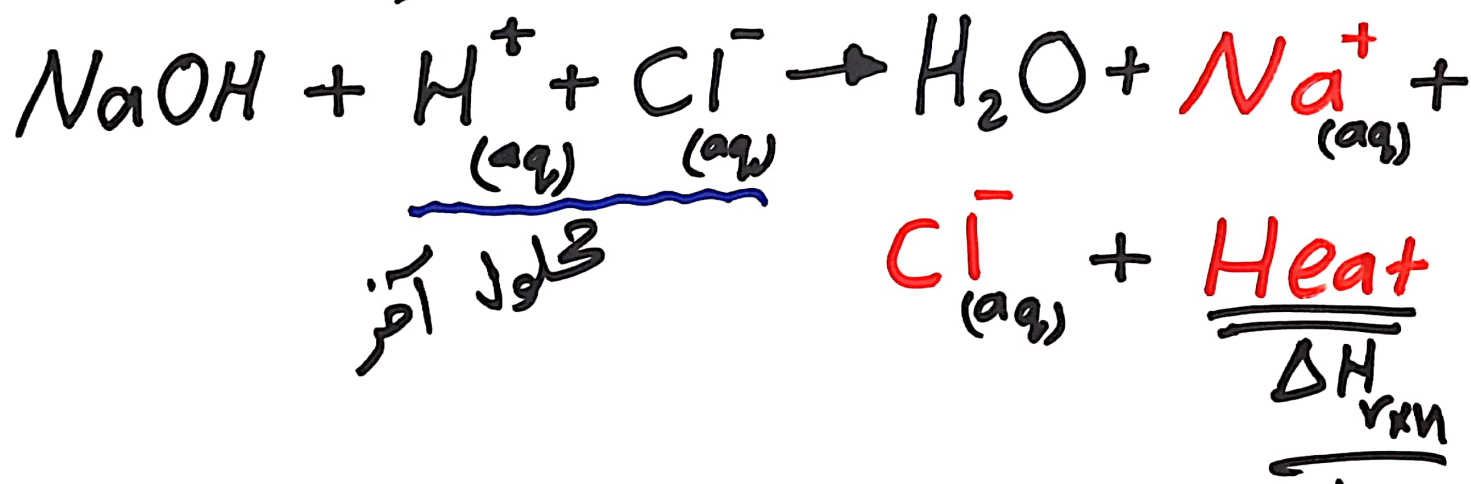
Yazam

8)

* ΔH_{sol} (kJ):



* ΔH_{rxn} (kJ):



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 the soln in kJ/mol . [Assume the s.p.H of the soln to be $4.184 \text{ J/g}^\circ\text{C}$ & The density of the soln to be 1 g/mL] ?!

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

$$M.m = 149.9 \text{ g/mol}$$

$$\text{CsOH}$$

$$\text{Yazan}$$

⑩ Sol $\Delta H = (-) \text{Mass}_{\text{soln.}} * \text{S.P.H} * \Delta T$

* Mass solute = 2 g * Mass solvent = M_w ↘

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

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

* $\text{Mass}_{\text{soln}} = 2 + 200 = \underline{\underline{202 \text{ g}}}$

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

$\Rightarrow \frac{-929.7}{0.0133} * 10^{-3} = \underline{\underline{-69.9 \text{ kJ/mol}}}$ $\Delta H_{\text{soln.}}$

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 $^{\circ}\text{C}$. Calculate The Heat of the reaction in kJ/mol ?
[Assume The sp.H of the soln. to be $4.184 \text{ J/g}^{\circ}\text{C}$ & The density of the soln to be 1 g/mL]
 $n_{\text{CsOH}} = \frac{2}{149.9} = 0.0133 \text{ mol}$

Sol ¹² * $\Delta H_{rxn} = (-) \text{Mass}_{soln.} * \text{s.p. H} * \Delta T$

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

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

* $\text{Mass}_{soln.} = 2 + 200 = \underline{202 \text{ g}}$

$\Rightarrow \Delta H_{rxn} = -202 * 4.184 * 2 = \underline{-1690.3 \text{ J}}$

$\Rightarrow \frac{-1690.3}{0.0133} * 10^{-3} = -127.1 \text{ kJ/mol}$
 ΔH_{rxn}

⑬ * from 2 Qus. before:

$$Q_2] \Delta H_{rxn} = -127.1 \text{ kJ/mol} \quad \text{Yazan}$$

$$Q_1] \Delta H_{soln.} = -69.9 \text{ kJ/mol}$$

Calculate ΔH_n ?

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

$$\Delta H_n = -57.2 \text{ kJ/mol} \quad \text{Yazan}$$