Example 1:

It is observed that when 8.0g of Lithium chloride (LiCl) at 25°C is dissolved in 100mL of water inside a calorimeter the final temperature of the water is 38°C.

Questions:

a) Calculate the molar heat of dissolution (ΔH_d) of Lithium chloride?

b) Write the thermochemical equation for the dissolution.

a) $m = 100mL = 100g$

$T_i = 25^oC$

$T_f = 38^oC$

$\Delta T = 13^oC$

$c = 4.18\ J / (g \bullet {}^oC)$

$Q = ???$

Step1: *Determine if the dissolution reaction is Endothermic or Exothermic*

If temperature of water increased it must have absorbed heat energy from the dissolution reaction.

Therefore the dissolution reaction must have been EXOTHERMIC

Example 1:

It is observed that when 8.0g of Lithium chloride (LiCl) at 25°C is dissolved in 100mL of water inside a calorimeter the final temperature of the water is 38°C.

Questions:

a) Calculate the molar heat of dissolution (ΔH_d) of Lithium chloride?

b) Write the thermochemical equation for the dissolution.

m = 100mL = 100g

T_i = 25°C

T_f = 38°C

ΔT = 13°C

c = 4.18 J / (g • °C)

Q = ???

Step2: *Calculate the Quantity of heat that was absorbed by the water*

$Q = m \bullet c \bullet \Delta T$

$Q = (100)(4.18)(13)$

Q = 5434 J

Step3: *Since it was determined that the dissolution reaction was exothermic:*

$H_d = -Q$

H_d = - 5434 J

Therefore 8g of dissolved Lithium chloride released -5434 J of Heat Energy

Example 1:

It is observed that when 8.0g of Lithium chloride (LiCl) at 25°C is dissolved in 100mL of water inside a calorimeter the final temperature of the water is 38°C.

Questions:

a) Calculate the molar heat of dissolution (ΔH_d) of Lithium chloride?

b) Write the thermochemical equation for the dissolution.

Step4: *In order to determine the Molar Heat of dissolution we must know how many moles of Lithium chloride we are dealing with:*

$$n = \frac{m}{M}$$

$$n = \frac{8g}{42.4\ g/mole}$$

n = 0.188 moles

Example 1:

It is observed that when 8.0g of Lithium chloride (LiCl) at 25°C is dissolved in 100mL of water inside a calorimeter the final temperature of the water is 38°C.

Questions:

a) Calculate the molar heat of dissolution (ΔH_d) of Lithium chloride?

b) Write the thermochemical equation for the dissolution.

Step5: Calculate the molar heat of dissolution (ΔH_d) for Lithium chloride

0.188 moles = -5434 J

1 mole = *x*

x = - 28904 J

or

-28.9 kJ

Therefore, when 1 mole of LiCl dissolves 28.9 kJ of heat is released

Molar heat of Dissolution of LiCl is

ΔH_d = -28.9 kJ/mol

Example 1:

It is observed that when 8.0g of Lithium chloride (LiCl) at 25^{o}C is dissolved in 100mL of water inside a calorimeter the final temperature of the water is 38^{o}C.

Questions:

a) Calculate the molar heat of dissolution (ΔH_d) of Lithium chloride?

b) Write the thermochemical equation for the dissolution.

b) $$LiCl_{(s)} \xrightarrow{H_2O} Li^+_{(aq)} + Cl^-_{(aq)} + 28.9kJ$$

Example 2:

If 6.5g of Sodium Nitrate ($NaNO_3$) is dissolved in 100mL of water at 24°C. What will the final temperature of the water be if it is known that the molar heat of dissolution for Sodium Nitrate is 21 kJ/mol.

Step1: *Determine if the dissolution reaction is Endothermic or Exothermic*

Since ΔH_d is (+), this means that the dissolution process is endothermic. It absorbs heat energy from the surrounding water

Step2: *Determine number of moles of Sodium Nitrate being dissolved*

$$n = \frac{m}{M}$$

$$n = \frac{6.5g}{85\ g/mole}$$

n = 0.076 moles

Example 2:

If 6.5g of Sodium Nitrate ($NaNO_3$) is dissolved in 100mL of water at 24°C. What will the final temperature of the water be if it is known that the molar heat of dissolution for Sodium Nitrate is 21 kJ/mol.

Step3: *Calculate heat involved when 0.076moles of Sodium Nitrate are dissolved*

1 moles = 21 kJ

0.076 mole = *x*

x = 1.596 kJ

or

1596 J

Therefore, when 0.076moles (6.5g) of $NaNO_3$ dissolves, 1596 J of heat is absorbed from the surrounding water.

Example 2:

If 6.5g of Sodium Nitrate ($NaNO_3$) is dissolved in 100mL of water at 24°C. What will the final temperature of the water be if it is known that the molar heat of dissolution for Sodium Nitrate is 21 kJ/mol.

m = 100mL = 100g

T_i = 24°C

T_f = ??? °C

ΔT = ??? °C

c = 4.18 J / (g • °C)

Q = -1596 J

Step4: *Since it was determined that the dissolution reaction was endothermic. The water must be releasing heat energy.*

$$Q_{water} = -H_d$$

$$\mathbf{Q_{water} = -1596\ J}$$

Step5: *Calculate the change in temperature*

$$Q = m \bullet c \bullet \Delta T$$

$$-1596 = (100)(4.18)(\Delta T)$$

$$\mathbf{\Delta T = -3.82\ ^oC}$$

Example 2:

If 6.5g of Sodium Nitrate ($NaNO_3$) is dissolved in 100mL of water at 24°C. What will the final temperature of the water be if it is known that the molar heat of dissolution for Sodium Nitrate is 21 kJ/mol.

m = 100mL = 100g

T_i = 24°C

T_f = ??? °C

ΔT = -3.82 °C

c = 4.18 J / (g • °C)

Q = -1596 J

Step6: *Determine Final Temperature*

$\Delta T = T_f - T_i$

$-3.82 = T_f - 24$

T_f = 20.18 °C

Example 1:

You conduct a reaction inside a calorimeter where you completely neutralize a 100 mL of NaOH at 2 M solution with 40 mL of HCl at 5 M. The initial temperatures of both the acid and the base are 22 C. During the reaction the highest temperature reached was to 38 C.
Calculate the molar heat of neutralization of NaOH?

m = (100 + 40) = 140mL = 140g

T_i = 22°C

T_f = 38°C

ΔT = 16°C

c = 4.18 J / (g • °C)

Q = ???

Step1: *Determine if the neutralization reaction is Endothermic or Exothermic*

If temperature of water produced increased it must have absorbed heat energy from the neutralization reaction.

Therefore the neutralization reaction must have been EXOTHERMIC

Example 1:

You conduct a reaction inside a calorimeter where you completely neutralize a 100 mL of NaOH at 2 M solution with 40 mL of HCl at 5 M. The initial temperatures of both the acid and the base are 22 C. During the reaction the highest temperature reached was to 38 C.
Calculate the molar heat of neutralization of NaOH?

m = (100 + 40) = 140mL = 140g

T_i = 22°C

T_f = 38°C

ΔT = 16°C

c = 4.18 J / (g • °C)

Q = ???

Step2: *Calculate the Quantity of heat that was absorbed by the water*

$Q = m \bullet c \bullet \Delta T$

$Q = (140)(4.18)(16)$

Q = 9363 J

Step3: *Since it was determined that the neutralization reaction was exothermic:*

$H_n = -Q$

H_n = - 9363 J

Therefore the neutralization released -9363 J of Heat Energy

Example 1:

You conduct a reaction inside a calorimeter where you completely neutralize a 100 mL of NaOH at 2 M solution with 40 mL of HCl at 5 M. The initial temperatures of both the acid and the base are 22 C. During the reaction the highest temperature reached was to 38 C.
Calculate the molar heat of neutralization of NaOH?

Step4: *In order to determine the Molar Heat of neutralization of NaOH, we must know how many moles of Sodium Hydroxide we are dealing with:*

$$C = \frac{n}{V}$$

$$C \bullet V = n$$

$$(2\ mol/L)(0.1L) = n$$

n = 0.2 moles

Example 1:

You conduct a reaction inside a calorimeter where you completely neutralize a 100 mL of NaOH at 2 M solution with 40 mL of HCl at 5 M. The initial temperatures of both the acid and the base are 22 C. During the reaction the highest temperature reached was to 38 C.
Calculate the molar heat of neutralization of NaOH?

Step5: Calculate the molar heat of neutralization (ΔH_n) for Sodium Hydroxide

0.2 moles = -9363 J
1 mole = *x*

x = - 46815 J

or

-46.8 kJ

Therefore, when 1 mole of NaOH is neutralized, 46.8 kJ of heat is released

Molar heat of Neutralization of NaOH in this reaction is

ΔH_n = -46.8 kJ/mol