Thermochemistry – Calorimetry – 3

Heat of neutralization

1) * A 50.0 mL sample of 0.250 M HCl at 19.50°C is added to 50.0 mL of 0.25 M NaOH, also at 19.50°C in a calorimeter. After mixing the acid/base, the temp. rises to 21.21°C. Calculate the ΔH for this reaction.

Ans

	T_i	T_f
50.0 mL of 0.250 M HCl	19.50°C	21.21°C
50.0 mL of 0.25 M NaOH	19.50°C	

$$HCl + NaOH \longrightarrow NaCl + H_2O \qquad \Delta H = \; ? \; J/mol$$

a) $50.0 + 50.0 = 100.0\,mL \times \dfrac{1\,g}{1\,mL} = 100.0\,g$.

b) sp. heat H_2O $4.18\,J/g^\circ C$

$$q_{cal.} = m\,s\,\Delta T$$
$$= 100\,g \times \frac{4.18\,J}{g^\circ C} \times (21.21 - 19.50)^\circ C.$$
$$= 715\,J \quad \text{heat absorbed by cal.}$$

$q_{rxn} = -q_{cal.} = -715\,J$ (heat of reaction).

$\Delta H = J/mol$

$M = \frac{mol}{L}$, $g\,mol = M \times L$

$$mol\,HCl = 0.0500\,L \times 0.25\,\frac{mol}{L} = 0.0125\,mol\,HCl.$$

$$mol\,NaOH = 0.0500\,L \times 0.25\,\frac{mol}{L} = 0.0125\,mol\,NaOH.$$

$$0.0125\,mol\,HCl \times \frac{1\,mol\,H_2O}{1\,mol\,HCl} = 0.0125\,mol\,H_2O.$$

$$\Delta H = \frac{-715\,J}{0.0125\,mol} = -5.72 \times 10^4\,J$$
$$\equiv \boxed{-57.2\,kJ}$$