Answer on Question # 72551 - Chemistry - Physical Chemistry

When 10cm3 of 10 molar potassium hydroxide at 35 degree celsius was added to 10cm3 of 10 molar hydrochloric acid solution at 35 degree celsius,the temperature of the mixture rose to 42 degree celsius.calculate the standard heat of neutralisation.given that the specific heat capacity of the solution is 4.2 joules per gramme per degree celsius

Solution

Reaction between potassium hydroxide and hydrochloric acid is as follows:

$$\mathrm{KOH + HCl = KCl + H_2O.}$$

Assuming additivity of volumes, the total volume of solution is the sum of the volumes, or 20 cm^3. Then assume that the density of each solution is approximately the same as of water, or 1 g/cm^3. The total mass of solution (m) can be calculated as the product of volume and density,

$$20\ \mathrm{cm^3}\ (1\ \mathrm{g/cm^3}) = 20\ \mathrm{g.}$$

The temperature difference (ΔT) is 42–35 = 7 degree Celsius. Now it is possible to calculate the heat (q) released by the reaction using the given heat capacity (c = 4.2 joules per gram per degree Celsius):

$$\mathrm{q = mc\Delta T,}$$

$$\mathrm{q = (20\ g)(4.2\ J/g\ °C)(7\ °C) = 588\ J.}$$

The standard heat of neutralization can be calculated from the formula:

$$\mathrm{\Delta H = -q/n,}$$

Where n is the number of moles of water produced by the neutralization reaction.

Using n = cV, one can get

$$\mathrm{n\ = 0.01\ L\ (10\ mol/L) = 0.1\ mol,}$$

$$\mathrm{\Delta H = -\ 588\ J\ /\ 0.1\ mol = -5880\ J,\ or\ -5.9\ kJ.}$$

Answer: -5.9 kJ.