Answer on Question #55347 – Chemistry – General chemistry

Question:

In a constant-pressure calorimeter, 65.0 mL of 0.870 M H_2SO_4 was added to 65.0 mL of 0.450 M NaOH. The reaction caused the temperature of the solution to rise from 24.09 °C to 27.16 °C. If the solution has the same density and specific heat as water, what is ΔH for this reaction (per mole of H_2O produced)? Assume that the total volume is the sum of the individual volumes.

Answer:

Conducted reaction is neutralization:

$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

The amount of produced water is defined:

$\nu(H_2O) = \nu(NaOH) = V(NaOH) \times C(NaOH) = 65\ ml \times 0.450\ mol/L = 29.25\ mmol = 29.25 \times 10^{-3}\ mol$

The total mass of the solution is: m = Vρ, where V – the total volume (V = 65 ml + 65 ml = 130 ml) and ρ – the density of water (ρ = 1 g/ml).

m = 130 ml × 1 g/ml = 130 g

Then find the heat released by this reaction:

Q = mCΔt, where C – the specific heat for water which equals 4.2 J g^{-1} $^oC^{-1}$ and Δt – the change of temperature (Δt = 27.16 ^oC – 24.09 ^oC = 3.07 ^oC)

Q = 130 g × 4.2 J g^{-1} $^oC^{-1}$ × 3.07 ^oC = 1676.22 J

Thus, $\Delta H = Q/\nu(H_2O) = 1676.22\ J/29.25 \times 10^{-3}\ mol = 56821.02\ J\ mol^{-1}$