Determining $\Delta H_n^{\varnothing}$

400.0 cm^3 of 0.600 mol dm^{-3} $HNO_3(aq)$ are mixed with 400.0 cm^3 of 0.300 mol dm^{-3} $Ba(OH)_2(aq)$ in a polystyrene cup.
The initial temperature of both solutions is the same at 18.9 °C, and the final temperature of the mixed solution is 22.5 °C.
What is the enthalpy change of neutralization between $HNO_3(aq)$ and $Ba(OH)_2(aq)$?
(Density of mixed solution = 1.00 g cm^{-3};
specific heat capacity of mixed solution = 4.18 J g^{-1} K^{-1})

Suggested Answer

1. Equation: $HNO_3(aq) + \frac{1}{2}Ba(OH)_2(aq) \longrightarrow \frac{1}{2}Ba(NO_3)_2(aq) + H_2O(l)$

2. number of mole of HNO_3 = 0.6 x 0.4 = 0.24
   number of mole of $Ba(OH)_2$ = 0.3 x 0.4 = 0.12
   number of mole of **water** = 0.24

3. Volume of resulting solution = 400 + 400 = 800 cm^3
   Mass of resulting solution = 800 x 1.00 = 800 g

4. ΔT = 22.5 – 18.9 = 3.6 ^oC

5. Calculation:

   Energy released, E = m c ΔT
   = (800)(4.18)(3.6)
   = 12038 J
   = 12.04 kJ

   Standard Enthalpy Change of Neutralization, $\Delta H_n^{\varnothing}$
   = - E / mole of water
   = - 12.04 / 0.24
   = - 50.16 kJ mol^{-1}