Answer on Question #57439 - Chemistry - General Chemistry

Question:

What amount of water would need to be added to 10g of ammonium nitrate to change the temperature of an instant cold pack from 20 degrees to 5 degrees?

Answer:

Upon dissolving of ammonium nitrate in water, the energy is absorbed:

$NH_4NO_3 \rightarrow NH_4^+(aq) + NO_3^-(aq) + 25.8$ kJ/mol (the heat of solution)

Therefore 10 g of ammonium nitrate absorbs:

$Q = \nu \times \Delta H$, where ν – the number of moles ($\nu = 10$ g/80 g $mol^{-1} = 0.125$ mol) and ΔH - the heat of solution.

Thus, $Q = 0.125$ mol × 25.8 kJ/mol = 3.225 kJ = 3225 J

The absorbed energy is connected with the decreasing of temperature and is defined by the equation:

$Q = C_w m \Delta t$, where C_w – the specific heat capacity of water (4.2 J/(g ^{0}C)), m – the mass of added water and Δt – the change of the temperature.

Hence, the mass of added water is:

$m = Q/(C_w m \Delta t) = 3225 /(4.2 \times 15)$ g = 51.2 g