## Answer on Question \#56248 - Chemistry - General chemistry

## Question:

what amount of water would be needed to be added to 10 g of ammonium nitrate to change the temperature of an instant cold pack form 20 degrees to 5 degrees?

## Solution:

Dissolution of ammonium nitrate is highly endothermic with $\Delta \mathrm{H}^{\circ}=+25.69 \mathrm{~kJ} \mathrm{~mol}^{-1}$.
$\mathrm{n}_{\text {NH4NO3 }}=\mathrm{m}_{\text {NH4NO3 }} / \mathrm{MW}_{\text {NH4NO3 }}=10 \mathrm{~g} / 80.052 \mathrm{~g} \mathrm{~mol}^{-1}=0.1249 \mathrm{~mol}$
$Q=-n \Delta H^{\circ}=-0.1249 \mathrm{~mol}^{25} .69 \mathrm{~kJ} \mathrm{~mol}^{-1}=-3.209 \mathrm{~kJ}$;
Specific heat capacity of water at these temperatures is $4.192 \mathrm{~kJ} \mathrm{~kg}^{-1} \mathrm{~K}^{-1}$
If we assume that specific heat capacity of solution will be equal to heat capacity of pure water.
Then:

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\(\mathrm{Q}=\mathrm{Cm} \Delta \mathrm{T} ; \mathrm{m}=\mathrm{Q} /(\mathrm{C} \Delta \mathrm{T})=-3.209 \mathrm{~kJ} /\left(4.192 \mathrm{~kJ} \mathrm{~kg}^{-1} \mathrm{~K}^{-1}(-15 \mathrm{~K})\right)=0.051 \mathrm{~kg}=51 \mathrm{~g} ;\)
\(\mathrm{m}=\mathrm{m}_{\text {H2O }}+\mathrm{m}_{\text {NH4NO3 }} ; \mathrm{m}_{\text {H2O }}=\mathrm{m}-\mathrm{m}_{\text {NH4NO3 }}=51 \mathrm{~g}-10 \mathrm{~g}=41 \mathrm{~g}\).
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Answer: 41 g of water

