**“4 Step” ∆H Problems**

**1)** **Q** **water** = m of **water** x c of **water** x change in temperature of the **water**

* The thermometer was stuck in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* The water is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* The water gives us information about the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**2)** **Q substance** = - Q water

* Whatever happens to the water is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of what

happens to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* Assuming \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ efficiency of energy transfer

**3) n of substance** i) grams of substance to moles of substance using \_\_\_\_\_\_\_\_\_\_\_\_

 ii) mL of a solution x concentration of the solution \_\_\_\_\_\_\_\_\_\_\_\_\_

4) **∆H of substance** = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Therefore the order is:**

i) Q water

ii) Q sub = - Q water

iii) n sub

iv) ∆H

**e.g. Calculating ∆Hcomb of Methanol**

 **Student Data--should be recorded in a data table!!**

Ti = 22.0 oC

 Tf = 55.0 oC

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**But** … if you can calculate steps i) to iv) you can do the reverse and start with the ∆H and work backwards to the initial or final temperature of the water!!

This means in a word problem you had better be able to identify if you are dealing with:

* the water (surroundings) or the system
* heat energy Q or a molar enthalpy ∆H

**List your givens just like in math class!**

**Reverse 4 Step Problem**

Lithium chloride dissolves in water according to the following equation:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **∆H = - 35.0 kJ/mol**

If 8.42 g of lithium chloride are dissolved in 200. mL of water at 22.0 oC, what will be the final temperature of the water?