# Engineering F 2017 Heating Exam Review Guide: Developing Flexibility

1. This is a variation of the calculation of the heat released per gram done for the project. It uses the same equations, but in a different order.

In an insulated calorimeter, 2.6 grams of solid ammonium chloride at 23.4°C was dissolved in 35.9 grams of water also at 23.4°C, after which the final temperature of the mixed solution was 18.6°C. If the specific heat of the mixed solution was 3.94 J/g•°C, determine ΔH for the dissolving process . (Molar masses: N: 14, H 1, Cl 35.49). n is the number of moles.
In this example, the mass of the entire solution was used; not required for the lab project.

Ionic equation shows both the form of the ion and the charge: (Ref Pg 112)

$$NH_4Cl \ (aq) \ \rightarrow \ NH_4{+} \ + \ Cl^-$$
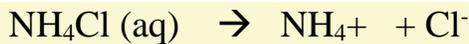
mass of mixed solution = mass of water + mass of salt :

$m_{soln} = 35.9 \ g \ H_2O \ + \ 2.6 \ g \ NH_4Cl \ = \ 38.5 \ g$

$q_{soln \ lost} = 38.5 \ g \left(\dfrac{3.94 \ J}{g \bullet °C} \right)(18.6°C \ - \ 23.4°C) \ = \ -728 \ J \left(\dfrac{1 \ kJ}{1000 \ J} \right) \ = \ -0.728 \ kJ$

$q_{rxn \ gained} = 0.728 \ kJ$

$n \ of \ NH_4Cl \ = \ 2.6 \ g \left(\dfrac{1 \ mol}{53.49 \ g} \right) \ = \ 0.0486 \ mol \ NH_4Cl$

$\Delta H \ = \ \dfrac{q_{rxn}}{n \ of \ NH_4Cl} \ = \ \dfrac{0.728 \ kJ}{0.0486 \ mol} \ = \ 15 \ kJ/mol \ NH_4Cl$

Compare this to the Quiz Problem. It uses the same equations, but provides the heat of solution and asks for the change in temperature.

A similar problem is on the Calculation worksheet handed out (and on the web).
In the book, there is a similar Problem: Pg 105 #4.

When you work on these problems together, the similarity becomes more clear.

2. Convection/Conduction Heat Losses: Most people did a good job on these. Some additional practice:

Heat flow (q) is measured in watts (J/sec). As in the project, need to multiply by time to determine the total heat loss (Q).

Conduction: Additional Problem Pg. 127 # 5. Convection: # 6.

3. Heat Released $Q = mCp\Delta T$

Read the problems carefully to see what is being asked. Then rearrange the equation before substituting numbers. The quiz asked for the calculation of specific heat. A number of people overlooked that.
There is an example of the rearrangement and solving for specific heat Cp on Pg 104

4. Variation of k, h, Cp with changing conditions.
Decide whether the value is dependent upon the material or the conditions. No need to memorize.

5. Risk Management
   Be able to apply strategies for managing risk. There are 4 and you should know them
   Know how to adapt a situation to the Reason's Swiss Cheese Model. Use a diagram. See returned homework and examples on Pg 69-71

6. Data Analysis:
Think at your results from the lab test. Make a graph of the temperature change with time for both the alcohol and water. (You need to do this for the report anyway).

How would the shape change if the salt dissolved more slowly? How would the shape change if the inner metal container were replace with a Styrofoam inner container? How would the shape change if the agitation rate were increased? Additional examples are in the "Best Practices" section on the last page of the Project Planning Guide

7. Data into Information
   Know the principles of an excellent visual and how to apply them (Pg 52-56 Returned HW)
   Brainstorming principles: Pg 45

8. Engineering Design Cycle
   The Steps and how they fit into a project (pg 26)

9. Test Strategy: Review the Test Taking Strategy (Pg 51) and identifying one or two that apply to you and that you can used during the test.