Name:

Content Formative
SCH4U: 3-2G: Calorimetry Lab

(Total : /15 marks)

Knowledge/Understanding (K/U)	Thinking/Inquiry (T/I)	Application (A)	Communication (C)
------	/15	----	------

Answer Key

In this lab you will construct a coffee-cup calorimeter using Rosedale's Virtual Chemistry Lab and then measure the temperature change that occurs when ammonium chloride is dissolved in water. From your observations you will be able to calculate the heat transferred during this reaction and thus determine the change in enthalpy.
The link to the lab is :

https://rosedaletube.com/zfiles/Science/sch4u/unit2/3-Calorimetry%20Lab%20output/story_html5.html

Equipment:

- safety goggles
- lab coat
- protective gloves
- coffee cups (2)
- styrofoam lid
- thermometer
- scale
- stirring rod
- beaker

Materials

- distilled water
- ammonium chloride powder

Procedure:

1. Put on your lab coat, goggles and gloves.
2. Construct the coffee-cup calorimeter by placing a styrofoam cup inside another styrofoam cup. Take the styrofoam lid, which has the thermometer and the stirring rod sticking through it, and place it on top of the nested coffee cups.
3. Place the calorimeter on the scale and record the mass, in grams, in the results table below.
4. Remove the lid of the calorimeter and pour 50 mL of distilled water into the nested styrofoam cups
5. Place the lid back on the calorimeter, and place the calorimeter, with the water in it on the scale. Record the mass in the results table.
6. Measure the temperature of the water in the calorimeter. Record this value in the results table, this will be your initial temperature.

7. Measure out 4.5 grams of ammonium chloride on the scale. Record the exact mass of ammonium chloride in the table below.
8. Add the ammonium chloride to the calorimeter and begin stirring the solution using the stirring rod. Continue stirring the solution throughout.
9. Observe the thermometer to see whether the temperature of the water increases or decreases.
10. Once the temperature stops changing, record the final temperature in the results table.
11. Clean up all your equipment and materials.

Results: (2 marks)

Table 1. Mass

Component	Mass (g)
Calorimeter	27.7
Calorimeter + water	75.5
Water (calorimeter - (calorimeter + water))	47.8
Ammonium chloride	4.55

Table 2. Temperature

Time	Temperature (°C)
Initial Temperature	22.5
Final Temperature	17.5
ΔT	-5

Analysis: (13 marks total)

1. Determine the heat change of the system (ammonium chloride). **Round your final answer to 3 significant digits. Show your calculations.** (3 marks)

$q_{system} = -q_{water}$

$q_{system} = -(m_{water} c_{water} \Delta T_{water})$

$q_{system} = -(47.8g) \times (4.18J/g°C) \times (-5°C)$

$q_{system} = +999\ J$

2. Calculate the moles of ammonium chloride that was dissolved in the water. **Round your final answer to 3 significant digits. Show your calculations.** **(2 marks)**

n = mass ÷ molar mass = 4.55g ÷ 53.53 g/mol = 0.08499 = 0.0850 mol

3. Calculate the molar enthalpy of ammonium chloride in the solution. **Round your final answer to 3 significant digits. Show your calculations.** **(2 marks)**

Molar enthalpy = ΔH/moles

Molar enthalpy = 999 J/ 0.0850 moles

Molar enthalpy = 11,722.94 J/mol

Molar enthalpy = 11,700 J/mol or 1.17×10^4 J/mol

4. The theoretical heat change for the dissolution of 1 mole of NH4Cl is +14.7 kJ/mol. If the molar enthalpy you calculated was different than this, suggest any potential sources of experimental error that could account for this difference. **(2 marks)**

Answers will vary:
Human error measuring temp or mass
Heat lost outside the calorimeter that wasn't accounted for
Loss of some ammonium chloride transferring to calorimeter
Evaporation of water
Ammonium chloride reacts with water in the air before it is put in calorimeter.

5. If the mass of ammonium chloride used in this experiment was increased, would the value of Q be different? Explain your reasoning. **(2 mark)**

Yes, the value of Q would be different. The value of Q is dependent on the number of moles of NH_4Cl used.

6. If the volume of water used in the experiment was 100 mL instead of 50 mL how would the results of the experiment be different? Explain your reasoning. **(2 marks)**

The ultimate value of molar enthalpy would be the same, however the change in temp and mass of water would also be proportionally different.