Revised August 2011

HONORS LAB 10b: Instant Cold Packs

Aim To determine the enthalpy change when an "Instant Cold Pack" is activated

Apparatus Insulated coffee-cups, thermometer, spatula, weighing boat, stirring rod, electronic balance, graduated cylinder

Chemicals Ammonium nitrate, water

The chemical substance used in an "Instant Cold Pack" is ammonium nitrate. In the cold pack the ammonium nitrate is separated from the water by placing it in a small, breakable tube. The cold pack is activated by breaking the tube that contains the ammonium nitrate and allowing it to mix with water. The process of the ammonium nitrate dissolving is accompanied by a significant enthalpy change. A typical cold pack may contain approx. 200 g of solid and 100 g of water.

Method

1. Use the attached MSDS (Material Safety Data Sheet) for ammonium nitrate to complete Table A in the results section.

2. Measure 30.0 mL of water using a graduated cylinder.

3. Transfer the water to a double coffee-cup calorimeter.

4. Using an electronic balance and weighing boat, mass between 4.00 and 5.00 g of ammonium nitrate. Record the mass accurately in Table B.

5. Place a thermometer in the cup of water and allow it to adjust to the temperature of the water by leaving it submerged for 5 minutes. Record the initial temperature of the water in Table B.

6. Carefully add the massed ammonium nitrate to the water in the cup and stir the contents.

7. Continue to stir, and monitor the temperature of the solution as the reaction proceeds, ultimately recording only the lowest temperature that the solution reaches as the final temperature in Table B.

8. When the reaction is complete, flush the solution down the drain with plenty of water.

9. Dry the cup with a paper towel.

10. Repeat steps 1-9 in two further trials.

Results

TABLE A – Ammonium nitrate information from MSDS

CAS # **(The CAS number is the Chemical Abstracts Service number that identifies a particular chemical substance)**	
Chemical formula	
Molar mass in g mol^{-1}	
ORL-RAT LD50 **(The LD50 number is the dose that kills 50% of a given sample of test animals)**	

TABLE B – Data from experiments

Expt.	Mass of ammonium nitrate	Volume of water in mL	Total Mass of solution (assuming H_2O has mass of 30.0 g) in g	Initial Temp in ^oC	Final Temp in ^oC	Temp Change in ^oC
1		30.0				
2		30.0				
3		30.0				

Conclusion/Calculation

1. Calculate the heat change in each experiment in units of Joules, given that the specific heat capacity of the solution is 4.184 $Jg^{-1}K^{-1}$.

Expt. 1

Expt. 2

Expt. 3

2. Convert each of your calculations in #1 above to units of kJ per mole of ammonium nitrate.

Expt. 1

Expt. 2

Expt. 3

3. Is the process of dissolving ammonium nitrate in water endothermic or exothermic? Explain your answer carefully.