

HANDWARMER LAB OVERVIEW

What is your hypothesis?

List chemicals from the most exothermic to the most endothermic

EXOTHERMIC - - - - - ENDOTHERMIC

(they are listed alphabetically right now)

Ammonium nitrate (NH_4NO_3) Calcium chloride (CaCl_2) Lithium chloride (LiCl) Magnesium Sulfate (MgSO_4) Sodium acetate ($\text{NaC}_2\text{H}_3\text{O}_2$) Sodium carbonate (Na_2CO_3) Sodium Chloride (NaCl)

Trial 1: Heats of solution and costs for the ionic compounds tested.

Trial 1	Class						
Compound	MgSO4	NH4NO3	CaCl2	NaCH3CO2	NaCl	LiCl	Na2CO3
H2O Volume (mL)	45	45	45	45	45	45	45
Mass (g)	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Temp _{initial} (°C)							
Temp _{final} (°C)							
ΔT (°C)							
q-aqueous (J)							
q-calorimeter (J)							
q-solution (J)							
FW	120.37	80.04	110.98	82.03	58.44	42.39	105.99
moles							
joules/moles							
Cost (\$/kg)*	\$73.00	\$16.70	\$8.50	\$28.30	\$8.80	\$71.50	\$6.98
Cost per mole							
cost per joule per mole							

*According to <https://www.flinnsci.com/>

$$\Delta E = q + w$$

Figure 1. The equation for the change in energy of a system

$$\Delta H_{\text{soln}} = \Delta H_{\text{bond}} + \Delta H_{\text{lattice}} + \Delta H_{\text{dipole}}$$

Figure 2. The formula for the change in enthalpy for a reaction involving H₂O and an ionic compound

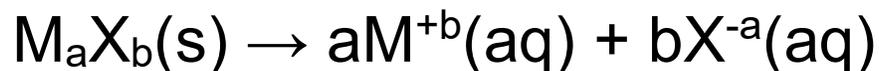


Figure 3. The general reaction for the disassociation of a salt into its cation and anion

$$T_{\text{Avg}} = (T_{\text{Hot}} + T_{\text{Cold}}) / 2$$

Figure 4. The equation for determining the average temperature (predicted mix temperature)

$$q_{\text{water}} = m \times c \times (T_{\text{mix}} - T_{\text{Avg}})$$

Figure 5. The formula for heat of the water surrounding, assuming that 1 mL H₂O is equivalent to 1 gram H₂O and the specific heat of water, c, is 4.184 J/g·°C.

$$q_{\text{aqueous}} = m \times c \times (T_{\text{Final}} - T_{\text{Initial}})$$

Figure 6. The formula for heat of the water surrounding, assuming that 1 mL H₂O is equivalent to 1 gram H₂O and the specific heat of water, c, is 4.184 J/g·°C.

$$q_{\text{calorimeter}} = C_{\text{calorimeter}} \times (T_{\text{Final}} - T_{\text{Initial}})$$

Figure 7. The formula for heat lost to the calorimeter in a reaction resulting in a certain change in temperature.

$$q_{\text{solution}} = -(q_{\text{aqueous}} + q_{\text{calorimeter}})$$

Figure 8. The formula for the heat of a solution of water and an salt contained in a calorimeter.

$$\text{Joule Cost} = p / (-q_{\text{solution}} / 5)$$

Figure 9. The formula for the cost to raise or lower the enthalpy of a solution by one kilojoule, assuming that p is the cost of the exothermic compound and that the result is of the units \$/kJ.