[redacted]

Purpose: To determine the change in enthalpy, ΔH, for a redox chemical reaction using an ice calorimeter

Procedure: Please refer to the 2009 Chem 1AO3 / 1EO3 lab manual for detailed procedure

Pre-lab:

1) $\overset{0}{Mg}_{(s)} + 2\overset{+1}{H}_2O_{(l)} \rightarrow \overset{+2}{Mg}(OH)_{2(s)} + \overset{0}{H}_{2(g)}$

a) Yes, it is a redox reaction. There is change in oxidation state for magnesium and hydrogen.

Reduction: $2H^+ + 2e^- \rightarrow H_2$ Oxidation: $Mg_{(s)} \rightarrow Mg^{2+} + 2e^-$

b) $m_{mg} = 0.0272\,g$

$MM_{mg} = 24.31\,g/mol$

$n_{mg} = m/MM = \frac{0.0272\,g}{24.31\,g/mol} = 1.119 \times 10^{-3}\,mol$

$\Delta H_{fusion\ for\ ice\ (s \rightarrow l)} = 333.55\,J/g \times \frac{1g}{ml} \times \frac{kJ}{1000J} = 6.003\,kJ/ml$

$\Delta H_{water} = 6.003\,kJ/ml \times 0.11664\,ml = 0.7002\,kJ$

$\Delta H_{mg} = -\Delta H_{water} = -0.7002\,kJ$

$\Delta H_{rxn} = \frac{\Delta H_{mg}}{n_{mg}} = \frac{-0.7002\,kJ}{1.119 \times 10^{-3}\,mol}$

$\Delta H_{rxn} \approx -630\,kJ/mol$

At 0°C $d_{water} = 1.000\,g/cm^3$

$d_{ice} = 0.917\,g/cm^3$

$\Delta V = -0.19\,mL$ (given)

$m_{water} = m_{ice}$

$\Delta V = \frac{mass\ of\ water\ made}{d_{water}} - \frac{mass\ ice\ melted}{d_{ice}}$

$-0.19\,mL = m\left(\frac{1}{1.000\,g/cm^3} - \frac{1}{0.917\,g/cm^3}\right)$

$m = -0.19\,cm^3\,(-11.05\,g/cm^3)$

$m_{ice} = 2.0995\,g$

$n_{ice} = 2.0995\,g / 18\,g/mol = 0.11664\,mol$

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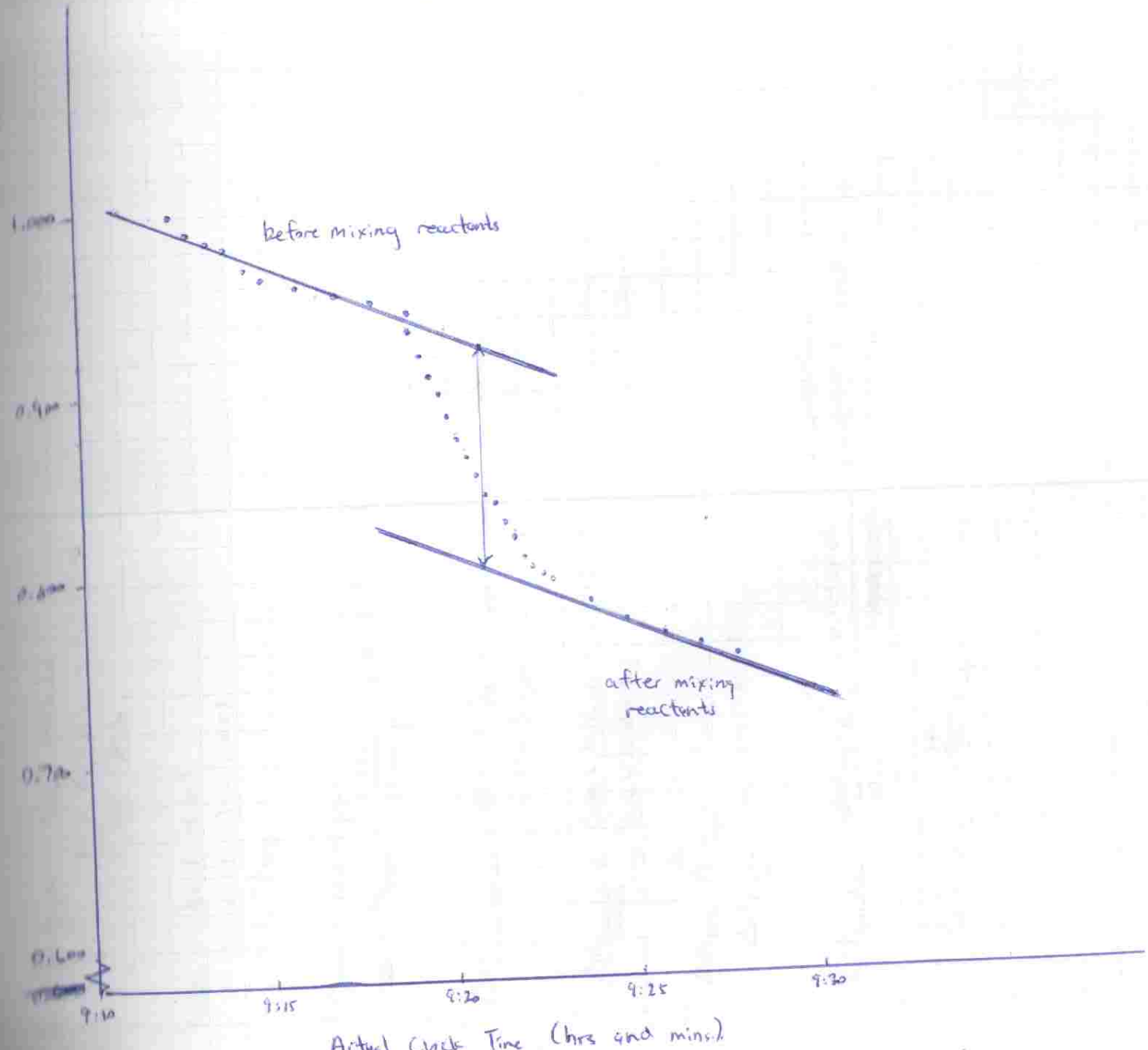
Volume change for redox reaction of magnesium and hydrochloric acid



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Δv from graph $= V_{final} - V_{initial}$
$= 0.805\,mL - 0.925\,mL$
$= -0.120\,mL$

$m_{ice} = \Delta v\,(-11.05)$
$= (-0.12\,mL)(-11.05)$
$= 1.326\,g$

$MM_{water} = 18.006\,g/mol$
$n_{ice} = m/MM = \frac{1.326\,g}{18.006\,g/mol} = 0.073642\,mol$

$\Delta H_{fusion\ for\ ice} = 333.55\,J/g \times \frac{18.006\,g}{mol} \times \frac{kJ}{1000\,J}$
$= 6.006\,kJ/mol$

$\Delta H_{vessel\ A\ (water)} = 6.006\,kJ/mol \times 0.073642\,mol$
$= 0.442286\,kJ$

$\Delta H_{vessel\ A} = -\Delta H_{vessel\ B}$
$\therefore \Delta H_{vessel\ B\ (mg)} = -0.442286\,kJ$

$\Delta H_{rxn\ of\ mg} = \frac{\Delta H_{vessel\ B}}{n_{mg}} = \frac{-0.442286\,kJ}{2.443\,mol \times 10^{-3}} = -181\,kJ/mol$

$\Delta H_{rxn\ of\ mg} = -181\,kJ/mol$

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Discussion: [illegible] Mg was reacted with HCl going through a [illegible] reaction and release heat to melt the ice in the ice calorimeter. Since density of solid ice is lower than density of water, once the ice melts there will be a decrease in volume. Using this decrease in volume, mass of ice melted can be found as a result of the heat released by the chemical reaction. Using this mass and the heat of fusion of ice, the enthalpy change is calculated for the ice. Using the enthalpy change of ice the enthalpy change per mole of magnesium reacted is calculated as a result of ice absorbing the heat released by the Mg and HCl reaction. However, the calculated enthalpy change of Mg may not be accurate due to some sources of error. For example, there were air bubbles in the ice calorimeter which made the measurement of volume in the pipet inaccurate since the air bubbles take up volume in the calorimeter. Another problem was that there might of being water in the vessel which may have absorbed some of the heat released by water. Also, reading the volume off the pipet was difficult because the change in volume in the 15 sec, 30 sec, 1 min intervals were very small, so small that it had 0.025 mL decrease in volume which was hard to measure w/ the human eye.

Conclusion: [illegible] Mg [illegible] ice melted (due to heat released by chemical reaction), the enthalpy change per mole of Mg is −[illegible] kJ/mol. The negative means that the rxn of Mg and HCl is exothermic as heat is released to melt the ice into water.

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