Latent Heat of Vaporization of Nitrogen

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Lab Section: B

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Sample Calculations

$\Delta M = M_1 - M_2$

$\Delta M = 681.50 \pm .02g - 613.00 \pm .02g$

$\Delta M = 48.50 \pm .04g$

$\Delta T = T_F - T_I$

$\Delta T = 15.1°C - 23.8°C$

$\Delta T = -8.7°C$

$Q_2 = m_w C_w \Delta T + m_c C_a \Delta T Q_2$

$Q_2 = (186.03g)(1.00 \frac{cal}{g°C})(-8.7°C) + (258.22g)(0.22 \frac{cal}{g°C})(-8.7°C)$

$Q_2 = -1770cal$

$Q_3 = M_a C_a (T_I - T_2)$

$Q_3 = (62.10g)(0.22 \frac{cal}{g°C})(24.6 - 15.1)$

$Q_3 = 129.8cal$

$Q_1 = -Q_2 + Q_3$

$Q_1 = -(-1770cal) + (129.8cal)$

$Q_1 = 1900cal$

$Q = \Delta M \cdot L$

$L = \frac{Q}{\Delta M}$

$L = \frac{1900cal}{48.50g}$

$L = 39.18 \frac{cal}{g}$

Discussion

The objective of this experiment was to determine the latent heat of vaporization of nitrogen. This was completed placing an aluminum cylinder into a Dewar flask containing liquid nitrogen. The heat imparted by the aluminum was then measured by placing the chilled cylinder into a calorimeter. The heat lost by the water and calorimeter is the inverse of the heat gained by the aluminum. Though the aluminum did not reach its initial temperature, it did reach a temperature in which there is a constant value for its specific heat. By adding the calculated additional amount of heat to raise the aluminum to room temperature and the amount of heat gained to reach an equilibrium temperature with water the total amount of heat lost by aluminum when placed in the nitrogen was determined. Errors in this experiment may have occurred when transferring the cylinder to the calorimeter: during the transfer the cylinder may have gained heat. The Dewar flask also imparted some heat to the nitrogen. This amount was not measured.

The volume of liquid nitrogen had heat transferred to it from the Dewar flask and the aluminum cylinder. The Dewar flask imparted heat to the liquid nitrogen; immediately following the immersion of the aluminum the flask would have heat transferred to it from the aluminum. The calorimeter cup imparted heat to the aluminum cylinder. While immersed in liquid nitrogen the aluminum cylinder imparted heat to the nitrogen and Dewar flask system. When immersed into water, the aluminum cylinder had heat transferred to it from the calorimeter system.

If a full minute passed before the aluminum was removed from the nitrogen an error would not have occurred. The two systems were assumed to be at their equilibrium temperatures before the first post immersion measurement was made. Therefore at any point after that the heat lost by aluminum would be the same.

The standard value for the specific heat of aluminum is not the same at very low temperatures. Therefore the equation $Q=mC\Delta T$ could not be used.