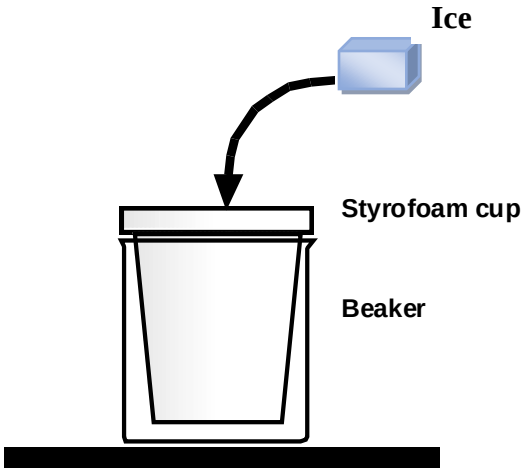
Name: _____

Date: _____ **Code:** ____

IB Physics: Thermodynamics. Dr. Persin.
Inquiry Activity: The Latent Heat of Fusion of Ice.

Introduction: In this activity, you will determine experimentally the heat of fusion of ice, H_f. This is the amount of heat energy required to melt 1.00 g ice at its melting point of 0.00 ^oC.

Materials: Styrofoam cups, or calorimeter, lid, hand magnifier, beaker, thermometer, water, ice, balance scale.



Prior knowledge: The following relationships will be used in this activity:

1. Heat is the thermal energy that spontaneously passes from an object at higher temperature to an object at lower temperature.
2. The amount of heat radiated or absorbed by a body depends on the mass, the temperature change, and the specific heat capacity.

The following relationships will be used in this activity:

a) **heat lost (or gained) by water+cup** = **original mass of water and cup** X **change in temp. of water+cup** X **specific heat of water and cup**

The equation to be used is: $\mathbf{Q = m \times c \times \Delta T}$

where **Q** = amount of heat in joules lost or gained by the substance

m = mass of the substance in grams

$\mathbf{\Delta T}$ = change in temperature in (^oC); $\mathbf{\Delta T = (T_2 - T_1)}$

c = specific heat of the substance; specific heat of liquid water is $\frac{4.186\ J}{(g)(^oC)}$

b) Law of Conservation of Energy:

amount of heat lost by one mass = amount of heat gained by another mass

c) Using the formula $\mathbf{Q = m \times H_f}$ and rearranging to solve for $\mathbf{H_f}$: $\mathbf{H_f = Q/m}$

heat of fusion of ice = $\frac{\text{amount of heat absorbed to melt the ice}}{\text{mass of the ice}}$

Procedure:

1. Determine the mass of the clean, dry cup and note its composition. **mass1** = _____
2. Add enough water to the cup to about 3/4 full. **Composition** = _____
3. Determine the mass of the cup and the water. **mass2** = _____
4. Subtract the mass of the cup from the mass of the cup and water. **mass2 – mass1** = _____
5. Record the mass of the water alone in the Data Table as $\mathbf{M_1}$ = _____.
6. Remove the cup with water from the balance, put on the lid, and insert the thermometer.
7. **Immediately** measure the temperature of the water in the cup as accurately as possible and record this initial temperature as $\mathbf{T_1}$ in the Data Table.
8. **Carefully** add an ice cube to the water in the cup and begin stirring **gently** with the thermometer.
9. Continue to check the temperature every minute and observe that it is decreasing.
10. Continue stirring as needed until the temperature of the water/ice mixture no longer decreases. Record this final temperature as $\mathbf{T_2}$ in the Data Table.
11. **Put the cup back on the balance scale**. Subtract the mass of the empty dry cup from the mass of the cup and water. Record this final mass of the water alone as $\mathbf{M_2}$ in the Data Table.

DATA TABLE (mass of clean, dry Cup: _____)

Original Mass of Water (g) **(M_1)**	Final Mass of Water (g) **(M_2)**	Mass of Melted Ice (g) **$M_3 = (M_2 - M_1)$**	Initial Water Temp **(T_1)** (^oC)	Final Water Temp **(T_2)** (^oC)	Change in Temp **(T_2-T_1)** (ΔT) (^oC)

Calculations: Show all work. Water: c = 4.186 J/(g ^{o}C) Aluminum: c = 0.902 J/(g ^{o}C)

1. **Calculate heat lost by original mass of water + cup. $Q_L = M_1 \cdot c \cdot \Delta T + m_1 \cdot c \cdot \Delta T$**

2. **Calculate the heat gained by the melted ice water. $Q_G = M_3 \cdot c \cdot \Delta T$**

3. **Calculate the amount of heat gained by the ice *during melting*. $Q = Q_L - Q_G$**

4. **Calculate the heat of fusion of the ice in Joules per gram, (J/g). $H_f = Q/m$**

5. **The accepted value for the heat of fusion of ice is 334.5 J/g. Calculate Percent Error.**