Lab - Work for Your Ice Cream

Name: _____ **Date: _____**

Purpose
To measure the energy transfers occurring during the making and freezing of homemade ice cream.

Required Equipment/Supplies
Ice
Rock salt
Thermometer
Insulated cups
Ice cream mix
Triple-beam balance spring scale

Discussion
Energy must be supplied to a home to heat it on a cold winter day. Energy must also be supplied to an air conditioner that is cooling a home on a hot summer day. The air conditioner is transferring heat from the cooler indoors to the warmer outdoors. Energy input is always required to move heat from a region of lower temperature to a region of higher temperature.

Energy must be taken away from a liquid to make it a solid. If the liquid is cooler than the surrounding air, additional energy must be added to move heat from the liquid to the warmer air, just as extra energy is needed to move heat from a room to the warmer outdoors in summer. When the liquid is sweet cream, the solid that results is ice cream. (Making ice cream also involves swirling in air; ice cream is actually a mixture of a solid and a gas.)

The freezing of homemade ice cream involves several energy transfers.

1. Energy (work) is expended in turning the crank to overcome inertia and friction.
2. The slush of ice and rock salt takes up energy as it melts.
3. The ice cream mix cools from its original to its final temperature.
4. The metal container cools from its original to its final temperature.
5. The ice cream mix gives up energy as it freezes.

Procedure
1. After getting some ice cream mix in a plastic bag measure the mass of the ice cream mix and the mass of the ice and salt mixture.

   Mass of ice cream mix = _____kg

   Mass of the ice and salt mixture = _____ kg

2. Measure the initial temperature of the ice cream mix and the ice and salt mixture.

   Initial temperature of ice cream = _____°C

   Initial temperature of ice and salt = _____°C

3. Place the bag of ice cream into the bag of the ice and salt and start to gently shaking the bags, so that the ice cream can start to freeze.
4. After the ice cream is ready to eat, take the final temperature of the ice cream and the ice and salt. (Make sure you have rinsed off the thermometer between each measurement.)

   Final temperature of ice cream = _____°C

   Final temperature of ice and salt = _____°C

   Change in temperature of the ice cream (ΔT_{IC}) = _____°C

   Change in temperature of the ice and salt (ΔT_{ICE}) = _____°C

Questions and Analysis

1. Calculate the heat lost by the ice cream as it was frozen. There is two parts to this problem. First the ice cream had to be cooled down to its freezing temperature and then ice cream had to be frozen The specific heat capacity of ice cream is 3350 J/kg °C and its heat of fusion is 188,370 J/kg

   a. Heat lost as ice cream cooled to its freezing point = _____ J

   b. Heat lost as the ice cream froze = _____ J

   c. Total Heat lost by ice cream = _____J

2. Would the heat gained by the ice and salt be equal to the heat lost by the ice cream? Explain your reasoning.

3. Which of the five processes listed on the first page is the greatest absorber of energy and why?

4. How did the energy absorbed by the melting slush of ice and salt compare with the energy released by the other processes?

5. Salt is put on icy roads to promote melting. When you make home-made ice cream, salt is used to help promote freezing. Is this practice paradoxical, or does it make good physics sense?