LAB 14. LATENT HEAT

Introduction

Temperature is related to heat, but the relationship can be complicated. Heat flows between objects at different temperatures until their temperatures become equal. Adding heat to an object usually raises its temperature. Since temperature is a measure of molecular kinetic energy and heat is transferred energy, heat transfer usually causes a temperature change.

However, if the *potential* energy of the system can vary, the possible outcomes are much richer. Energy transferring between potential and kinetic can change a system's temperature even if no heat flows between the system and its surroundings. By the same token, transferred heat energy can change a system's potential energy without affecting its kinetic energy, keeping its temperature, though not its energy, constant.

Phase changes can release or absorb heat without an accompanying change in temperature. Conversely, phase changes can change a system's temperature without a transfer of heat. In this activity, you will see examples of both of these types of process.

Experiment

You will add salt to ice to make a slush bath that is colder than the starting ice. Water in a test tube placed in the cold bath will freeze as you observe its temperature at regular intervals. This will allow you to plot a cooling curve for the water-to-ice phase change.

Materials

Test tube, foam cup, thermometer, ice, salt, stirrer, distilled water, graph paper

Observations

1. Make a cold bath. Load a foam cup about half full with crushed ice. Make sure there is plenty of room in your cup for both the ice and the test tube. Put in a layer of salt and add a little water to help the salt dissolve if necessary. Stir from the bottom frequently and carefully until the temperature drops to about –10 °C. It should be a soupy mix of ice and salt water. If your cold bath stops getting colder before it reaches –10 °C, stir in more salt.
2. Organize three people for data collection. The roles are (1) call out 1-min intervals using the timer, (2) read and call out the temperatures, and (3) record the temperatures in the Table.
3. Add water to the test tube to a depth of about 5 cm and measure its temperature. Place the test tube in the cold bath and take temperature readings every minute until the temperature of the water reaches –5 °C. Record your data in the Table. **Stir the water sample in the cup frequently**, at a very minimum each time before taking its temperature. Check periodically that the cold bath remains cold. If it warms, set up a new cold bath and transfer your sample cup to it.
4. Note the times when you first see ice forming in the test tube and when there is no more liquid water there. Enter these times in the spaces beneath the Table. At the end, the thermometer will be stuck in the ice.

Table. Phase change of water

Time (min)	Temp (°C)	Time (min)	Temp (°C)	Time (min)	Temp (°C)	Time (min)	Temp (°C)	Time (min)	Temp (°C)
0		15		30		45		60	
1		16		31		46		61	
2		17		32		47		62	
3		18		33		48		63	
4		19		34		49		64	
5		20		35		50		65	
6		21		36		51		66	
7		22		37		52		67	
8		23		38		53		68	
9		24		39		54		69	
10		25		40		55		70	
11		26		41		56		71	
12		27		42		57		72	
13		28		43		58		73	
14		29		44		59		74	

Time ice first formed: _____ Time sample froze solid: _____

Data Processing

1. On graph paper or a spreadsheet, make a plot of temperature vs. time from the data. Scale your graph to use at least half of each axis. Title your graph.