

Ice Cream Chemistry – Lowering the Freezing Point

Materials

- Thermometer capable of reading at least -10°C
- Large 12-oz Styrofoam cup (You could also use a 400mL beaker)
- 100 mL graduated cylinder
- Gram balance (accurate to 0.1 g)
- Six 250 mL beakers (or you can use six disposable cups)
- Seven test tubes, 18 mm by 150 mm
- 500 g of table salt
- 360 g of granulated sugar
- Water
- Ice
- Stirring rod or spoon for mixing solutions
- Small spoon or scoop, for scooping up salt and sugar
- Permanent marker
- Test tube stand (optional, but helpful)

Procedure – Part 1: Prepare the Ice Bath

- 1 Fill the Styrofoam three-quarters full of ice.
- 2 Cover the ice with 1/4 to 1/2 inches of table salt and stir so the salt is dissolved.
- 3 Using your thermometer, check to make sure that the ice-salt mixture is at least -10°C .
- 4 You will use this ice bath to freeze many samples of test liquids. During the course of your experiments, you may need to pour melted water out of the ice bath and replenish the ice and salt. When you do this, wait until the temperature of the ice bath drops to at least -10°C before continuing your experiment.

Procedure Part 2: Finding the Freezing Points

You're going to prepare six test liquids and measure each of their freezing points. You also must measure the freezing point of a test tube of water to establish its freezing point in your lab. For each test tube follow this procedure:

- 1 First establish your control. Add 100 mL of water to a test tube.
- 2 Place your test tube in the ice bath. As soon as you see ice crystals forming, take the temperature of the liquid. Note that due to differences in water, this temperature might not be 0°C .
- 3 Next, make your first solution. Mark a test tube and beaker with a '1'.
- 4 Place your measuring beaker on the scale and press zero/tare. (If your scale doesn't have this button, follow the manufacturer's directions for taring your scale.)
- 5 Add 2.9g of table salt to the beaker.
- 6 Take the beaker off the scale and add 100mL to the beaker. With a spoon or stirring rod, gently stir the mixture.
- 7 Once the salt is dissolved, fill beaker #1 half-way full with the solution.

- 8 Place the beaker in the ice bath, and record the temperature. When you start to see the first ice crystals form on the inside, record the temperature again - this is the test liquid's freezing point. Make sure to rinse and dry your thermometer thoroughly so as not to contaminate other liquids.
- 9 Repeat steps #3 through #8 for each of the remaining test liquids, making sure to use a different test tube and beaker for each test solution:
 - a. Test liquid #2 = 5.8 g salt in 100 mL water
 - b. Test liquid #3 = 11.7 g salt in 100 mL water
 - c. Test liquid #4 = 17.1 g sugar in 100 mL water
 - d. Test liquid #5 = 34.2 g sugar in 100 mL water
 - e. Test liquid #6 = 68.5 g sugar in 100 mL water

Record the freezing point depression and molality for each of your substances. How do the sucrose and sodium solutions compare in terms of molality and freezing point?