a 0.250 M solution. What mass of $CuCl_2$ should be used to make the stock solution?

385. You have a bottle containing a 2.15 M $BaCl_2$ solution. You must tell other students how to dilute this solution to get various volumes of a 0.65 M $BaCl_2$ solution. By what factor will you tell them to dilute the stock solution? In other words, when a student removes any volume, V, of the stock solution, how many times V of water should be added to dilute to 0.65 M?

386. You have a bottle containing an 18.2% solution of strontium nitrate (density = 1.02 g/mL).
- **a.** What mass of strontium nitrate is dissolved in 80.0 mL of this solution?
- **b.** How many moles of strontium nitrate are dissolved in 80.0 mL of the solution?
- **c.** If 80.0 mL of this solution is diluted with 420.0 mL of water, what is the molarity of the solution?

Colligative Properties: Chap. 13, Sec. 2

387. Determine the freezing point of a solution of 60.0 g of glucose, $C_6H_{12}O_6$, dissolved in 80.0 g of water.

388. What is the freezing point of a solution of 645 g of urea, H_2NCONH_2, dissolved in 980. g of water?

389. What is the expected boiling point of a brine solution containing 30.00 g of KBr dissolved in 100.00 g of water?

390. What is the expected boiling point of a $CaCl_2$ solution containing 385 g of $CaCl_2$ dissolved in 1.230×10^3 g of water?

391. A solution of 0.827 g of an unknown non-electrolyte compound in 2.500 g of water has a freezing point of −10.18°C. Calculate the molar mass of the compound.

392. A 0.171 g sample of an unknown organic compound is dissolved in ether. The solution has a total mass of 2.470 g. The boiling point of the solution is found to be 36.43°C. What is the molar mass of the organic compound?

Mixed Review

In each of the following problems, assume that the solute is a nonelectrolyte unless otherwise stated.

393. Calculate the freezing point and boiling point of a solution of 383 g of glucose dissolved in 400. g of water.

394. Determine the boiling point of a solution of 72.4 g of glycerol dissolved in 122.5 g of water.

395. What is the boiling point of a solution of 30.20 g of ethylene glycol, $HOCH_2CH_2OH$, in 88.40 g of phenol?

396. What mass of ethanol, CH_3CH_2OH, should be dissolved in 450. g of water to obtain a freezing point of −4.5°C?

397. Calculate the molar mass of a nonelectrolyte that lowers the freezing point of 25.00 g of water to −3.9°C when 4.27 g of the substance is dissolved in the water.

398. What is the freezing point of a solution of 1.17 g of 1-naphthol, $C_{10}H_8O$, dissolved in 2.00 mL of benzene at 20°C? The density of benzene at 20°C is 0.876 g/mL. K_f for benzene is −5.12°C/*m*, and benzene's normal freezing point is 5.53°C.

399. The boiling point of a solution containing 10.44 g of an unknown nonelectrolyte in 50.00 g of acetic acid is 159.2°C. What is the molar mass of the solute?

400. A 0.0355 g sample of an unknown molecular compound is dissolved in 1.000 g of liquid camphor at 200.0°C. Upon cooling, the camphor freezes at 157.7°C. Calculate the molar mass of the unknown compound.

401. Determine the boiling point of a solution of 22.5 g of fructose, $C_6H_{12}O_6$, in 294 g of phenol.

402. Ethylene glycol, $HOCH_2CH_2OH$, is effective as an antifreeze, but it also raises the boiling temperature of automobile coolant, which helps prevent loss of coolant when the weather is hot.
- **a.** What is the freezing point of a 50.0% solution of ethylene glycol in water?
- **b.** What is the boiling point of the same 50.0% solution?

403. The value of K_f for cyclohexane is −20.0°C/*m*, and its normal freezing point is 6.6°C. A mass of 1.604 g of a waxy solid dissolved in 10.000 g of cyclohexane results in a freezing point of −4.4°C. Calculate the molar mass of the solid.

404. What is the expected freezing point of an aqueous solution of 2.62 kg of nitric acid, HNO_3, in a solution with a total mass of 5.91 kg? Assume that the nitric acid is completely ionized.

405. An unknown organic compound is mixed with 0.5190 g of naphthalene crystals to give a mixture having a total mass of 0.5959 g. The mixture is heated until the naphthalene melts and the unknown substance dissolves. Upon cooling, the solution freezes at a temperature of 74.8°C. What is the molar mass of the unknown compound?

406. What is the boiling point of a solution of 8.69 g of the electrolyte sodium acetate, $NaCH_3COO$, dissolved in 15.00 g of water?

407. What is the expected freezing point of a solution of 110.5 g of H_2SO_4 in 225 g of water? Assume sulfuric acid completely dissociates in water.

408. A compound called pyrene has the empirical formula C_8H_5. When 4.04 g of pyrene is dissolved in 10.00 g of benzene, the boiling point of the solution is 85.1°C. Calculate the molar mass of pyrene and determine its molecular formula. The molal boiling-point constant for benzene is 2.53°C/*m*. Its normal boiling point is 80.1°C.

409. What mass of $CaCl_2$, when dissolved in 100.00 g of water, gives an expected freezing point of −5.0°C; $CaCl_2$ is ionic? What mass of glucose would give the same result?