

+ WS 8.8 - Molality & Colligative Properties

(side 1)

1. Molality (m) represents the number of _____ of _____ in one _____ of _____. The units of molality are thus _____.
2. Compute the molality (m) of 78 g of NaCl in 1000 g of H₂O.
3. Compute the molality (m) of 23.7 g of NaNO₃ in 250 ml of H₂O.
(Hint: the density of water is 1g/ml)
4. What is the molar mass of a substance in which 475.6 g of the substance is dissolved in 2 L of water yielding a 2 m solution?
5. The van't Hoff factor (i) indicates how many moles of solute are in a solution, per mole of solid solute added to the solution. For example, in water one mole of C₆H₁₂O₆ does not form any ions, so $i=1$. In water, one mole of NaCl will yield one mole of Na⁺ ions and one mole of Cl⁻ ions, so $i=2$.

In water, one mole of CaCl₂ forms one mole of Ca⁺ ions and two moles of Cl⁻ ions, so $i=$ ____. In contrast, in water, one mole of NaNO₃ forms ____ mole(s) _____ and ____ mole(s) _____, so $i=$ ____.
6. What is the freezing point depression of water in a solution of 10.0 g of NaCl and 1300 g of water? (k_f for water is $-1.86\text{ }^{\circ}\text{C}/m$)
7. What is the actual freezing point for an aqueous solution of 25 g of CaCl₂ in 500 ml of water?

8. How many grams of NaCl are required to lower the freezing point of 1.0 L of water by 6 °C?
How many grams of CaCl₂ would be required to achieve the same temperature change?
9. What is the boiling point elevation for an aqueous solution of 50. g of NaCl in 475 ml of water?
(*k_b* for water is 0.51 °C/m)
10. In water, HCl forms two ions and hence *i*=2. In benzene, however, HCl does not form any ions and *i*=1. Pure benzene boils at 80.1 °C. Imagine that you have 1000 g of water and 1000 g of benzene in separate beakers. Into each beaker you add 250 g of HCl. What will be the new boiling points of benzene and water?
(*k_b* for benzene is 2.53 °C/m while the *k_b* for water is 0.51 °C/m)
11. Suppose 65.0 g of a nonionic substance is dissolved in 2.00 L of water. The freezing point is observed to decrease by 1.30 °C. What is the molar mass of the substance?
(*k_f* for water is -1.86 °C/m)

Answers (IRO+1):

2 gram 1.1 3 7.00 moles 2 1 1 1.3 moles Na⁺ solvent N³⁻ 1.8 O₃ dogs kilogram NO₃⁻ 118.9
1.8 -0.49 97 -2.5 2.5 107 130.8 201 solute /kilogram /Liter 17.3 120 94.2 46.5