Honors Chemistry

Answers to More Chapter 11 Study Questions

1. 5.00 g NaClO per 100. g solution; contains 95.0 g H_2O.

$$5.00\ g\ NaClO \times \frac{1\ mole\ NaClO}{74.5\ g\ NaClO} = 0.0671\ mol;\ \ 95.0\ g\ H_2O \times \frac{1\ kg\ H_2O}{1000\ g\ H_2O} = 0.0950\ kg\ H_2O$$

$$\text{molality} = \frac{moles\ NaClO}{kg\ H_2O} = \frac{0.0671\ moles\ NaClO}{0.0950\ kg\ H_2O} = 0.706\ m$$

$$95.0\ g\ H_2O \times \frac{1\ mole\ H_2O}{18.0\ g\ H_2O} = 5.28\ moles\ H_2O;$$ total moles = 5.28 + 0.07 = 5.35 moles

$$\text{mole fraction} = \frac{moles\ NaClO}{total\ moles} = \frac{0.0671\ moles\ NaClO}{5.35\ moles} = 0.0125$$

2. 12.8 g NaOH $\times \frac{100\ g\ solution}{32.0\ g\ NaOH} =$ 40.0 g solution

3. 0.0476 moles NaOH; (1-0.0476) = 0.952 mole H_2O.

$$0.0476\ \text{mol NaOH} \times \frac{40.0\ g\ NaOH}{1\ mol\ NaOH} = 1.90\ g\ NaOH;$$

$$0.952\ mol\ H_2O \times \frac{18.0\ g\ H_2O}{1\ mol\ H_2O} = 17.1\ g\ H_2O;$$ mass of solution = 17.1 + 1.90 = 19.0 g solution

$$\text{mass percent} = \frac{mass\ NaOH}{mass\ solution} \times 100\% = \frac{1.90\ g\ NaOH}{19.0\ g\ solution} = 10.0\%\ \text{NaOH}$$

$$\frac{0.0476\ mol\ NaOH}{19.0\ g\ solution} \times \frac{1.11\ g}{1\ mL} \times \frac{1000\ mL}{1\ L} = 2.78\ \text{M NaOH}$$

4. A saturated solution at 80.°C contains 167 g KNO_3 dissolved in 100. g H_2O.

$$167\ \text{g}\ KNO_3 \times \frac{1\ mol\ KNO_3}{101.1\ g\ KNO_3} = 1.65\ \text{mol}\ KNO_3$$

$$100.\ \text{g}\ H_2O \times \frac{1\ mol\ H_2O}{18.0\ g\ H_2O} = 5.56\ \text{mol}\ H_2O;$$ total moles = 1.65 + 5.56 = 7.21 moles

$$\text{mole fraction} = \frac{moles\ KNO_3}{total\ moles} = \frac{1.65\ moles\ KNO_3}{7.21\ moles} = 0.229$$

5. 44.6 g C_7H_8 in 250. g of benzene.
From the chart, bp(benzene) = 80.10°C; k_b(benzene) = 2.53 °C·kg/mol

$$\Delta T_b = k_b \times \frac{mol\ solute\ particles}{kg\ solvent}$$

$$44.6\ C_7H_8 \times \frac{1\ mol\ C_7H_8}{92.0\ g\ C_7H_8} = 0.485 \text{ moles } C_7H_8$$

$$250.\text{ g benzene} \times \frac{1\ kg\ benzene}{1000\ g\ benzene} = 0.250 \text{ kg benzene}$$

$$\Delta T_b = 2.53\ ^\circ C \times \frac{0.485\ moles}{0.250\ kg\ benzene} = 4.91^\circ C;\quad T_b = 80.10 + 4.91 = 85.01^\circ C$$

6. $\Delta T_F = k_F \times \frac{mol\ solute\ particles}{kg\ solvent}$; k_F(H_2O) = 1.86 °C·kg/mol; ΔT_f = 10.0°C

$$\Delta T_F = 1.86 \times \frac{moles\ solute\ particles}{kg\ H_2O};\ 10.0^\circ C = 1.86 \times \frac{moles\ solute\ particles}{0.200\ kg\ H_2O}$$

$$\text{moles} = \frac{10.0}{1.86} \times 0.200 \text{ kg} = 1.08 \text{ mol particles}$$

$$1.08 \text{ mol particles} \times \frac{1\ mol\ CaCl_2}{3\ mol\ particles} \times \frac{111\ g\ CaCl_2}{1\ mol\ CaCl_2} = 40.0 \text{ g } CaCl_2$$

7. 9.00 g solute; 300.0 g water; T_f = -0.930°C. $\Delta T_F = k_F \times \frac{mol\ solute\ particles}{kg\ solvent}$

300. g H_2O = 0.300 kg H_2O. ΔT_f = 0.930°C; k_F(H_2O) = 1.86 °C·kg/mol

$$0.930^\circ C = 1.86^\circ C \cdot kg/mol \times \frac{mol\ solute}{0.300\ kg\ H_2O};\ \text{moles} = \frac{0.930}{1.86} \times 0.300 = 0.150 \text{ moles}$$

$$\text{molar mass} = \frac{mass}{moles} = \frac{9.00\ g}{0.150\ mol} = 60.0 \text{ g/mol};\ \text{alcohol is propanol: } C_3H_8O$$