Answers to Problems, Ch. 15, p. 499

(1) Homogeneous mixture is one that appears the same throughout; it has a uniform composition by all appearances.
solutions: air, saltwater

(4) Polar: usually soluble in water. Nonpolar: usually insoluble in water.
Longer molecules are often harder to dissolve than molecules of lower molecular weight

(6) unsaturated (8) large

(9) Incr in surface area = decrease in particle size. Greater surface area allows greater # of solute-solvent collisions per unit time

(12) (a) $\frac{5.00\text{g } CaCl_2}{5+95} \times 100 = 5\%$ solution

(c) $\frac{15.0\text{g } CaCl_2}{15+285} = \frac{15}{300} \times 100 = 5\%$ solution

(13) (a) $6.25\% = \frac{6.25\text{g NaCl}}{100\text{g total}} = \frac{x\text{g NaCl}}{11.5\text{g}} \Rightarrow (11.5)(6.25) = 100x$

$\frac{(11.5)(6.25)}{100} = x$

$0.719\text{g} = x$

(c) $0.91\% = \frac{0.91\text{g NaCl}}{100\text{g total}} = \frac{x\text{g NaCl}}{54.3\text{g}}$

$(54.3)(0.91) = 100x$

$\frac{(54.3)(0.91)}{100} = x$

$0.494\text{g} = x$

(15) $= \frac{67.5\text{g}}{67.5+275} \times 100$

$= \frac{67.5}{342.5} \times 100 = 19.7\%$

(17) 93 total

$5.2\% \times 93 = 4.84 = 4.8\text{g}$

$2.9\% \times 93 = 2.70 = 2.7\text{g}$

Hexane is presumably the rest.

$93 - (4.84 + 2.70) =$

85.5g (86g)

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(19) $\frac{0.221 \text{ moles } CaCl_2}{\text{liter}} \times \frac{1 \text{ mol } Ca^{2+}}{1 \text{ mol } CaCl_2} = 0.221 \text{ mol } Ca^{2+}$

$\frac{0.221 \text{ mol } CaCl_2}{\text{liter}} \times \frac{2 \text{ mol } Cl^-}{1 \text{ mol } CaCl_2} = 0.442 \text{ mol } Cl^-$

(21) (a) $M = \frac{n}{V}$ $M = \frac{0.50 \text{ mol}}{0.250 \text{ L}} = 2.0 M$

(c) $M = \frac{n}{V}$ $M = \frac{0.50 \text{ mol}}{0.750 \text{ L}} = 0.67 M$

(22) (a) $4.25 \text{ g} \times \frac{1 \text{ mol } CuCl_2}{134.45 \text{ g } CuCl_2} = 0.0316 \text{ mol}$ $63.55 + (2 \times 35.45) = 134.45$

$M = \frac{n}{V} = \frac{0.0316 \text{ mol}}{0.125 \text{ L}} = 0.253 M$

(c) $52.9 \text{ g } Na_2CO_3 \times \frac{1 \text{ mol}}{106 \text{ g}} = 0.499 \text{ mol}$

$\begin{array}{r} 23 \\ 23 \\ 12 \\ 48 \\ \hline 106 \end{array}$

$M = \frac{0.499 \text{ mol}}{1.15 \text{ L}} = 0.434 M$

(24) $\frac{5.15 \text{ g } I_2}{225 \text{ ml}} \Rightarrow M = \frac{0.0203}{0.225 \text{ L}} = 0.0902 M = 9.02 \times 10^{-2} M$

$5.15 \text{ g } I_2 \times \frac{1 \text{ mol}}{253.8 \text{ g}} = 0.0203 \text{ mol}$

(25) 

calibration mark in a 10.0 ml flask is at exactly 10.0 ml volume.

$1.01 \text{ g } FeCl_3 \times \frac{1 \text{ mol}}{162.2 \text{ g}} = 0.00623 \text{ mol}$

$55.85 + (3 \times 35.45) = 162.2$

$M = \frac{0.00623 \text{ mol}}{0.0100 \text{ L}} = 0.623 M$

$\frac{0.623 \text{ Mol } FeCl_3}{\text{L}} \times \frac{1 \text{ mol } Fe^{3+}}{1 \text{ mol } FeCl_3} = \frac{0.623 \text{ mol } Fe^{3+}}{\text{L}}$

$0.623 \text{ mol } FeCl_3 \times \frac{3 \text{ mol } Cl^-}{1 \text{ mol } FeCl_3} = 1.87 M \ Cl^-$

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27 (a) $0.127\,\text{L} \times \frac{0.105\,\text{mol}}{1\,\text{L}} = 0.0133\,\text{mol}$

} or, you could use $M = \frac{n}{V}$, but this is the same thing: $M \cdot V = n$

$0.133\,\text{mol} \times \frac{63.01\,\text{g}}{1\,\text{mol}} = 0.840\,\text{g}\ HNO_3$

$1.01 + 14.0 + (3 \times 16) = 63.01\,\text{g/mol}$

(c) $2.51\,\text{L} \times \frac{2.01 \times 10^{-3}\,\text{mol}}{1\,\text{L}} = 5.05 \times 10^{-3}\,\text{mol}$

$5.05 \times 10^{-3}\,\text{mol} \times \frac{97.18\,\text{g}}{1\,\text{mol}} = 4.90 \times 10^{-1}\,\text{g}$

1	
39.10	
32.06	
12.01	
14.01	
97.18	

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28 (a) $m = ?$, $V = 450.\,\text{mL}$, $M = 0.251\,M$

$M = \frac{n}{V}$

$0.251\,M = \frac{n}{0.450\,\text{L}}$

$n = 0.113\,\text{mol} \times \frac{53.5\,\text{g}}{1\,\text{mol}} = 6.04\,\text{g}$

NH_4Cl

$14 + 4 + 35.5 = 53.5\,\text{g/mol}$

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29 (a) $M = 0.451\,M$, $V = 0.0102\,\text{L}$, $n = ?$

$M = \frac{n}{V}$

$n = MV$

$n = (0.451)(0.0102) = 0.00460\,\text{mol}\ AlCl_3$

$0.00460\,\text{mol}\ AlCl_3 \times \frac{1\,\text{mol}\ Al^{3+}}{1\,\text{mol}\ AlCl_3} = 0.00460\,\text{mol}\ Al^{3+}\ \text{ions}$

$0.00460\,\text{mol}\ AlCl_3 \times \frac{3\,\text{mol}\ Cl^-}{1\,\text{mol}\ AlCl_3} = 0.0138\,\text{mol}\ Cl^-\ \text{ions}$

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31 (a) Well, we're going to have to assume that the volumes are additive, which usually isn't a good idea. On the other hand, there's not another way to solve these (at least as written).

$V_2 = 250 + 125 = 375\,\text{mL} = 0.375\,\text{L}$

$M_1V_1 = M_2V_2$

$\frac{(.261)(125)}{375} = 0.0837\,M$

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(31) (c) $V_1 = 5.25\ L$ $M_1 = 0.101\ M$

$V_2 = 5.25\ L + 0.250\ L = 5.50\ L$ $M_2 = ?$

$M_1V_1 = M_2V_2$ $M_2 = \frac{M_1V_1}{V_2} = \frac{(0.101\ M)(5.25\ L)}{(5.50\ L)} = 0.0964\ M$

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(33) $M_1 = 3.02\ M$ $V_1 = ?$

$M_2 = 0.150\ M$ $V_2 = 125\ ml$

$M_1V_1 = M_2V_2$ $V_1 = \frac{M_2V_2}{M_1} = \frac{(0.150)(125)}{3.02} = 6.21\ ml$

Add 6.21 ml of the stock 3.02 M solution to a 125-ml volumetric flask. Add water until the 125-ml mark, invert 10-20 times to mix.

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(36) $Ba(NO_3)_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaNO_3$

$Ba(NO_3)_2$		Na_2SO_4
0.15 M	M	0.25 M
12.5 ml	V	(c) 7.5 ml?
(a) 0.001875 mol	n	(b) 0.001875

(a) $M = \frac{n}{V} \Rightarrow n = MV = (0.15\ M)(0.0125\ L)$

$= 0.001875\ mol$

(b) $0.001875\ mol\ Ba(NO_3)_2 \times \frac{1\ mol\ Na_2SO_4}{1\ mol\ Ba(NO_3)_2} = 0.001875\ mol\ Na_2SO_4$

(c) $M = \frac{n}{V} \Rightarrow V = \frac{n}{M} = \frac{0.001875\ moles}{0.25\ \frac{moles}{liter}}$

$= 0.0075\ L$

$= 7.5\ ml$

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(38)

$Pb(NO_3)_{2\,(aq)} + K_2CrO_{4\,(aq)} \rightarrow PbCrO_{4\,(s)} + 2KNO_{3\,(aq)}$

1.00 g

$1.00\ g\ Pb(NO_3)_2 \times \frac{1\ mol}{331.2\ g} = 0.00302\ mol$

25.0 ml, 1.00 M

$M = \frac{n}{V} \Rightarrow 1.00\ \frac{mol}{L} = \frac{n}{0.0250\ L} \Rightarrow 0.025$ moles K_2CrO_4 (excess reagent!)

$0.00302\ mol\ Pb(NO_3)_2 \times \frac{1\ mol\ PbCrO_4}{1\ mol\ Pb(NO_3)_2} \times \frac{323\ g\ PbCrO_4}{1\ mol\ PbCrO_4} = 0.976\ g\ PbCrO_4$

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(40) $HCl + NaOH \rightarrow NaCl + HOH$

0.104	M	?
50.0 ml	V	48.7 ml
(a) 0.0052 mol	n	(b) 0.0052 mol

(a) $0.104\ \frac{mol}{L} \times 0.050\ L = 0.0052\ mol$

(b) $0.0052\ mol\ HCl \times \frac{1\ mol\ NaOH}{1\ mol\ HCl} = 0.0052\ mol\ NaOH$

(c) $n = 0.0052\ mol$

$V = 0.0487\ L$ $\quad M = \frac{n}{V} = \frac{0.0052\ mol}{0.0487\ L}$

$= 0.107\ M$

(For now, I'm not going to solve these problems on normality (#42 → #48).)

(49) Colligative = property that deals w/ solute sticking to solvent, thus affecting the vapor pressure, boiling point, & freezing point of a solution.