

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, salt water

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

(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) $\frac{5.00 \text{ g CaCl}_2}{5 + 95} \times 100 = 5\% \text{ solution}$

(c) $\frac{15.0 \text{ g CaCl}_2}{15 + 285} = \frac{15}{300} \times 100 = 5\% \text{ solution}$

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

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

$(54.3)(0.91) = 100x$

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

$0.494 \text{ g} = x$

$\frac{(11.5)(6.25)}{100} = x$
 $0.719 \text{ g} = x$

(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.

$93 - (4.84 + 2.70) =$

$85.5 \text{ g } (86 \text{ g})$

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

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

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

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

22 (a) $4.25 \text{ g} \times \frac{1 \text{ mol CuCl}_2}{134.45 \text{ g CuCl}_2} = 0.0316 \text{ mol}$

$63.55 + (2 \times 35.45) = 134.45$

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


(c) $52.9 \text{ g Na}_2\text{CO}_3 \times \frac{1 \text{ mol}}{106 \text{ g}} = 0.499 \text{ mol}$

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

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

24 $\frac{5.15 \text{ g I}_2}{225 \text{ ml}} \Rightarrow M = \frac{0.0203}{0.225 \text{ L}} = 0.0902 \text{ M} = 9.02 \times 10^{-2} \text{ M}$

$5.15 \text{ g I}_2 \times \frac{1 \text{ mol}}{253.8 \text{ g}} = 0.0203 \text{ mol}$

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

$1.01 \text{ g FeCl}_3 \times \frac{1 \text{ mol}}{162.2 \text{ g}} = 0.00623 \text{ mol}$

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

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

$\frac{0.623 \text{ mol FeCl}_3}{\text{L}} \times \frac{1 \text{ mol Fe}^{3+}}{1 \text{ mol FeCl}_3} = \frac{0.623 \text{ mol Fe}^{3+}}{\text{L}}$

$\frac{0.623 \text{ mol FeCl}_3 \times 3 \text{ mol Cl}^-}{1 \text{ mol FeCl}_3} = 1.87 \text{ M Cl}^-$

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27 a) $0.127 \cancel{\Delta} \times \frac{0.105 \text{ mol}}{\cancel{\Delta}} = 0.0133 \text{ mol}$ } or, you could use $M = \frac{n}{V}$, but this is the same thing: $M \cdot V = n$

$0.133 \text{ mol} \times \frac{63.01 \text{ g}}{1 \text{ mol}} = 0.840 \text{ g HNO}_3$

c) $2.51 \cancel{\Delta} \times \frac{2.01 \times 10^{-3} \text{ mol}}{\cancel{\Delta}} = 5.05 \times 10^{-3} \text{ mol}$

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

$$\begin{array}{r} 39.10 \\ 32.06 \\ 12.01 \\ 14.01 \\ \hline 97.18 \end{array}$$

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

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

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

NH_4Cl
 $14 + 4 + 35.5$
 $= 53.5 \text{ g/mol}$

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

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

$n = MV$

$n = (0.451)(0.0102) = 0.00460 \text{ mol AlCl}_3$

$0.00460 \text{ mol AlCl}_3 \times \frac{1 \text{ mol Al}^{3+}}{1 \text{ mol AlCl}_3} = 0.00460 \text{ mol Al}^{3+} \text{ ions}$

$0.00460 \text{ mol AlCl}_3 \times \frac{3 \text{ mol Cl}^-}{1 \text{ mol AlCl}_3} = 0.0138 \text{ mol Cl}^- \text{ ions}$

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 this (at least as written).

$\frac{1}{2} 250 + 125 = 375 \text{ mL} = 0.375 \text{ L}$

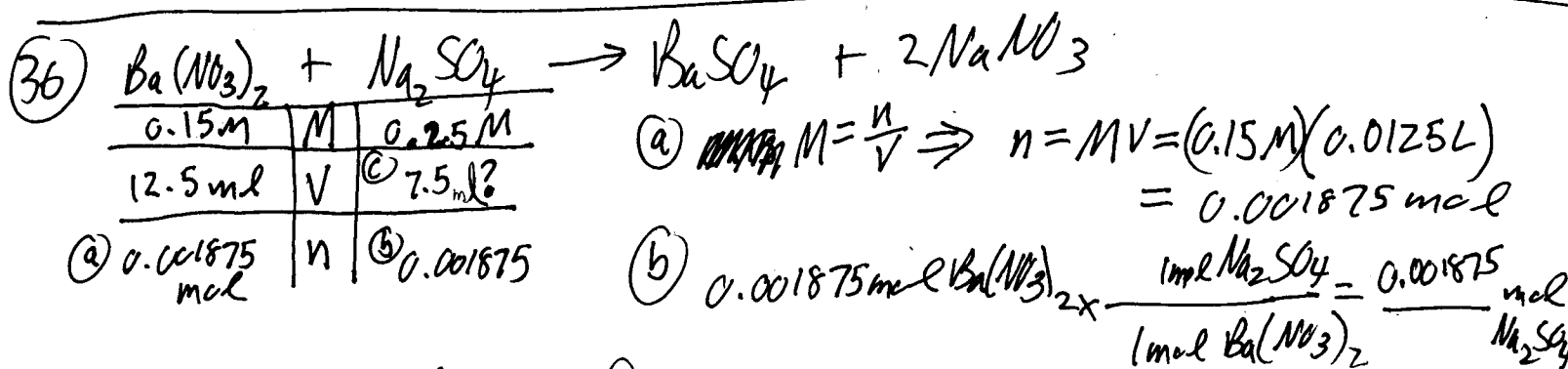
$M_1 V_1 = M_2 V_2$
 $\frac{(201)(125)}{375} = 0.0837 \text{ M}$

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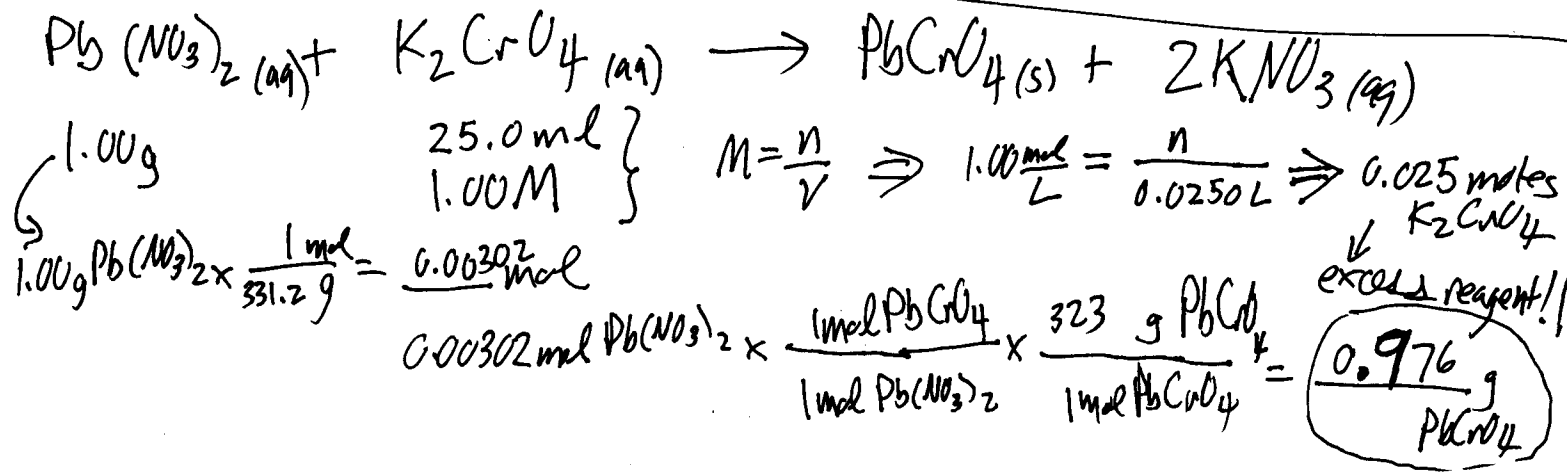
31) C $V_1 = 5.25 \text{ L}$ $M_1 = 0.101 \text{ M}$
 $V_2 = 5.25 \text{ L} + 0.250 \text{ L} = 5.50 \text{ L}$ $M_2 = ?$
 $M_1 V_1 = M_2 V_2$ $M_2 = \frac{M_1 V_1}{V_2} = \frac{(0.101 \text{ M})(5.25 \text{ L})}{(5.50 \text{ L})} = 0.0964 \text{ M}$

33) $M_1 = 3.02 \text{ M}$ $V_1 = ?$
 $M_2 = 0.150 \text{ M}$ $V_2 = 125 \text{ ml}$
 $M_1 V_1 = M_2 V_2$ $V_1 = \frac{M_2 V_2}{M_1} = \frac{(0.150)(125)}{3.02} = 6.21 \text{ ml}$

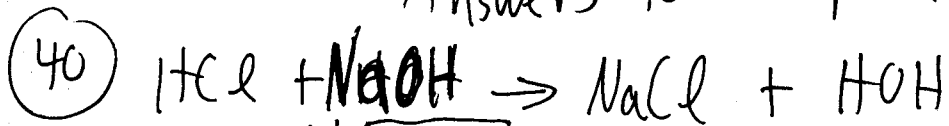
Add 6.21 ml of the stock 3.02 M solution to a 125-ml volumetric flask. ~~with a pipette~~ Add water until the 125-ml mark, invert 10-20 times to mix.



38) $M = \frac{n}{V} \Rightarrow V = \frac{n}{M} = \frac{0.001875 \text{ moles}}{0.25 \frac{\text{moles}}{\text{liter}}} = 0.0075 \text{ L} = 7.5 \text{ ml}$



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0.104 M		?
50.0 ml	V	48.7 ml

a) 0.0052 mol n b) 0.0052 mol

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

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

c) $n = 0.0052 \text{ mol}$
 $V = 0.0487 \text{ L}$ $M = \frac{n}{V} = \frac{0.0052 \text{ mol}}{0.0487 \text{ L}}$

$= 0.107 \text{ M}$

(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.