Molarity Worksheet

1) $\left(\frac{6.73\text{g } Na_2CO_3}{0.250\text{L}}\right)\left(\frac{1\text{ mol}}{106\text{g}}\right) = 0.254\text{ M } Na_2CO_3$ $[Na^+] = 0.508\text{ M}$ $[CO_3^{2-}] = 0.254\text{ M}$

2) $\left(\frac{2.335\text{g}}{0.5\text{L}}\right)\left(\frac{1\text{ mol}}{294.2\text{g}}\right) = 0.0159\text{ M } K_2Cr_2O_7$ $[K^+] = 0.0317\text{ M}$ $[Cr_2O_7^{2-}] = 0.0159\text{ M}$

3) $(0.250\text{L})\left(\frac{.0125\text{ mol}}{1\text{L}}\right)\left(\frac{158.94\text{g}}{1\text{ mol}}\right) = 0.5\text{ g } KMnO_4$

4) $\left(0.125\text{L}\right)\left(\frac{1.023\times10^{-3}\text{ mol}}{\text{L}}\right)\left(\frac{163.97\text{g}}{1\text{ mol}}\right) = 0.0209\text{ } Na_3PO_4$ $[Na^+] = 0.003069\text{M}$ $[PO_4^{3-}] = 1.023\times10^{-3}\text{M}$

5) $\left(25\text{g } N_2OH\right)\left(\frac{1\text{ mol}}{40.01\text{g}}\right)\left(\frac{1\text{L}}{0.123\text{mol}}\right) = 5.08\text{L}$

6) $\left(322\text{g } KMnO_4\right)\left(\frac{1\text{ mol}}{158.04\text{g}}\right)\left(\frac{1\text{L}}{2.06\text{ Mol}}\right) = 0.989\text{ L}$

7) $\left(0.004\text{L}\right)\left(\frac{0.0250\text{ mol}}{1\text{L}}\right) = \frac{1.0\times10^{-4}\text{ mol}}{.010\text{L}} =$ $0.01\text{ M } CoSO_4$

or use $M_1V_1 = M_2V_2$

8) $\left(0.025\text{L}\right)\left(\frac{1.50\text{mol}}{1\text{L}}\right) = \frac{0.0375\text{mol}}{0.500\text{L}} = 0.075\text{ M}$

or

$M_1V_1 = M_2V_2$ $\quad M_2 = \frac{M_1V_1}{V_2} = \frac{(1.50)(.025)}{(.5)} = 0.075\text{ M}$

9) $\left(\frac{0.125\text{mol } H_2SO_4}{1\text{L}}\right)\left(\frac{98.09\text{g}}{1\text{mol}}\right) = 12.26\text{g}$

use method "a"

10. The technique gives the answer: "add enough water to make 300 mL solution"
note: volumes are not always additive – the solute changes the volume...

11) a) $[NH_4^+] = 0.50\ M$ $[SO_4^{2-}] = 0.25\ M$

b) $[H^+] = 0.056\ M$ $[NO_3^-] = 0.056\ M$

c) $[Na^+] = 0.246\ M$ $[CO_3^{2-}] = 0.123\ M$

d) $[K^+] = 0.00124\ M$ $[ClO_4^-] = 0.00124\ M$

12) a) $[Ba^{2+}] = 0.12\ M$ $[Cl^-] = 0.24\ M$

b) $[Cu^{2+}] = 0.0125\ M$ $[SO_4^{2-}] = 0.0125\ M$

c) $[Al^{3+}] = 0.146\ M$ $[Cl^-] = 0.438\ M$

d) $[K^+] = 1.00\ M$ $[Cr_2O_7^{2-}] = 0.500\ M$

13) $2\ HNO_{3(aq)} + Ba(OH)_{2(s)} \rightarrow Ba(NO_3)_{2(aq)} + 2\ H_2O_{(l)}$

0.125 M (↑ HNO_3) 1.30 g (↑ $Ba(OH)_2$)

$$(1.30\text{ g } Ba(OH)_2)\left(\frac{1\text{ mol}}{171.35\text{ g}}\right)\left(\frac{2\text{ mol } HNO_3}{1\text{ mol } Ba(OH)_2}\right)\left(\frac{1\text{ L}}{0.125\text{ mol}}\right)\left(\frac{1000\text{ mL}}{1\text{ L}}\right) = 121.4\text{ mL}$$

0.125 M HNO_3

14) $2\ NaCl_{(aq)} + 2\ H_2O_{(l)} \rightarrow H_2{}_{(g)} + Cl_{2(g)} + 2\ NaOH_{(aq)}$

10 L, 0.5 M (NaCl) g? (↑ NaOH)

$$(10\text{ L})\left(\frac{0.5\text{ mol}}{1\text{ L}}\right)\left(\frac{2\text{ mol NaOH}}{2\text{ mol NaCl}}\right)\left(\frac{40.01\text{ g}}{1\text{ mol}}\right) = 60.\text{ g NaOH}$$

15) $(.250\text{g AgBr})\left(\frac{1\text{mol AgBr}}{187.77\text{g AgBr}}\right)\left(\frac{2\text{ mol } Na_2S_2O_3}{1\text{ mol AgBr}}\right)\left(\frac{1\text{ L } Na_2S_2O_3}{0.0138\text{ mol}}\right)\left(\frac{1000\text{mL}}{1\text{ L}}\right) = 192.96\text{mL}$ of 0.0138 M $Na_2S_2O_3$

16) $(2.25\text{ mol NaCl})\left(\frac{1\text{ mol } Pb(NO_3)_2}{2\text{ mol NaCl}}\right)\left(\frac{1\text{ L}}{0.750\text{ mol } Pb(NO_3)_2}\right)\left(\frac{1000\text{ mL}}{1\text{ L}}\right) = 1500\text{ mL}$ 0.750 M $Pb(NO_3)_2$

17) $(2.56\text{g } CaCO_3)\left(\frac{1\text{ mol } CaCO_3}{100.09\text{ g}}\right) = 0.026\text{ mol } CaCO_3$ available to react.

$(.250\text{L})\left(\frac{0.125\text{ mol HCl}}{1\text{ L}}\right) = .031\text{ mol HCl}$ available to react

since 2 mol HCl are required to react with every 1 mol of $CaCO_3$, $CaCO_3$ is in excess, HCl is limiting

$(0.031\text{ mol HCl})\left(\frac{1\text{ mol } CaCO_3}{2\text{ mol HCl}}\right)\left(\frac{100.09\text{ g}}{1\text{ mol } CaCO_3}\right) = 1.55\text{g } CaCO_3$ will be used in reaction

$2.56\text{g} - 1.55\text{g} = 1.01\text{ g } CaCO_3$ will remain

Mass $CaCl_2$ which can be produced:

$(0.031\text{ mol HCl})\left(\frac{1\text{ mol } CaCl_2}{2\text{ mol HCl}}\right)\left(\frac{110.98\text{g}}{1\text{ mol } CaCl_2}\right) = 1.72\text{g } CaCl_2$

18. $(1.33\text{ g NaOH})\left(\frac{1\text{ mol NaOH}}{40.0\text{ g NaOH}}\right)\left(\frac{1\text{ mol HCl}}{1\text{ mol NaOH}}\right)\left(\frac{1\text{ L}}{0.812\text{ mol}}\right)\left(\frac{1000\text{ mL}}{1\text{ L}}\right) = 40.9\text{ mL}$ 0.812 M HCl

19. $(2.152\text{ g } Na_2CO_3)\left(\frac{1\text{ mol } Na_2CO_3}{106.01\text{ g}}\right)\left(\frac{2\text{ mol HCl}}{1\text{ mol } Na_2CO_3}\right)\left(\frac{1\text{ L}}{0.955\text{ mol HCl}}\right)\left(\frac{1000\text{ mL}}{1\text{ L}}\right)$

$= 42.5\text{ mL}$ 0.955 M HCl

20 $(0.03351\text{ L})\left(\frac{0.0102\text{ mol NaOH}}{1\text{ L}}\right)\left(\frac{1\text{ mol } H_3C_6H_5O_7}{3\text{ mol NaOH}}\right)\left(\frac{192.14\text{ g}}{1\text{ mol } H_3C_6H_5O_7}\right)$

$= 0.022\text{ g } H_3C_6H_5O_7 / 100\text{ mL}$