particles = molecules = compound units = Formula units (FU)

① mole calculations
② Molarity
③ Dilution
④ Percent Composition
⑤ Empirical Formula
⑥ Molecular Formula

Convert from atoms, molecules, or formula units to grams.

① 35. 6.55×10^{24} atoms Ag

$$6.55 \times 10^{24} \text{ atoms} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ atoms}} \times \frac{107.868 \text{ g Ag}}{1 \text{ mol Ag}} = \boxed{1173.65 \text{ g}}$$

① 36. 8.66×10^{26} FU RbCl

$$8.66 \times 10^{26} \text{ FU RbCl} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ FU}} \times \frac{120.9207 \text{ g RbCl}}{1 \text{ mol RbCl}} = \boxed{173949.0468 \text{ g}}$$

① 37. 5.00×10^{32} molecules N_2H_4

$$5.00 \times 10^{32} \text{ molecules} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molecules}} \times \frac{32.0414 \text{ g } N_2H_4}{1 \text{ mol}} = \boxed{2.66 \times 10^{10} \text{ g } N_2H_4}$$

① 38. 5.3×10^{29} FU KBr

$$5.3 \times 10^{29} \text{ FU KBr} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ FU}} \times \frac{119.002 \text{ g KBr}}{1 \text{ mol}} = \boxed{104769202.7 \text{ g KBr}}$$

① 39. 25.3×10^{28} molecules C_4H_{10}

$$25.3 \times 10^{28} \text{ molecules} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molecules}} \times \frac{58.1144 \text{ g } C_4H_{10}}{1 \text{ mol}} = \boxed{24423493.69 \; C_4H_{10}}$$

① 40. 1.33×10^{25} atoms Ag

$$1.33 \times 10^{25} \text{ atoms Ag} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ atoms Ag}} \times \frac{107.868 \text{ g Ag}}{1 \text{ mol}} = \boxed{2383.13 \text{ g Ag}}$$

① 44. 1.55×10^{16} FU NaCl

$$1.55 \times 10^{16} \text{ FU NaCl} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ FU NaCl}} \times \frac{58.44277 \text{ g NaCl}}{1 \text{ mol}} = \boxed{1.50 \times 10^{-6} \text{ g NaCl}}$$

① 45. 2.55×10^{27} molecules NH_3

$$2.55 \times 10^{27} \text{ molecules} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molec.}} \times \frac{17.0277 \text{ g } NH_3}{1 \text{ mol}} = \boxed{72127.30 \text{ g } NH_3}$$

1 46. 5.3×10^{29} FU KBr

$$5.3 \times 10^{29}\ \text{FU KBr} \times \frac{1\ \text{mol}}{6.02 \times 10^{23}\ \text{FU}} \times \frac{119.002\ \text{g KBr}}{1\ \text{mol}} \boxed{= 1047692\,02.7\ \text{g}}$$

Convert from grams to **atoms, molecules, or formula units.**

1 47. 100. g H_2O_2

$$100\ \text{g}\ H_2O_2 \times \frac{1\ \text{mol}}{34.0128\ \text{g}\ H_2O_2} \times \frac{6.02 \times 10^{23}\ \text{particles}}{1\ \text{mol}} = \boxed{1.77 \times 10^{24}\ \text{particles}}$$

1 48. 2.6 g MgF_2

$$2.6\ \text{g}\ MgF_2 \times \frac{1\ \text{mol}}{62.301\ \text{g}\ MgF_2} \times \frac{6.02 \times 10^{23}}{1\ \text{mol}} = \boxed{2.51 \times 10^{22}\ \text{particles}}$$

1 49. 0.211 g C_5H_{12}

$$0.211\ \text{g}\ C_5H_{12} \times \frac{1\ \text{mol}}{72.1498\ \text{g}} \times \frac{6.02 \times 10^{23}\ \text{particles}}{1\ \text{mol}} = \boxed{1.76 \times 10^{21}\ \text{particles}}$$

1 50. 3.33×10^{-2} g Fe

$$3.33 \times 10^{-2}\ \text{g Fe} \times \frac{1\ \text{mol}}{55.847\ \text{g Fe}} \times \frac{6.02 \times 10^{23}\ \text{particles}}{1\ \text{mol}} = \boxed{3.59 \times 10^{20}\ \text{particles}}$$

1 51. 0.126 g Co

$$0.126\ \text{g Co} \times \frac{1\ \text{mol}}{58.933\ \text{g}} \times \frac{6.02 \times 10^{23}\ \text{particles}}{1\ \text{mol}} \boxed{= 1.29 \times 10^{21}\ \text{particles}}$$

1 7. Calculate the mass of 4.56×10^{25} atoms of Sr.

$$4.56 \times 10^{25} \text{ atoms Fe} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ atoms}} \times \frac{55.847 \text{ g Fe}}{1 \text{ mol}} = \boxed{4230.27 \text{ g}}$$

1 8. Calculate the mass of 6.33×10^{20} molecules of CO_2.

$$6.33 \times 10^{20} \text{ molecules} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molecules}} \times \frac{44.0099 \text{ g } CO_2}{1 \text{ mol}} = \boxed{0.0463 \text{ g}}$$

1 9. Calculate the mass of 8.66×10^{26} FU of SrO.

$$8.66 \times 10^{26} \text{ FU SrO} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ FU}} \times \frac{103.6194 \text{ g SrO}}{1 \text{ mol}} = \boxed{149060.4658 \text{ g}}$$

1 10. Calculate the mass of 2.3×10^{28} FU of $SrCO_3 \cdot H_2O$.

$$2.3 \times 10^{28} \text{ FU } SrCO_3 \cdot H_2O \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ FU}} \times \frac{\overset{165.6427}{\cancel{147.6293}} \text{ g } SrCO_3 \cdot H_2O}{1 \text{ mol}} \boxed{= 6328541.694 \text{ g}}$$

1 11. Calculate the number of H atoms in 5.02 g of CH_4. There are 4 atoms of H in one molecule of CH_4.

$$5.02 \text{ g } CH_4 \times \frac{1 \text{ mol}}{16.0391 \text{ g } CH_4} \times \frac{6.02 \times 10^{23} \text{ particles}}{1 \text{ mol}} \times \frac{4 \text{ H atoms}}{1 \text{ particle}} \boxed{= 7.54 \times 10^{23} \text{ atoms}}$$

1 12. Calculate the number of O atoms in 200. g $Al_2(SO_4)_3$. There are 12 atoms of O in one formula unit of $Al_2(SO_4)_3$.

$$200 \text{ g } Al_2(SO_4)_3 \times \frac{1 \text{ mol}}{342.1358 \text{ g } Al_2(SO_4)_3} \times \frac{6.02 \times 10^{23} \text{ particles}}{1 \text{ mol}} \times \frac{12 \text{ atoms}}{1 \text{ particle}}$$

$$\boxed{= 4.22 \times 10^{24} \text{ atoms}}$$

1 13. Calculate the mass of $CaCO_3$ that contains 2.00×10^{28} atoms of O. There are 3 atoms of O per one FU of $CaCO_3$.

$$2.00 \times 10^{28} \text{ atoms O} \times \frac{1 \text{ particle}}{3 \text{ atoms}} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ particles}} \times \frac{100.0893 \text{ g } CaCO_3}{1 \text{ mol}}$$

$$\boxed{= 1108408.638 \text{ g}}$$

$1 \text{ particles} = 12 \text{ atoms}$

1 14. Calculate the mass of $Al_2(SO_4)_3$ that contains 2.00×10^{28} atoms of O.

M. M.

$2.00 \times 10^{28} \text{ atoms O} \times \frac{1 \ Al_2(SO_4)_3 \text{ particles}}{12 \text{ atoms}} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ particles}} \times \frac{g}{\text{mol}}$

$2.00 \times 10^{28} \text{ atoms} \times \frac{1 \text{ particle}}{12 \text{ atoms}} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ particles}} \times \frac{342.1358 \text{ g}}{1 \text{ mol}} = \boxed{947219.8228 \text{ g } Al_2(SO_4)_3}$

1 15. Calculate the mass of $Al_2(SO_4)_3$ that contains 2.00×10^{20} atoms of Al.

$2.00 \times 10^{20} \text{ atoms Al} \times \frac{1 \text{ part.}}{2 \text{ atoms}} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ part.}} \times \frac{342.1358 \text{ g}}{1 \text{ mol}} = \boxed{0.0568 \text{ g } Al_2(SO_4)_3}$

1 16. Calculate the number of Al atoms in 500. g $Al_2(SO_4)_3$.

$500 \text{ g } Al_2(SO_4)_3 \times \frac{1 \text{ mol}}{342.1358 \text{ g } Al_2(SO_4)_3} \times \frac{6.02 \times 10^{23} \text{ particles}}{1 \text{ mol}} \times \frac{2 \text{ atoms}}{1 \text{ particles}} = \boxed{1.76 \times 10^{24} \text{ atoms}}$

Draw Electron-dot Diagrams for each of the following. Remember, use brackets for cations or anions. Covalent compounds do not require brackets.

17. C_2F_6

18. $KClO_4$

19. NH_3

20. Li_2CO_3

21. N_2

22. PO_3^{3-}

Worksheet #4 **Empirical Formula**

Use a calculation to determine the empirical formula of each of the following compounds. Show all of your work.

5 1. A compound is found to be 6.353 g Ag, 0.823 g N, and 2.824 g of O. Calculate the empirical formula of the compound.

$6.353\ g\ Ag \times \frac{1\ mol}{107.868\ g\ Ag} = 0.058896\ mol\ Ag$ $0.823\ g\ N \times \frac{1\ mol}{14.0067\ g} = 0.058758\ mol\ N$

$2.824\ g\ O \times \frac{1\ mol}{15.9994\ g\ O} = 0.176507\ mol\ O$ $\boxed{Ag}\ \frac{0.058896\ mol\ Ag}{0.058758\ mol\ N} = 1.0023$

$\boxed{AgNO_3}$ $\boxed{N}\ \frac{0.058758\ mol}{0.058758\ mol} = 1.000$ $\boxed{O}\ \frac{0.176507\ mol\ O}{0.058758\ mol\ N} = 3.003$

5 2. A compound is found to be 6.25 g Pb, 0.846 g N, and 2.90 g of O. Calculate the empirical formula of the above compound.

$6.25\ g\ Pb \times \frac{1\ mol}{207.2\ g\ Pb} = 0.030164\ mol\ Pb$ $2.90\ g\ O \times \frac{1\ mol}{15.9994\ g} = 0.181257\ mol\ O$

$0.846\ g\ N \times \frac{1\ mol}{14.0067\ g} = 0.0603997\ mol\ N$ $\boxed{Pb}\ \frac{0.03..\ mol\ Pb}{0.03..\ mol\ Pb} = 1.000$ $\boxed{N}\ \frac{0.0603..\ mol\ N}{0.03...\ mol\ Pb} = 2.00$ $\boxed{O}\ \frac{0.18..\ mol\ O}{0.03\ mol\ Pb} = 6.01$

$\boxed{PbN_2O_6}$

5 3. A compound is found to be 1.00 g Ca, 0.700 g N, and 2.40 g O. Calculate the empirical formula of the above compound.

$1.00\ g\ Ca \times \frac{1\ mol\ Ca}{40.078\ g} = 0.024951\ mol\ Ca$ $\boxed{Ca}\ \frac{0.02...\ mol\ Ca}{0.02..\ mol\ Ca} = 1.000...$

$0.700\ g\ N \times \frac{1\ mol\ N}{14.00674\ g} = 0.049976\ mol\ N$ $\boxed{N}\ \frac{0.049976\ mol\ N}{0.02..\ mol\ Ca} = 20.029$

$2.40\ g\ O \times \frac{1\ mol\ O}{15.9994\ g} = 0.15000\ mol\ O$ $\boxed{O}\ \frac{0.15001\ mol\ O}{0.02..\ mol\ Ca} = 6.012..$ $\boxed{CaN_2O_6}$

5 4. A compound is found to be 27.91 % Fe, 24.08 % S, and 48.0 % O. Calculate the empirical formula.

$27.91\ g\ Fe \times \frac{1\ mol}{55.845\ g\ Fe} = 0.49978\ mol\ Fe$ $24.08\ g\ S \times \frac{1\ mol}{32.066\ g} = 0.74995\ mol\ S$

$\boxed{Fe}\ \frac{0.49...\ mol\ Fe}{0.49..\ mol\ Fe} = 1.000$ x2 $\boxed{S}\ \frac{0.74..\ mol\ S}{0.49..\ mol\ Fe} = 1.500$ x2

$48.0\ g\ O \times \frac{1\ mol}{15.9994\ g} = 3.00011\ mol\ O$ $\boxed{O}\ \frac{3.000..\ mol\ O}{0.49..\ mol\ Fe} = 6.0026$ x2

$\boxed{Fe_2O_{12}S_3}$

5 5. A compound is found to be 15.38 % Co, 40.74 % Cr, and 43.88 % O. Calculate the empirical formula.

$5.28\ g\ Co \times \frac{1\ mol}{58.933\ g} = 0.260974\ mol\ Co$ $\boxed{Co}\ \frac{0.26..\ mol\ Co}{0.26..\ mol\ Co} = 1.000$ x2 $= 2.0$

$0.74\ g\ Cr \times \frac{1\ mol}{51.9961\ g} = 0.78352\ mol\ Cr$ $\boxed{Cr} = \frac{0.78...\ mol\ Cr}{0.26...\ mol\ Co} = 3.0022$ x2 $= 6.0$ $\boxed{Co_2Cr_2O_{21}}$

$13.88\ g\ O \times \frac{1\ mol}{15.9994\ g\ O} = 2.7426\ mol\ O$ $\boxed{O}\ \frac{2.74...\ mol\ O}{0.26...\ mol\ Co} = 10.509$ x2 $= 21.01$

5 6. A compound is found to be 63.65 % C, 10.71 % H, 18.56 % N, and 7.072 % O. Calculate the empirical formula.

$63.65\,g\,C \times \frac{1\ mol}{12.01079} = 5.2994\ mol\ C$ $\quad 10.71\,g \times \frac{1\ mol}{1.007949\ H} = 10.6256\ mol\ H$ $\quad 18.56\,g\,N \times \frac{1\ mol}{14.00679} = 1.32508\ mol\ N$

$1.072\,g\,O \times \frac{1\ mol}{15.9994\,g} = 0.44202\ mol\ O$

$\boxed{C}\ \frac{5.2994\ mol\ C}{0.44\ mol\ O} = 11.989$ $\quad \boxed{O}\ \frac{0.44..\ mol\ O}{0.44\ mol\ O} = 1.00$ $\quad \boxed{N}\ \frac{1.32\ mol\ N}{0.44\ mol\ O} = 2.997$ $\quad \boxed{H}\ \frac{10.6...\ mol\ H}{0.44...\ mol\ O} = 24.03$

$\boxed{C_{12}ON_3H_{24}}$

1 7. Change 5.0 x 10^{26} formula units $CoCl_2 \cdot 6H_2O$ to grams.

$5.0 \times 10^{26}\ FU \times \frac{1\ mol}{6.02 \times 10^{23}\ FU} \times \frac{237.93028\ g}{1\ mol} = \boxed{197616.51\ g\ CoCl_2 \cdot 6H_2O}$

1 8. Convert 2.36 g $FeSO_4 \cdot 5H_2O$ to formula units.

$2.36\,g\ FeSO_4 \cdot 5H_2O \times \frac{1\ mol}{241.985\ g\ FeSO_4 \cdot 5H_2O} \times \frac{6.02 \times 10^{23}\ FU}{1\ mol} = \boxed{5.87 \times 10^{21}\ FU}$

1 9. Change 3.65 x 10^{22} molecules CO_2 to grams.

$3.65 \times 10^{22}\ molecules \times \frac{1\ mol}{6.02 \times 10^{23}\ molecules} \times \frac{44.0095\ g}{1\ mol} = \boxed{2.668\ g\ CO_2}$

1 10. Convert 2.36 g grams P_2O_5 to molecules.

$2.36\,g\ P_2O_5 \times \frac{1\ mol}{141.944522\,g} \times \frac{6.02 \times 10^{23}\ molec.}{1\ mol} = \boxed{1.00 \times 10^{22}\ molecules}$

Calculate the percentage composition for:

$\boxed{O} = \frac{4(15.9994)}{161.4536} \times 100 \boxed{= 39.6\%}$

4 16. $ZnSO_4 \rightarrow$ M. M. = 161.4536 g/mol

$\boxed{Zn}\ \frac{65.39}{161.4536} \times 100 = \boxed{40.5\%}$ $\boxed{S}\ \frac{32.066}{161.4536} \times 100 = \boxed{19.9\%}$

4 17. $Al_2(CO_3)_3 \rightarrow$ 233.989776 g/mol

$Al = \frac{2(26.981538)}{233.989776} \times 100 = \boxed{23.1\%}$ $C = \frac{3(12.0107)}{233.989776} \times 100 = \boxed{15.4\%}$ $O = \frac{9(15.9994)}{233.989776} \times 100 = \boxed{61.5\%}$

4 18. $Ca_3(PO_4)_2 \rightarrow$ 310.176722 g/mol

% Ca = $\frac{3(40.078)}{310.176722} \times 100 \boxed{= 38.9\%}$ $\%P = \frac{2(30.973761)}{310.176722} \times 100 \boxed{= 20.0\%}$ $\%O = \frac{8(15.9994)}{310.176722} \times 100 \boxed{= 41.3\%}$

1 19. Convert 3.66 kg CO_2 to molecules.

$3.66\ \text{Kg} \times \frac{1000\ g}{1\ Kg} \times \frac{1\ mol}{44.0095\ g} \times \frac{6.02 \times 10^{23}\ \text{molecules}}{1\ mol} = \boxed{5.01 \times 10^{25}\ \text{molecules}}$

1 20. Covert 4.0 x 10^{26} FU of $MgCl_2$ to Kg.

$4.0 \times 10^{26}\ FU \times \frac{1\ mol\ MgCl_2}{6.02 \times 10^{23}\ FU} \times \frac{95.2104\ g\ MgCl_2}{1\ mol\ MgCl_2} \times \frac{1\ Kg}{1000\ g} = \boxed{63.26\ Kg}$

1 21. In a propane tank there are 9.0 Kg of C_3H_8, calculate the number of H atoms. (First calculate molecules and then H atoms)

$9.0\ kg\ C_3H_8 \times \frac{1000\ g}{1\ Kg} \times \frac{1\ mol\ C_3H_8}{44.09562 g} \times \frac{6.02 \times 10^{23}\ \text{molecules}}{1\ mol.} \times \frac{8\ \text{H atoms}}{1\ \text{molecule}}$

$\boxed{= 9.83 \times 10^{26}\ \text{atoms}}$

1 22. A certain mass of complex $Co(NH_3)_6Cl_3$ was found to contain 2.65 x 10^{21} atoms ~~of~~ H, calculate the mass of cobalt III chloride hexammine. (Change the number of atoms to FU's first).

$2.65 \times 10^{21}\ \text{atoms H} \times \frac{1\ FU}{18\ atoms} \times \frac{1\ mol}{6.02 \times 10^{23}\ FU} \times \frac{267.47466 g\ Co(NH_3)_6Cl_3}{1\ mol}$

$\boxed{0.0654\ g\ Co(NH_3)_6Cl_3}$

Worksheet # 6 Mole Calculations to Molecular Formula

1 1. Convert 500. g NaCl to formula units.

$$500.\text{ g NaCl} \times \frac{1 \text{ mol NaCl}}{58.44247 \text{ g NaCl}} \times \frac{6.02 \times 10^{23}\text{ FU}}{1 \text{ mol}} = \boxed{5.15 \times 10^{24}\text{ FU.}}$$

1 2. Convert 9.8×10^{24} molecules of C_2H_6 to grams.

$$9.8 \times 10^{24}\text{ molecules } C_2H_6 \times \frac{1 \text{ mol } C_2H_6}{6.02 \times 10^{23}\text{ molec.}} \times \frac{30.06904 \text{ g } C_2H_6}{1 \text{ mol } C_2H_6}$$

$$\boxed{= 489.496 \text{ g } C_2H_6}$$

1 3. Calculate the number of O atoms in 50.0 lb of dry ice CO_2.
(2.21 lb = 1.00Kg)

$$50.0\text{ lb} \times \frac{1 \text{ Kg}}{2.21 \text{ lb}} \times \frac{1000 \text{ g}}{1 \text{ Kg}} \times \frac{1 \text{ mol } CO_2}{44.0095 \text{ g}} \times \frac{6.02 \times 10^{23}\text{ molecules}}{1 \text{ mol}} \times \frac{2 \text{ O atom}}{1 \text{ molecule}}$$

$$\boxed{= 6.19 \times 10^{26}\text{ atoms}}$$

4 4. Calculate the percentage composition of $Al_2(SO_4)_3$. 3 significant figures! → 342.153876 g/mol

$$\%Al = \frac{2(26.981538)}{342.153876} \times 100 \quad \boxed{= 15.8\%}$$

$$\%S = \frac{3(32.066)}{342.153876} \times 100 \quad \boxed{= 28.1\%}$$

$$\%O = \frac{12(15.9994)}{342.153876} \times 100 \quad \boxed{= 56.1\%}$$

1 5. Calculate the molar mass of $Co_2(SO_4)_3 \cdot 6H_2O$

Co = 2(58.933200)
S = 3(32.066)
O = + 12(15.9994)
406.0572

H = 2(1.00794)
O = + 15.9994
6 + 18.01528

$\boxed{514.14888 \text{ g/mol}}$

5 6 6. The empirical formula for a compound is C_2H_5O and its molecular mass is 135 g/mol. The molecular formula is: → 45.0605 g/mol

$$T.F. = \frac{M.T.F}{M.E.F} = \frac{135\ g/mol}{45.0605\ g/mol} \cong 3 \quad \boxed{C_6H_{15}O_3}$$

5 7. A compound is 24.4 % Ca, 17.1 % N and 58.5 % 0. Calculate the empirical formula.

$$Ca\ 24.4g \times \frac{1\ mol}{40.0789} = 0.67881\ mol\ Ca$$

$$N = 17.1g \times \frac{1\ mol}{14.00674g} = 1.22084\ mol\ N$$

$$O \cdot 58.5g \times \frac{1\ mol\ O}{15.99949\ O} = 3.65639\ mol\ O$$

$$\boxed{Ca}\ \frac{0.6..mol\ Ca}{0.6..mol\ Ca} = 1.000... \times 5 = 5$$

$$\boxed{N}\ \frac{1.22..mol\ N}{0.6..mol\ Ca} = 1.7985 \times 5 = 9$$

$$\boxed{O}\ \frac{3.6...mol\ O}{0.6...mol\ Ca} = 5.39 \times 5 = 27$$

$$\boxed{Ca_5N_9O_{27}}$$

5 6 8. Hydroquinone, a chemical used for photographic developing, is 65.45 % C, 5.51 % H and 29.09 % O. Calculate the empirical and molecular formula. The molecular mass is 110g/mol.

$$65.45g\ C \times \frac{1\ mol}{12.0107g} = 5.44931\ mol\ C$$

$$5.51g\ H \times \frac{1\ mol}{1.00794\ g} = 5.46660\ mol\ H$$

$$29.09\ g\ O \times \frac{1\ mol\ O}{15.9994\ gO} = 1.81819\ mol\ O$$

$$\boxed{C}\ \frac{5.44..mol\ C}{1.8...mol\ O} = 3.0 \qquad \boxed{H}\ \frac{5.46..mol\ H}{1.8..mol\ O} = 3.0 \qquad \boxed{C_3H_3O}$$

$$\boxed{O}\ \frac{1.8..mol\ O}{1.8..mol\ O} = 1.0$$

$$T.F. = \frac{MTF}{MEF} = \frac{110\ g/mol}{55.05532} = 2 \quad \boxed{C_6H_6O_2}$$

5 6 9. A compound is 50.5 % C, 5.26 % H, and 44.2 % N, calculate the empirical formula. If the molecular mass is 380.2 g / mole, calculate the molecular formula.

$$50.5g\ C \times \frac{1\ mol}{12.0107\ g} = 4.20458\ mol\ C$$

$$5.26g\ H \times \frac{1\ mol}{1.00794\ g} = 5.21856\ mol\ H$$

$$44.2g\ N \times \frac{1\ mol\ N}{14.00674\ g} = 3.15562\ mol\ N$$

$$\boxed{E}\ \frac{4.2...mol\ C}{3.1...mol\ N} = 1.33 \times 3 = 4$$

$$\boxed{H}\ \frac{5.2...mol\ H}{3.1...mol\ N} = 1.654 \times 3 = 5$$

$$\boxed{N}\ \frac{3.1...mol\ N}{3.1...mol\ N} = 1.0 \times 3 = 3$$

$$\boxed{C_4H_5N_3} \quad T.F. = \frac{M.T.F}{MEF} = \frac{380.2}{95.10272} = 4 \longrightarrow \boxed{C_{16}H_{20}N_{12}}$$

5 6 10. A compound is 50.5 % C, 5.26 % H, and 44.2 % N, calculate the empirical formula. If the molecular mass is 285.15 g/mole, what is the molecular formula?

$$50.5g\ C \times \frac{1\ mol}{12.0107g} =$$

$$5.26g\ H \times \frac{1\ mol}{1.00794\ g} =$$

Just realized this is the same as #9

$$E.F. = \boxed{C_4H_5N_3}$$

$$T.F. = \frac{M.T.F}{M.E.F} = \frac{285.15}{95.10272} = 3$$

$$T.F. = \boxed{C_{12}H_{15}N_9}$$

1 9. In a propane tank there are 8.0 Kg of C_3H_8. Calculate the number of H atoms. (First calculate molecules and then H atoms).

$8.0 \text{ Kg } C_3H_8 \times \frac{1000 \text{ g } C_3H_8}{1 \text{ Kg}} \times \frac{1 \text{ mol}}{44.09562 \text{ g}} \times \frac{6.02\times10^{23} \text{ molec.}}{1 \text{ mol}} \times \frac{8 \text{ H atoms}}{1 \text{ molecule}}$

$\boxed{= 8.74 \times 10^{26} \text{ H atoms}}$

1 10. A certain mass of complex $Co(NH_3)_6Cl_3$ was found to contain 2.65×10^{25} FU, calculate the mass of cobalt III chloride hexammine.

$2.65 \times 10^{25} \text{ FU} \times \frac{1 \text{ mol}}{6.02\times10^{23} \text{ FU}} \times \frac{267.47466 \text{ g}}{1 \text{ mol } Co(NH_3)_6Cl_3} = \boxed{11774.22 \text{ g } Co(NH_3)_6Cl_3}$

6 11. The empirical formula of a compound is $C_3H_{11}O_3$ and its molecular mass is 380.44 g/mole. Determine the molecular formula. → 95.11764 g/mol

$\text{T.F.} = \frac{\text{MTF}}{\text{MEF}} = \frac{380.44 \text{ g/mol}}{95.11764 \text{ g/mol}} \cong 4$

$\boxed{C_{12}H_{44}O_{12}}$

4 12. Calculate the percentage composition of $Co(NH_3)_6Cl_3$ to three significant figures. → 267.4766 g/mol

$\% Co = \frac{58.9332}{267.4766} \times 100 = \boxed{22.0\%}$

$\% H = \frac{18(1.00794)}{267.4766} \times 100 = \boxed{6.78\%}$

$\% N = \frac{6(14.00674)}{267.4766} \times 100 = \boxed{31.4\%}$

$\% Cl = \frac{3(35.4527)}{267.4766} \times 100 = \boxed{39.8\%}$

5 13. A compound is 27.73 % Mg, 23.58 % P, and 48.69 % O, calculate the empirical formula.

$27.73 \text{ g Mg} \times \frac{1 \text{ mol}}{24.305 \text{ g}} = 1.14092 \text{ mol Mg} \div 0.761... \text{mol P} = 1.498 \times 2 = 3$

$23.58 \text{ g P} \times \frac{1 \text{ mol}}{30.973761 \text{ g}} = 0.76129 \text{ mol P} \div 0.761... \text{mol P} = 1.000 \times 2 = 2$

$48.69 \text{ g O} \times \frac{1 \text{ mol}}{15.9994 \text{ g}} = 3.043239 \text{ mol O} \div 0.761... \text{mol P} = 3.997 \times 2 = 8$

$\boxed{Mg_3P_2O_8}$

Worksheet #8 **Review of Mole Calculations**

1 1. Convert 2.59 g of SO_3 to molecules.

$$2.59g\ SO_3 \times \frac{1\ mol\ SO_3}{80.0642\ g} \times \frac{6.02 \times 10^{23}\ molecules}{1\ mol\ SO_3} = \boxed{1.95 \times 10^{22}\ molecules}$$

1 2. Convert 3.56 x 10^{25} FU of $CoCl_4$ to Kg.

$$3.56 \times 10^{25} FU\ CoCl_4 \times \frac{1\ mol\ CoCl_4}{6.02 \times 10^{23}\ FU\ CoCl_4} \times \frac{200.74428 g}{1\ mol} \times \frac{1\ Kg}{1000\ g}$$
$$\boxed{= 11.81 Kg\ CoCl_4}$$

1 3. In a propane tank there are 26.5 Kg. of C_2H_6. Calculate the number of H atoms.

$$26.5 Kg\ C_2H_6 \times \frac{1000\ g}{1\ Kg} \times \frac{1\ mol}{60.30724 g\ C_2H_6} \times \frac{6.02 \times 10^{23} molecule}{1\ mol\ C_2H_6} \times \frac{6\ H\ atoms}{1\ molecule}$$
$$\boxed{= 1.59 \times 10^{27} atoms\ of\ H}$$

4. Describe each atom as an atom, molecule, anion, cation, or a formula unit:

CO_2	molecule
Co	atom
$AgNO_3$	Formula Unit
KCl	Formula Unit
$Cr_2O_7^{2-}$	anion
NH_4^+	Cation

1 5. Convert 568 g of H_3PO_4 to moles.

$$568 g\ H_3PO_4 \times \frac{1\ mol}{142.969561\ g}\ H_3PO_4 = \boxed{3.97\ mole\ H_3PO_4}$$

1 6. Convert 3.25 x 10^5g Rh into atoms.

$$3.25 \times 10^5 g\ Rh \times \frac{1\ mol\ Rh}{102.9055\ g} \times \frac{6.02 \times 10^{23}\ particles\ \cancel{molecules}}{1\ mol} \times \frac{1\ atom\ Rh}{1\ particle}$$
$$\boxed{= 1.90 \times 10^{27}\ Rh\ atoms}$$

1 7. Calculate the molar mass of the following compounds:

$Hg_3(PO_4)_2$ = 791.71 g/mol

CuI_2 = 317.35 g/mol

Pb_2SO_4 = 510.4636 g/mol

Li_2SO_3 = 93.9462 g/mol

30.06904 g/mol

4 8. What is the percent composition of $C_2H_6 \longrightarrow$

$\boxed{\%C} = \frac{2(12.0107)}{30.06904} \times 100$ $\boxed{= 79.9\%}$

$\boxed{\%H} = \frac{6(1.00794)}{30.06904} \times 100$ $\boxed{= 20.1\%}$

4 9. What is the percent composition of $CaCl_2 \cdot 2H_2O \longrightarrow$ 147.0141

$\%Ca = \frac{40.078}{147.0141} \times 100 = \boxed{27.3\%}$ $\%H = \frac{4(1.00794)}{147.0141} \times 100 = \boxed{2.7\%}$

$\%Cl = \frac{2(35.45277)}{147.0141} \times 100 = \boxed{48.2\%}$ $\%O = \frac{2(15.9994)}{147.0141} \times 100 = \boxed{21.8\%}$

6 10. The empirical formula of a compound is SiH_3. If 0.0275 mol of the compound has a mass of 1.71 g, what is the compounds molecular formula?

$SiH_3 \rightarrow 31.10932$ g/mol

$M.M = \frac{1.71 \text{ g}}{0.0275 \text{ mol}} = 62.1\overline{8}$

$T.F. = \frac{M.T.F}{M.E.F} = \frac{62.18}{31.11} \cong 2$ $\boxed{Si_2H_6}$

5 11. A compound is 27.73% Mg, 23.58% P, and 48.69% O, calculate the empirical formula.

identical to #13 on pg 99

5 12. Find the empirical formula for a compound containing 46.3 % Li and 53.7 % O.

$46.3\text{ g Li} \times \frac{1 \text{ mol}}{6.941 \text{ g}} = 6.67051 \text{ mol Li} \div 3.3\ldots \text{mol O} = 1.98 \cong 2$

$53.7\text{ g O} \times \frac{1 \text{ mol}}{15.9994 \text{ g}} = 3.35638 \text{ mol O} \div 3.3\ldots \text{mol O} = 1.000 = 1$

$\boxed{Li_2O}$

1 13. Convert 5.65 x 10^{17} atoms of Fe into grams.

$5.65 \times 10^{17} \text{ atoms Fe} \times \frac{1 \text{ particle Fe}}{1 \text{ atom Fe}} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ part.}} \times \frac{55.845 \text{ g Fe}}{1 \text{ mol Fe}}$

$= 5.24 \times 10^{-5} \text{ g Fe}$

Worksheet # 5 Review of moles to STP

1 1. Convert 1.65 Kg CO_2 to molecules.

$$1.65\text{ Kg } CO_2 \times \frac{1000\text{ g}}{1\text{ Kg}} \times \frac{1\text{ mol } CO_2}{44.0098\text{ g } CO_2} \times \frac{6.02\times10^{23}\text{ molec. } CO_2}{1\text{ mol } CO_2} = \boxed{2.26\times10^{25}\text{ molec.}}$$

1 2. Covert 2.0 x 10^{26} FU of $MgCl_2$ to Kg.

$$2.0\times10^{26}\text{ FU} \times \frac{1\text{ mol}}{6.02\times10^{23}\text{ FU}} \times \frac{95.2104\text{ g}}{1\text{ mol}} \times \frac{1\text{ Kg}}{1000\text{ g}} = \boxed{31.63\text{ Kg}}$$

1 3. In a propane tank there are 9.0 Kg of C_3H_8, calculate the number of H atoms. (First calculate molecules and then H atoms).

$$9.0\text{ Kg} \times \frac{1000\text{ g}}{1\text{ Kg}} \times \frac{1\text{ mol}}{44.0962\text{ g}} \times \frac{6.02\times10^{23}\text{ molec}}{1\text{ mol}} \times \frac{8\text{ atoms}}{1\text{ molec.}} = \boxed{9.83\times10^{26}\text{ atoms}}$$

1 4. A certain mass of complex $Co(NH_3)_6Cl_3$ was found to contain 2.65 x 10^{21} atoms of H, calculate the mass of cobalt III chloride hexammine (change atoms to FU's 1st).

$$2.65\times10^{21}\text{ atoms H} \times \frac{1\text{ FU}}{18\text{ atoms H}} \times \frac{1\text{ mol}}{6.02\times10^{23}\text{ FU}} \times \frac{267.4735\text{ g } Co(NH_3)_6Cl_3}{1\text{ mol}}$$

$$\boxed{= 0.0654\text{ g}}$$

4 5. Calculate the percentage composition of $Co(NH_3)_6Cl_3$ to three significant digits.
→ 267.4735 g/mol

$$\%Co = \frac{58.933}{267.4735}\times100 = \boxed{22.0\%}$$

$$\%H = \frac{18(1.0079)}{267.4735}\times100 = \boxed{6.78\%}$$

$$\%N = \frac{6(14.0067)}{267.4735}\times100 = \boxed{31.4\%}$$

$$\%Cl = \frac{3(35.5427)}{267.4735}\times100 = \boxed{39.8\%}$$

5 6 6. A compound is 71.6 % C, 6.03 % H, 10.4 % N, and 11.9 % O. If the molecular mass of the compound is 268.16 g/mol, calculate the empirical and the molecular formula.

I think this question is off...

$$71.6\text{ g C} \times \frac{1\text{ mol C}}{12.011\text{ g C}} = 5.96120\text{ mol C}$$

$$6.03\text{ g} \times \frac{1\text{ mol H}}{1.0079\text{ g H}} = 5.98274\text{ mol H}$$

$$10.4\text{ g N} \times \frac{1\text{ mol N}}{14.0067\text{ g}} = 0.74250\text{ mol N}$$

$$11.9\text{ g O} \times \frac{1\text{ mol O}}{15.9994\text{ g O}} = 0.74378\text{ mol O}$$

C: $\frac{5.96...\text{ mol C}}{0.74...\text{ mol N}} = 8.03$ (x16) = 129 yikes

H: $\frac{5.98...\text{ mol H}}{0.74...\text{ mol N}} = 8.06$ (x16)

N: $\frac{0.74...\text{ mol N}}{0.74...\text{ mol N}} = 1.0$ (x16)

O: $\frac{0.74...\text{ mol O}}{0.74...\text{ mol N}} = 1.0$ (x16)

$\boxed{C_8H_8NO}$

T.F. $= \frac{268.16}{134.1573} = 2$

$C_{16}H_{16}N_2O_2$

Molarity Worksheet # 1

2

1. 15.8 g of KCl is dissolved in 225 mL of water, calculate the molarity.

$15.8\ g\ KCl \times \frac{1\ mol\ KCl}{74.551\ g\ KCl} = 0.2119..\ mol\ KCl$

$M = \frac{mol}{V_L}$

$= \frac{0.2119..\ mol}{0.225 L} = 0.9419...M$

$\boxed{0.942 M}$

2

2. Calculate the mass of KCl required to prepare 250. mL of 0.250 M solution.

$mol = M \times V_L$

$= (0.250M)(0.250L)$

$= 0.0625\ mol\ KCl$

$0.0625\ mol\ KCl \times \frac{74.551\ g\ KCl}{1\ mol\ KCl}$

$\boxed{= 4.66 g}$

2

3. Calculate the volume of 0.30 M KCl solution that contains 6.00 g of KCl.

$V_L = \frac{mol}{M} = \frac{0.0805 mol}{0.30 M}$

$\boxed{= 0.268 L}$

$6.00 g\ KCl \times \frac{1\ mol\ KCl}{74.551\ g\ KCl} = 0.0805\ mol\ KCl$

2

4. Calculate the volume of 0.250 M H_2SO_4 that contains .250 g H_2SO_4.

$V_L = \frac{mol}{M} = \frac{0.00255\ mol}{0.250\ M}$

$\boxed{= 0.010 M}$

$0.250 g\ H_2SO_4 \times \frac{1\ mol\ H_2SO_4}{98.0784\ g\ H_2SO_4}$

$= 0.00255\ mol$

2

5. 1.50 g of NaCl is dissolved in 100.0 mL of water, calculate the concentration.

$M = \frac{mol}{V_L} = \frac{0.0257\ mol}{0.100 L}$

$\boxed{= 0.257 M}$

$1.50 g\ NaCl \times \frac{1\ mol\ NaCl}{58.4425 g\ NaCl}$

$= 0.0257\ mol$

2

6. How many moles of NaCl are in 250.0 mL of a 0.200 M solution?

$mol = M \times V_L$

$= (0.200 M)(0.2500L)$

$\boxed{= 0.050\ mol\ NaCl}$

2

7. How many litres of a 0.200 M KCl solution contain 0.250 moles?

$V_L = \frac{mol}{M}$

$V_L = \frac{0.250\ mol}{0.200\ M}$

$\boxed{= 1.25 L}$

~~8. How many millilitres of 0.200 M H_2SO_4 are required to completely neutralize 250 mL of 0.250 M NaOH?~~

stoich question

2

9. Calculate the mass of $CuSO_4 \cdot 5H_2O$ required to prepare 100.0 mL of 0.100 M solution.

$mol = M \times V_L$

$= (0.100M)(0.100L)$

$= 0.0100\ mol$

$0.0100\ mol\ CuSO_4 \cdot 5H_2O \times \frac{249.6846\ g}{1\ mol}$

$\boxed{= 2.497\ g\ CuSO_4 \cdot 5H_2O}$

12. $2\,NO + O_2 \rightarrow 2\,NO_2$

	$2\,NO$	O_2	$2\,NO_2$
	100g	100g	0
Init:			
Change:			
End:			
Grams:			

13. Calculate the volume of H_2 gas produced at STP by the reaction of 300 mL of 0.500 M HCl with excess Zn.

$$Zn + 2HCl \rightarrow H_2 + ZnCl_2$$

14. ~~Calculate the volume of 0.30 M KCl solution that contains 9.00 g~~ of KCl.

Dilutions Worksheet # 7

3 1. 20.0 mL of 0.200 M NaOH solution is diluted to a final volume of 100.0 mL, calculate the new concentration.

$$M_d = \frac{M_c V_c}{V_d} = \frac{(20.0\,mL)(0.200\,M)}{100.0\,mL} \boxed{= 0.040\,M}$$

3 2. 15.0 mL of a solution of NaOH is diluted to a final volume of 250.0 mL and the new molarity is 0.0500 M. Calculate the original molarity of the base.

$$M_c = \frac{M_d V_d}{V_c} = \frac{(0.0500\,M)(250\,mL)}{15.0\,mL} \boxed{= 0.833\,M}$$

3 3. 50.0 mL of 0.025 M NaOH solution is added to 150 mL of water. Calculate the new molarity.

$$M_d = \frac{M_c V_c}{V_d} = \frac{(0.025\,M)(50.0\,mL)}{200\,mL} \boxed{= 0.00625\,M}$$

Dilution

3 4. 45.0 mL of a solution of NaOH is diluted by adding 250.0 mL of water to produce a new molarity of 0.0500 M. Calculate the molarity of the base.

$$M_c = \frac{M_d V_d}{V_c} = \frac{(0.050M)(250mL)}{45.0mL} = \boxed{0.278\,M}$$

3 5. A 0.125 M solution is concentrated by evaporation to a reduced final volume of 100.0 mL and a molarity of. 0.150 M. Calculate the original volume.

$$V_d = \frac{M_c V_c}{M_d} = \frac{(0.150M)(100.0mL)}{(0.125M)} = \boxed{120\,mL \text{ (or } 0.120L)}$$

3 6. 850.0 mL of 0.280 M KOH solution is diluted to a final volume of 1000.0 mL, calculate the new concentration.

$$M_d = \frac{M_c V_c}{V_d} = \frac{(850.0mL)(0.280M)}{1000.0mL} \boxed{= 0.238M}$$

3 7. 95.0 mL of a solution of NaOH is diluted to a final volume of 135 mL and the new molarity is 0.0500 M. Calculate the original molarity of the base.

$$M_c = \frac{M_d V_d}{V_c} = \frac{(135mL)(0.0500M)}{95.0mL} \boxed{= 0.071\,M}$$

Mole Stuff

~~Molarity Review # 8~~

1 1. Convert 250. g $AgNO_3$ to formula units and then to atoms of O.

$$250g\ AgNO_3 \times \frac{1 \text{ mol } AgNO_3}{169.8749 \text{ g } AgNO_3} \times \frac{6.02\times10^{23} \text{ FU}}{1 \text{ mol}} \times \frac{3 \text{ atoms O}}{1 \text{ FU}} \boxed{= 2.66\times10^{24} \text{atoms}}$$

1 2. Convert 5.9×10^{25} H_2 molecules to grams.

$$5.9\times10^{25} \text{ molec. } H_2 \times \frac{1 \text{ mol}}{6.02\times10^{23} \text{ molec } H_2} \times \frac{2.0158 \text{ g } H_2}{1 \text{ mol } H_2} = \boxed{197.56}$$

4 3. Calculate the percentage composition of $MgSO_4$. → 120.3676

$$\%Mg = \frac{24.305}{120.3676} \times 100 \boxed{= 20.2\%}$$

$$\%S = \frac{32.065}{120.3676} \times 100 \boxed{= 26.6\%}$$

$$\%O = \frac{4(15.9994)}{120.3676} \times 100 \boxed{= 53.2\%}$$

9

14. 1.5 g of NaCl is dissolved in 100.0 mL of water. Calculate the concentration.

2

$$1.5\,g\ NaCl \times \frac{1\ mol\ NaCl}{58.4425\ g\ NaCl} = 0.0257\ mol \qquad M = \frac{0.0257\,mol}{0.100\,L}$$

$$M = \frac{mol}{V_L} \qquad \boxed{= 0.257\,M}$$

15. How many moles of NaCl are in 250.0 mL of a 0.200 M solution?

2

$$mol = M \times V_L$$
$$= (0.200\,M)(0.250\,L)$$
$$= 0.050\ moles$$

16. How many litres of a 0.200 M KCl solution contain 0.250 moles?

2

$$V_L = \frac{mol}{M} = \frac{0.250\,mol}{0.200\,M} = 1.25\,L$$

~~17. Calculate the volume of H_2 gas produced at STP by the reaction of 400.0 mL of 0.800 M HCl with excess Zn.~~

~~$Zn + 2HCl \rightarrow H_2 + ZnCl_2$~~

~~18. Calculate the volume of 0.250 M H_3PO_4 required to neutralize 25.5 mL of 0.200 M NaOH.~~

~~19. Calculate the volume of 0.500 M KOH required to neutralize 45.3 mL of 0.320 M H_2SO_4.~~

~~20. Calculate the mass of $CoCl_3 \cdot 6H_2O$ required to prepare 500.0 mL of a 0.200 M solution.~~

Worksheet # 9 **Dilutions and Molarity**

3

1. 40.0 mL of 0.400 M NaOH solution is diluted to a final volume of 200.0 mL, calculate the new concentration.

$$Md = \frac{McVc}{Vd} = \frac{(40\,mL)(0.400M)}{200\,mL}$$

$$= 0.080M$$

3

2. 85.0 mL of a solution of NaOH is diluted to a final volume of 290.0 mL and the new molarity is 0.0500 M. Calculate the original molarity of the base.

$$Mc = \frac{MdVd}{Vc} = \frac{(0.0500\,M)(290.0\,mL)}{85.0\,mL}$$

$$\boxed{= 0.171M}$$

3

3. 150.0 mL of 0.025 M NaOH solution is added to 150.0 mL of water. Calculate the new molarity.

$$Md = \frac{McVc}{Vd} = \frac{(0.025M)(150\,mL)}{300\,mL}$$

$$\boxed{= 0.0125M}$$

3

4. 220.0 mL of a solution of NaOH is diluted by adding 250.0 mL of water to produce a new molarity of 0.0500 M. Calculate the molarity of the base.

$$M_c = \frac{M_d V_d}{V_c} = \frac{(470\,\text{mL})(0.0500\,\text{M})}{220\,\text{mL}}$$

$$\boxed{= 0.107\,\text{M}}$$

3

5. A 0.350 M solution is concentrated by evaporation to a reduced final volume of 100.0 mL and a molarity of 0.825 M. Calculate the original volume.

$$V_d = \frac{M_c V_c}{M_d} = \frac{(0.825\,\text{M})(100.0\,\text{mL})}{0.350\,\text{M}} \quad \boxed{= 0.236\,\text{L}}$$

3

6. 850.0 mL of 0.280 M KOH solution is diluted to a final volume of 1000.0 mL, calculate the new concentration.

$$M_d = \frac{M_c V_c}{V_d} = \frac{(850.0\,\text{mL})(0.280\,\text{M})}{100.0\,\text{mL}} \quad \boxed{= 2.38\,\text{M}}$$

2

7. 28 g of KCl is dissolved in 225 mL of water, calculate the molarity.

$$28\,\text{g KCl} \times \frac{1\,\text{mol KCl}}{74.551\,\text{g KCl}} = 0.376\,\text{mol} \qquad M = \frac{\text{mol}}{V_L} = \frac{0.376\,\text{mol}}{0.225\,\text{L}} \quad \boxed{= 1.67\,\text{M}}$$

2

8. Calculate the mass of KCl required to prepare 125 mL of 0.450 M solution.

$$\text{mol} = M \times V_L$$
$$= (0.450\,\text{M})(0.125\,\text{L})$$
$$= 0.05625$$

$$0.05625\,\text{mol KCl} \times \frac{74.551\,\text{g KCl}}{1\,\text{mol KCl}} \quad \boxed{= 4.19\,\text{g KCl}}$$

2

9. Calculate the volume of 0.40 M KCl solution that contains 8.00 g of KCl.

$$8.00\,\text{g KCl} \times \frac{1\,\text{mol}}{74.551\,\text{g}} = 0.107\,\text{mol} \qquad V_L = \frac{\text{mol}}{M} = \frac{0.107\,\text{mol}}{0.40\,\text{M}} \quad \boxed{= 0.268\,\text{L}}$$

~~10. Calculate the volume of 0.400 M H_2SO_4 required to neutralize 25.0 mL of 0.200 M NaOH.~~

15

~~11. Calculate the volume of H_2 gas produced at STP by the reaction of 250.0 mL of 0.600 M HCl with excess Zn. $Zn + 2HCl \rightarrow H_2 + ZnCl_2$~~

2 12. 8.5 L of HCl gas at STP is dissolved in 325 mL of water, calculate the molarity of the acid solution.

$$8.5\ L\ HCl \times \frac{1\ mol}{22.4\ L} = 0.379\ mol \qquad M = \frac{mol}{V_L} = \frac{0.379\ mol}{0.325\ L} = \boxed{1.168\ M}$$

2 13. How many moles of NaCl are in 350.0 mL of a 0.400 M solution?

$$mol = M \times V_L = (0.400\ M)(0.350\ L) \boxed{= 0.140\ mol}$$

2 14. How many litres of a 0.300 M KCl solution contain 0.350 moles?

$$V_L = \frac{mol}{M} = \frac{0.350\ mol}{0.300\ M} \boxed{= 1.17\ L}$$

1 15. Calculate the mass of 8.25×10^5 mL of H_2 gas at STP.

$$8.25 \times 10^5\ mL \times \frac{1\ L}{1000\ mL} \times \frac{1\ mol}{22.4\ L} \times \frac{2.0158\ g\ H_2}{1\ mol\ H_2} = \boxed{74.24\ g\ H_2}$$

1 16. Calculate the number of formula units of KCl in 200.0 mL of 0.300 M solution.

$$mol = M \times V_L = (0.300\ M)(0.200\ L) = 0.600\ mol$$

$$0.600\ mol\ KCl \times \frac{6.02 \times 10^{23}\ FU\ KCl}{1\ mol\ KCl} \boxed{= 3.61 \times 10^{23}\ FU}$$

17