

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

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

35.  $6.55 \times 10^{24}$  atoms Ag

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

36.  $8.66 \times 10^{26}$  FU RbCl

$$8.66 \times 10^{26} \text{ FU RbCl} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ FU}} \times \frac{136.523 \text{ g RbCl}}{1 \text{ mol RbCl}} = \boxed{196393.5515 \text{ g}}$$

37.  $5.00 \times 10^{32}$  molecules  $\text{N}_2\text{H}_4$

$$5.00 \times 10^{32} \text{ molecules} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molecules}} \times \frac{32.0414 \text{ g N}_2\text{H}_4}{1 \text{ mol}} = \boxed{2.66 \times 10^{10} \text{ g N}_2\text{H}_4}$$

38.  $5.3 \times 10^{29}$  FU KBr

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

39.  $25.3 \times 10^{28}$  molecules  $\text{C}_4\text{H}_{10}$

$$25.3 \times 10^{28} \text{ molecules} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molecules}} \times \frac{58.1144 \text{ g C}_4\text{H}_{10}}{1 \text{ mol}} = \boxed{24423493.69 \text{ g C}_4\text{H}_{10}}$$

40.  $1.33 \times 10^{25}$  atoms Ag

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

44.  $1.55 \times 10^{16}$  FU NaCl

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

45.  $2.55 \times 10^{27}$  molecules  $\text{NH}_3$

$$2.55 \times 10^{27} \text{ molecules} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molec.}} \times \frac{17.0277 \text{ g NH}_3}{1 \text{ mol}} = \boxed{72127.30 \text{ g NH}_3}$$

46.  $5.3 \times 10^{29}$  FU KBr

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

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

47. 100. g  $\text{H}_2\text{O}_2$

$$100 \text{ g H}_2\text{O}_2 \times \frac{1 \text{ mol}}{34.0128 \text{ g H}_2\text{O}_2} \times \frac{6.02 \times 10^{23} \text{ particles}}{1 \text{ mol}} = 1.77 \times 10^{24} \text{ particles}$$

48. 2.6 g  $\text{MgF}_2$

$$2.6 \text{ g MgF}_2 \times \frac{1 \text{ mol}}{62.301 \text{ g MgF}_2} \times \frac{6.02 \times 10^{23}}{1 \text{ mol}} = 2.51 \times 10^{22} \text{ particles}$$

49. 0.211 g  $\text{C}_5\text{H}_{12}$

$$0.211 \text{ g C}_5\text{H}_{12} \times \frac{1 \text{ mol}}{72.1395 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ particles}}{1 \text{ mol}} = 1.76 \times 10^{21} \text{ particles}$$

50.  $3.33 \times 10^{-2}$  g Fe

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

51. 0.126 g Co

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

7. Calculate the mass of  $4.56 \times 10^{25}$  atoms of Sr.

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

8. Calculate the mass of  $6.33 \times 10^{20}$  molecules of  $\text{CO}_2$ .

$$6.33 \times 10^{20} \text{ molecules} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molecules}} \times \frac{44.0099 \text{ g CO}_2}{1 \text{ mol}} = 0.0463 \text{ g}$$

9. Calculate the mass of  $8.66 \times 10^{26}$  FU of  $\text{SrO}$ .

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

10. Calculate the mass of  $2.3 \times 10^{28}$  FU of  $\text{SrCO}_3 \cdot \text{H}_2\text{O}$ .

$$2.3 \times 10^{28} \text{ FU SrCO}_3 \cdot \text{H}_2\text{O} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ FU}} \times \frac{165.6427 \text{ g SrCO}_3 \cdot \text{H}_2\text{O}}{1 \text{ mol}} = 6328541.694 \text{ g}$$

11. Calculate the number of H atoms in 5.02 g of  $\text{CH}_4$ . There are 4 atoms of H in one molecule of  $\text{CH}_4$ .

$$5.02 \text{ g CH}_4 \times \frac{1 \text{ mol}}{16.0391 \text{ g CH}_4} \times \frac{6.02 \times 10^{23} \text{ particles}}{1 \text{ mol}} \times \frac{4 \text{ H atoms}}{1 \text{ particle}} = 7.54 \times 10^{23} \text{ atoms}$$

12. Calculate the number of O atoms in 200. g  $\text{Al}_2(\text{SO}_4)_3$ . There are 12 atoms of O in one formula unit of  $\text{Al}_2(\text{SO}_4)_3$ .

$$200 \text{ g Al}_2(\text{SO}_4)_3 \times \frac{1 \text{ mol}}{342.1358 \text{ g Al}_2(\text{SO}_4)_3} \times \frac{6.02 \times 10^{23} \text{ particles}}{1 \text{ mol}} \times \frac{12 \text{ atoms}}{1 \text{ particle}} = 4.22 \times 10^{24} \text{ atoms}$$

13. Calculate the mass of  $\text{CaCO}_3$  that contains  $2.00 \times 10^{28}$  atoms of O. There are 3 atoms of O per one FU of  $\text{CaCO}_3$ .

$$2.00 \times 10^{28} \text{ atoms O} \times \frac{1 \text{ particle}}{3 \text{ atoms}} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ particles}} \times \frac{100.0893 \text{ g CaCO}_3}{1 \text{ mol}} = 1108408.638 \text{ g}$$

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

14. Calculate the mass of  $\text{Al}_2(\text{SO}_4)_3$  that contains  $2.00 \times 10^{28}$  atoms of O.

$$2.00 \times 10^{28} \text{ atoms O} \times \frac{1 \text{ particle}}{12 \text{ atoms}} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ particles}} \times \frac{342.1358 \text{ g}}{1 \text{ mol}} = 947219.8228 \text{ g Al}_2(\text{SO}_4)_3$$

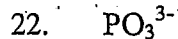
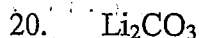
15. Calculate the mass of  $\text{Al}_2(\text{SO}_4)_3$  that contains  $2.00 \times 10^{20}$  atoms of Al.

$$2.00 \times 10^{20} \text{ atoms Al} \times \frac{1 \text{ part.}}{2 \text{ atoms}} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ part.}} \times \frac{342.1358 \text{ g}}{1 \text{ mol}} = 0.0568 \text{ g Al}_2(\text{SO}_4)_3$$

16. Calculate the number of Al atoms in 500. g  $\text{Al}_2(\text{SO}_4)_3$ .

$$500 \text{ g Al}_2(\text{SO}_4)_3 \times \frac{1 \text{ mol}}{342.1358 \text{ g Al}_2(\text{SO}_4)_3} \times \frac{6.02 \times 10^{23} \text{ particles}}{1 \text{ mol}} \times \frac{2 \text{ atoms}}{1 \text{ particles}} = 1.76 \times 10^{24} \text{ atoms}$$

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



Worksheet #4 Empirical Formula

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

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.

$$6.353 \text{ g Ag} \times \frac{1 \text{ mol}}{107.868 \text{ g Ag}} = 0.058896 \text{ mol Ag}$$

$$0.823 \text{ g N} \times \frac{1 \text{ mol}}{14.0067 \text{ g}} = 0.058758 \text{ mol N}$$

$$2.824 \text{ g O} \times \frac{1 \text{ mol}}{15.9994 \text{ g O}} = 0.176507 \text{ mol O}$$

$$\frac{0.058896 \text{ mol Ag}}{0.058758 \text{ mol N}} = 1.0023$$

$$\frac{0.176507 \text{ mol O}}{0.058758 \text{ mol N}} = 3.003$$

**AgNO<sub>3</sub>**

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.

$$6.25 \text{ g Pb} \times \frac{1 \text{ mol}}{207.2 \text{ g Pb}} = 0.030164 \text{ mol Pb}$$

$$2.90 \text{ g O} \times \frac{1 \text{ mol}}{15.9994 \text{ g}} = 0.181257 \text{ mol O}$$

$$0.846 \text{ g N} \times \frac{1 \text{ mol}}{14.0067 \text{ g}} = 0.0603997 \text{ mol N}$$

$$\frac{0.030164 \text{ mol Pb}}{0.030164 \text{ mol Pb}} = 1.000$$

$$\frac{0.181257 \text{ mol O}}{0.0603997 \text{ mol N}} = 3.001$$

**PbN<sub>2</sub>O<sub>6</sub>**

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.

$$1.00 \text{ g Ca} \times \frac{1 \text{ mol}}{40.078 \text{ g}} = 0.024951 \text{ mol Ca}$$

$$0.700 \text{ g N} \times \frac{1 \text{ mol}}{14.0067 \text{ g}} = 0.049976 \text{ mol N}$$

$$2.40 \text{ g O} \times \frac{1 \text{ mol}}{15.9994 \text{ g}} = 0.150006 \text{ mol O}$$

$$\frac{0.024951 \text{ mol Ca}}{0.024951 \text{ mol Ca}} = 1.000$$

$$\frac{0.049976 \text{ mol N}}{0.024951 \text{ mol Ca}} = 2.003$$

$$\frac{0.150006 \text{ mol O}}{0.024951 \text{ mol Ca}} = 6.012$$

**CaN<sub>2</sub>O<sub>6</sub>**

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

$$27.91 \text{ g Fe} \times \frac{1 \text{ mol}}{55.845 \text{ g Fe}} = 0.49978 \text{ mol Fe}$$

$$24.08 \text{ g S} \times \frac{1 \text{ mol}}{32.066 \text{ g}} = 0.74995 \text{ mol S}$$

$$48.0 \text{ g O} \times \frac{1 \text{ mol}}{15.9994 \text{ g}} = 3.00011 \text{ mol O}$$

$$\frac{0.49978 \text{ mol Fe}}{0.49978 \text{ mol Fe}} = 1.000$$

$$\frac{0.74995 \text{ mol S}}{0.49978 \text{ mol Fe}} = 1.500$$

$$\frac{3.00011 \text{ mol O}}{0.49978 \text{ mol Fe}} = 6.0022$$

**Fe<sub>2</sub>O<sub>12</sub>S<sub>3</sub>**

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

$$15.38 \text{ g Co} \times \frac{1 \text{ mol}}{58.933 \text{ g}} = 0.260974 \text{ mol Co}$$

$$40.74 \text{ g Cr} \times \frac{1 \text{ mol}}{51.9961 \text{ g}} = 0.78352 \text{ mol Cr}$$

$$43.88 \text{ g O} \times \frac{1 \text{ mol}}{15.9994 \text{ g}} = 2.7426 \text{ mol O}$$

$$\frac{0.260974 \text{ mol Co}}{0.260974 \text{ mol Co}} = 1.000$$

$$\frac{0.78352 \text{ mol Cr}}{0.260974 \text{ mol Co}} = 3.0022$$

$$\frac{2.7426 \text{ mol O}}{0.260974 \text{ mol Co}} = 10.509$$

**Co<sub>2</sub>Cr<sub>2</sub>O<sub>21</sub>**

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

$$\begin{aligned}
 3.65 \text{ g C} \times \frac{1 \text{ mol}}{12.0107 \text{ g}} &= 5.2994 \text{ mol C} & 10.71 \text{ g H} \times \frac{1 \text{ mol}}{1.00794 \text{ g}} &= 10.6256 \text{ mol H} & 18.56 \text{ g N} \times \frac{1 \text{ mol}}{14.0067 \text{ g}} &= 1.32508 \text{ mol N} \\
 0.72 \text{ g O} \times \frac{1 \text{ mol}}{15.9994 \text{ g}} &= 0.44202 \text{ mol O} & & & & \\
 \left. \begin{array}{l} \text{C } 5.2994 \text{ mol C} \\ \text{O } 0.44 \text{ mol O} \\ \text{N } 1.32 \text{ mol N} \end{array} \right\} &= 11.989 & \left. \begin{array}{l} \text{O } 0.44 \text{ mol O} \\ \text{H } 10.6 \text{ mol H} \end{array} \right\} &= 2.997 & & \\
 & & & & & \\
 & & & & & \text{C}_{12}\text{O}_3\text{N}_3\text{H}_{24}
 \end{aligned}$$

7. Change  $5.0 \times 10^{26}$  formula units  $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$  to grams.

$$5.0 \times 10^{26} \text{ FU} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ FU}} \times \frac{237.93028 \text{ g}}{1 \text{ mol}} = 197616.51 \text{ g CoCl}_2 \cdot 6\text{H}_2\text{O}$$

8. Convert 2.36 g  $\text{FeSO}_4 \cdot 5\text{H}_2\text{O}$  to formula units.

$$2.36 \text{ g FeSO}_4 \cdot 5\text{H}_2\text{O} \times \frac{1 \text{ mol}}{241.985 \text{ g FeSO}_4 \cdot 5\text{H}_2\text{O}} \times \frac{6.02 \times 10^{23} \text{ FU}}{1 \text{ mol}} = 5.87 \times 10^{21} \text{ FU}$$

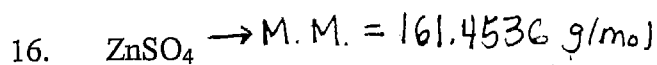
9. Change  $3.65 \times 10^{22}$  molecules  $\text{CO}_2$  to grams.

$$3.65 \times 10^{22} \text{ molecules} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molecules}} \times \frac{44.0095 \text{ g}}{1 \text{ mol}} = 2.668 \text{ g CO}_2$$

10. Convert 2.36 g  $\text{P}_2\text{O}_5$  to molecules.

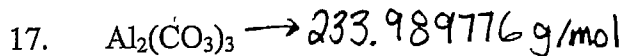
$$2.36 \text{ g P}_2\text{O}_5 \times \frac{1 \text{ mol}}{141.944522 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ molec.}}{1 \text{ mol}} = 1.00 \times 10^{22} \text{ molecules}$$

Calculate the percentage composition for:

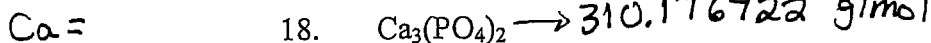


$$\boxed{\text{Zn}} \frac{65.39}{161.4536} \times 100 = \boxed{40.5\%} \quad \boxed{\text{S}} \frac{32.066}{161.4536} \times 100 = \boxed{19.9\%}$$

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



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



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

19. Convert 3.66 kg  $\text{CO}_2$  to molecules.

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

20. Convert  $4.0 \times 10^{26}$  FU of  $\text{MgCl}_2$  to Kg.

$$4.0 \times 10^{26} \text{ FU} \times \frac{1 \text{ mol } \text{MgCl}_2}{6.02 \times 10^{23} \text{ FU}} \times \frac{95.2104 \text{ g } \text{MgCl}_2}{1 \text{ mol } \text{MgCl}_2} \times \frac{1 \text{ kg}}{1000 \text{ g}} = \boxed{63.26 \text{ kg}}$$

21. In a propane tank there are 9.0 Kg of  $\text{C}_3\text{H}_8$ , calculate the number of H atoms.

(First calculate molecules and then H atoms)

$$9.0 \text{ kg } \text{C}_3\text{H}_8 \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mol } \text{C}_3\text{H}_8}{44.09562 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \times \frac{8 \text{ H atoms}}{1 \text{ molecule}} = \boxed{9.83 \times 10^{26} \text{ atoms}}$$

22. A certain mass of complex  $\text{Co}(\text{NH}_3)_6\text{Cl}_3$  was found to contain  $2.65 \times 10^{21}$  atoms of H, calculate the mass of cobalt III chloride hexammine. (Change the number of atoms to FU's first).

$$2.65 \times 10^{21} \text{ atoms H} \times \frac{1 \text{ FU}}{18 \text{ atoms}} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ FU}} \times \frac{267.4746 \text{ g } \text{Co}(\text{NH}_3)_6\text{Cl}_3}{1 \text{ mol}} = \boxed{0.0654 \text{ g } \text{Co}(\text{NH}_3)_6\text{Cl}_3}$$

## Worksheet # 6 Mole Calculations to Molecular Formula

1. Convert 500. g NaCl to formula units.

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

2. Convert
- $9.8 \times 10^{24}$
- molecules of
- $\text{C}_2\text{H}_6$
- to grams.

$$9.8 \times 10^{24} \text{ molecules C}_2\text{H}_6 \times \frac{1 \text{ mol C}_2\text{H}_6}{6.02 \times 10^{23} \text{ molec.}} \times \frac{30.06904 \text{ g C}_2\text{H}_6}{1 \text{ mol C}_2\text{H}_6} = \boxed{489.496 \text{ g C}_2\text{H}_6}$$

3. Calculate the number of O atoms in 50.0 lb of dry ice
- $\text{CO}_2$
- .
- 
- (2.21 lb = 1.00 kg)

$$50.0 \text{ lb} \times \frac{1 \text{ kg}}{2.21 \text{ lb}} \times \frac{1000 \text{ g}}{1 \text{ kg}} \times \frac{1 \text{ mol CO}_2}{44.0095 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} \times \frac{2 \text{ O atoms}}{1 \text{ molecules}} = \boxed{6.19 \times 10^{26} \text{ atoms}}$$

4. Calculate the percentage composition of
- $\text{Al}_2(\text{SO}_4)_3$
- . 3 significant figures!

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

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

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

5. Calculate the molar mass of
- $\text{Co}_2(\text{SO}_4)_3 \cdot 6\text{H}_2\text{O}$

$$\begin{array}{r} \text{Co} = 2(58.933200) \\ \text{S} = 3(32.066) \\ \text{O} = 12(15.9994) \\ + \\ \hline 406.0572 \end{array}$$

$$\begin{array}{r} \text{H} = 2(1.00794) \\ \text{O} = 15.9994 \\ + \\ \hline 18.01528 \end{array}$$

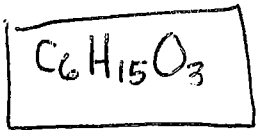
$$+ \quad \boxed{514.14888 \text{ g/mol}}$$



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

$$T.F. = \frac{M.T.F.}{M.E.F.}$$

$$= \frac{135 \text{ g/mol}}{45.0605 \text{ g/mol}} \approx 3$$



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

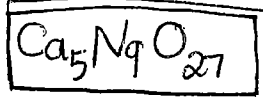
$$Ca \ 24.4 \text{ g} \times \frac{1 \text{ mol}}{40.078 \text{ g}} = 0.67881 \text{ mol Ca}$$

$$O \ 58.5 \text{ g} \times \frac{1 \text{ mol}}{15.9994 \text{ g}} = 3.65639 \text{ mol O}$$

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

$\frac{0.6... \text{ mol Ca}}{0.6... \text{ mol Ca}} = 1.000... \times 5 = 5$   
 $\frac{1.22... \text{ mol N}}{0.6... \text{ mol Ca}} = 1.7985 \times 5 = 9$

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



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.

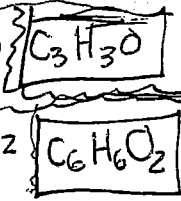
$$65.45 \text{ g C} \times \frac{1 \text{ mol}}{12.0107 \text{ g}} = 5.44931 \text{ mol C}$$

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

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

$\frac{5.44... \text{ mol C}}{1.8... \text{ mol O}} = 3.0$   
 $\frac{1.8... \text{ mol O}}{1.8... \text{ mol O}} = 1.0$

$\frac{5.46... \text{ mol H}}{1.8... \text{ mol O}} = 3.0$   
 $T.F. = \frac{M.T.F.}{M.E.F.} = \frac{110 \text{ g/mol}}{55.05532} = 2$



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.

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

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

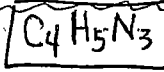
$$44.2 \text{ g N} \times \frac{1 \text{ mol}}{14.00674 \text{ g}} = 3.15562 \text{ mol N}$$

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

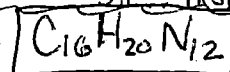
$\frac{5.2... \text{ mol H}}{3.1... \text{ mol N}} = 1.654 \times 3 = 5$

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

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



$T.F. = \frac{M.T.F.}{M.E.F.} = \frac{380.2}{95.10272} = 4$



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?

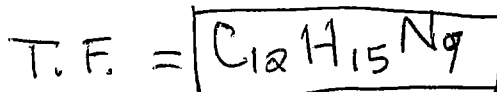
$$50.5 \text{ g C} \times \frac{1 \text{ mol}}{12.0107 \text{ g}} =$$

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

Just realized this is the same as #9



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



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).

$$8.0 \text{ Kg } C_3H_8 \times \frac{1000 \text{ g } C_3H_8}{1 \text{ Kg}} \times \frac{1 \text{ mol}}{44.09562 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ molec.}}{1 \text{ mol}} \times \frac{8 \text{ H atoms}}{1 \text{ molecule}}$$

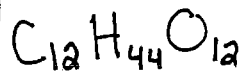
$$= 8.74 \times 10^{26} \text{ H atoms}$$

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

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

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.  $\rightarrow 95.11764 \text{ g/mol}$

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

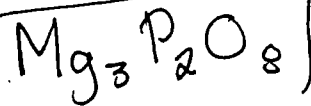


12. Calculate the percentage composition of  $Co(NH_3)_6Cl_3$  to three significant figures.

$$\begin{aligned} \% \text{ Co} &= \frac{58.9332}{267.4766} \times 100 = 22.0\% \\ \% \text{ H} &= \frac{18(1.00794)}{267.4766} \times 100 = 6.78\% \\ \% \text{ N} &= \frac{6(14.00674)}{267.4766} \times 100 = 31.4\% \\ \% \text{ Cl} &= \frac{3(35.4527)}{267.4766} \times 100 = 39.8\% \end{aligned}$$

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

$$\begin{aligned} 27.73 \text{ g Mg} \times \frac{1 \text{ mol}}{24.305 \text{ g}} &= 1.14092 \text{ mol Mg} \div 0.761 \dots \text{ mol P} = 1.498 \times 2 = 3 \\ 23.58 \text{ g P} \times \frac{1 \text{ mol}}{30.973761 \text{ g}} &= 0.76129 \text{ mol P} \div 0.761 \dots \text{ mol P} = 1.000 \times 2 = 2 \\ 48.69 \text{ g O} \times \frac{1 \text{ mol}}{15.9994 \text{ g}} &= 3.043239 \text{ mol O} \div 0.761 \dots \text{ mol P} = 3.997 \times 2 = 8 \end{aligned}$$



## Worksheet #8 Review of Mole Calculations

1. Convert 2.59 g of
- $\text{SO}_3$
- to molecules.

$$2.59 \text{ g } \text{SO}_3 \times \frac{1 \text{ mol } \text{SO}_3}{80.0642 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol } \text{SO}_3} = 1.95 \times 10^{22} \text{ molecules}$$

2. Convert
- $3.56 \times 10^{25}$
- FU of
- $\text{CoCl}_4$
- to Kg.

$$3.56 \times 10^{25} \text{ FU } \text{CoCl}_4 \times \frac{1 \text{ mol } \text{CoCl}_4}{6.02 \times 10^{23} \text{ FU } \text{CoCl}_4} \times \frac{200.74428 \text{ g}}{1 \text{ mol}} \times \frac{1 \text{ Kg}}{1000 \text{ g}} = 11.81 \text{ Kg } \text{CoCl}_4$$

3. In a propane tank there are 26.5 Kg. of
- $\text{C}_2\text{H}_6$
- . Calculate the number of H atoms.

$$26.5 \text{ Kg } \text{C}_2\text{H}_6 \times \frac{1000 \text{ g}}{1 \text{ Kg}} \times \frac{1 \text{ mol}}{60.30724 \text{ g } \text{C}_2\text{H}_6} \times \frac{6.02 \times 10^{23} \text{ molecule}}{1 \text{ mol } \text{C}_2\text{H}_6} \times \frac{6 \text{ H atoms}}{1 \text{ molecule}} = 1.59 \times 10^{27} \text{ atoms of H}$$

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

$\text{CO}_2$	molecule
Co	atom
$\text{AgNO}_3$	Formula Unit
KCl	Formula Unit
$\text{Cr}_2\text{O}_7^{2-}$	anion
$\text{NH}_4^+$	cation

5. Convert 568 g of
- $\text{H}_3\text{PO}_4$
- to moles.

$$568 \text{ g } \text{H}_3\text{PO}_4 \times \frac{1 \text{ mol}}{142.96951 \text{ g}} \text{H}_3\text{PO}_4 = 3.97 \text{ mole } \text{H}_3\text{PO}_4$$

6. Convert
- $3.25 \times 10^5$
- g Rh into atoms.

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

7. Calculate the molar mass of the following compounds:

$$\text{Hg}_3(\text{PO}_4)_2 = 791.71 \text{ g/mol}$$

$$\text{Cu}_2 = 317.35 \text{ g/mol}$$

$$\text{Pb}_2\text{SO}_4 = 510.4636 \text{ g/mol}$$

$$\text{Li}_2\text{SO}_3 = 93.9462 \text{ g/mol}$$

8. What is the percent composition of  $C_2H_6$  M.M. = 30.0642 g/mol

$$\% C = \frac{2(12.011)}{30.0642} \times 100 = \boxed{79.9\%}$$

$$\% H = \frac{6(1.007)}{30.0642} \times 100 = \boxed{20.1\%}$$

9. What is the percent composition of  $CaCl_2 \cdot 2H_2O$  M.M. = 147.01248 g/mol

$$\% Ca = \frac{40.08 \text{ g/mol}}{147.01248 \text{ g/mol}} \times 100 = \boxed{27.2\%}$$

$$\% H = \frac{4(1.007)}{147.01248} \times 100 = \boxed{2.7\%}$$

$$\% Cl = \frac{2(35.453)}{147.01248} \times 100 = \boxed{48.2\%}$$

$$\% O = \frac{2(15.9994)}{147.01248} \times 100 = \boxed{21.8\%}$$

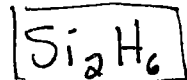
10. The empirical formula of a compound is  $SiH_3$ . If 0.0275 mol of the compound has a mass of 1.71 g, what is the compounds molecular formula? M.M. = 1.71 g

$$SiH_3 \rightarrow \begin{array}{l} Si = 28.0855 \\ H = 3(1.007) \\ \hline 31.1065 \text{ g/mol} \end{array}$$

$$T.F. = \frac{M.T.F.}{M.E.F.}$$

$$= \frac{62.18}{31.11} \approx 2$$

$$\frac{1.71 \text{ g}}{0.0275 \text{ mol}} = 62.18 \text{ g/mol}$$



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

$$27.73 \text{ g Mg} \times \frac{1 \text{ mol Mg}}{24.305 \text{ g Mg}} = 1.140918 \text{ mol Mg}$$

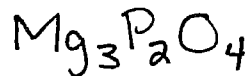
$$\boxed{Mg} \frac{1.14 \dots \text{mol Mg}}{0.76 \dots \text{mol P}} = 1.49 \dots (\times 2) = 3$$

$$3.58 \text{ g P} \times \frac{1 \text{ mol}}{30.9738 \text{ g}} = 0.7613082 \text{ mol P}$$

$$\boxed{P} = \frac{0.76 \dots \text{mol P}}{0.76 \dots \text{mol P}} = 1.0 (\times 2) = 2$$

$$8.69 \text{ g O} \times \frac{1 \text{ mol}}{15.9994 \text{ g}} = 3.043239 \text{ mol O}$$

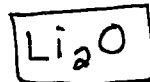
$$\boxed{O} \frac{3.04 \dots \text{mol O}}{0.76 \dots \text{mol P}} = 3.99 \dots (\times 2) = 4$$



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

$$46.3 \text{ g Li} \times \frac{1 \text{ mol}}{6.941 \text{ g Li}} = 6.67051 \text{ mol Li}$$

$$\boxed{Li} \frac{6.67 \dots \text{mol}}{3.35 \dots \text{mol}} = 1.98$$



$$53.7 \text{ g O} \times \frac{1 \text{ mol O}}{15.9994 \text{ g O}} = 3.35637 \text{ mol O}$$

$$\boxed{O} \frac{3.35 \dots \text{mol O}}{3.35 \dots \text{mol O}} = 1.0$$

13. Convert  $5.65 \times 10^{17}$  atoms of Fe into grams.

$$5.65 \times 10^{17} \text{ atoms Fe} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ atoms}} \times \frac{55.847 \text{ g Fe}}{1 \text{ mol Fe}} = \boxed{0.0000524 \text{ g}} \\ \text{OR} \\ \boxed{5.24 \times 10^{-5} \text{ g}}$$

1 particle = 1 atom

Worksheet # 5 Review of moles to STP

1. Convert 1.65 Kg CO<sub>2</sub> to molecules.

$$1.65 \text{ Kg CO}_2 \times \frac{1000 \text{ g}}{1 \text{ Kg}} \times \frac{1 \text{ mol CO}_2}{44.0098 \text{ g CO}_2} \times \frac{6.02 \times 10^{23} \text{ molec. CO}_2}{1 \text{ mol CO}_2} = 2.26 \times 10^{25} \text{ molec.}$$

2. Convert 2.0 x 10<sup>26</sup> FU of MgCl<sub>2</sub> to Kg.

$$2.0 \times 10^{26} \text{ FU} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ FU}} \times \frac{95.2104 \text{ g}}{1 \text{ mol}} \times \frac{1 \text{ Kg}}{1000 \text{ g}} = 31.63 \text{ Kg}$$

3. In a propane tank there are 9.0 Kg of C<sub>3</sub>H<sub>8</sub>, calculate the number of H atoms. (First calculate molecules and then H atoms).

$$9.0 \text{ Kg} \times \frac{1000 \text{ g}}{1 \text{ Kg}} \times \frac{1 \text{ mol}}{44.0962 \text{ g}} \times \frac{6.02 \times 10^{23} \text{ molec.}}{1 \text{ mol}} \times \frac{8 \text{ atoms}}{1 \text{ molec.}} = 9.83 \times 10^{26} \text{ atoms}$$

4. A certain mass of complex Co(NH<sub>3</sub>)<sub>6</sub>Cl<sub>3</sub> was found to contain 2.65 x 10<sup>21</sup> atoms of H, calculate the mass of cobalt III chloride hexammine (change atoms to FU's 1st).

$$2.65 \times 10^{21} \text{ atoms H} \times \frac{1 \text{ FU}}{18 \text{ atoms H}} \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ FU}} \times \frac{267.4735 \text{ g Co(NH}_3)_6\text{Cl}_3}{1 \text{ mol}} = 0.0654 \text{ g}$$

5. Calculate the percentage composition of Co(NH<sub>3</sub>)<sub>6</sub>Cl<sub>3</sub> to three significant digits.

$$\% \text{Co} = \frac{58.933}{267.4735} \times 100 = 22.0\%$$

$$\% \text{H} = \frac{18(1.0079)}{267.4735} \times 100 = 6.78\%$$

$$\% \text{N} = \frac{6(14.0067)}{267.4735} \times 100 = 31.4\%$$

$$\% \text{Cl} = \frac{3(35.4527)}{267.4735} \times 100 = 39.8\%$$

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.

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

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

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

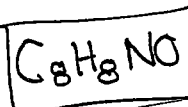
$$11.9 \text{ g O} \times \frac{1 \text{ mol O}}{15.9994 \text{ g O}} = 0.74378 \text{ mol O}$$

$$\text{C } \frac{5.96 \dots \text{ mol C}}{0.74 \dots \text{ mol N}} = 8.03 \times 16 = 129 \text{ yikes}$$

$$\text{H } \frac{5.98 \dots \text{ mol H}}{0.74 \dots \text{ mol N}} = 8.06 \times 16$$

$$\text{N } \frac{0.74 \dots \text{ mol N}}{0.74 \dots \text{ mol N}} = 1.0 \times 16$$

$$\text{O } \frac{0.74 \dots \text{ mol O}}{0.74 \dots \text{ mol N}} = 1.0 \times 16$$



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



I think this question is off....

## Molarity Worksheet # 1

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

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

$$M = \frac{\text{mol}}{V_L} = \frac{0.2119 \dots \text{ mol}}{0.225 \text{ L}} = 0.9419 \dots \text{ M}$$

**0.942 M**

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

$$\text{mol} = M \times V_L = (0.250 \text{ M})(0.250 \text{ L}) = 0.0625 \text{ mol KCl}$$

$$0.0625 \text{ mol KCl} \times \frac{74.551 \text{ g KCl}}{1 \text{ mol KCl}} = 4.66 \text{ g}$$

**4.66 g**

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

$$V_L = \frac{\text{mol}}{M} = \frac{0.0805 \text{ mol}}{0.30 \text{ M}} = 0.268 \text{ L}$$

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

**0.268 L**

4. Calculate the volume of 0.250 M H<sub>2</sub>SO<sub>4</sub> that contains .250 g H<sub>2</sub>SO<sub>4</sub>.

$$V_L = \frac{\text{mol}}{M} = \frac{0.00255 \text{ mol}}{0.250 \text{ M}} = 0.010 \text{ M}$$

$$0.250 \text{ g H}_2\text{SO}_4 \times \frac{1 \text{ mol H}_2\text{SO}_4}{98.0784 \text{ g H}_2\text{SO}_4} = 0.00255 \text{ mol}$$

**0.010 M**

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

$$M = \frac{\text{mol}}{V_L} = \frac{0.0257 \text{ mol}}{0.100 \text{ L}} = 0.257 \text{ M}$$

$$1.50 \text{ g NaCl} \times \frac{1 \text{ mol NaCl}}{58.4425 \text{ g NaCl}} = 0.0257 \text{ mol}$$

**0.257 M**

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

$$\text{mol} = M \times V_L = (0.200 \text{ M})(0.250 \text{ L}) = 0.050 \text{ mol NaCl}$$

**0.050 mol NaCl**

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

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

**1.25 L**

~~8.~~ How many millilitres of 0.200 M H<sub>2</sub>SO<sub>4</sub> are required to completely neutralize 250 mL of 0.250 M NaOH?

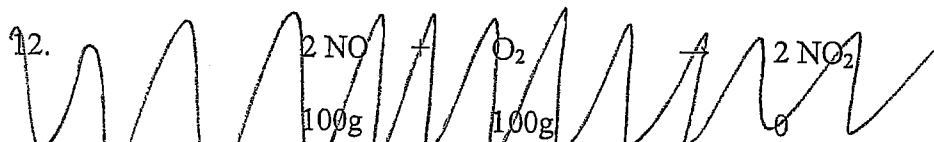
stoich question

9. Calculate the mass of CuSO<sub>4</sub>·5H<sub>2</sub>O required to prepare 100.0 mL of 0.100 M solution.

$$\text{mol} = M \times V_L = (0.100 \text{ M})(0.100 \text{ L}) = 0.0100 \text{ mol}$$

$$0.0100 \text{ mol CuSO}_4 \cdot 5\text{H}_2\text{O} \times \frac{249.6846 \text{ g}}{1 \text{ mol}} = 2.497 \text{ g CuSO}_4 \cdot 5\text{H}_2\text{O}$$

**2.497 g CuSO<sub>4</sub>·5H<sub>2</sub>O**



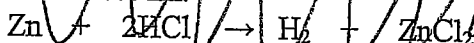
Limit:

Change:

End:

Grams:

13. Calculate the volume of  $\text{H}_2$  gas produced at STP by the reaction of 300 mL of 0.500 M HCl with excess Zn.



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

### Dilutions Worksheet # 7

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

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

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.

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

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

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

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.

$$M_c = \frac{M_d V_d}{V_c} = \frac{(0.0500 \text{ M})(250.0 \text{ mL})}{45.0 \text{ mL}} = \boxed{0.278 \text{ M}}$$

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.

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

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

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

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.

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

~~Molarity Review #8~~

## Mole Stuff

1. Convert 250. g AgNO<sub>3</sub> to formula units and then to atoms of O.

$$250 \text{ g AgNO}_3 \times \frac{1 \text{ mol AgNO}_3}{169.87 \text{ g AgNO}_3} \times \frac{6.02 \times 10^{23} \text{ FU}}{1 \text{ mol}} \times \frac{3 \text{ atoms O}}{1 \text{ FU}} = \boxed{2.66 \times 10^{24} \text{ atoms}}$$

2. Convert  $5.9 \times 10^{25}$  H<sub>2</sub> molecules to grams.

$$5.9 \times 10^{25} \text{ molec. H}_2 \times \frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molec H}_2} \times \frac{2.0158 \text{ g H}_2}{1 \text{ mol H}_2} = \boxed{197.56}$$

3. Calculate the percentage composition of MgSO<sub>4</sub>. → 120.3676

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

$$= \boxed{20.2\%}$$

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

$$= \boxed{26.6\%}$$

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

$$= \boxed{53.2\%}$$



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

$$1.5 \text{ g NaCl} \times \frac{1 \text{ mol NaCl}}{58.4425 \text{ g NaCl}} = 0.0257 \text{ mol NaCl}$$

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

$= 0.257 \text{ M}$

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

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

$$\text{mol} = M \times V_L$$

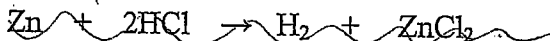
$$= (0.200 \text{ M})(0.250 \text{ L})$$

$$= 0.050 \text{ moles}$$

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

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

17. Calculate the volume of H<sub>2</sub> gas produced at STP by the reaction of 400.0 mL of 0.800 M HCl with excess Zn.



18. Calculate the volume of 0.250 M H<sub>3</sub>PO<sub>4</sub> 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  $CdCl_2 \cdot 6H_2O$  required to prepare 500.0 mL of a 0.200 M solution.

### Worksheet # 9 Dilutions and Molarity

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

$$M_d = \frac{M_c V_c}{V_d} = \frac{(40 \text{ mL})(0.400 \text{ M})}{200 \text{ mL}} = 0.080 \text{ M}$$

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.

$$M_c = \frac{M_d V_d}{V_c} = \frac{(0.0500 \text{ M})(290.0 \text{ mL})}{85.0 \text{ mL}} = 0.171 \text{ M}$$

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

$$M_d = \frac{M_c V_c}{V_d} = \frac{(0.025 \text{ M})(150 \text{ mL})}{300 \text{ mL}} = 0.0125 \text{ M}$$

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.

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

$$= 0.107 \text{ M}$$

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.

$$V_d = \frac{M_c V_c}{M_d} = \frac{(0.825 \text{ M})(100.0 \text{ mL})}{0.350 \text{ M}}$$

$$= 0.236 \text{ L}$$

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

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

$$= 0.238 \text{ M}$$

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

$$28 \text{ g KCl} \times \frac{1 \text{ mol KCl}}{74.551 \text{ g KCl}} = 0.376 \text{ mol}$$

$$M = \frac{\text{mol}}{V_L} = \frac{0.376 \text{ mol}}{0.225 \text{ L}}$$

$$= 1.67 \text{ M}$$

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

$$\text{mol} = M \times V_L$$

$$= (0.450 \text{ M})(0.125 \text{ L})$$

$$= 0.05625$$

$$0.05625 \text{ mol KCl} \times \frac{74.551 \text{ g KCl}}{1 \text{ mol KCl}}$$

$$= 4.19 \text{ g KCl}$$

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

$$8.00 \text{ g KCl} \times \frac{1 \text{ mol}}{74.551 \text{ g}} = 0.107 \text{ mol}$$

$$V_L = \frac{\text{mol}}{M} = \frac{0.107 \text{ mol}}{0.40 \text{ M}}$$

$$= 0.268 \text{ L}$$

10. Calculate the volume of 0.400 M  $\text{H}_2\text{SO}_4$  required to neutralize 25.0 mL of 0.200 M NaOH.

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.



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

$$8.5 \text{ L HCl} \times \frac{1 \text{ mol}}{22.4 \text{ L}} = 0.379 \text{ mol}$$

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

$$= \frac{0.379 \text{ mol}}{0.325 \text{ L}} = \boxed{1.168 \text{ M}}$$

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

$$\text{mol} = M \times V_L$$

$$= (0.400 \text{ M})(0.350 \text{ L})$$

$$= \boxed{0.140 \text{ mol}}$$

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

$$V_L = \frac{\text{mol}}{M} = \frac{0.350 \text{ mol}}{0.300 \text{ M}}$$

$$= \boxed{1.17 \text{ L}}$$

15. Calculate the mass of  $8.25 \times 10^5$  mL of  $H_2$  gas at STP.

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

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

$$\text{mol} = M \times V_L$$

$$= (0.300 \text{ M})(0.200 \text{ L})$$

$$= 0.600 \text{ mol}$$

$$0.600 \text{ mol KCl} \times \frac{6.02 \times 10^{23} \text{ FU KCl}}{1 \text{ mol KCl}}$$

$$= \boxed{3.61 \times 10^{23} \text{ FU}}$$