

## Unit 4 - Quiz/Test Review and Key

### MOLES, MOLAR MASS, PERCENT COMPOSITION, EMPIRICAL AND MOLECULAR FORMULAS

*The quiz will cover items 1-3 only. The test will cover items 1-5.*

1. Students should be able to calculate the molar mass of elements and compounds. Calculate the molar mass of the following:

- A.  $\text{Fe}(\text{NO}_3)_3$
- B.  $\text{FeCl}_2$
- C.  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

2. Students should be able to convert moles to grams, grams to moles, moles to particles, and particles to moles.

- A. Calculate the number of atoms in a 0.75 mole carbon dioxide.
- B. How many grams are there in  $1.5 \times 10^{25}$  molecules of  $\text{CO}_2$ ?
- C. How many atoms are there in  $1.3 \times 10^{22}$  molecules of  $\text{NO}_2$ ?

3. Students should be able to determine the percent composition of a given compound based on its chemical formula. Calculate the percent composition of all elements in the following compounds:

- A.  $\text{AgNO}_3$
- B.  $\text{Pb}(\text{SO}_4)_2$
- C. Percent by mass of water in magnesium sulfate heptahydrate.

4. Students should be able to find the empirical formula of a compound given its percent composition.

- A. 20.2% Al, 79.8% Cl
- B. 80.3% Zn, 19.7% O

5. Students should be able to find the molecular formula of a compound when given the molar mass of a compound and enough information to find the empirical formula.

- A. Find the molecular formula of a compound made up of 92.3% carbon and 7.7% hydrogen. The molar mass of the compound is 78.00 g/mole.
- B. Find the molecular formula of a compound made up of 94.1% oxygen and 5.9% hydrogen. The molar mass of the compound is 34.00 g/mole.

# KEY

$$1. A) \text{Fe(NO}_3)_3 \quad \left. \begin{array}{l} 1 \text{ Fe} \times 55.85 = 55.85 \\ 3 \text{ N} \times 14.01 = 42.03 \\ 9 \text{ O} \times 16.00 = 144.00 \end{array} \right\} = \boxed{241.88 \text{ g}}$$

$$B) \text{FeCl}_2 \quad \left. \begin{array}{l} 1 \text{ Fe} \times 55.85 = 55.85 \\ 2 \text{ Cl} \times 35.45 = 70.90 \end{array} \right\} = \boxed{126.75 \text{ g}}$$

$$C) \text{CuSO}_4 \cdot 5\text{H}_2\text{O} \quad \left. \begin{array}{l} 1 \text{ Cu} \times 63.55 = 63.55 \\ 1 \text{ S} \times 32.07 = 32.07 \\ 4 \text{ O} \times 16.00 = 64.00 \\ 10 \text{ H} \times 1.01 = 10.10 \\ 5 \text{ O} \times 16.00 = 80.00 \end{array} \right\} = \boxed{249.72 \text{ g}}$$

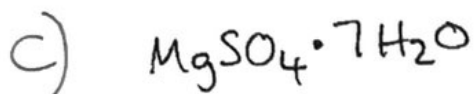
$$2. A) \frac{.75 \text{ mol CO}_2}{1} \frac{6.02 \times 10^{23} \text{ molecules CO}_2}{1 \text{ mol CO}_2} \frac{3 \text{ atoms}}{1 \text{ molecule CO}_2} = \boxed{1.4 \times 10^{24} \text{ atoms}}$$

$$B) \frac{1.5 \times 10^{25} \text{ molecules CO}_2}{1} \frac{1 \text{ mol CO}_2}{6.02 \times 10^{23} \text{ molecules CO}_2} \frac{(12.01 + 16.00 + 16.00)}{44.01 \text{ g CO}_2}}{1 \text{ mol CO}_2} = \boxed{1.1 \times 10^3 \text{ g CO}_2}$$

$$C) \frac{1.3 \times 10^{22} \text{ molecules NO}_2}{1} \frac{3 \text{ atoms}}{1 \text{ molecule NO}_2} = \boxed{3.9 \times 10^{22} \text{ atoms}}$$

$$3. A) \text{AgNO}_3 \quad \begin{array}{l} 1 \text{ Ag} \times 107.87 = 107.87 \\ 1 \text{ N} \times 14.01 = 28.02 \\ 3 \text{ O} \times 16.00 = 48.00 \\ \hline 183.89 \end{array} \quad \begin{array}{l} \% \text{ Ag} = \frac{107.87}{183.89} \times 100 = 58.66\% \\ \% \text{ N} = \frac{28.02}{183.89} \times 100 = 15.23\% \\ \% \text{ O} = \frac{48.00}{183.89} \times 100 = 26.10\% \end{array}$$

$$B) \text{Pb(SO}_4)_2 \quad \begin{array}{l} 1 \text{ Pb} \times 207.2 = 207.2 \\ 2 \text{ S} \times 32.07 = 64.14 \\ 8 \text{ O} \times 16.00 = 128.00 \\ \hline 399.34 \end{array} \quad \begin{array}{l} \% \text{ Pb} = \frac{207.2}{399.34} \times 100 = 51.89\% \text{ Pb} \\ \% \text{ S} = \frac{64.14}{399.34} \times 100 = 16.06\% \text{ S} \\ \% \text{ O} = \frac{128.00}{399.34} \times 100 = 32.05\% \text{ O} \end{array}$$



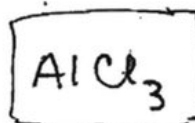
$$\begin{array}{r} 1 \text{ Mg} \times 24.31 = 24.31 \\ 1 \text{ S} \times 32.07 = 32.07 \\ 4 \text{ O} \times 16.00 = 64.00 \\ 14 \text{ H} \times 1.01 = 14.14 \\ 7 \text{ O} \times 16.00 = 112.00 \\ \hline 246.52 \end{array} \left. \vphantom{\begin{array}{r} 1 \text{ Mg} \\ 1 \text{ S} \\ 4 \text{ O} \\ 14 \text{ H} \\ 7 \text{ O} \end{array}} \right\} 126.14 \text{ g}$$

$$\% \text{H}_2\text{O} = \frac{126.14 \text{ g H}_2\text{O}}{246.52 \text{ g total}} \times 100 =$$

51.17%  $\text{H}_2\text{O}$

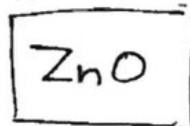
4. a)  $\frac{20.2 \text{ g Al}}{1} \frac{1 \text{ mol Al}}{26.98 \text{ g Al}} = \frac{.749 \text{ mol Al}}{.749} = 1$

$\frac{79.8 \text{ g Cl}}{1} \frac{1 \text{ mol Cl}}{35.45 \text{ g Cl}} = \frac{2.25 \text{ mol Cl}}{.749} = 3$



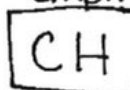
b)  $\frac{80.3 \text{ g Zn}}{1} \frac{1 \text{ mol Zn}}{65.39 \text{ g Zn}} = 1.23 \text{ mol Zn}$

$\frac{19.7 \text{ g O}}{1} \frac{1 \text{ mol O}}{16.00 \text{ g O}} = 1.23 \text{ mol O}$



5. a)  $\frac{92.3 \text{ g C}}{1} \frac{1 \text{ mol C}}{12.01 \text{ g C}} = 7.69 \text{ mol empirical}$

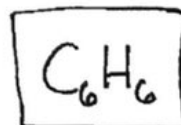
$\frac{7.7 \text{ g H}}{1} \frac{1 \text{ mol H}}{1.01 \text{ g H}} = 7.62 \text{ mol}$



weighs

$$\frac{12.01 \text{ g}}{1.01 \text{ g}} = 13.01 \text{ g}$$

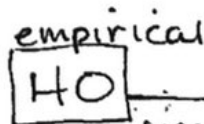
$$\frac{78.00 \text{ g}}{13.01 \text{ g}} = 6$$



molecular

b)  $\frac{94.1 \text{ g O}}{1} \frac{1 \text{ mol O}}{16.00 \text{ g O}} = 5.88 \text{ mol O}$

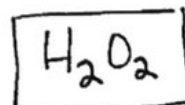
$\frac{5.9 \text{ g H}}{1} \frac{1 \text{ mol H}}{1.01 \text{ g H}} = 5.8 \text{ mol H}$



weighs

$$\frac{1.01}{16.00} = 17.01 \text{ g}$$

$$\frac{34.00 \text{ g}}{17.01 \text{ g}} = 2$$



molecular