Chemistry Chapter 7 Review

Name KEY Period ____ Date _____

Find the Molar Mass of each of the following compounds:

1. $Fe_3(PO_4)_2$

Fe: 55.85 g/mol × 3 = 167.55 g/mol
P: 30.97 g/mol × 2 = 61.94 g/mol
O: 16 g/mol × 8 = 128 g/mol

167.55 g/mol
61.94 g/mol
+128 g/mol
357.49 g/mol

Molar Mass of $Fe_3(PO_4)_2$

2. $Zn(C_2H_3O_2)_2$

Zn: 65.39 g/mol
C: 12.01 × 4 = 48.04 g/mol
H: 1.01 × 6 = 6.06 g/mol
O: 16 × 4 = 64 g/mol

add up = 183.49 g/mol = Molar Mass of $Zn(C_2H_3O_2)_2$

Calculate the Percent Composition of each element in the following compounds:

3. $YBa_2Cu_3O_7$, a superconductor

Y: 88.91 g/mol ÷ 666.22 g/mol × 100 = 13.35% Y
Ba: 137.33 g/mol × 2 = 274.66 g/mol ÷ 666.22 g/mol × 100 = 41.23% Ba
Cu: 63.55 g/mol × 3 = 190.65 g/mol ÷ 666.22 g/mol × 100 = 28.62% Cu
O: 16 g/mol × 7 = 112 g/mol ÷ 666.22 g/mol × 100 = 16.81% O

Total 666.22 g/mol

4. tin (IV) oxide, SnO_2, an ingredient in fingernail polish

Sn: 118.71 g/mol ÷ 150.71 × 100 = 78.77% Sn
O: 16 g/mol × 2 = 32 g/mol ÷ 150.71 × 100 = 21.23% O
total = 150.71 g/mol

Find the average atomic mass

5. Calculate the average atomic mass of bromine. One isotope of bromine has an atomic mass of 78.92amu and a relative abundance of 50.69%. The other major isotope of bromine has an atomic mass of 80.92amu.

50.69% ÷ 100 = 0.5069
78.92amu × 0.5069 = 40.00amu
100% − 50.69% = 49.31%
49.31% ÷ 100 = 0.4931
80.92amu × 0.4931 = 39.90amu
40 + 39.9 = 79.9amu

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Mass to moles to molecules unit conversion calculations:

6. How many moles of rubidium are in 8.22×10^{23} atoms of rubidium?

$$8.22\times10^{23}\ \text{atoms Rb} \left| \frac{1\ \text{mol Rb}}{6.022\times10^{23}\ \text{atoms Rb}} \right. = 1.36\ \text{mol Rb}$$

7. What is the mass of 5.11×10^{-7} mol of Vitamin E, $C_{29}H_{50}O_2$?

C: $12.01\times29 = 348.29$ g/mol
H: $1.01\times50 = 50.50$ g/mol
O: $16\times2 = 32$ g/mol
430.79 g/mol

$$5.11\times10^{-7}\ \text{mol } C_{29}H_{50}O_2 \left| \frac{430.79\ \text{g } C_{29}H_{50}O_2}{1\ \text{mol } C_{29}H_{50}O_2} \right. = 2.2\times10^{-4}\ \text{g } C_{29}H_{50}O_2$$

8. How many formula units of tungsten (VI) oxide, WO_3, are in 4.27 grams of tungsten (VI) oxide?

W: 183.84 g/mol
O: $16\times3 = 48$ g/mol
$= 231.84$ g/mol

$$4.27\ \text{g } WO_3 \left| \frac{1\ \text{mol } WO_3}{231.84\ \text{g } WO_3} \right| \frac{6.022\times10^{23}\ \text{formula units } WO_3}{1\ \text{mol } WO_3} = 1.11\times10^{23}\ \text{formula units } WO_3$$

a. How many ions of W^{6+} are in this sample?

1 mol WO_3 = 1 mol W^{+}
Therefore, there are also 1.11×10^{23} ions W^{6+}

b. How many ions of O^{2-} are in this sample?

1 mol WO_3 = 3 mol O^{2-}
There are 3x as many O^{2-} ions as WO_3 units. So,
$1.11\times10^{23}\times3 = 3.33\times10^{23}$ ions O^{2-}

9. How many grams of $Ba_3(PO_4)_2$ does a sample contain, if there are found to be 3.63×10^{23} ions of PO_4^{3-}.

$$3.63\times10^{23}\ \text{ions } PO_4^{3-} \left| \frac{1\ \text{mol } PO_4^{3-}}{6.022\times10^{23}\ \text{ions } PO_4^{3-}} \right| \frac{1\ \text{mol } Ba_3(PO_4)_2}{2\ \text{mol } PO_4^{3-}}$$

1 mol $Ba_3(PO_4)_2$ = 2 mol PO_4^{3-}

Ba: $137.33\times3 = 411.99$ g/mol
P: $30.97\times2 = 61.94$ g/mol
O: $16\times8 = 128$ g/mol
601.93 g/mol

$$\frac{601.93\ \text{g } Ba_3(PO_4)_2}{1\ \text{mol } Ba_3(PO_4)_2} = 181.4\ \text{g } Ba_3(PO_4)_2$$

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10. Precious metals are commonly measured in troy ounces. A troy ounce is equivalent to 31.1g. How many moles are in a troy ounce of... 1 t.o. = 31.1 g

a. gold? $1\text{ t.o. Au} \left| \frac{31.1\text{ g Au}}{1\text{ t.o. Au}} \right| \frac{1\text{ mol Au}}{196.97\text{ g Au}} = 0.158\text{ g Au}$

b. platinum? $1\text{ t.o. Pt} \left| \frac{31.1\text{ g Pt}}{1\text{ t.o Pt}} \right| \frac{1\text{ mol Pt}}{195.08\text{ g Pt}} = 0.159\text{ g Pt}$

c. silver? $1\text{ t.o Ag} \left| \frac{31.1\text{ g Ag}}{1\text{ t.o. Ag}} \right| \frac{1\text{ mol Ag}}{107.87\text{ g Ag}} = 0.288\text{ g Ag}$

Determine the Empirical Formula for the following problems:

11. The analysis of a compound shows that it is 27.0% Na, 16.5% N, and 56.5% O. What is the empirical formula of this compound?

$27\text{ g Na} \left| \frac{1\text{ mol Na}}{23\text{ g Na}} \right. = 1.17\text{ mol Na}$ ← smallest

$\frac{1.17\text{ mol Na}}{1.17\text{ mol}} = 1$

$16.5\text{ g N} \left| \frac{1\text{ mol N}}{14.0\text{ g N}} \right. = 1.18\text{ mol N}$

$\frac{1.18\text{ mol N}}{1.17\text{ mol}} = 1$

$56.5\text{ g O} \left| \frac{1\text{ mol O}}{16\text{ g O}} \right. = 3.53\text{ mol}$

$\frac{3.53\text{ mol}}{1.17\text{ mol}} = 3$

$NaNO_3$ Empirical Formula

12. An oxide of phosphorus is 56.34% phosphorus, and the rest is oxygen. Calculate the empirical formula for this compound. 100 − 56.34 = 43.66 g O

$56.34\text{ g P} \left| \frac{1\text{ mol P}}{30.97\text{ g P}} \right. = 1.82\text{ mol P}$ ← smaller #

$\frac{1.82\text{ mol}}{1.82\text{ mol}} = 1 \times 2$

$43.66\text{ g O} \left| \frac{1\text{ mol O}}{16\text{ g O}} \right. = 2.73\text{ mol O}$

$\frac{2.73\text{ mol O}}{1.82\text{ mol}} = 1.5 \times 2$

P_2O_3 Empirical Formula

Determine the Molecular Formula for the following problems:

13. Determine the molecular formula for a compound with the empirical formula CoC_4O_4 and an experimental molar mass of 341.94 g/mol.

Co = 59 g/mol
C = 12 × 4 = 48 g/mol
O = 16 × 4 = 64 g/mol
171 g/mol

$\frac{341.94\text{ g/mol}}{171\text{ g/mol}} = 2$

Molecular Formula

$Co_2C_8O_8$

14. The empirical formula of the anticancer drug altretamine is $C_3H_6N_2$. The experimental molar mass is 210 g/mol. What is its molecular formula?

C: 12 × 3 = 36 g/mol
H: 1 × 6 = 6 g/mol
N: 14 × 2 = 28 g/mol
70 g/mol

$\frac{210}{70} = 3$

$C_9H_{18}N_6$ Molecular Formula

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15. What's the empirical formula of a molecule containing 65.5% carbon, 5.5% hydrogen, and 29.0% oxygen?

$65gC \left| \frac{1molC}{12gC} \right. = \frac{5.42mol}{1.81mol} = 3$ $\quad 29gO \left| \frac{1molO}{16gO} \right. = \frac{1.81mol}{1.81mol} = 1$

$5.5gH \left| \frac{1molH}{1gH} \right. = \frac{5.5mol}{1.81mol} = 3$

Empirical Formula C_3H_3O

a. If the experimental molar mass of this compound is 110 g/mol, then calculate the molecular formula?

M.M. of $C_3H_3O = 12(3) + 1(3) + 16 = 55g/mol$

$\frac{110g/mol}{55g/mol} = 2$

Molecular Formula $C_6H_6O_2$

16. What's the empirical formula of a molecule containing 18.7% lithium, 16.3% carbon, and 65.0% oxygen?

$18.7gLi \left| \frac{1molLi}{7gLi} \right. = \frac{2.67mol}{1.36mol} = 2$ $\quad 16.3gC \left| \frac{1molC}{12gC} \right. = \frac{1.36mol}{1.36mol} = 1$ $\quad 65gO \left| \frac{1molO}{16gO} \right. = \frac{4.06mol}{1.36mol} = 3$

Empirical Formula = Li_2CO_3

a. If the experimental molar mass of this compound is 73.8 g/mol, then calculate the molecular formula?

M.M. of $Li_2CO_3 = 7(2) + 12 + 16(3) = 74g/mol$

$\frac{73.8g/mol}{74g/mol} = 1$

Molecular Formula = Li_2CO_3

17. A compound is 75.46% carbon, 4.43% hydrogen, and 20.10% oxygen by mass. It has a molecular weight of 318.31 g/mol. What is the molecular formula for this compound?

$75.46gC \left| \frac{1molC}{12gC} \right. = \frac{6.29mol}{1.26mol} = 5 \times 2 = 10$

$4.43gH \left| \frac{1molH}{1gH} \right. = \frac{4.43mol}{1.26mol} = 3.5 \times 2 = 7$ ← Because this is a half an atom which cannot be we x by 2 to get into whole #. What you do to one you must do to all.

$20.10gO \left| \frac{1molO}{16g} \right. = \frac{1.26mol}{1.26mol} = 1 \times 2 = 2$

Emp. Form = $C_{10}H_7O_2$

M.M. = $12(10) + 7 + 2(16) = 159g/mol$

$\frac{318.31g/mol}{159g/mol} = 2$

Molecular Formula = $C_{20}H_{14}O_4$