Name **Key** Period _____

Worksheet: Calculating Empirical & Molecular Formulas

1. The empirical formula for the compound having the formula $H_2C_2O_4$ is:

[A] C_2H_2 (B) CO_2H [C] COH   [D] $C_2O_4H_2$ [E] COH2

2. Calculate the empirical formula of a compound that is 85.6% C and 14.4% H (by mass).

(A) CH_2 [B] CH [C] C_3H_5 [D] C_2H_4 [E] C_2H

$C \frac{85.6}{12.01} = \frac{7.12}{7.12} = 1$ $H \frac{14.4}{1.01} = \frac{14.25}{7.12} = 2$

3. A compound is analyzed and found to contain 12.1% carbon, 16.2% oxygen, and 71.7% chlorine (by mass). Calculate the empirical formula of this compound.

(A) $COCl_2$ [B] CO_2Cl_2 [C] CO2Cl   [D] COCl4   [E] COCl

$C \frac{12.1}{12.01} = 1$ $Cl \frac{71.7}{35.45} = 2$
$O \frac{16.2}{16.00} = 1$

4. A compound contains 40.0% carbon, 6.7% hydrogen, and 53.3% oxygen (by mass). Calculate the empirical formula.

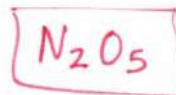[A] C_2H2O (B) CH_2O [C] CH_4O [D] C_2HO2 [E] $C_3H_6O_3$

$C: \frac{40.0}{12.01} = \frac{3.33}{3.33} = 1$ $O: \frac{53.3}{16.0} = \frac{3.33}{3.33} = 1$
$H: \frac{6.7}{1.01} = \frac{6.63}{3.33} = 2$

5. A compound contains 25.94% N and 74.06% O (by mass). What is the empirical formula?

$\frac{25.94 g N}{14.07} = \frac{1.84}{1.84} = 1 \times 2 = 2$

$\frac{74.06 g O}{16.00} = \frac{4.63}{1.84} = 2.5 \times 2 = 5$

$\boxed{N_2O_5}$

6. Determine the empirical formula of a compound containing 54.2% F and 45.8% S (by mass).

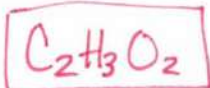$\frac{54.2 g F}{19.00 g/mol} = \frac{2.85 \, mol \, F}{1.43} = 1.99 \sim 2$

$\frac{45.8 g S}{32.07 g/mol} = \frac{1.43 \, mol \, S}{1.43} = 1$ $\boxed{SF_2}$
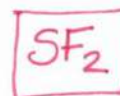
7. A compound has 40.68% carbon, 5.12% hydrogen, and 54.20% oxygen (by mass). Calculate its empirical formula.

$\frac{40.68 g C}{12.01 g/mol} = \frac{3.387}{3.387}$ $\frac{5.12 g H}{1.01 g/mol} = \frac{5.069}{3.387}$ $\frac{54.20 g O}{16.00 g/mol} = \frac{3.388}{3.387}$

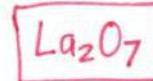$\boxed{C_2H_3O_2}$ $= 1 \times 2 = 2$ $= 1.496 \times 2 = 3$ $= 1 \times 2 = 2$

8. A 7.33-g sample of lanthanum, La, combines with oxygen to give 10.29 g of the oxide. Calculate the empirical formula of this oxide.

$10.29 g - 7.33 g \, La = 2.96 g \, O$

$\frac{7.33 g \, La}{138.91 g/mol} = \frac{.0527}{.0527}$ $\frac{2.96 g \, O}{16.00 g/mol} = \frac{.1850}{.0527} = 3.5 \times 2 = 7$ $\boxed{La_2O_7}$
$= 1 \times 2 = 2$

9. Calculate the molecular formula of a compound with the empirical formula CH_2O and a molar mass of 150 g/mol.

30    $150 \div 30 = 5$

[A] $C_3H_6O_3$ (B) $C_5H_{10}O_5$ [C] $C_2H_4O_2$ [D] $C_4H_8O_4$ [E] $C_6H_{12}O_6$

10. The empirical formula of a compound is CH_2O, and its mass is 120 amu/molecule. Calculate its molecular formula.

$\overset{30}{CH_2O}$ $\dfrac{120}{30} = 4$

[A] C_3H6O_3 [B] $C_2H_4O_2$ [C] $C_4H_8O_4$ [D] CH_2O [E] none of these

11. The empirical formula of a compound is known to be CH_2, and its molar mass is 56 g/mol. What is the molecular formula?

$\overset{14}{\dfrac{56}{14}} = 4$ $4(CH_2) = \boxed{C_4H_8}$

12. A compound contains 12.8% C, 2.1% H, and 85.1% Br (by mass). Calculate the empirical formula and the molecular formula of this compound given that the molar mass is 188 g/mol.

$\dfrac{12.8 \text{ g } C}{12.01 \text{ g/mol}} = 1.07 \text{ mol}$, $\dfrac{1.07}{1.06} = 1$ $\dfrac{85.1 \text{ g } Br}{79.90 \text{ g/mol}} = \dfrac{1.06}{1.06} = 1$ $\dfrac{188}{93} = 2$

$\dfrac{2.1 \text{ g } H}{1.01 \text{ g/mol}} = 2.1 \text{ mol}$, $\dfrac{2.1}{1.06} = 1.98$ $2\left(\underset{93}{CH_2Br}\right) = \boxed{C_2H_4Br_2}$

13. A compound contains 10.13% C and 89.87% Cl (by mass). Determine both the empirical formula and the molecular formula of the compound given that the molar mass is 237 g/mol.

$\dfrac{10.13 \text{ g } C}{12.01 \text{ g/mol}} = \dfrac{0.8435}{0.8435} = 1$ $\boxed{CCl_3}$ 118

$\dfrac{89.87 \text{ g } Cl}{35.45 \text{ g/mol}} = \dfrac{2.535}{0.8435} = 3.1$ $237 \div 118 = 2$

$2(CCl_3) = \boxed{C_2Cl_4}$

14. A compound has a molar mass of 86 g/mol and has the percent composition (by mass) of 55.8% C, 37.2% O, and 7.0% H. Determine the empirical formula and the molecular formula.

$\dfrac{55.8 \text{ g } C}{12.01 \text{ g/mol}} = \dfrac{4.65}{2.33} = 1.99$ $\dfrac{7.0 \text{ g } H}{1.01 \text{ g/mol}} = \dfrac{6.93}{2.33} = 2.97$

$\dfrac{37.2 \text{ g } O}{16.00 \text{ g/mol}} = \dfrac{2.33}{2.33} = 1$ $\boxed{\underset{43}{C_2OH_3}}$ $\dfrac{86}{43} = 2$

$\underset{(116)}{\qquad}$ $C_4O_2H_6$

15. A compound has a molar mass of 100 g/mol and the percent composition (by mass) of 65.45% C, 5.45% H, and 29.09% O. Determine the empirical formula and the molecular formula.

$\dfrac{65.45}{12.01} = \dfrac{5.45}{1.818} = 2.99$ $\boxed{\underset{55}{C_3H_3O}}$ $\boxed{C_6H_6O_2}$

$\dfrac{5.45}{1.01} = \dfrac{5.41}{1.818} = -2.97$ $\dfrac{110}{55} = 2$

$\dfrac{29.09}{16.00} = \dfrac{1.818}{1.818} = 1$