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** (circled)   [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 (circled)   [B] CH   [C] C_3H_5 [D] C_2H_4 [E] C_2H

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

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

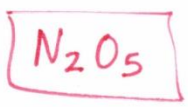 $C\ \dfrac{12.1}{12.01} = 1$ $Cl\ \dfrac{71.7}{35.45} = 2$

   $O\ \dfrac{16.2}{16.00} = 1$

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

   [A] C2H2O   **[B] CH_2O** (circled)   [C] CH_4O [D] C_2HO2 [E] $C_3H_6O_3$

   $C: \dfrac{40.0}{12.01} = \dfrac{3.33}{3.33} = 1$ $O: \dfrac{53.3}{16.0} = \dfrac{3.33}{3.33} = 1$

   $H: \dfrac{6.7}{1.01} = \dfrac{6.63}{3.33} = 2$

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

   $\dfrac{25.94\,gN}{14.07} = \dfrac{1.84}{1.84} = 1 \times 2 = 2$

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

   $\boxed{N_2O_5}$

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

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

   $\dfrac{45.8\,g\,S}{32.07\,g/mol} = \dfrac{1.43\ mol\,S}{1.43} = 1$

   $\boxed{SF_2}$

7. A compound has 40.68% carbon, 5.12% hydrogen, and 54.20% oxygen (by mass). Calculate its empirical formula.

   $\boxed{C_2H_3O_2}$

   $\dfrac{40.68\,gC}{12.01\,g/mol} = \dfrac{3.387}{3.387}$ $\dfrac{5.12\,g\,H}{1.01\,g/mol} = \dfrac{5.069}{3.387}$ $\dfrac{54.20\,g\,O}{16.00\,g/mol} = \dfrac{3.388}{3.387}$

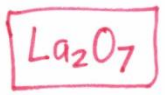 $= 1 \times 2 = 2$ $= 1.496 \times 2 = 3$ $= 1 \times 2 = 2$
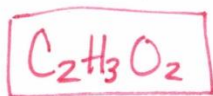
8. A 7.33-g sample of lanthanum, La, combines with oxygen to give 10.29 g of the oxide. Calculate the empirical formula of this oxide.

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

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

   $= 1 \times 2 = 2$

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] $C_5H_{10}O_5$** (circled)   [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. $\frac{30}{}$ $\frac{120}{30} = 4$
Calculate its molecular formula.

[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? 14

$$\frac{56}{14} = 4 \qquad\qquad 4(CH_2) = \boxed{C_4H_8}$$

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.

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

$$\frac{2.1g\ H}{1.01g/mol} = 2.1 mol \quad \frac{2.1 mol}{1.06} = 1.98 \qquad\qquad 2(\underline{CH_2Br}) = \boxed{C_2H_4Br_2}$$

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.

$$\frac{10.13g\ C}{12.01g/mol} = 0.8435 \quad \frac{0.8435}{0.8435} = 1 \qquad \boxed{CCl_3} \quad 118$$

$$\frac{89.87g\ Cl}{35.45g/mol} = 2.535 \quad \frac{2.535}{0.8435} = 3. \qquad 237 \div 118 = 2$$

$$2(CCl_3) = \boxed{C_2Cl_6}$$

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.

$$\frac{55.8g\ C}{12.01g/mol} = 4.65 \quad \frac{4.65}{2.33} = 1.99 \qquad \frac{7.0g\ H}{1.01g/mol} = 6.93 \quad \frac{6.93}{2.33} = 2.97$$

$$\frac{37.2g\ O}{16.00g/mol} = 2.33 \quad \frac{2.33}{2.33} = 1 \qquad \boxed{C_2OH_3} \qquad \frac{86}{43} = 2$$

$$\underline{43} \qquad\qquad C_4O_2H_6$$

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.

$$\frac{65.45}{12.01} = 5.45 \quad \frac{5.45}{1.818} = 2.99 \qquad \boxed{C_3H_3O} \qquad\qquad \boxed{C_6H_6O_2}$$

$$\frac{5.45}{1.01} = 5.41 \quad \frac{5.41}{1.818} = 2.97 \qquad 55 \qquad\qquad \frac{110}{55} = 2$$

$$\frac{29.09}{16.00} = 1.818 \quad \frac{1.818}{1.818} = 1$$