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

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] C2H2O [B] CH_2O [C] CH_4O [D] C_2HO2 [E] $C_3H_6O_3$

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

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

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

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

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

N_2O_5

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

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

$\frac{45.8\text{ g S}}{32.07\text{ g/mol}} = \frac{1.43\text{ mol S}}{1.43} = 1$

SF_2

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

$\frac{40.68\text{ g C}}{12.01\text{ g/mol}} = \frac{3.387}{3.387} = 1 \times 2 = 2$ $\frac{5.12\text{ g H}}{1.01\text{ g/mol}} = \frac{5.069}{3.387} = 1.496 \times 2 = 3$ $\frac{54.20\text{ g O}}{16.00\text{ g/mol}} = \frac{3.388}{3.387} = 1 \times 2 = 2$

$C_2H_3O_2$

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

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

$= 1 \times 2 = 2$

La_2O_7

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

30 150 ÷ 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.

30

$\frac{120}{30} = 4$

[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?

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

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.

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

$\frac{2.1\text{ g H}}{1.01\text{ g/mol}} = \frac{2.1\text{ mol}}{1.06} = 1.98$

$2(CH_2Br) = C_2H_4Br_2$

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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.

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

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

$2(CCl_3) = C_2Cl_6$

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.

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

$\frac{37.2\text{ g O}}{16.00\text{ g/mol}} = \frac{2.33}{2.33} = 1$

C_2OH_3

43

$\frac{86}{43} = 2$

$C_4O_2H_6$

110

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.

$\frac{65.45}{12.01} = \frac{5.45}{1.818} = 2.99$ $\quad C_3H_3O$ $\quad 55$ $\quad C_6H_6O_2$

$\frac{5.46}{1.01} = \frac{5.41}{1.818} = 2.97$ $\quad \frac{110}{55} = 2$

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