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| **Empirical/Molecular Formula** | Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

1. What is an empirical formula? How is it different from a molecular formula?

**The empirical formula is the lowest whole number ratio of atoms in a compound. The molecular formula shows the true number of atoms in the molecule and is a whole number multiple of the empirical formula.**

1. State the empirical formula for each of the following.
2. C6H14  **C3H7**
3. Fe2O3  **Fe2O3**
4. K2C2O4  **KCO2**
5. A sample of a compound is 50.0% sulfur and 50.0% oxygen by mass. What is the empirical formula?

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| S: | 50.0 g S | 1 mol S | = | 1.559 mol S | = 1 S |
|  | 32.07 g S | 1.559 mol |

**EF: SO2**

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| O: | 50.0 g O | 1 mol O | = | 3.125 mol O | = 2 O |
|  | 16.00 g O | 1.559 mol |

1. A sample of a compound is 52.9% aluminum. The rest is oxygen. What is the empirical formula

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| Al: | 52.9 g Al | 1 mol Al | = | 1.961 mol Al | = 1 Al × 2 = 2 Al |
|  | 26.98 g Al | 1.961 mol |

**EF: Al2O3**

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| O: | 47.1 g O | 1 mol O | = | 2.944 mol O | = 1.5 O × 2 = 3 O  Ratio must be a whole number. |
|  | 16.00 g O | 1.961 mol |

1. A compound is 48.65% carbon, 8.11 % hydrogen and 43.24 % oxygen. Determine the empirical formula.

4.05 mol carbon, 8.11 mol H, 2.70 mol O

C4.05/2.70 H8.11/2.70 O2.70/2.70

1. Divide by the smallest # to get = C1.5H3O1

2. Multiply to get a whole number ratio (x2) = C3H6O2

1. Vinegar is a dilute solution of acetic acid. The molar mass of acetic acid is 60.0 g/mol and it has an empirical formula of CH2O. What is the molecular formula of acetic acid?

CH2O M.M.= 30.0 g/mol

C2H4O2 M.M. = 60.0 g/mol 🡨 molecular formula

1. A compound has an empirical formula of C3H4. Which of the following are possible molar masses of the compound? 20 g/mol, 55 g/mol, 80 g/mol, 120 g/mol.

C3H4 M.M. = 40 g/mol

C6H8 M.M. = 80 g/mol

C9H12 M.M. = 120 g/mol

1. A compound contains 9.93 g C, 58.6 g Cl, and 31.4 g F. Determine its empirical formula.

0.8275 mol carbon, 1.66 mol Cl, 1.65 mol F

C0.8274/0.8274Cl1.66/0.8274F1.65/0.8274

1. Divide by the smallest # to get = C1Cl2F2

2. Multiply to get a whole number ratio (didn’t have to multiply!) = CCl2F2

1. A compound has an empirical formula of CH2 and a molar mass of 42.0 g/mol. Determine its molecular formula.

CH2 M.M. = 14.0 g/mol

C2H4 M.M. = 28 g/mol

C3H6 M.M. = 42 g/mol

1. The empirical formula of a compound is P2O5. Its gram formula mass is about 284 grams. What is the molecular formula?

EF: P2O5 = 2(30.97) + 5(16.00) = 141.94

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| 284 | = 2 |  | **MF: (P2O5)2 = P4O10** |
| 141.94 |

1. A small sample of antifreeze was analyzed. It contained 4.51 g C, 1.13 g H and 6.01 g O. It was determined that the molar mass is 62.0 g/mol. What is the molecular formula of antifreeze?

0.376 mol C, 1.13 mol H, 0.375 mol O

C0.376/0.375H1.13/0.375O0.375/0.375

1. Divide by the smallest # to get = C1H3O1

2. Multiply to get a whole number ratio (didn’t have to multiply!) = CH3O

N = Molar Mass/Empirical Mass = 2

CH3O M.M. = 31 g/mol

C2H6O2 M.M. = 62 g/mol

1. A hydrocarbon is a compound containing only carbon and hydrogen. One particular hydrocarbon is 92.29% carbon by mass. If the compound’s molar mass is 78.0 g/mol then what is its molecular formula?

7.69 mol C, 7.71 mol H

C7.69/7.69H7.71/7.69

1. Divide by the smallest # to get = C1H1

2. Multiply to get a whole number ratio (didn’t have to multiply!) = CH

N = Molar Mass/Empirical Mass = 6

C6H6 M.M. = 78 g/mol

1. A sample has mass of 43.0 grams. Its percent composition is 40.0% carbon, 6.7% hydrogen and 53.3% oxygen. Its gram formula mass is about 180 grams. What are the empirical and molecular formulas of the compound?

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| C: | 40.0 g C | 1 mol C | = | 3.331 mol C | = 1 C |
|  | 12.01 g C | 3.331 mol |

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| H: | 6.7 g H | 1 mol H | = | 6.634 mol H | = 2 H |
|  | 1.01 g H | 3.331 mol |

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| O: | 53.3 g O | 1 mol O | = | 3.331 mol O | = 1 O |
|  | 16.00 g O | 3.331 mol |

**EF: CH2O** = 12.01 + 2(1.01) + 16.00 = 30.03

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| 180 | = 6 |  | **MF: (CH2O)6 = C6H12O6** |
| 30.03 |