Molecular Formula Worksheet

Molecular formula – a formula showing the types and numbers of atoms combined in a single molecule of a molecular compound. It is a whole number multiple of the empirical formula.

The relationship between a compound's empirical and molecular formula can be written as:

x(empirical formula) = molecular formula

also

x(empirical formula mass) = molecular formula mass

1. To determine the molecular formula of a compound, you must know the compound's molar mass.

2. Divide the molecular mass by the empirical formula mass to determine the whole number multiple (x). You may have to find the empirical formula in order to obtain the empirical formula mass.

Problems:

1. In a previous problem, the empirical formula of a compound of phosphorus and oxygen was found to be P_2O_5. Experimentation shows that the molar mass of this compound is 283.89g/mol. What is the compounds molecular formula?

2. Determine the molecular formula of the compound with an empirical formula of CH and a molar mass of 78.110 g/mol.

3. A sample with a molar mass of 34.00 g/mol is found to consist of 0.44g H and 6.92g O. Find its molecular formula.

4. If 4.04g of N combine with 11.46g O to produce a compound with a molar mass of 108.0 g/mol, what is the molecular formula of this compound?

5. The empirical formula for trichloroisocyanuric acid, the active ingredient in many household bleaches, is OCNCl. The molar mass of this compound is 232.41g/mol. What is the molecular formula of trichloroisocyanuric acid.

6. The molar mass of a compound is 92g/mol. Analysis of a sample of the compound indicates that it contains 0.606g N and 1.390g O. Find its molecular formula.

7. Determine the molecular formula of a compound with an empirical formula of NH_2 and a formula mass of 32.06 g/mol.

1. Empirical Formula = P_2O_5 Empirical Mass = 2(31.0) + 5(16.0) = 142g

Molecular Mass = 283.89g.

$\frac{283.89}{142} \approx 2$

$2(P_2O_5)$ = **P_4O_{10}**

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2. Empirical Formula = CH Empirical Mass = 1(12.0) + 1(1.0) = 13g

Molecular Mass = 78.110 amu

$\frac{78.110}{13} \approx 6$

$6(CH)$ = **C_6H_6**

3.

$\frac{0.44\text{g H}}{} \left| \frac{1\text{ mol H}}{1.0\text{g H}} \right. = 0.44\text{ mol H}$ $\qquad \frac{0.44}{0.433} = 1\text{ H}$

$\frac{6.92\text{g O}}{} \left| \frac{1\text{ mol O}}{16.0\text{g O}} \right. = 0.433\text{ mol O}$ $\qquad \frac{0.433}{0.433} = 1\text{ O}$

HO

Empirical Formula = HO Empirical Mass = 1(1.0) + 1(16.0) = 17g

Molecular Mass = 34.00 amu

$\frac{34.00}{17} \approx 2$

$2(HO)$ = **H_2O_2**

4.

$\frac{4.04\text{ N}}{} \left| \frac{1\text{ mol N}}{14.0\text{g N}} \right. = 0.289\text{ mol N}$ $\qquad \frac{0.289}{0.289} = 1\text{ N}$

$\frac{11.46\text{g O}}{} \left| \frac{1\text{ mol O}}{16.0\text{g O}} \right. = 0.7163\text{ mol O}$ $\qquad \frac{0.7163}{0.289} = 2.5\text{ O}$

} X's 2

N_2O_5

Empirical Formula = N_2O_5 Empirical Mass = 2(14.0) + 5(16.0) = 108.0g

Molecular Mass = 108.0 amu

$\frac{108.0}{108.0} = 1$

$1(N_2O_5)$ = **N_2O_5**

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5. Empirical Formula = OCNCl Empirical Mass = 16.0+12.0+14.0+35.5 = 77.5g

Molecular Mass = 232.41 amu

$\frac{232.41}{77.5} \approx 3$

$3(OCNCl)$ = **$O_3C_3N_3Cl_3$**

6.

$\frac{0.606g\ N}{} \left| \frac{1\ mol\ N}{14.0g\ N} \right. = 0.0433\ mol\ N$ $\frac{0.0433}{0.0433} = 1\ N$

$\frac{1.390g\ O}{} \left| \frac{1\ mol\ O}{16.0g\ O} \right. = 0.08688\ mol\ O$ $\frac{0.08688}{0.0433} = 2\ O$

NO_2

Empirical Formula = NO_2 Empirical Mass = 1(14.0) + 2(16.0) = 46.0g

Molecular Mass = 92 g

$\frac{92}{46} = 2$

$2(NO_2)$ = **N_2O_4**

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7. Empirical Formula = NH_2 Empirical Mass = 1(14.0) + 2(1.0) = 16g

Molecular Mass = 32.06 amu

$\frac{32.06}{16} \approx 2$

$2(NH_2)$ = **N_2H_4**