

# Molecular Formula Notes

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## Molecular Formula Notes

Definition:

What does it mean?

When do you have Molecular formula:

### Step to Calculate Molecular Formula

1. Change mass percent (%) to actual masses or use given masses directly
  - **Assume the mass of one mole of the compound NOT 100.g compound (cpd).** If you assume 100g, you will determine the empirical formula instead.
2. Change mass of element to mole of element
3. Since you assumed mass of one mole of cpd, the moles should be close enough to whole to assume they are whole. So you do not have change to a molar ratio or multiple by a common number.
  - Take smaller mole number and divide this number into all other mole number.

### Step to Calculate Molecular Formula (MF) from Empirical Formula (EF)

As you know, molecular formula are really a certain number of "empirical formula" units. An analogue is a chain with several links. The chain is made up of several identical links so if you know the mass of the chain and the mass of a single link, then you can determine how many links there are in the chain. Similarly, the MF is made up of a certain number of EF units. Therefore, if you know the mass of the molecular formula (we call molar mass) and mass of a mole of the EF, if you divide the two, you get how many EF units there are in the MF.

1. Determine the molar mass of the EF (you have to be given this or given the chemical formula of the EF).
2. Must be given the molar mass of the MF. 3. Divide the molar mass of the EF into the molar mass of the MF or
$$\frac{\text{MM of MF}}{\text{MM of EF}} = \# \text{ of EF units in MF}$$

4. Then multiple the subscripts in the EF with the # of EF in the MF to determine the correct subscript for the chemical formula for the MF.

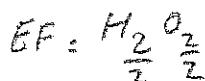
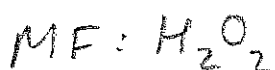
### Example When Give Actual Mass or Mass Percent Information and Asked for Both EF and MF.

What is the EF and MF of a compound that is 94.2% oxygen and rest hydrogen? The molar mass of the compound is 34.0g/mole.

Assume: Mass of 1 mole of compound = 34.0g

$$\text{Step 1} \quad \text{Step 2} \quad \text{O: } (34.0 \text{ g cpd}) \left( \frac{94.2 \text{ g O}}{100. \text{ g cpd}} \right) \left( \frac{1 \text{ mole O}}{16 \text{ g O}} \right) = 2.00 \text{ mole O}$$

$$\text{H: } (34.0 \text{ g cpd}) \left( \frac{5.8 \text{ g H}}{100. \text{ g cpd}} \right) \left( \frac{1 \text{ mole H}}{1 \text{ g H}} \right) = 1.97 \text{ mole H} \approx 2.0 \text{ mole H}$$



SHOWING WORK TO GET EF FROM MF.

### Example of MF Calculation when given Molar Mass and EF of compound.

What is Molecular Formula of a compound that has a molar mass of 342g/mole and has an Empirical Formula of  $\text{Co}_1\text{C}_4\text{O}_4$

Molar mass of cpd: 342g/mole

$$\text{Molar mass of Empirical Formula } \text{Co}_1\text{C}_4\text{O}_4: 1(59 \text{ g Co}) + 4(12 \text{ g C}) + 4(16 \text{ g O}) = 171 \text{ g Co}_1\text{C}_4\text{O}_4$$

showing work  
✓ ↘

$$\frac{\text{Molar Mass of MF}}{\text{Molar Mass of EF}} = \frac{342 \text{ g}}{171 \text{ g}} = 2$$

