Moles in Reverse – Empirical Formulas

An empirical formula is the simplest version of a formula. It only looks at the ratio of the different elements. For example, glucose is $C_6H_{12}O_6$, but the empirical formula is the simplified numbers, in other words, CH_2O. For something like salt (NaCl) the formula and the empirical formula are the same.

Before, we calculated percent by mass. For water, we added the mass of the oxygen (16) to the mass of the hydrogens (2 total). The total mass was 18. To find the percent, we divide the mass of the part (16 for oxygen, or 2 for hydrogen) by the total mass.

In this lesson, we will do the reverse. Given percentages, you will need to find the empirical formula of a compound.

EXAMPLE: What is the formula for a substance containing 11% hydrogen and 89% oxygen?

> STEP 1: Change percent into grams
> Pretend we have 11 grams hydrogen and 89 grams oxygen.
>
> STEP 2: Divide by the mass
> The mass of hydrogen is 1, so we have 11 parts hydrogen.
> The mass of oxygen is 16, so we have 89/16 or 5.56 parts oxygen
>
> Step 3: Divide both of those by the smallest number
> The smallest number is 5.56. Divided by itself = 1
> The larger number divided by 5.56 is 1.978. Round this off to 2.
>
> Step 4: If necessary, multiply until both are whole numbers.
> Because they already are, we're done.
> We have 1 part oxygen to 2 parts hydrogen.   That's H_2O!

EXAMPLE: What is the empirical formula of a compound that contains 82.2% nitrogen and 17.8% mass hydrogen?

> Step 1: Convert percent to mass
>   82.2 g N   and 17.8 g H
> Step 2: Divide by atomic mass to find moles
>
>   82.2/14   =
>
>   17.8 / 1.008 =
>
> Step 3: Divide both by the smaller number

Name _____

Percent to Moles to Formula

1. What is the formula for a compound with 26.5% potassium, 35.4% chromium, and 38.1% oxygen?

2. Propane is 4.08g C, and 0.915 g H. Calculate the formula.

3. A sample of rock contains 145g iron and 55.3g oxygen. What is the formula?

4. Lysine is 19.1% N... 9.6% H... 22.0% O... 49.3% C. Calculate the formula

5. Calcium fluoride is 119.4g Ca and 114.7g F. Calculate the formula

6. Butane is 82.7% C and 17.3% H. Calculate the formula.

7. Borax is 12.1% Na, 11.3% B, 71.3% O, and 5.29% H. Calculate the formula.

8. Ethanol is 52.2% C, 13.1% H, and 34.7% O. Calculate the formula.