

Percent composition is the percent by mass of each element found in a compound.

Example: What percent of iron(III) hydroxide,  $Fe(OH)_3$ , is oxygen?

Step 1: Find the molar mass of the compound.

1 mol Fe	=	55.85 g
3 mol O	= $3 \times 16.00$ g	= 48.00 g
3 mol H	= $3 \times 1.008$ g	= 3.024 g
Molar Mass $Fe(OH)_3$	=	106.87 g/mo

Step 2: Find the percentage by dividing the part by the whole and multiplying by 100.

$$\frac{48.00 \text{ g O}}{106.87 \text{ g } Fe(OH)_3} \times 100 \% = 44.91\% \text{ oxygen}$$

Part 1: Finding Percent

1. What percent of magnesium bromide,  $MgBr_2$ , is magnesium?

$$1 \text{ Mg} \cdot 24.31 \text{ g/mol} = 24.31 \text{ g}$$

$$2 \text{ Br} \cdot 79.90 \text{ g/mol} = 159.80 \text{ g}$$

$$\frac{24.31 \text{ g Mg}}{184.11 \text{ g}} \times 100 = 13.20\% \text{ Mg}$$

$$\frac{159.80 \text{ g Br}}{184.11 \text{ g}} \times 100 = 86.796\% \text{ Br}$$

2. What percent of glucose,  $C_6H_{12}O_6$ , is carbon?

$$6 \text{ C} \cdot 12.01 \text{ g/mol} = 72.06 \text{ g C}$$

$$12 \text{ H} \cdot 1.01 \text{ g/mol} = 12.12 \text{ g H}$$

$$6 \text{ O} \cdot 16.00 \text{ g/mol} = 96.00 \text{ g O}$$

$$\frac{72.06 \text{ g C}}{180.18 \text{ g}} \times 100 = 39.999\% \text{ C}$$

$$\frac{12.12 \text{ g H}}{180.18 \text{ g}} \times 100 = 6.727\% \text{ H}$$

$$\frac{96.00 \text{ g O}}{180.18 \text{ g}} \times 100 = 53.28\% \text{ O}$$

3. What percent of  $Zn_3(PO_4)_2$  is zinc?

$$3 \text{ Zn} \cdot 65.41 \text{ g/mol} = 196.23 \text{ g Zn}$$

$$2 \text{ P} \cdot 30.97 \text{ g/mol} = 61.94 \text{ g P}$$

$$8 \text{ O} \cdot 16.00 \text{ g/mol} = 128.00 \text{ g O}$$

$$\frac{196.23 \text{ g Zn}}{386.17 \text{ g}} \times 100 = 60.162\% \text{ Zn}$$

$$\frac{61.94 \text{ g P}}{386.17 \text{ g}} \times 100 = 16.049\% \text{ P}$$

$$\frac{128.00 \text{ g O}}{386.17 \text{ g}} \times 100 = 33.146\% \text{ O}$$

4. Which has the higher percent of aluminum,  $Al_2O_3$  or  $Al(NO_3)_3$ ?

$$MM \text{ } Al_2O_3 = 101.96 \text{ g/mol}$$

$$\frac{53.96 \text{ g Al}}{101.96 \text{ g/mol}} \times 100 = 52.92\% \text{ Al}$$

$$MM \text{ } Al(NO_3)_3 = 213.00 \text{ g/mol}$$

$$\frac{26.98}{213.00} \times 100 = 12.67\% \text{ Al}$$

$Al_2O_3$  has a higher %

Part 2: Find the percent compositions of all of the elements in the following compounds and name all compounds:

5.  $CuBr_2$

Name Copper (II) Bromide

$$MM = 223.37 \text{ g/mol}$$

$$\frac{63.55 \text{ g Cu}}{223.37 \text{ g}} \times 100 = 28.45\%$$

%Cu: 28.45%

$$79.90 \text{ g Br} \cdot 2 = 159.80 \text{ g Br}$$

$$\frac{159.80 \text{ g Br}}{223.37 \text{ g}} \times 100 = 71.54\%$$

%Br: 71.54%



6.  $(\text{NH}_4)_2\text{S}$  Name Ammonium Sulfide

$$\text{MM} = 68.15 \text{ g/mol}$$

%N: 41.12

%H: 11.9%

%S: 47.06

7.  $\text{N}_2\text{S}_2$  Name dinitrogen disulfide

$$\text{MM} = 92.14 \text{ g/mol}$$

%N: 30.41

%S: 69.61

8.  $\text{Al}_2(\text{SO}_4)_3$  Name Aluminum Sulfate

$$\text{MM} = 342.15 \text{ g/mol}$$

%Al: 15.77%

%S: 28.12

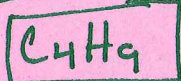
%O: 56.116

**Part 3: Empirical Formulas:** Find the empirical formula for the following compounds. See page 2 in Baby Blue and pages 86-89 in Big Blue.

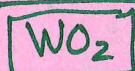
9.  $\text{C}_6\text{H}_6$   
 $\frac{6}{6}$



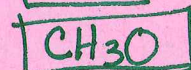
10.  $\text{C}_8\text{H}_{18}$   
 $\frac{8}{2}$   $\frac{18}{2}$



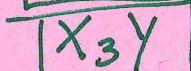
11.  $\text{WO}_2$   
 $\frac{1}{1}$



12.  $\text{C}_2\text{H}_6\text{O}_2$   
 $\frac{2}{2}$   $\frac{6}{2}$   $\frac{2}{2}$



13.  $\text{X}_{39}\text{Y}_{13}$   
 $\frac{39}{13}$   $\frac{13}{13}$



Example Problem: A compound with an empirical formula of  $\text{C}_2\text{OH}_4$  and a molar mass of 88 grams per mole. What is the molecular formula of this compound?

First find the empirical formula mass of the compound.

Carbon: 2 (12.01 g/mol)

Oxygen: 1 (16.00 g/mol)

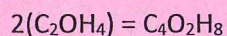
Hydrogen: 4 (1.01 g/mol)

44.01 g/mol

So this compound has a molar mass of 88.02 g/mol and an empirical formula mass of 44.01 g/mol. So the molecular formula must have twice as many of each atom as the empirical formula.

$$88 / 44 = 2$$

Molecular formula is 2 times the empirical formula





14. A compound with an empirical formula of  $C_4H_4O$  and a molar mass of 136 grams per mole. What is the molecular formula of this compound?

$$MM \ C_4H_4O = 68 \text{ g/mol}$$

$$\frac{\text{Molecular Mass}}{\text{Molar Mass}} = \frac{136}{68} = 2$$

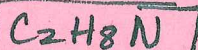


15. A compound with an empirical formula of  $C_2H_8N$  and a molar mass of 46 grams per mole. What is the molecular formula of this compound?

$$MM \ C_2H_8N = 46 \text{ g/mol}$$

$$46/46 = 1$$

Molecular Formula = Empirical Formula



16. Nitrogen and oxygen form an extensive series of oxides with the general formula  $N_xO_y$ . One of them is a blue solid that comes apart, reversibly, in the gas phase. It contains 36.84% N. What is the empirical formula of this oxide?

Pretend you have 100 grams of this substance. That way you can convert all the percentages directly into grams.

Divide all mol values by the smallest # of moles.

$$\frac{36.84 \text{ g N}}{14.01 \text{ g/mol}} = 2.630 \text{ mol N}$$

$$100 - 36.84 \text{ g} = \text{g O} = 63.16 \text{ g O}$$

MUST HAVE WHOLE # RATIO SO...  
 $2(N, O_{1.5})$   
 $= N_2O_3$

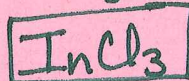
$$\frac{63.16 \text{ g O}}{16.00 \text{ g/mol}} = 3.948 \text{ mol O} = 1.5$$

17. A sample of indium chloride weighing 0.5000 g is found to contain 0.2404 g of chlorine. What is the empirical formula of the indium compound?

$$0.5000 \text{ g Indium Chloride} - 0.2404 \text{ g Cl} = 0.2596 \text{ g In}$$

$$\frac{0.2404 \text{ g Cl}}{35.45 \text{ g/mol}} = 6.781 \times 10^{-3} \text{ mol Cl}$$

$$\frac{0.2596 \text{ g In}}{114.82 \text{ g/mol In}} = 2.261 \times 10^{-3} \text{ mol In}$$



$$= (3)$$

$$\frac{2.261 \times 10^{-3} \text{ mol In}}{2.261 \times 10^{-3}} = 1$$

18. Rubbing alcohol was found to contain 60.0% carbon, 13.4% hydrogen, and the remaining mass was due to oxygen. What is the empirical formula of rubbing alcohol?

$$60.0\% + 13.4\% + x = 100\%$$

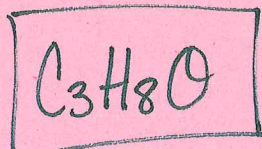
$$x = \% O = 26.6\%$$

$$\frac{60.0 \text{ g C}}{12.01 \text{ g/mol}} = 5 \text{ mol C}$$

$$\frac{13.4 \text{ g H}}{1.01 \text{ g/mol}} = 13.27 \text{ mol H}$$

$$\frac{26.6 \text{ g O}}{16.00 \text{ g/mol}} = 1.6625 \text{ mol O}$$

$$= (3) = \frac{13.27 \text{ mol H}}{1.6625} = (8) = \frac{1.6625 \text{ mol O}}{1.6625} = (1)$$



Metal always first in formula!



