

Key

### Percent Composition Problems

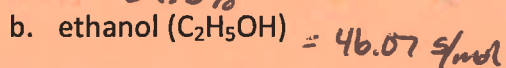
- 1) Determine the percent composition for each element in each of the following compounds:



$$\text{Na} = \frac{2(22.98)}{134.00} (100) = 34.3\%$$

$$\text{C} = \frac{2(12.01)}{134.00} (100) = 17.9\%$$

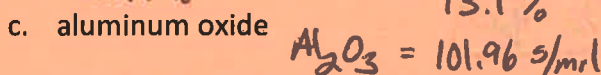
$$\text{O} = \frac{4(16.00)}{134.00} (100) = 47.8\%$$



$$\text{C} = \frac{2(12.01)}{46.07} (100) = 52.1\%$$

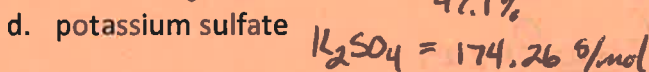
$$\text{H} = \frac{6(1.008)}{46.07} (100) = 13.1\%$$

$$\text{O} = \frac{16}{46.07} (100) = 34.7\%$$



$$\text{Al} = \frac{2(26.98)}{101.96} (100) = 52.9\%$$

$$\text{O} = \frac{3(16)}{101.96} (100) = 47.1\%$$

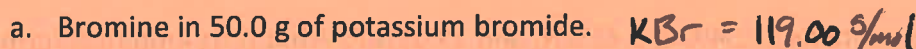


$$\text{K} = \frac{2(39.10)}{174.26} (100) = 44.9\%$$

$$\text{S} = \frac{32.07}{174.26} (100) = 18.4\%$$

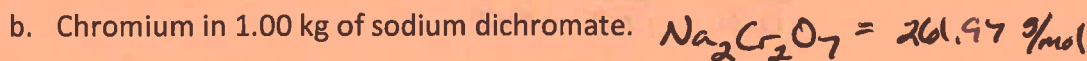
$$\text{O} = \frac{4(16)}{174.26} (100) = 36.7\%$$

- 2) Calculate the mass of the given element in each of the following compounds:



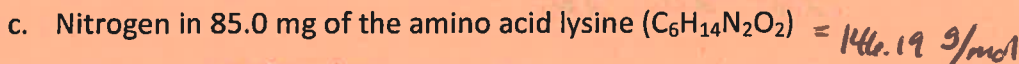
$$\% \text{Br} = \frac{79.90}{119.00} (100) = 67.14\%$$

$$50.0 \text{ g} \cdot 0.6714 = \boxed{33.6 \text{ g Br}}$$



$$\% \text{Cr} = \frac{2(52.00)}{261.97} (100) = 39.70\%$$

$$1.00 \text{ kg} \cdot 0.3970 = \boxed{0.397 \text{ kg Cr}}$$



$$\% \text{N} = \frac{2(14.01)}{146.19} (100) = 19.17\%$$

$$85.0 \text{ mg} \cdot 0.1917 = \boxed{16.3 \text{ mg N}}$$

3) Calculate the percentage of water in each of the following hydrates:

a. Sodium carbonate decahydrate  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O} = 286.13 \text{ g/mol}$

$$\begin{aligned} \% \text{H}_2\text{O} &= \frac{10(2(1.008) + 16)}{286.13} (100) \\ &= \frac{180.16}{286.13} (100) = \boxed{62.96 \% \text{H}_2\text{O}} \end{aligned}$$

b. Nickel (II) iodide hexahydrate  $\text{NiI}_2 \cdot 6\text{H}_2\text{O} = 420.59 \text{ g/mol}$

$$\begin{aligned} \% \text{H}_2\text{O} &= \frac{6(18.02)}{420.59} (100) \\ &= \boxed{25.70 \% \text{H}_2\text{O}} \end{aligned}$$

4) A mass spec analysis of an unknown white crystal comes back as 44.59% Na, 12.02% C, and 47.29% O. Identify the empirical formula for the ionic compound and name it.

$$\begin{array}{ccc} \text{Na} & \text{C} & \text{O} \\ \frac{44.59}{22.98} & \frac{12.02}{12.01} & \frac{47.29}{16} \end{array}$$

$$\text{Na}_{1.94} \text{C}_{1.00} \text{O}_{2.96} \Rightarrow \boxed{\text{Na}_2\text{CO}_3} \quad \boxed{\text{Sodium Carbonate}}$$

5) A compound contains 57.54% C, 3.45% H, and 39.01% F. What is its empirical formula?

$$\begin{array}{ccc} \text{C} & \text{H} & \text{F} \\ \frac{57.54}{12.01} & \frac{3.45}{1.008} & \frac{39.01}{19.00} \end{array}$$

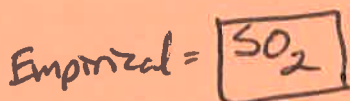
$$\begin{array}{ccc} \text{C}_{4.79} & \text{H}_{3.42} & \text{F}_{2.05} \\ \frac{4.79}{2.05} & \frac{3.42}{2.05} & \frac{2.05}{2.05} \end{array}$$

$$\text{C}_{2.33} \text{H}_{1.67} \text{F}_1 \xrightarrow{\times 3} \boxed{\text{C}_7\text{H}_5\text{F}_3}$$

- 6) A compound is found to contain 50.05 % sulfur and 49.95 % oxygen by weight. What is the empirical formula for this compound? The molecular weight for this compound is 64.07 g/mol. What is its molecular formula?

$$\begin{array}{cc} \text{S} & \text{O} \\ \frac{50.05}{32.07} & \frac{49.95}{16} \end{array}$$

$$\begin{array}{cc} \text{S} & \text{O} \\ \frac{1.56}{1.56} & \frac{3.12}{1.56} \end{array}$$



Empirical Weight = 64.07 g/mol

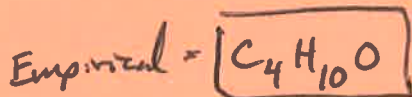
$$\frac{64.07}{64.07} = 1 \quad 1 \times \text{SO}_2 = \text{SO}_2$$



- 7) A compound is found to contain 64.80 % carbon, 13.62 % hydrogen, and 21.58 % oxygen by weight. What is the empirical formula for this compound? The molecular weight for this compound is 148.08 g/mol. What is its molecular formula?

$$\begin{array}{ccc} \text{C} & \text{H} & \text{O} \\ \frac{64.80}{12.01} & \frac{13.62}{1.008} & \frac{21.58}{16} \end{array}$$

$$\begin{array}{ccc} \text{C} & \text{H} & \text{O} \\ \frac{5.40}{1.35} & \frac{13.57}{1.35} & \frac{1.35}{1.35} \end{array}$$



Empirical weight = 74.12

$$\frac{148.08}{74.12} = 2 \quad 2 \times \text{C}_4\text{H}_{10}\text{O} = \text{C}_8\text{H}_{20}\text{O}_2$$

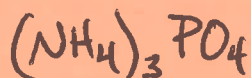


- 8) Ammonia reacts with phosphoric acid to form a compound that contains 28.2% nitrogen, 20.8% phosphorous, 8.1% hydrogen and 42.9% oxygen.  
a) Calculate the empirical formula of this compound.

$$\begin{array}{cccc} \text{N} & \text{P} & \text{H} & \text{O} \\ \frac{28.2}{14.0} & \frac{20.8}{30.97} & \frac{8.1}{1.008} & \frac{42.9}{16} \end{array}$$

$$\begin{array}{cccc} \text{N} & \text{P} & \text{H} & \text{O} \\ \frac{2.01}{.67} & \frac{0.67}{.67} & \frac{8.04}{.67} & \frac{2.65}{.67} \end{array} \Rightarrow \text{N}_{\frac{11}{3}}\text{P}_1\text{H}_{12}\text{O}_4$$

- b) Assuming the product is an ionic salt, determine the molecular formula and name the compound.



Ammonium Phosphate

Answers

1a 34.31%Na, 17.93%C, 47.76%O

1b 52.13%C, 13.15%H, 34.72%O

1c 52.92%Al, 47.08%O

1d 44.87%K, 18.40%S, 36.72%O

2a 33.6g Br

2b 397 g Cr

2c 16.3mg N

3a 62.97% water

3b 25.71% water

4 Sodium carbonate,  $\text{Na}_2\text{CO}_3$

5  $\text{C}_7\text{H}_5\text{F}_3$

6 empirical =  $\text{SO}_2$  molecular =  $\text{SO}_2$

7 empirical =  $\text{C}_4\text{H}_{10}\text{O}$  molecular =  $\text{C}_8\text{H}_{20}\text{O}_2$

8a  $\text{N}_3\text{H}_{12}\text{PO}_4$

8b  $(\text{NH}_4)_3\text{PO}_4$