During Class Invention

Name(s) with Lab section in Group

Percent Composition and Empical Formulas

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1. For the compound $Na_2S_2O_3$.

a) Determine its molar mass (how many grams of $Na_2S_2O_3$ in 1 mol of $Na_2S_2O_3$.)

Na: 2 x 23.0 u = 46.0 u
S: 2 x 32.0 u = 64.0 u
<u>O: 3 * 16.0 u = 48.0 u</u>
158.0 u

Molar mass of $Na_2S_2O_3$ is 158 g mol^{-1}

b) Calculate the percent (by mass) of the element sodium in $Na_2S_2O_3$.

$$\left(\frac{46.0\ \mathrm{g}}{158.0\ \mathrm{g}}\right) \cdot 100 = 29.11\%\ \mathrm{Na}$$

c) Calculate the percent (by mass) of the element sulfur in $Na_2S_2O_3$.

$$\left(\frac{64.0\ \mathrm{g}}{158.0\ \mathrm{g}}\right) \cdot 100 = 40.50\%\ \mathrm{S}$$

d) Calculate the percent (by mass) of the element oxygen in $Na_2S_2O_3$.

$$\left(\frac{48.0\ \mathrm{g}}{158.0\ \mathrm{g}}\right) \cdot 100 = 30.38\%\ \mathrm{O}$$

2. A compound is analyzed and found to contain 1.89 g Na, 2.632 g S and 1.975 g O. Calculate the percent composition of sodium, sulfur and oxygen in the compound.

$$\left(\frac{1.89\ \mathrm{g\ Na}}{1.893\ \mathrm{g} + 2.632\ \mathrm{g} + 1.975\ \mathrm{g}}\right) \cdot 100 = 29.08\%$$

$$\left(\frac{2.632\ \mathrm{g\ S}}{1.893\ \mathrm{g} + 2.632\ \mathrm{g} + 1.975\ \mathrm{g}}\right) \cdot 100 = 40.49\%$$

$$\left(\frac{1.975\ \mathrm{g\ O}}{1.893\ \mathrm{g} + 2.632\ \mathrm{g} + 1.975\ \mathrm{g}}\right) \cdot 100 = 30.38\%$$

3. A compound is analyzed and found to be 29.11% sodium, 40.50% sulfur and 30.38% oxygen. Determine the empirical formula of this compound.

Remember a formula is the ration of the moles of each element in the compound.

Assume 100. grams of the compound.

$$29.11 \text{ g Na}\left(\frac{1 \text{ mol Na}}{23.0 \text{ g Na}}\right) = 1.266 \text{ mol Na}$$

$$40.50 \text{ g S}\left(\frac{1 \text{ mol S}}{32.0 \text{ g S}}\right) = 1.266 \text{ mol S}$$

$$30.38 \text{ g O}\left(\frac{1 \text{ mol O}}{16.0 \text{ g O}}\right) = 1.899 \text{ mol O}$$

1.266 mol Na : 1.266 mol S : 1.899 mol O

So now determine a ratio of these elements by dividing by the smallest number of moles.

$$\left(\frac{1.266 \text{ mol Na}}{1.266}\right) : \left(\frac{1.266 \text{ mol S}}{1.266}\right) : \left(\frac{1.899 \text{ mol O}}{1.266}\right)$$

1 mol Na : 1 mol S : 1.500 mol O

2 · (1 mol Na : 1 mol S : 1.500 mol O) = 2 mol Na : 2 mol S : 3 mol O = $Na_2S_2O_3$

4. A sample of an unknown compound containing sodium, sulfur and oxygen has a mass of 1.006 g. Analysis shows this sample to contain 0.2928 g of sodium and 0.4074 g of sulfur. Assuming the remaining mass is oxygen determine the empirical formula of this compound.

$$0.2928 \text{ g Na}\left(\frac{1 \text{ mol Na}}{23.0 \text{ g Na}}\right) = 0.01273 \text{ mol Na}$$

$$0.4074 \text{ g S}\left(\frac{1 \text{ mol S}}{32.0 \text{ g S}}\right) = 0.01273 \text{ mol S}$$

$$0.3058 \text{ g O}\left(\frac{1 \text{ mol O}}{16.0 \text{ g O}}\right) = 0.01911 \text{ mol O}$$

0. 01273 mol Na : 0. 01273 mol S : 0. 01911 mol O

So now determine a ratio of these elements by dividing by the smallest number of moles.

$$\left(\frac{0.01273 \text{ mol Na}}{0.01273}\right) : \left(\frac{0.01273 \text{ mol S}}{0.01273}\right) : \left(\frac{0.01911 \text{ mol O}}{0.01273}\right)$$

1 mol Na : 1 mol S : 1.500 mol O

2 · (1 mol Na : 1 mol S : 1.500 mol O) = 2 mol Na : 2 mol S : 3 mol O = $Na_2S_2O_3$