

Name Mrs. K Key

Date _____

Hour _____

Empirical & Molecular Formulas

1. Samples of a compound are found to be 27.91% Fe, 24.08% S, and 48.01% O Determine the empirical formula.

$$27.91 \text{ g Fe} \times \frac{1 \text{ mol}}{55.85 \text{ g}} = 0.49973 \text{ mol} / 0.499 = 1 \times 2 = 2$$

$$24.08 \text{ g S} \times \frac{1 \text{ mol}}{32.06 \text{ g}} = 0.75109 \text{ mol} / 0.499 = 1.5 \times 2 = 3$$

$$48.01 \text{ g O} \times \frac{1 \text{ mol}}{16 \text{ g}} = 3.00 / 0.499 = 6 \times 2 = 12$$

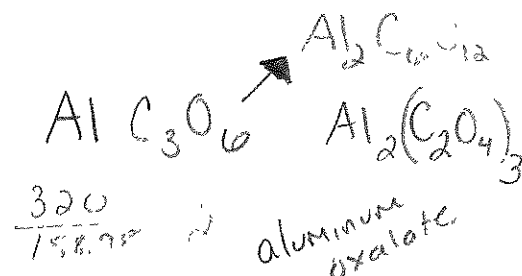


2. A certain compound is known to have a molar mass of slightly under 320 grams. If a sample contains 0.226 moles of aluminum, 8.21 grams of carbon, and 21.6 grams of oxygen, what is the molecular formula and the name of this compound?

$$0.226 \text{ mol Al} / 0.226 = 1$$

$$8.21 \text{ g C} \times \frac{1 \text{ mol}}{12.01 \text{ g}} = 0.68359 \text{ mol} / 0.226 = 3$$

$$21.6 \text{ g O} \times \frac{1 \text{ mol}}{16 \text{ g}} = 1.35 \text{ mol} / 0.226 = 6$$



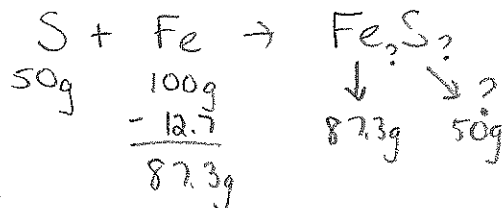
3. 250.0 ml of a vapor weighs 1.035 grams. If the compound consists of 30.43% nitrogen and 69.57% oxygen, what is the empirical formula of this compound?

$$30.43 \text{ g N} \times \frac{1 \text{ mol}}{14.01 \text{ g}} = 2.172 \text{ mol} / 2.172 = 1$$



$$69.57 \text{ g O} \times \frac{1 \text{ mol}}{16 \text{ g}} = 4.348 / 2.172 = 2$$

4. 50.0 grams of sulfur is mixed with 100.0 grams of metallic iron and the mixture is heated. When the reaction is completed, 12.7 grams of iron remains unreacted. What is the empirical formula of the compound formed?

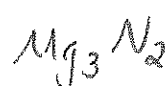
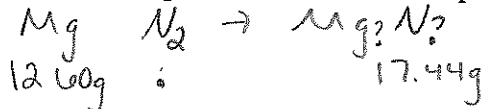


$$87.3 \text{ g} \times \frac{1 \text{ mol}}{55.85 \text{ g}} = 1.56 \text{ mol} / 1.56 = 1$$

$$50 \text{ g} \times \frac{1 \text{ mol}}{32.06 \text{ g}} = 1.559 \text{ mol} / 1.56 = 1$$



5. When 12.60 grams of magnesium metal is ignited in air, it reacts with the nitrogen in the air to produce 17.44 grams of a compound. What is the empirical formula of this compound?



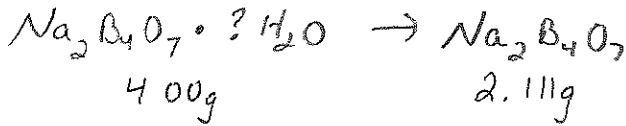
assume all Mg reacts

$$12.60 \text{ g} \times \frac{1 \text{ mol}}{24.30 \text{ g}} = 0.5185 / 0.345 = 1.5 \times 2 = 3$$

$$4.84 \text{ g} \times \frac{1 \text{ mol}}{14.01 \text{ g}} = 0.345 / 0.345 = 1 \times 2 = 2$$

LAB

6. When 4.000 grams of the hydrate salt of sodium tetraborate ($\text{Na}_2\text{B}_4\text{O}_7$) is heated to drive off the water. The anhydrous residue is found to have a mass of 2.111g. What is the correct formula for this hydrate?



$$4.00 - 2.111 = 1.889 \text{g H}_2\text{O}$$

$$2.111 \text{g Na}_2\text{B}_4\text{O}_7 \times \frac{1 \text{ mol}}{206.10 \text{ g}} = 0.01024 \text{ mol} / 0.01024 = 1$$

$$1.889 \text{g H}_2\text{O} \times \frac{1 \text{ mol}}{18.02 \text{ g}} = 0.10483 \text{ mol} / 0.01024 = 10$$

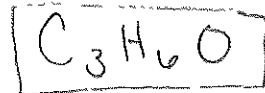


7. A 15.25g sample of an organic compound was combusted in oxygen which produced 34.71g of carbon dioxide and 14.20g of water. In addition, it was found that the compound contained 27.59% oxygen. What is the empirical formula of the compound? ($\text{C}_3\text{H}_6\text{O}$)

$$34.71 \text{g CO}_2 \times \frac{12.01 \text{g C}}{44.01 \text{g CO}_2} \times \frac{1 \text{ mol C}}{12.01 \text{g C}} = 0.788868 \text{ mol C} / 0.262967 = 3$$

$$14.20 \text{g H}_2\text{O} \times \frac{2.02 \text{g H}}{18.02 \text{g H}_2\text{O}} \times \frac{1 \text{ mol H}}{1.008 \text{g H}} = 1.5795 \text{ mol H} / 0.262967 = 6$$

$$0.2759(15.25) = 4.207 \text{g O} \times \frac{1 \text{ mol O}}{16 \text{g O}} = 0.262967 \text{ mol O} / 0.262967 = 1$$



8. A 20g sample of an organic compound was combusted in oxygen which produced 47.57g of carbon dioxide and 4.86 grams of water. What is the empirical formula of the compound? ($\text{C}_8\text{H}_4\text{O}_3$)

$$47.57 \text{g CO}_2 \times \frac{12.01 \text{g C}}{44.01 \text{g CO}_2} = 12.9815 \text{g C} \times \frac{1 \text{ mol}}{12.01 \text{g}} = 1.08089 \text{ mol} / 0.4046 = 2.67 \times 3 = 8$$

$$4.86 \text{g H}_2\text{O} \times \frac{2.02 \text{g H}}{18.02 \text{g}} = 0.54479 \text{g H} \times \frac{1 \text{ mol}}{1.008 \text{g}} = 0.54057 \text{ mol} / 0.4046 = 1.33 \times 3 = 4$$

$$20 - 12.9815 - 0.54479 = 6.4737 \text{g O} \times \frac{1 \text{ mol}}{16 \text{g}} = 0.4046 \text{ mol} / 0.4046 = 1 \times 3 = 3$$

