

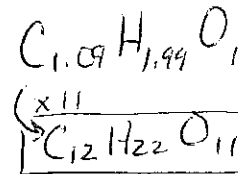
Stoichiometry and the Combustion of Sucrose

Poor Gummy Bears

For each question, show all work, include units and box your answer.

key

1. A sample of gummy bears were analyzed. It was found that the sugar in gummy bears (sucrose) contains 42.10% carbon, 6.491% hydrogen and 51.41% oxygen. Determine the empirical formula for sucrose.



$$C = \frac{42.10g C}{12.01g} \times \frac{1 \text{ mol}}{1} = 3.505 \text{ mol C}$$

$$\frac{3.505 \text{ mol C}}{3.215 \text{ mol O}} = 1.09 \frac{\text{mol C}}{\text{mol O}}$$

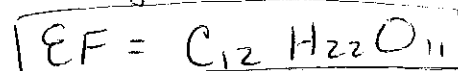
$$O = \frac{51.41g O}{15.99g} \times \frac{1 \text{ mol}}{1} = 3.215 \text{ mol O}$$

$$\frac{3.215 \text{ mol O}}{3.215 \text{ mol O}} = 1$$

$$H = \frac{6.491g H}{1.01g} \times \frac{1 \text{ mol}}{1} = 6.427 \text{ mol H}$$

$$\frac{6.427 \text{ mol H}}{3.215 \text{ mol O}} = 1.99 \frac{\text{mol H}}{\text{mol O}}$$

* multiply all by 11 to get whole #'s



2. The molar mass of sucrose was experimentally determined to be 342.34 g/mol. Determine the molecular formula of sucrose.

$$n = \frac{342.34 \text{ g/mol}}{342.34 \text{ g/mol}} = 1$$



3. According to the **Nutritional Facts** on a package of gummy bears, there are 17 gummy bears in a serving and each serving contains 21 grams of sugar (sucrose). Calculate the mass of sugar in 1 gummy bear (in grams).

$$\frac{21g}{17GB} = 1.23g \text{ of sugar / GB}$$

$$\boxed{\hookrightarrow 1.2g \text{ (2SF)}}$$

4. If the mass of a single gummy bear is approximately 2.2 grams, what percent of the gummy bear is made of sucrose?

$$\frac{1.2g}{2.2g} \cdot 100 = 54.54\%$$

$$\boxed{\hookrightarrow 55\% \text{ (2SF)}}$$

5. Using your answers from #1 & #2, determine how many moles of sucrose are in 1 gummy bear. (i.e. Convert your answer in #2 from grams to moles using the molar mass of sucrose you calculated from #1.)

$$\frac{1.2g \text{ sucrose}}{342.34g} \times \frac{1 \text{ mol}}{1} = \boxed{0.0035 \text{ mol sucrose}}$$

Stoichiometry and the Combustion of Sucrose

Poor Gummy Bears

For each question, show all work, include units and box your answer.

6. How many molecules of sucrose is this?

$$\frac{0.0035 \text{ mol}}{1 \text{ mol}} \times \frac{6.022 \times 10^{23} \text{ molecules}}{1 \text{ mol}} = 2.1 \times 10^{21} \text{ molecules}$$

7. When you complete all of these calculations, we will combust a gummy bear, which is mostly composed of sucrose. Below, write and balance the chemical equation for the combustion of sucrose.



8. Using the coefficients written in the balanced equation from #7, what is the stoichiometric mole ratio of sucrose to oxygen needed to complete the reaction?

$$\frac{1 \text{ mol sucrose used}}{12 \text{ mol oxygen needed}}$$

9. Using the stoichiometric ratio from #8, determine how many moles of oxygen will be used if we combust an entire gummy bear. (Use the number of moles of sugar in 1 gummy bear calculated in #5 and the ratio from #8.) 1GB = 1.2g sucrose

$$\frac{1.2 \text{ g sucrose}}{342.34 \text{ g}} \times \frac{1 \text{ mol sucrose}}{1 \text{ mol sucrose}} \times \frac{12 \text{ mol oxygen needed}}{1 \text{ mol sucrose used}} = 0.042 \text{ mol O}_2 \text{ needed}$$

10. How many grams of oxygen is this?

$$\frac{0.042 \text{ mol O}_2}{1 \text{ mol}} \times \frac{32 \text{ g}}{1 \text{ mol}} = 1.3 \text{ g O}_2 \text{ needed.}$$

11. How many molecules of oxygen is this?

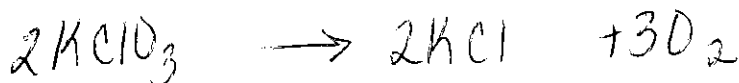
$$\frac{1.3 \text{ g O}_2}{32 \text{ g}} \times \frac{1 \text{ mol}}{1 \text{ mol}} \times \frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol}} = 2.4 \times 10^{22} \text{ O}_2 \text{ molecules}$$

Stoichiometry and the Combustion of Sucrose

Poor Gummy Bears

For each question, show all work, include units and box your answer.

12. To generate enough oxygen to combust a gummy bear, we are going to decompose potassium chlorate by heating it. Write and balance the chemical equation that represents this reaction.



13. Determine the molar mass of potassium chlorate.

$$122.52 \text{ g/mol}$$

14. Determine the percent composition of potassium chlorate.

$$\text{K} = \frac{39.10}{122.52 \text{ g/mol}} \cdot 100$$

$$\text{K} = 31.91\%$$

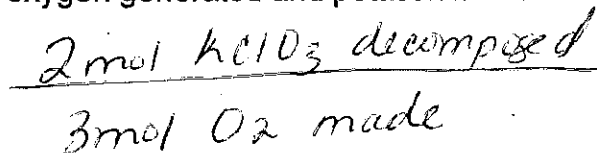
$$\text{Cl} = \frac{35.45}{122.52 \text{ g/mol}} \cdot 100$$

$$\text{Cl} = 28.93\%$$

$$\text{O} = \frac{47.97}{122.52 \text{ g/mol}} \cdot 100$$

$$\text{O} = 39.15\%$$

15. According to your balanced equation in #12, what is the stoichiometric mole ratio between oxygen generated and potassium chlorate decomposed?



16. Use your answers from #9 and #15 to determine how many moles of potassium chlorate we should start with.

$$\frac{1.3 \text{ g O}_2 \text{ needed}}{32 \text{ g}} \times \frac{1 \text{ mol O}_2}{3 \text{ mol O}_2 \text{ made}} \times \frac{2 \text{ mol KClO}_3 \text{ needed}}{1 \text{ mol O}_2}$$

$$= 0.027 \text{ mol KClO}_3 \text{ needed to react w. } 1.3 \text{ g of O}_2$$

17. How many grams of potassium chlorate is this?

$$0.027 \text{ mol} \times \frac{122.52 \text{ g}}{1 \text{ mol}} = 3.3 \text{ g of KClO}_3$$

18. Read the following 2 pages. List all of the safety hazards and precautions we should take before conducting this experiment.