

CAUTION!!! Do not eat anything (Skittles, cylinders, dishes, etc.) associated with the lab!!!

Estimate: Make an educated guess about how many Skittles are in the large graduated cylinder on the desk at the front of the room: Any number > 100, less than 5,000 skittles

Make an educated guess about what the volume of the M&Ms in the large cup is: Any amount greater than 500, but less than 2,000 ml

Make an educated guess about what the mass of the M&Ms in the large cup is: Any amount greater than 300g, but less than 5,000 g

Large beaker measurements:

Volume of Skittles (remember to estimate to correct level of precision): 1,894 ml
(precision can only be to the nearest 2ml, so must be a full, even number greater than 1890 but less than 1,910ml)

Mass of empty beaker: 914.6g; Mass of beaker and Skittles: 2688.9g

Mass of Skittles alone (show your work): 2,688.9g - 914.6g = 1,774.3g

Part 2: Write down how many M&M's you are told there are in the large cup at the front 321.

Task: You will create conversion factors that will help you determine the number of skittles in the large beaker. You **MUST** use correct precision and significant figures information for this lab to get full credit.

- 1) Count the number of skittles in your dish: 53.0 skittles
- 2) Find the mass of your skittles (make sure to use the TARE or Zero button on the scale, or subtract out the mass of the empty container from the mass of the container with Skittles): 54.43 grams
- 3) Find the volume occupied by your **dry** skittles (**DO NOT PUT SKITTLES IN WATER**): 68.6 ml
- 4) The above information can be written as two different conversion factors:

$$\underline{53.0} \text{ Skittles} = \underline{54.43} \text{ grams}$$

AND

$$\underline{53.0} \text{ Skittles} = \underline{68.6} \text{ ml}$$

Part 2: M&Ms DO NOT USE a scale to measure the mass of the M&Ms AND DO NOT USE an actual graduated cylinder or beaker to measure the actual volume of the M&M's

- 5) Fill the smaller cup with M&Ms until the cup is just filled to the top. Count how many M&Ms that took. 92-103 M&Ms to fill cup

Write as a conversion:

$$\underline{264} \text{ Skittles} = \underline{92-103} \text{ M\&Ms_by_vol}$$

- 6) Watch the classroom demonstration on the bar balance, record how many M&Ms it takes to balance out Skittles.

Write as a conversion:

$$\underline{121, 119, 127, 147} \text{ Skittles} = \underline{52, 48, 52, 62} \text{ M\&Ms_by_mass}$$

Calculations: Part 1 Skittles

- 1) Use the mass conversion factor to find the mass of a single skittle using the grid conversion method shown in class (put your conversion factor correctly into the blank grids so that unwanted units cancel out):

$$\frac{1 \text{ Skittle}}{1} \left| \frac{54.43\text{g}}{53.0\text{Skittles}} \right. = \underline{1.027} \text{ grams}$$

- 2) Use the volume conversion factor to find the volume of a single skittle (and surrounding air) (show your work using the grid method shown in class):

$$\frac{1 \text{ Skittle}}{1} \left| \frac{68.6\text{ml}}{53.0\text{Skittles}} \right. = \underline{1.294} \text{ ml}$$

- 3) Using both conversion factors you created, determine the number of skittles in the large beaker (start with large beaker measurements and go to skittles)

- a) Using the **mass** conversion factor (**show work using grid method!!**) For your final answer, assume there are only whole skittles in the beaker.

$$\frac{1774.3\text{g}}{1} \left| \frac{1\text{skittle}}{1.027\text{g}} \right. = 1,727.7 \text{ skittles}$$

Large Beaker has 1,728 Skittles

- b) Using the **volume** conversion factor (**show work using grid method!!**) For your final answer, assume there are only whole skittles in the beaker.

$$\frac{1894\text{ml}}{1} \left| \frac{1\text{skittle}}{1.294\text{g}} \right. = 1,463.8 \text{ skittles}$$

Large Beaker has 1,464
Skittles

- 4) The answers from calculations #3 are likely somewhat different. Select **one** of the answers from #3 (the one you think is closest, if you think they are equally close, you can find the average of them) and write your final answer below.

FINAL ANSWER your pick Skittles*

*Most accurate final answer (**with grid method shown above number 3**) gets extra credit points on the lab.

Calculations: Part 2

- 5) Use the M&M data as well as the Skittle data to find the mass of a single M&M (show your work using the grid method shown in class):

$$\frac{1 \text{ M\&M}}{1} \left| \begin{array}{l} 121, 119, 127, 147 \text{ skittles} \\ 52, 48, 52, 62 \text{ M\&Ms} \end{array} \right| \frac{54.43 \text{ g}}{53.0 \text{ Skittles}} = \underline{2.2 - 2.7} \text{ g}$$

- 6) Use the M&M data as well as the Skittle data to find the volume of a single M&M (and surrounding air) (show your work using the grid method shown in class):

$$\frac{1 \text{ M\&M}}{1} \left| \begin{array}{l} 264 \text{ skittles} \\ 92 - 103 \text{ M\&Ms} \end{array} \right| \frac{68.6 \text{ ml}}{53.0 \text{ skittles}} = \underline{3.2 - 3.8} \text{ ml}$$

- 7) Using both conversion factors you created, determine mass and volume of the M&Ms in the large cup with 321 M&Ms (start with number of M&Ms, and go to ml or g)

- a) What is the mass of all the M&Ms in the large cup? (**Show work using grid method!!**)

$$\frac{321 \text{ M\&M}}{1} \left| \begin{array}{l} 2.405 \text{ g} \\ 1 \text{ M\&M} \end{array} \right| = \underline{750 - 850} \text{ g}$$

Mass of M&Ms in large cup is: 753.7g

- b) What is the volume of all the M&Ms in the large cup? (**Show work using grid method!!**)

$$\frac{321 \text{ M\&M}}{1} \left| \begin{array}{l} 3.451 \text{ ml} \\ 1 \text{ M\&M} \end{array} \right| = \underline{1,000 - 1,200} \text{ ml}$$

Volume of M&Ms in large cup is: _____

Questions: Where written out answers are required, ANSWER IN COMPLETE SENTENCES!!

1. In number 1 of part 1 procedure, you counted the number of Skittles in your dish. Is this number exact, or rounded? exact Will this number affect the reliability of the overall answer? no Explain why or why not.

With exact numbers, we can have as many significant figures as necessary (as many 0s after the decimal as we want), so they don't affect the results

2. How close was your initial guess to your final answer for number of Skittles in the beaker? What about for the volume and mass of the M&Ms?

3. Which conversion factors should give the best answer (the ones related to mass or volume)? Why (use ideas of accuracy and precision in your description)?

Mass, because the mass can be accurately measured and has more levels of precision (4 digits), but the volume must be estimated and only has 3 digits of precision.

4. From your data, calculate the approximate density (density = mass/volume) of a single Skittle and M&M (we will have to assume the whole volume is for the candy, but we know part of the volume comes from the air between candy pieces). (SHOW WORK and make sure you answer has correct units!):
- Skittle

$$1.029\text{g}/1.294\text{ml} = 0.794\text{g/ml}$$

- M&M:

$$2.470\text{g}/3.451\text{ml} = 0.7155\text{g/ml}$$

5. What could you do to get a better measure of a Skittle's volume (including air around it)? Why would that be better?

Any idea with reasoning. For example put water in the container until all the skittles are just covered with water and then measure the top of the water.

Put skittles in water and measure their volume with water displacement, drain, and then put just enough water to cover the skittles, and measure that water. The two added together would be an accurate volume taken up.

What were some sources of error for this experiment?

Not all the skittles and M&Ms are the same size/shape, so they fit in different containers differently and have different masses. The narrower the container that is measuring the volume, the more error there would be with measuring the volume. It is hard to estimate the volume precisely.

6. If this room is 15.0m X 10.0m X 3.00m.

- a. What is the volume of the room in m³? 450. or 4.50x10² m³
 b. How many Skittles would fill the room? (You need to use conversion factors to find number Skittles -- it might be helpful to note that 1m³ = 1,000,000 cm³ and that 1 ml = 1 cm³) SHOW WORK using grid conversion factor method shown in class!!!). Express your answer using scientific notation.

$$\frac{450. m^3}{1} \left| \frac{1,000,000 cm^3}{1 m^3} \right| \frac{1 ml}{1 cm^3} \left| \frac{1 skittle}{1.294 ml} \right| = 347,758,887.17$$

$$\approx 348,000,000 skittles = 3.48 \times 10^8 skittles$$

- c. How many M&Ms would fill the room? (You'll need to find the volume of the room in m³ first, then use conversion factors to find number Skittles -- it might be helpful to note that 1m³ = 1,000,000 cm³ and that 1 ml = 1 cm³) SHOW WORK using grid conversion factor method shown in class!!!). Express your answer using scientific notation.

$$\frac{450. m^3}{1} \left| \frac{1,000,000 cm^3}{1 m^3} \right| \frac{1 ml}{1 cm^3} \left| \frac{1 M\&M}{3.4512 ml} \right| = 130,389,429.76$$

$$\approx 130,000,000 M\&M = 1.30 \times 10^8 M\&M$$

7. A person does a similar lab to this as we did, but with Mentos. They find the following information:

Mass of Mentos in large beaker = 655.21g;

Estimated volume of Mentos in large beaker = 785ml

The group's sample has 22 Mentos

Mass of the group's sample is 41.82g

Volume of the group's sample when placed in graduated cylinder is 48.5ml

- a. Find the mass of a single Mento using the grid method (Show your work!!!)

$$\frac{1 Mento}{1} \left| \frac{41.82 g}{22 Mentos} \right| = 1.901g$$

- b. Find the volume of a single Mento using the grid method (Show your work!!!)

$$\frac{1 Mento}{1} \left| \frac{48.5 ml}{22 Mento} \right| = 2.205ml$$

- c. Find number of Mentos in beaker using mass conversion factor and grid method shown in class:

$$\frac{655.21g}{1} \left| \frac{1 Mento}{1.901g} \right| = 344.79 \approx 345 Mentos$$

- d. Find number of Mentos in beaker using volume conversion factor and grid method shown in class:

$$\frac{785ml}{1} \left| \frac{1 Mento}{2.205g} \right| = 356.82 \approx 357 Mentos$$

- e. There is a large cup filled with 563 Mike & Ikes, you find that the volume of 123 Mike & Ikes = the volume of 164 Mentos, and the mass of 142 Mike & Ikes = the mass of 112 Mentos. What is the mass and volume of the Mike & Ikes in the large cup with 563 Mike & Ikes? Show your work using the grid conversion factor methods shown in class.

$$\frac{563 \text{ Mike \& Ikes}}{1} \left| \frac{112 \text{ Mentos}}{123 \text{ Mike \& Ikes}} \right| \frac{1.901\text{g}}{1 \text{ Mento}} = 974.5\text{g}$$

$$\frac{563 \text{ Mike \& Ikes}}{1} \left| \frac{164 \text{ Mentos}}{142 \text{ Mike \& Ikes}} \right| \frac{2.205\text{ml}}{1 \text{ Mento}} = 1433.\text{ml}$$

(1,430 ml to 3 sig figs)

- f. If this room is 15.0m X 10.0m X 3.00m, how many Mentos would fill the room? (You need to use conversion factors to find number Mentos -- it might be helpful to note that $1\text{m}^3 = 1,000,000 \text{ cm}^3$ and that $1 \text{ ml} = 1 \text{ cm}^3$) SHOW WORK using grid conversion factor method shown in class!!!). Express your answer using scientific notation.

$$\frac{450. \text{ m}^3}{1} \left| \frac{1,000,000 \text{ cm}^3}{1 \text{ m}^3} \right| \frac{1 \text{ ml}}{1 \text{ cm}^3} \left| \frac{1 \text{ Mento}}{2.2045 \text{ ml}} \right| = 204,127,920.16 \text{ Mento}$$

$$\approx 204,000,000 \text{ Mentos} = 2.04 \times 10^8 \text{ Mentos}$$