Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Period \_\_\_\_\_\_

|  |
| --- |
| **Percent Sodium Bicarbonate in a Mixture** |

|  |
| --- |
| **Your Tasks (Mark these off as you go)** |
| * Determine the average mass of one “mole” of candy * Convert between grams, pieces, and “moles” of candy * Explore the stoichiometry of candy reactions * Receive credit for this lab |

* + **Define key vocabulary**

**Avogadro’s number**

|  |
| --- |
|  |

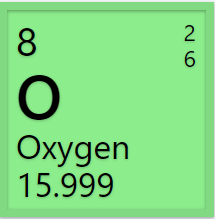
**Molar mass**

|  |
| --- |
|  |

* + **Determine the average mass of one “mole” of candy**

Recall that the mass of any element can be identified by using the [periodic table](https://ptable.com/).

Below is a screenshot of oxygen from the periodic table. Notice the number on the bottom represents the mass of the element. So, in atomic mass units, the mass of oxygen would be written as 16.0 amu.

****



Previously we learned that atomic mass units are not a very useful measurement – we do not have an atomic mass unit balance! Grams however are. Recall that if we have an Avogadro’s amount (6.022 x 1023) of atoms, the mass of the element can be expressed in grams.

For example,

6.022 x 1023 atoms of oxygen = 16.0 g

Also recall, that the quantity, 6.022 x 1023, is referred to as a mole. That is,

1 mole = 6.022 x 1023 things

Putting this all together, we now have a relationship for moles, atoms, and mass,

1 mole = 6.022 x 1023 atom = mass of element (g)

Because a mole represents a fixed number of things, 1 mole of hydrogen weighs less than 1 mole helium,

1 mole H = 1.0 g

1 mole He = 4.0 g

The concept of a mole can also be applied to other things. Consider for example how the mass of 1 mole of mini marshmallows compares to the mass of 1 mole of peanut m & m’s. While the number of mini marshmallows and m & m’s are the same. The mass of 1 mole of m&m’s greater because on average they weigh more,

1 mole mini marshmallows = 6.022 x 1023 mini marshmallows

1 mole m & m’s = 6.022 X 1023 m & m’s

mass of 1 mole m & m’s > mass of 1 mole mini marshmallows

|  |  |
| --- | --- |
| For each pair indicate what weighs more, | |
| 1 mole cotton balls | 1 mole marbles |
| 1 mole hot tamales | 1 mole mini marshmallows |
| 1 mole jelly bellys | 1 mole mini snicker bars |

6.022 x 1023 is a HUGE number and representing amounts of candy in moles is inconvenient. So, instead, we will represent our amounts of candy in terms of a unit you are more familiar with, the dozen. But the concept is still the same,

mass of 1 dozen m & m’s > mass of 1 dozen marshmallows

For the remainder of this lab 1 “mole” of candy will represent 12 pieces of candy, or 1 dozen.

|  |
| --- |
| Obtain 12 gumdrops  Mass each gumdrop and record the mass in the data table below  When you are done, calculate the average mass of 1 of one gum drops  Repeat the above for hot tamales, mini marshmallows, and candy corn  Multiply the average mass by 12 – this will represent the mass of 1 mole of your candy, or the molar mass. |

**Data table 1: Average mass of 1 dozen**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Mass gumdrops** | **Mass hot tamales** | **Mass mini marshmallows** | **Mass candy corn** |
| **1** |  |  |  |  |
| **2** |  |  |  |  |
| **3** |  |  |  |  |
| **4** |  |  |  |  |
| **5** |  |  |  |  |
| **6** |  |  |  |  |
| **7** |  |  |  |  |
| **8** |  |  |  |  |
| **9** |  |  |  |  |
| **10** |  |  |  |  |
| **11** |  |  |  |  |
| **12** |  |  |  |  |
| **Average** |  |  |  |  |
| **Molar mass** |  |  |  |  |

* + **Convert between grams, pieces, and “moles” of candy**

|  |  |  |  |
| --- | --- | --- | --- |
| Mass the provided bags of candy. Using the average mass of 1 “mole” of each candy, complete the following. DO NOT open the bags! | | | |
| **Gumdrops** | | | |
| **Bag** | **Mass** | **“Moles”** | **Pieces** |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |
| **Hot tamales** | | | |
| **Bag** | **Mass** | **“Moles”** | **Pieces** |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |
| **Mini marshmallows** | | | |
| **Bag** | **Mass** | **“Moles”** | **Pieces** |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |
| **Candy corn** | | | |
| **Bag** | **Mass** | **“Moles”** | **Pieces** |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Complete the following table for each unknown bag of candy | | | |
| **Unknown 1** | | | |
| **Identity** | **Mass** | **“Moles”** | **Pieces** |
|  |  |  | **24** |
| **Unknown 2** | | | |
| **Identity** | **Mass** | **“Moles”** | **Pieces** |
|  |  | **0.5** |  |
| **Unknown 3** | | | |
| **Identity** | **Mass** | **“Moles”** | **Pieces** |
|  |  |  | **6** |

* + **Convert between grams, pieces, and “moles” of candy compounds**

Elements on the periodic table can be represented with symbols and so too can our candy. To explore our candy reactions, we will use the following symbols to represent each type of candy.

Mini Marshmallows = M

Hot tamales = T

Gumdrops = G

Candy corn = C

|  |  |
| --- | --- |
| Refer to the molar mass for each candy, then calculate the mass of 1 “mole” of each candy compound. | |
| **Compound** | **Mass of 1 “mole”** |
| M2 |  |
| T2 |  |
| M2T |  |
| G |  |
| MC |  |
| GC2 |  |

|  |  |  |
| --- | --- | --- |
| Refer to the mass of 1 “mole” of each candy compound above to complete the following table. | | |
| **M2T** | | |
| **Mass** | **“Moles”** | **Candy compound units** |
|  |  | 6 |
|  | 1.5 |  |
| **GC2** | | |
| **Mass** | **“Moles”** | **Candy compound units** |
|  | 0.25 |  |
|  |  | 4 |
| **MC** | | |
| **Mass** | **“Moles”** | **Candy compound units** |
|  | 2 |  |
|  |  | 2 |

* + **Explore the stoichiometry of candy reactions**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Consider the following hypothetical candy reaction,  2M2 + T2 🡪 2M2T  Combine pieces of candy to make each reactant combination. Then rearrange the pieces to create as many M2T compounds as you can. Record the amounts of products, and the amounts of leftovers in the data table below. | | | | | | |
| **Reactants** | | **Products** | | **Leftovers** | | |
| M2 | T2 | M2T | | M2 | | T2 |
| 8 | 8 |  | |  | |  |
| 5 | 8 |  | |  | |  |
| 4 | 8 |  | |  | |  |
| 6 | 3 |  | |  | |  |
| Calculate the “moles” and mass of M2T you made for each combination. | | | | | | |
| **Reactants** | | **Moles** | | **Mass** | | |
| M2 | T2 | M2T | | M2T | | |
| 8 | 8 |  | |  | | |
| 5 | 8 |  | |  | | |
| 4 | 8 |  | |  | | |
| 6 | 3 |  | |  | | |
| Calculate the “moles” and mass of leftovers | | | | | | |
| **Reactants** | | **Leftovers** | | | | |
| M2 | T2 | Moles M2 | Mass M2 | Moles T2 | Mass T2 | |
| 8 | 8 |  |  |  |  | |
| 5 | 8 |  |  |  |  | |
| 4 | 8 |  |  |  |  | |
| 6 | 3 |  |  |  |  | |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Consider the following hypothetical candy reaction,  G + 2MC 🡪 GC2 + M2  Combine pieces of candy to make each reactant combination. Then rearrange the pieces to create as many M2T compounds as you can. Record the amounts of products, and the amounts of leftovers in the data table below. | | | | | | |
| **Reactants** | | **Products** | | **Leftovers** | | |
| G | MC | GC2 | M2 | G | | MC |
| 4 | 4 |  |  |  | |  |
| 6 | 3 |  |  |  | |  |
| 2 | 4 |  |  |  | |  |
| 3 | 3 |  |  |  | |  |
| Calculate the “moles” and mass of GC2 you made for each combination. | | | | | | |
| **Reactants** | | **Moles** | | **Mass** | | |
| G | MC | GC2 | | GC2 | | |
| 4 | 4 |  | |  | | |
| 6 | 3 |  | |  | | |
| 2 | 4 |  | |  | | |
| 3 | 3 |  | |  | | |
| Calculate the “moles” and mass of leftovers | | | | | | |
| **Reactants** | | **Leftovers** | | | | |
| G | MC | Moles G | Mass G | Moles MC | Mass MC | |
| 4 | 4 |  |  |  |  | |
| 6 | 3 |  |  |  |  | |
| 2 | 4 |  |  |  |  | |
| 3 | 3 |  |  |  |  | |

* + **Receive Credit for this lab**

Each group member must complete and submit their own lab to receive credit