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

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| **Chemical Formulas** |

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| **Your Tasks (Mark these off as you go)** |
| * Assign group roles * Review molar mass of compounds * Review mass-mole-molecule conversions * Explore the precision and accuracy virtual lab * Complete the data collection * Complete the data analysis * Write your own conclusion * Receive credit for this lab |

* + **Assign group roles**

Before you continue, record your group number, then collaborate with your group and assign each person a role. Each role and a description is provided below.

|  |  |
| --- | --- |
| **Project manager (PM)** | Leads the team discussion and keeps the team on task and on schedule. Considers how the team is working and ensures all voices are heard. Makes sure the final lab is submitted. |
| **Recorder (R)** | Ensures that all members have correct answers. Presents answers (or questions) to the class, instructor, or other teams. |

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| --- | --- |
| **Group Number:** | |
| **Name** | **Role** |
|  |  |
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* + **Review molar mass of compounds**

The molar mass of a compound is the mass of 1 mole of the compound. It can be calculated by summing the atomic masses that make up the compound. For example, H2O contains 2 hydrogens, each with a mass of 1.0 g and 1 oxygen, which has a mass of 16.0 g. The mass of 1 mole of H2O is therefore,

1 mole = 2(1.0 g) + 16.0g = 18 g

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| --- |
| Calculate the mass of 1 mole of each of the following |
| CO2 |
| CuSO4 |
| MgO |
| Al(NO3)3 |

* + **Review mass-mole-molecule conversions**

Knowledge of the mass of the compound enables for the calculation of the number of moles, mass, or individual molecules in a given sample.

1 mole = 6.022 x 1023 atoms = mass of compound (g)

Just as before, when using this relationship, it is important to show your work. Using the units to guide you through the problem-solving process will help ensure you arrive at the correct result. Below is an example of how this can be done.

Example

Determine the number of moles in 12.0 g of H2O.

To set up this problem we first identify the given which is 12.0 g of H2O and the unknown which is moles.

|  |  |  |
| --- | --- | --- |
| **given** | **conversion** | **asked to find (unknown)** |
| **12.0 g H2O** |  | **moles oxygen** |
|  |  |  |

Next, we identify the conversion factor.

1 mole = mass of H2O (g)

On the [periodic table](https://ptable.com/) we see that the mass of oxygen is 16.0 g and the mass of hydrogen is 1.0 g. So the mass of 1 mole of H2O is,

1 mole = 2(1.0 g) + 16.0g = 18.0 g

Or,

1 mole = 18.0 g

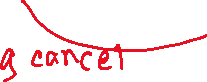
Next, we arrange the conversion factor such that what we are asked to find appears on top and what we are given appears on the bottom.



|  |  |  |
| --- | --- | --- |
| **given** | **conversion** | **asked to find (unknown)** |
| 12.0 g H2O | **1 mole H2O** | moles H2O |
|  | **18.0 g H2O** |  |

Now that we have set up our problem, we can solve for what we are asked to find. To do this, we multiply the quantities on top, then divide by the quantities on the bottom. The result is 0.50 moles oxygen. Notice, that the grams cancel, and we end with moles as our final unit.

|  |  |  |
| --- | --- | --- |
| **given** | **conversion** | **asked to find (unknown)** |
| 12.0 g H2O | 1 mole H2O | **0.67 moles oxygen** |
|  | 18.0 g H2O |  |



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| --- |
| **Skill 10.03 Exercise 1** |
| How much in moles is 10.0 g of water (H2O)?   |  |  |  | | --- | --- | --- | | **Conversion factor** | | | |  | | | | **Given** | **Conversion** | **Asked to find (unknown)** | |  |  |  | |  |  |  | |
| How much in grams is 1.25 moles of carbon monoxide (CO)?   |  |  |  | | --- | --- | --- | | **Conversion factor** | | | |  | | | | **Given** | **Conversion** | **Asked to find (unknown)** | |  |  |  | |  |  |  | |
| How much in grams is 6.022 x 1022 molecules of nitrogen dioxide (NO2)?   |  |  |  | | --- | --- | --- | | **Conversion factor** | | | |  | | | | **Given** | **Conversion** | **Asked to find (unknown)** | |  |  |  | |  |  |  | |
| How many molecules are the in 4.25 g of hydrogen peroxide (H2O2)?   |  |  |  | | --- | --- | --- | | **Conversion factor** | | | |  | | | | **Given** | **Conversion** | **Asked to find (unknown)** | |  |  |  | |  |  |  | |

* + **Explore the precision and accuracy virtual lab**

Navigate to precision and accuracy virtual lab. You may need to edit your browser settings to play Flash.

<https://moodle.resa.net/images/Chemistry_v10/Number_1/Lessons/01.07_Accuracy_and_Precision/Upload_Folder/01_07c_c.htm>

|  |  |
| --- | --- |
| Click the Begin button to get started |  |
| Click on PART 1: Density of an unknown liquid |  |
| To mass an object, click and drag to the balance |  |
| Move the weights to measure the mass. Then type the amount in the box. To record the amount, click on the notebook. |  |
| Drag the liquid to the graduated cylinder to pour the liquid. To stop pouring, click on the graduated cylinder. To resume pouring, click on it again. |  |
| To record the volume, type the amount in the box and click on the notebook. |  |
| Mass the graduated cylinder with the liquid by dragging it to the balance.  Move the weights to measure the mass. Then type the amount in the box. To record the amount, click on the notebook. |  |
| Once you have successfully completed one trial, click the New Trial button and repeat the process until you have completed 3.  Complete three trials for each Part. |  |
| To view the data for each trial, click the Data Table button. Record the data you collected on this lab guide. |  |

* + **Complete the data collection**

Complete three trials for each part of the simulator. Have each group member complete one for each part. **Create a table to record your results below**. The table should be well organized and easy to read. All data should include appropriate significant figures and units.

**Create your data table here**

* + **Complete the data analysis**

**Precision**

For each part of this lab you completed three trials. Calculate the density for each trial. Record your results below,

|  |  |  |  |
| --- | --- | --- | --- |
| **Results Table** | | | |
|  | **Part 1** | **Part 2** | **Part 3** |
| **Trial 1** |  |  |  |
| **Trial 2** |  |  |  |
| **Trial 3** |  |  |  |
| **Average** | =average(B2:B4) | =average(C2:C4) | =average(D2:D4) |
| **Standard Deviation** | =stdev(B2:B4) | =stdev(C2:C4) | =stdev(D2:D4) |
| **Precision** |  |  |  |
| **Accuracy (Percent Error)** |  |  |  |

Once you have calculated the densities, copy (Ctrl-c) and paste (Ctrl-v) the data table above into a Google Sheet. If you paste the contents in cell A! the average and standard deviation for each part should calculate automatically.

Use the values for the standard deviation and average, calculate the precision for each part. Record these values in the Results Table above.

**Accuracy**

The accepted values associated for each part of this lab are as follows. Use these values and the average values for each part to calculate the percent error. Record these values in the Results Table above.

**Part I accepted value = 1.37 g/mL**

**Part 2 accepted value = 8.67 g/mL**

**Part 3 accepted value = 0.637 g/cm3**

* + **Write your own conclusion**

A conclusion is a concise summary of the lab. A conclusion should include the following elements (1) The purpose of the lab, (2) A summary of what you did to accomplish the purpose (3) A summary of your results (4) A summary of errors. For this lab we will only consider the first three parts.

In the space below, use complete sentences to summarize the purpose of this lab.

|  |
| --- |
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In the space below, use complete sentences to describe what you did to accomplish the purpose. You could say for example, “In this lab, we used a simulator to determine the density of three unknown substances. For the first unknown we… For the second unknown we.., etc. “

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In the space below, use complete sentences to summarize your results. You could say for example, “The first unknown had an average density of 1.41 g/mL, this corresponded to 3% error and 2% precision. The second unknown, etc…”. In your summary, you should also indicate for which part you had the best precision and for which part you had the best accuracy.

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|  |

* + **Receive Credit for this lab**

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