**Balloon Science: Inviting Chemistry and Physics to the Party**

Student Worksheet

**Purpose:** Determine the volume of helium gas in an irregularly-shaped Mylar balloon.

**Guiding questions:**

1. What factors influence the volume of a gas?
2. Which of these factors can we measure or determine to calculate the volume? How will they be measured? If you can make the measurement, record it!

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| --- | --- | --- |
| **Factor** | **Describe how it could be measured** | **Record the measurement** |
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1. It’s more direct to measure the weight of the He gas, then determine the number of moles. Develop a procedure to determine the total weight of air present in the balloon. You have the following items available to you:
   * Electronic balance
   * Rock
   * Small piece of tape
   * Floating balloon filled partially with He, attached to a ribbon
   * Identical uninflated balloon and ribbon
   * Resources to get gas constants

Before you record the numbers on the electronic balance, draw force diagrams for the following:

Rock on scale, attached to balloon Bag (balloon/ribbon/gas combination)

1. Using the force diagrams to guide you, write an expression for the **force** that could be determined from the measurement on the scale.
2. Break apart this expression so that you can get the force of the earth on the He gas (weight) alone!
3. Of all of these forces in the equation, how could we measure each one in order to have the weight of the He (Fg Earth on He) be the only unknown?

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| --- | --- | --- |
| **Factor** | **Describe how it could be measured** | **Record the measurement** |
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1. At this point, it seems as though the quest to measure the volume of the He in the balloon has only gotten more complicated! Using Archimedes’ Principle, explain what information must be known to determine the weight of the displaced air.

Typically, with two unknowns, scientist and mathematicians will use a “series of equations” Two equations with two unknowns each should solve this problem.

In the spaces below, start with the Ideal Gas Law, and create two separate expressions for the number of moles of He and displaced air.

|  |  |  |
| --- | --- | --- |
|  | He | Displaced Air |
| Expressions for n |  |  |

1. Ultimately, we are interested in developing expressions for the weight of the He and the weight (buoyant force caused by) the displaced air so we can place it into the equation from 5. Rewrite the above expressions so that you could solve for mass, and then write a modified expression to solve for weight.

|  |  |  |
| --- | --- | --- |
|  | He | Displaced Air |
| Expressions for **mass**  (Hint: n = m/M)  M is molar mass for the substance |  |  |
| Expression for **weight** |  |  |

1. Using the expressions for weight, substitute these into the equation from 5.
2. Explain what is similar and what is different about VHe and Vair in the expressions above. Provide a justification!
3. Insert all known values, and solve for V!