Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period: \_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Mystery Metals!**

**Lab Activity**

**Purpose**: The purpose of this experiment is to identify four (4) unknown metals using two different methods for determining volume. To determine the reliability of their results, students will also calculate their percent error.

**Method 1** –Rectangular Samples

For each block, (1) measure the mass using an electronic balance; and (2) measure the length, width, and height of the block using a ruler. Using these measurements, calculate the metal’s density knowing that

$$Density=\frac{Mass}{Volume}$$

|  |  |  |
| --- | --- | --- |
| **Metal A** |  | **Metal B** |
| Mass (m): |  |  | Mass (m): |  |
| Length (L): |  |  | Length (L): |  |
| Width (W): |  |  | Width (W): |  |
| Height(H): |  |  | Height(H): |  |
| Volume (V):$$V=L ×W ×H$$ |  |  | Volume (V):$$V=L ×W ×H$$ |  |
| Density (D): |  |  | Density (D): |  |

*SHOW ALL VOLUME AND DENSITY CALCULATIONS HERE:*

**Identity of Metal A**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **Identity of Metal B:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Percent Error Calculations:**

|  |  |  |
| --- | --- | --- |
| **Metal A** |  | **Metal B** |
| Accepted Density:(from table on back) |  |  | Accepted Density:(from table on back) |  |
| Measured Density: |  |  | Measured Density: |  |
| Percent Error: |  |  | Percent Error: |  |

*SHOW PERCENT ERROR CALCULATIONS HERE:*

**Method 2** – Cylindrical Samples

For each cylinder, (1) measure the mass using an electronic balance; and (2) use the water displacement method to determine the samples volume. Using these measurements, calculate the metal’s density knowing that

$$Density=\frac{Mass}{Volume}$$

|  |  |  |
| --- | --- | --- |
| **Metal A** |  | **Metal B** |
| Mass (m): |  |  | Mass (m): |  |
| Volume of water: |  |  | Volume of water: |  |
| Volume of water + sample: |  |  | Volume of water + sample: |  |
| Volume of Sample: |  |  | Volume of Sample: |  |
| Density (D): |  |  | Density (D): |  |

*SHOW ALL DENSITY CALCULATIONS HERE:*

**Identity of Metal A**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **Identity of Metal B:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Percent Error Calculations:**

|  |  |  |
| --- | --- | --- |
| **Metal A** |  | **Metal B** |
| Accepted Density:(from table below) |  |  | Accepted Density:(from table below) |  |
| Measured Density: |  |  | Measured Density: |  |
| Percent Error: |  |  | Percent Error: |  |

*SHOW PERCENT ERROR CALCULATIONS HERE:*

**Accepted Densities**:

|  |  |
| --- | --- |
| **Name of Metal** | **Accepted Density** |
| Aluminum | 2.7 g/mL |
| Brass | 8.6 g/mL |
| Copper | 8.96 g/mL |
| Steel | 7.874 g/mL |

**Lab Questions:**

1. Calculate the density of a 129.5-gram sample of bronze that has a volume of 14.8 cubic centimeters. Your response must include a correct numerical setup and the calculated result with units.
2. Base your answer on the following information.

Carbon and oxygen are examples of elements that exist in more than one form in the same phase. Graphite and diamond are two crystalline arrangements for carbon. The crystal structure of graphite is organized layers. The bonds between carbon atoms within each layer of graphite are strong. The bonds between carbon atoms that connect different layers of graphite are weak because the shared electrons in these bonds are loosely held by carbon atoms. The crystal structure of diamond is a strong network of atoms in which the shared electrons are strongly held by the carbon atoms. Graphite is an electrical conductor, but diamond is now. At 25oC, graphite has a density of 2.2 g/cm3 and diamond has a density of 3.51 g/cm3. The element oxygen can exist as diatomic molecules, O2, and as ozone, O3. At standard pressure, the boiling point of ozone is 161 K.

Calculate the volume, in cm3, of a diamond at 25oC that has a mass of 0.200 gram. Your response must include both a correct numerical setup and the calculated result.

1. Which element has the greatest density at STP? (*Use Reference Table S!*)

|  |  |  |  |
| --- | --- | --- | --- |
| 1. barium
 | 1. beryllium
 | 1. magnesium
 | 1. radium
 |

1. Base your answer on the information below.

An unlit candle is secured to the bottom of a 200-mL glass beaker. Baking soda (sodium hydrogen carbonate) is added around the base of the candle as shown below.

The candle is lit and dilute ethanoic acid is poured down the inside of the beaker. As the acid reacts with the baking soda, bubbles of CO2 gas form. After a few seconds, the air in the beaker is replaced by 0.20 liter of CO2 gas, causing the flame to go out. The density of CO2 gas is 1.8 grams per liter at room temperature.

Calculate the mass of the CO2 gas that replaced the air in the beaker. Your response must include both a correct numerical setup and the calculated result.