**NAME: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ PERIOD: \_\_\_ DATE: \_\_\_\_\_\_\_\_\_\_\_\_\_**

**CYLINDERS DENSITY LAB**

**BACKGROUND:** All matter has mass and volume. Mass (M) is a measure of the amount of matter (stuff) an object has. Its measure is usually given in grams (g), milligrams (mg), or kilograms (kg). Volume (V) is the amount of space an object occupies. There are numerous units for volume including liters (L), milliliters (mL), or centimeters cubed (cm3).

Density is an intrinsic property (does not depend on the amount of matter) whereas mass and volume are extrinsic properties (depend on the amount of matter). Density is defined as the ratio of a material’s mass to its volume and the ration is constant for any particular type of matter. This means density can be used to help determine the identity of an unknown sample of matter. The equation for density (p) is given by .

**Materials:**

* Goggles
* 1000 mL Beakers
* Calipers/Rulers
* Triple Beam Balances/Electronic Scales
* Cylinders of Various Substances

**PROCEDURE**:

Record the color of the cylinders on the line next to the word cylinders that is located in the box above the table.

MASS: Use a triple beam balance to mass each cylinder. Include units and sig. fig.

VOLUME BY GEOMETRY: Using a metric ruler measure the height and diameter of the cylinder. Calculate the radius. The volume of a cylinder can be calculated using the formula . Include units and sig. fig.

VOLUME BY WATER DISPLACEMENT: Place enough water into a 100 mL graduated cylinder to cover each cylinder. Use a disposable eyedropper to adjust the water level and to dislodge trapped air bubbles. Read the water level at the bottom of the meniscus to +/- 0.5mL. Record this as the initial volume (Vi) reading. Include units and sig. fig.

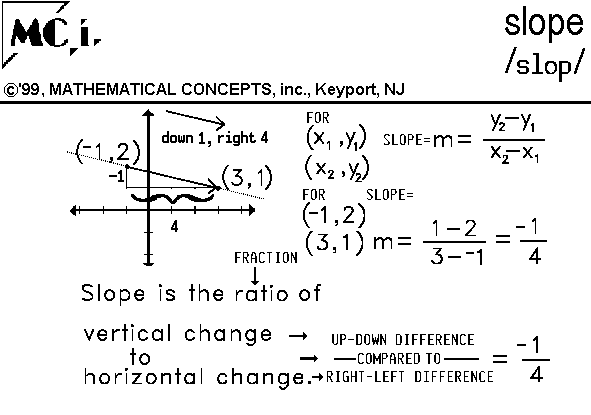
Tilt the graduated cylinder and carefully place the cylinder in it. Record the water level to +/- 0.5 mL as the final volume (Vf) reading. Calculate the volume of the cylinder by subtracting the initial volume from the final volume. Include units and the correct significant figures in your values.

Collect the data for two different cylinder colors.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Cylinder Color:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | | | | | |
| Cylinder # | Diameter | Radius | Height | Volume by  Geometry | Water Volume Initial | Water Volume Final | Volume by Water Displacement | Mass |
| 1 |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |  |  |
| 11 |  |  |  |  |  |  |  |  |
| 12 |  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Cylinder Color:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | | | | | | | | |
| Cylinder # | Diameter | Radius | Height | Volume by  Geometry | Water Volume Initial | Water Volume Final | Volume by Water Displacement | Mass |
| 1 |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |  |  |
| 11 |  |  |  |  |  |  |  |  |
| 12 |  |  |  |  |  |  |  |  |

**DATA ANALYSIS**: Use the data from the tables above to construct a line graph.

1. Plot the points for one cylinders color at a time and draw a line of best fit.
2. Calculate density by calculating the slope (m) of the line using the formula 
3. Record results below. Include units and sig fig.
4. Repeat the above steps for the other cylinders color.

**RESULTS**: Show all work.

|  |  |  |
| --- | --- | --- |
|  | Cylinder Color:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | Cylinder Color:\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Density (Experimental) |  |  |
| Density (Actual) |  |  |
| Percent Error |  |  |

**QUESTIONS**: Answer questions on a separate sheet of paper.

What does the slope of each line represent?

Why are the slopes of the lines different?

As the volume occupied by the metal cylinder increases, what happens to the density of the cylinder?

As the mass of the metal cylinder increases, what happens to the density?

% RROR