Objective: to accurately measure the mass and volumes of solids and liquids using direct and indirect measuring techniques

***Part A: Direct measurement to determine the volume of a liquid***

*Take a guess - How many drops of water will it take to equal 1 milliliter?\_\_\_\_\_\_\_\_ drops*

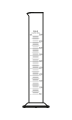
Remember to read the **bottom of the meniscus** when you are reading the volume of a liquid in a graduated cylinder.

1. Fill a small graduated cylinder with 4 ml of water (use dropper to get it exact).
2. Count the number of drops it takes to raise the water 1 mL. Record the number in table 1, column 1.
3. Leave the water in the graduated cylinder and count the number of drops it takes to raise the water one more ml. Record the number in table 1, column 2.
4. Leave the water in the graduated cylinder and count the number of drops it takes to raise the water one more ml. Record the number in table 1, column 3.
5. Calculate your average and round to the nearest tenth.

Table 1: # of drops of water in 1 mL

|  |  |  |  |
| --- | --- | --- | --- |
| # of drops to 5 mL | # of drops to 6 mL | # of drops to 7 mL | Average # of drops of water to equal 1 mL |
|  |  |  |  |

Average calculations here:



Questions:

1. How many drop of water equals 1 mL? \_\_\_\_\_\_\_\_\_\_\_\_\_
2. Based on your answer to number 1, how many drops would it take to make 1 liter? \_\_\_\_\_\_\_\_\_\_\_\_\_

show your calculations here:

***Part B: Indirect measurement to determine the volume of a solid (Water Displacement)***

Follow the directions to find the volume of three marbles using water displacement.

1. Add 20 mL of water to a \_\_\_\_\_\_\_ mL graduated cylinder. Record the volume in table 2, column 1.
2. With the graduated cylinder slightly, add 3 marbles and record the volume in table 2, column 2.
3. Find the difference between the two measurements and record in table 2, column 3. The difference is the volume of 3 marbles.
4. Determine the volume of 1 marble in table 2, column 4.

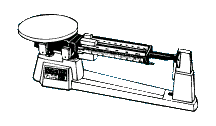
Table 2: Water Displacement

|  |  |  |  |
| --- | --- | --- | --- |
| Volume of Water Before adding Marbles (mL) | Volume of Water After Adding Marbles (mL) | Volume of 3 Marbles  (mL) | Volume of 1 Marbles (mL) |
|  |  |  |  |

Calculations of determine the Observations:

volume of 1 marble below:

The gram is the standard unit of mass in the metric or SI system. The basic instrument used to measure mass is the mass balance.  Some mass measurements can be made using an electronic balance.



***Part C: Direct measurement to determine the mass of a solid***

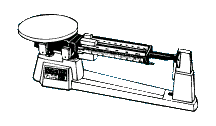
1. Check to see that the **Pointer** is pointing to zero.
2. If it is not, check to see that all the **Riders (weights)** are all the way to the left at the Zero mark.
3. Adjust the balance by turning the **Adjustment Screw** *slowly* until it points to zero.
4. Measure the mass of 3 marbles and record the mass in table 3.

Table 3: Mass of Marbles

|  |  |
| --- | --- |
| Mass of 3 marbles (g) | Mass of 1 marble (show calculations) |
|  |  |

Determine the average density of a marble using your volume from part b and mass from part c:

Density =



***Part D: Indirect measurement to determine the mass of a liquid***

1. Reset the balance to ZERO
2. Record the mass of the dry, empty \_\_\_\_\_\_\_\_\_ mL beaker in table 4, column 1.
3. Using a graduated cylinder record the **exact** volume of water (~40 mL) and record in table 4, column 3.
4. Transfer the water to beaker.
5. Record the mass of the water filled beaker in table 4, column 2.
6. Determine the mass of the water by finding the difference between the mass of the beaker and mass of the beaker with water in it. Record in table 4, column 3.

Table 4: Mass of water

|  |  |  |
| --- | --- | --- |
| Mass of beaker (g) | Mass of water and beaker | Mass of \_\_\_\_\_\_\_\_ mL of water |
|  |  |  |

Determine the density of water:

Density =