**Introduction**

Explain the property of density. Determine the density of substances. Identify unknown substances based on an intensive property.

**Purpose**

The purpose of this experiment is to measure the density of substances in order to identify or distinguish substances based on an intensive property.

**Background Information**

Density of a substance is the ratio of the substance’s mass to its volume. D = m/v. A substance’s mass is the measure of how much matter the substance contains. A substance’s volume is the measure of how much space the substance occupies. By dividing a substance’s mass by its volume, the density of a substance can be determined. Density is an intensive property that is used to identify substances.

In order to determine density, volume must be measured. Therefore, density is found in three ways: 1) regularly shaped solids (L x W x H) in cubic units, 2) direct volume measurement in a graduated cylinder, and 3) water displacement for irregularly shaped solids. In this lab, we used direct volume and water displacement.

**Hypothesis**

Experiments 1-4 … If / then

Experiment 5 … If / then

**Equipment**

*Use the Density video:* [*https://screencast-o-matic.com/watch/cqe63b0wVL*](https://screencast-o-matic.com/watch/cqe63b0wVL) *to record data for experiments 1-4.*

Experiment #1:

Electronic balance 50 mL graduated cylinder water ethanol

Experiment #2:

Electronic balance 50 mL graduated cylinder unknown liquid

Experiment #3:

Electronic balance 50 mL graduated cylinder iron, aluminum, and water

Experiment #4:

Electronic balance 50 mL graduated cylinder water unknown metal

Experiment #5:

Electronic balance Diet Soda Pop Regular Soda Pop Large Container

**Procedures**

*Note: For each experiment in the Density Video, the volume of each substance in the graduated cylinder is zoomed in using the cursor tool.*

**Experiment #1: Find the Density of Various Liquids**

1. The balance was placed on the workbench and zeroed.

2. The 50 mL graduate cylinder was placed on the balance and its mass was measured to the nearest 0.001 g.

3. 10.00 mL of water was added to the cylinder and the total mass and the total volume was measured. Record results on the data table in the calculations and data section.

4. 10.00 mL of water was added to the cylinder and the total mass and the total volume was measured. Record results on the data table in the calculations and data section.

5. 10.00 mL more of water was added to the cylinder and the total mass and the total volume was measured. Record results on the data table in the calculations and data section.

6. The workbench was cleared and the balance was zeroed.

7. Steps 2-5 were repeated with ethanol instead of water.

**Experiment #2: Determine the Density and Identify an Unknown Liquid**

1. A balance was placed on the workbench and zeroed.

2. A 50 mL graduate cylinder was placed on the balance and its mass was measured to the nearest 0.001 g.

3. 10.00 mL of the unknown liquid was added to the cylinder and the total mass and total volume were measured.

4. Step 3 was repeated until the cylinder held a total of 30.00 mL.

**Experiment #3: Find the Density of Various Metals**

1. A balance was placed on the workbench and zeroed.

2. A 50 mL graduated cylinder was placed on the balance and the mass was measured.

3. 30.00 mL of water was added to the cylinder, and the total mass and total volume were measured.

4. 5.000 g of iron was added to the cylinder and the total mass and total volume were measured.

5. Iron was added in 5.000 g amounts and the mass and volume were measured until the total amount added equaled 25.000 g.

6. The workbench was cleared and the balance was zeroed.

7. Steps 2-5 was repeated using aluminum.

**Experiment #4: Determine the Density and Identify an Unknown Metal**

1. A balance was placed on the workbench and zeroed.

2. A 50 mL graduated cylinder was placed on the balance and the mass was measured.

3. The graduated cylinder was filled with 30.00 mL of water. The initial volume and initial mass was measured.

4. 5.000 g of the unknown metal was added to the cylinder. The mass and volume was measured.

5. The unknown metal was added to the cylinder in 5.000 g amounts and the mass and volume were measured until the total amount added equaled 25.000 g.

6. The workbench was cleared of all materials and containers.

**Calculations and Data**

*Copy and paste the appropriate data table for each substance used in experiments 1-4.*

*Use the nearest 0.01 for mL and 0.001 for grams for all data collection and calculations. Densities should be to the nearest 0.01 g/ml.*

**Sample of Data Table for Density of Various Liquids**

**Clearly identify the substance used in each table.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Data Type** | **Measurement of Data** | | |
| *Mass of graduated cylinder (g)* | mm.mmm g | | |
| *Volume of substance (mL)* | vv.vv mL | vv.vv mL | vv.vv mL |
| *Mass of graduated cylinder plus substance (g)* | mm.mmm g | mm.mmm g | mm.mmm g |
| *Total mass of substance added (g)* | mm.mmm g | mm.mmm g | mm.mmm g |
| *Density of substance (g/mL)* | d.dd g/mL | d.dd g/mL | d.dd g/mL |
| *Average density of substance (g/mL)* | d.dd g/mL | | |

**Sample Table for the Density of Various Metals**

**Clearly identify the substance used in each table.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Data Type** | **Measurement of Data** | | | | |
| *Initial volume of water (mL)* | vv.vv mL | | | | |
| *Initial mass of cylinder and water (g)* | mm.mmm g | | | | |
| *Total volume of water and substance (mL)* | vv.vv mL | vv.vv mL | vv.vv mL | vv.vv mL | vv.vv mL |
| *Total mass of substance in the cylinder (g)* | mm.mmm g | mm.mmm g | mm.mmm g | mm.mmm g | mm.mmm g |
| *Net volume of substance (mL)* | vv.vv mL | vv.vv mL | vv.vv mL | vv.vv mL | vv.vv mL |
| *Density of substance (g/mL)* | d.dd g/mL | d.dd g/mL | d.dd g/mL | d.dd g/mL | d.dd g/mL |
| *Average density of substance (g/mL)* | d.dd g/mL | | | | |

Note: Be sure to show work for at least one density calculation for each substance.

**Conclusions**

Address Hypothesis

Analysis

**Lab Questions**

1. Given that the density of glycerol is 1.261 g/mL, how much will 15.00 mL of glycerol weigh?



2. According to the Density Lab what is the identity of the unknown liquid and the unknown metal? [You may use the internet to look this up or the table to the right.]

3. Why is it important to record data with all the decimals provided by the instruments even if they are zero? How will this help with data analysis?

4. Based on real life application, how can one tell that one type of soda pop is different than another using density?