Name: Tom Ralph

Class: AP Physics II

Period: 2

Group #: 6

Lab # and Title: 3 – Archimedes' Principle

Laboratory Report

Purpose

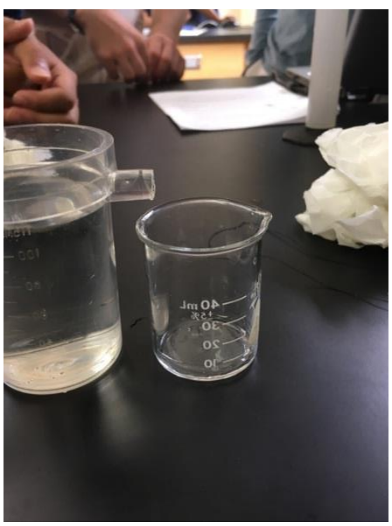
The purposes of this lab is to analyze the factors that affect buoyant force. To do this we measured two relationships: the relationship between buoyant force and volume of liquid displaced, and between buoyant force against mass of volume displaced. With these two relations we will develop an understanding of Archimedes' principle

Equipment Used

Procedure

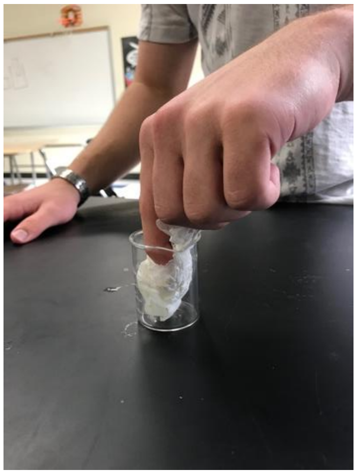
Set Up

1. Set up the overflow can and the small beaker right under the spout of the overflow can



2. Fill overflow can with water using the large beaker until it begins to drip into the small beaker

3. Dry the small beaker

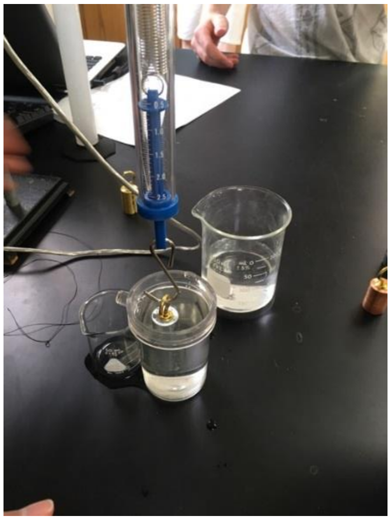


4. Measure the mass of the small beaker for record

Collect Data

5. Hang the metal material sample on the spring scale and record the force in the air

6. Then completely submerge the material in the overflow can with it hanging on the spring scale and record the force in the water



7. Calculate the buoyant force by subtracting the force in water from the force in air

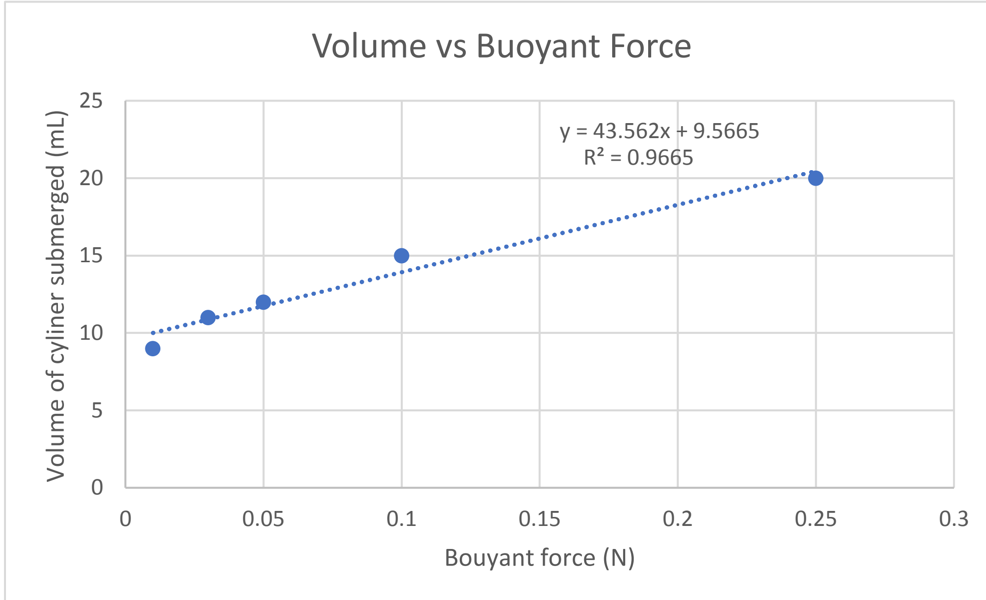
8. Record the volume of water in the small beaker, and record it on a table as the y-value with the buoyant force as the x-value
9. Measure the mass of the small beaker with the water on the triple beam balance

10. Subtract the measured mass with the mass of the empty small beaker to find the mass of the water, and record this on the table as the y-value with the buoyant force as the x-value

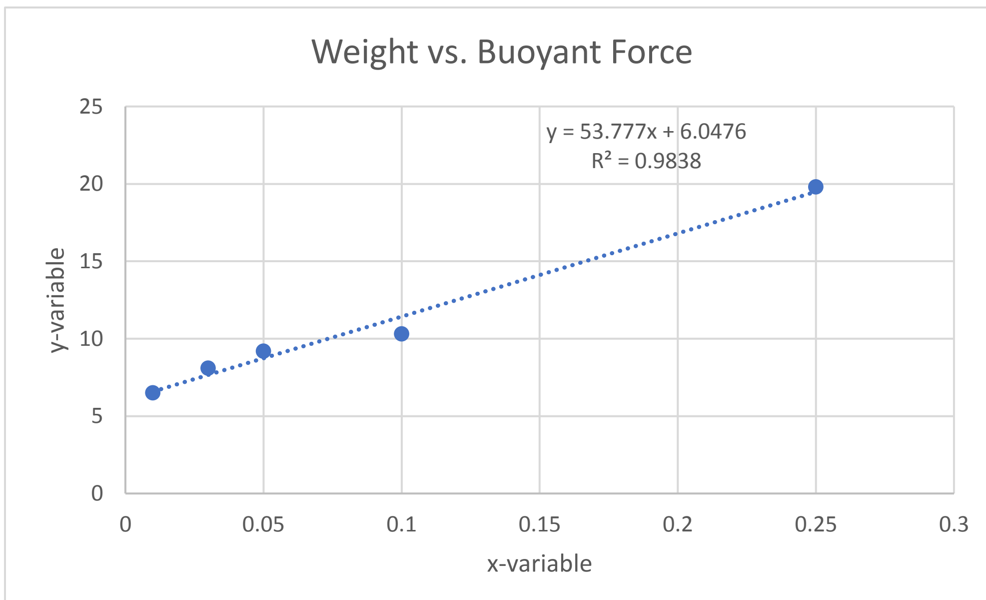
Data

Empty small beaker: 29.2g

Buoyant force (N)	Volume of cylinder submerged (mL)
0.25	20
0.1	15
0.05	12
0.03	11
0.01	9



Buoyant Force (N)	Weight of fluid displaced (sub. Beaker) (g)
0.25	19.8
0.1	10.3
0.05	9.2
0.03	8.1
0.01	6.5



Material	Force in air (N)	Force in water (N)	Bouyant force (N)
Aluminum	0.75	0.5	0.25
Zinc	0.7	0.6	0.1
Brass	0.7	0.65	0.05
Copper	0.7	0.67	0.03
Lead	0.7	0.69	0.01

Analysis Questions

1. What mathematical relationship between the buoyant force and the submerged volume is implied by your data?

The data we gathered strongly suggests that submerged volume is directly correlated to buoyant force.

2. The buoyant force F_b acting on an object that is partially or completely submerged in a fluid is described by the equation,

$$F_b = \rho V g$$

where V is the submerged volume of the object and ρ is the density of the **fluid** in which the object is submerged. Use your data to determine an experimental value for the density of the fluid in which you are submerging the cylinders.

$$.05\ N = \rho * 0.000005\ m^3 * 9.8$$

$$\frac{.05\ N}{0.000005\ m^3 * 9.8} = \rho$$

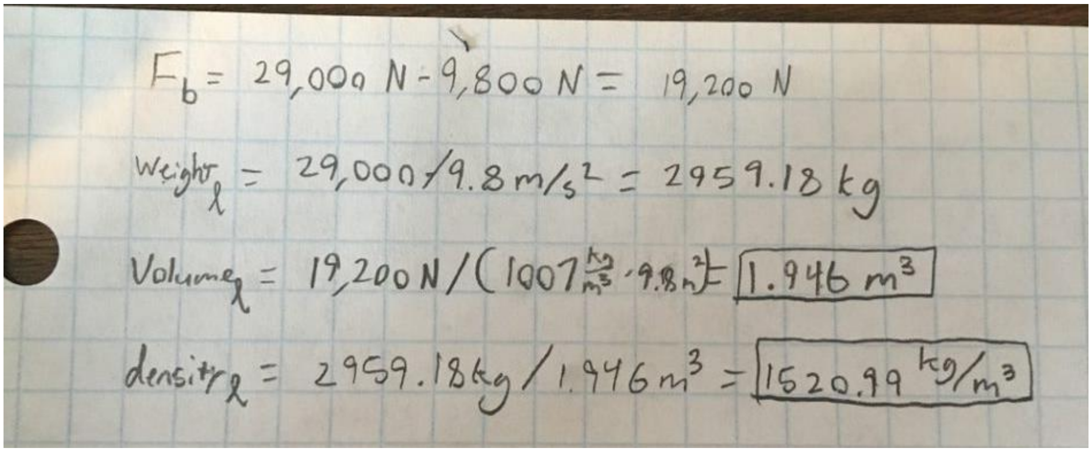
$$1020.408\ {}^{kg}/_{m^3} = \rho$$

3. Archimedes' principle states that an object completely submerged or partially submerged in a fluid experiences an upward buoyant force equal in magnitude to the weight of the fluid displaced by the object. Does your data support this statement? If yes, explain how it supports it; if no, identify which data do not support it, and what may have cause this disagreement.

Our data supports this conclusion very nearly, with our trendline supporting the direct correlation between these two variables at 98.4% confidence. Our data does offer some disagreements, but this can easily be explained by the imprecise and inaccurate measurement tools for both force and volume of displaced liquid

Synthesis Questions

1. A wood salvage company is hoisting an old tree trunk off the bottom and out of a lake. The cable from the hoist is tied around the log above its center of mass. The hoist applies a force of 9,800N to the cable to suspend the log in the lake water (T_{water}), and a force of 29,000 N to suspend the log above the lake surface (T_{air}). What are the volume and density of the log? Assume the lake water has a density of 1,007 kg/m^2. Show your work on a piece of paper and upload a picture below.



2. A cylinder with radius 5.00 cm and length 20.0 cm is lowered into a tank of glucose, which has a density of 1,385 kg/m^3. The cylinder is lowered in four stages:
   a. Zero submersion
   b. Half-submersion to a depth of 10.0 cm
   c. Fully submerged to a depth of 20.0 cm
   d. Fully submerged to a depth of 30.0 cm

   i. What is the buoyant force on the cylinder at each stage?
      a. 0 N
      b. 33.49 N
      c. 66.98 N
      d. 66.98 N

   ii. After being lowered to a depth of 30.0 cm, the string holding a cylinder is cut. If the net force on the cylinder after the string is cut is 1.00 N downward, what is the density of the cylinder material?
      a. 1405 kg/m^3

3. A crab fisherman has built a crab trap out of plastic pipe and wire mesh. The overall mass and volume of the trap are 5.59 kg and 6,213 cm^3, respectively. To catch crab, the trap must sink to the ocean floor. The fisherman has several lead weights to add to the trap to ensure it sinks. If sea water has density of 1,021 kg/m^3, and each lead weight has mass of 113.4 g and volume of 10.0 cm^3, what is the minimum number of weights the fisherman must add so that the trap sinks to the ocean floor? Please show your work on a piece of paper and attach a picture below.

$$1021 = \frac{5.59 + .1134x}{0.006213 + 0.00001x}$$

$$6.343 + 0.0102x = 5.59 + 0.1134x$$

$$0.753 = 0.103x$$

$$7.3018 = x$$

$$\boxed{8}$$