Date of Lab 11/8 Date of Submission 11/15

Laboratory Report

Title
表題 Proving of Archimedes' Principle

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Summary

This time we tried to prove Archimedes' Principle. For the first lab, we calculate the theoretical buoyant force and compared with Observed buoyant force. For the second lab, we made "Cartesian Diver". We put a glass test tube instead of a doll into the PET bottle and read the volume of air. For this lab, I compared F_b and W. Both lab had an error, but it was small, so I can say that it was proved.

・Meet a deadline ・Write logically ・Write clearly ・Write with your own words
・締切り守って ・論理的に ・わかりやすく ・自分のことばで

Teacher Comments

a good summary. a good report with clear table.
You don't have to put Japanese in your report.

1 Due 提出期限	2 Summary 要旨	3 Intro. 序	4 Method. 方法	5 Results 結果	6 Table/Fig. 表/図	7 Discussion 考察	8 Clearness わかりやすさ	9 General 全般
+	+			+	+	+	++	++

* Write your report in Japanese or in English * Use this form as a cover sheet.
* Submit your reports by the seventh day after your lab.

Objectives

Measuring buoyant force on a body in water.

Hypothesis

An object completely immersed in a fluid experiences an upward buoyant force equal to the weight to fluid displaced by the object. (Archimedes' Principle)

Apparatus

Overflow can, Aluminum foil cup, String, Spring measure, Water, Weight, PET bottle, Glas Test tube

Experiment for the first part

1. Measuring the mass of an aluminum foil cup with a scale.
2. Put water into an overflow cup (Eureka can) to overflow
3. The above aluminum foil cap is placed under the mouth of the overflow cup. A weight is hang with string and sank completely in the water in the overflow cup. Overflowed water is collected in the aluminum foil cup.
4. Measuring the mass of the aluminum foil cup/water with a scale.
5. Measuring the mass (m) of the weight with a scale.
6. Calculation of the volume of the weight. (Density of water; ρ_w=1.000g/cm^3 =1000kg/m^3)
7. Calculation of the theoretical value (ρ_w Vg) of the buoyant force exerted on the weight in water
8. Calculation of the density of the weight
9. Zero adjustment of a spring scale
10. Put water into an overflow cup (Eureka can)
11. The weight is hang with string, and the mass is measured with the spring scale (The weight is in air)
12. The weight is hang with string, and the elastic force exerted on the weight is measured with the spring scale (The weight is in air)
13. The weight is hang with string, sank completely in water in the overflow cup, and the elastic force exerted on the weight is measured with the spring scale. (The weight is in water)
14. Calculation of the observed value (ρ_w Vg) of the buoyant force exerted on the weight in water.

Experiment For the second lab

1. Measuring the mass of a test tube with a scale (m)
2. Calculation of the volume of solid glass of the tube (V_g) using the mass and the density of glass, $\rho_g = 2500 kg/m^3$.
3. Put water in a PET bottle up to the neck. Put water in the test tube to the about half height. Insert the test tube by upside down into the PET bottle. At this moment the test tube must be placed upward. If not, take the test tube out and try again.
4. Close a bottle stopper tightly. Push the body of the bottle tightly and observe how the test tube goes down. Read the volume of air inside the test tube (Va) when it is in the intermediate position of the bottle.
5. Discuss about the equilibrium between the buoyant force and gravity.

   Buoyancy --- By the volume of the solid glass + the volume of air

   $$Fb = (V_g + V_a)\,\rho_w g$$

   Gravity --- The mass of the test tube W=mg

Results

Volume of the weight V	[cm^3] [m^3]	32.1 cm^3 $32.1 \times 10^{-6}\ m^3$
Mass of the weight m	[g] [kg]	103.8 g 0.103 kg
The Buoyant force (Theoretical) $\rho_w Vg$	[N]	0.31 N
Density of the weight $\rho_m = m/V$	[g/cm^3] [kg/m^3]	3.23 g/cm^3 3230 kg/m^3

※mass of an aluminum foil cup was 0.9g

Mass of the weight m	[g] [kg]	100 g 0.10 kg
Elastic force F_1 (The weight is in air)	[N]	1.00 N
Elastic Force F_2 (The weight is in water)	[N]	0.70 N
Buoyant force (observed) $F_b=F_1-F_2$	[N]	0.30 N

For the second lab

Experimental 1	[g] [kg]	14.1 g 0.014 kg
Experimental 2	[cm^3] [m^3]	5.6 cm^3 5.6×10^{-6} m^3
Experimental 4	[cm^3] [m^3]	8.2 cm^3 8.2×10^{-6} m^3
Experimental 5	[N]	F_b=0.135N W=0.137N

Discussion

For the first lab, I calculated the error of theoretical buoyant force and observed buoyant force.
(0.31-0.3)/0.3*100=3

It means I had 3% error. (3%の差で一致した)

For the second lab, I calculated the error of the W which means mass*gravity and Fb which means observed buoyant force.
(0.137-0.135)/0.135*100=1.4

It means I had 1.4% error. (1.4%の差で一致した)

These errors are come from...
-We only could know the scale of one tenths from the spring measure, so we get wrong number.

(ばね測りでは少数第一位までしかNを測れなかったから)

-We read the number from the test tube which is in the water, so we get wrong number.

(水の中に試験官があったため)

Conclusion

-Archimedes' Principle, which tells us that an object completely immersed in a fluid experiences an upward buoyant force equal to the weight of fluid displaced by the object, was proved.

(アルキメデスの原理、流体中の物体は、その物体が押しのけている流体の重さと同じ大きさで上向きの浮力を受けるということは証明された)

My Impressions for this experiment

This is the first lab for me to do in the Honor's class, and Honor's class was much faster than Intermediate class, so it was difficult to know what I was doing. However, I researched in the internet and past lab report, and I understood a bit.

物理の上級クラスに来た初日から実験をすることになり、何をしているか最初はよくわかりませんでした。しかし、インターネットや過去の先輩方の実験レポートを見て、少しだけ何をしているかがわかりました。また、これによって、浮沈子という今までに見たことのあるおもちゃの仕組みや、人は沈むのに船なぜ浮くか等を理解できてよかったです。今後、今現在開いている単元の差を埋めて、次回の実験はしっかりと何をするか分かったうえでやってみたいと思います。

Reference

Lab Report by Mauro Niikura(2015)
Lab Report by Kana Kato(2015)
Wikipedia