Date of Lab 11/8/2017 Date of Submission 11/15/2017

Laboratory Report

Title Buoyancy

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Summary

Through using the Eureka can, the experiment was held to measure the buoyant force in water. At first, we used a string to measure Fb (buoyant force), and then, we used a spring scaler to measure Fb. In the next experiment, we learned the principle of Cartesian Diver by a plastic bottle filled with water, and a test tube with one-half of water. We observed the Fb when the test tube is in the middle of the plastic bottle.

・Meet a deadline ・Write logically ・Write clearly ・Write with your own words

Teacher's Comments

A good report with a beautiful table and clear discussion.

1	2	3	4	5	6	7	8	9
Due	Summary	Intro.	Method.	Results	Table/Fig.	Discussion	Clearness	General
+	+			+	+	++	+	++

* Use this form as a cover sheet.
* Submit your reports by the seventh day after your lab.

Physics
Lab Report #2-1
Mr. Tohei Moritani
Section.1
Yamato Okuda

Buoyancy

INTRODUCTION

A. Objective

Measuring buoyant force on a body in water.

B. Hypothesis

H_0: An object completely immersed in a fluid experiences an upward buoyant force equal to the weight of fluid displaced by the object. (Archimedes' Principle)

C. Preparation

1. Overflow can (Eureka can)
2. Aluminum foil cup
3. String
4. Spring measure
5. Water
6. Weight
7. Plastic bottle (Experiment 2)
8. Glass test tube (Experiment 2)

D. Formula

1. Density - $\rho = \frac{m}{V}$

   ρ (Rho/density)…[kg/m^{3}]

   m (mass)…[kg][g]

   v (volume)…[m^3][cm^3]

2. Gravity – W=mg

   W (gravity)…[N]

   g (gravitational acceleration rate)…[m/cm^2]
3. Density of water… $\rho_w = 1.000g/cm^3 = 1000kg/m^3$
4. Buoyant force…$F_b = \rho_w Vg$

E. How to do experiments

(Experiment 1)

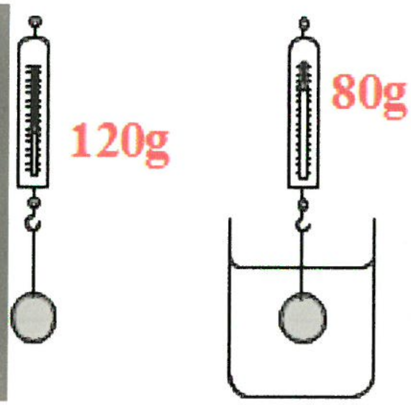
1. Measuring the mass of an aluminum foil cup with a scale.
2. Put water into a Eureka can.
3. The above aluminum foil cup is placed under the mouth of the Eureka can. The weight is hanged with string and sunk completely in the water in the Eureka can.
4. Measuring the mass of the aluminum foil cup/water with a scale.
5. Measuring the mass of the weight with a scale.
6. Calculate the volume of the weight.
7. Calculate the theoretical value of the buoyant force exerted on the weight in water.
8. Calculate the density of the weight.
9. Adjust a spring scale to zero.
10. Put water into a Eureka can.
11. The weight is hung with string, and the mass is measured with a spring scale. (The weight is in air.)
12. The weight is hung 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 hung with string, sunk completely in water in the Eureka can, and the elastic force exerted on the weight is measured with the spring scale. (The weight is in water.)
14. Calculate the observed value of the buoyant force exerted on the weight in water.

(Experiment 2; Cartesian Diver)

15. Measuring the mass of a test tube with a scale.
16. Calculate the volume of solid glass of the tube using the mass and the

density of glass.

17. Put water in a plastic 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 plastic bottle. At this moment the test tube must be placed upward. If not, take the test tube out and try again.
18. Close a bottle stopper tightly. Push the body of the bottle tightly and observe ho the test tube goes down. Read the volume of air inside the test tube (V_a) when it is in the intermediate position of the bottle.
19. Discuss about the equilibrium between the buoyant force and gravity.



↑ Eureka can ↑ Buoyancy's example ↑ Spring scale

RESULTS

Table of Results

PROCEDURE NO.	TYPES OF RESULTS	RESULTS
1	The mass of an aluminum foil cup	0.00090 kg (0.90 g)
4	The mass of the aluminum foil cup/water	0.0306 kg (30.6 g)
5	The mass of the weight	0.104 kg (104 g)

	6	The volume of the weight	ρ_w = m/v = 0.0306/1000 = 3.06×10^{-5} m^3 (30.6 cm^2)
	7	The theoretical value of the buoyant force	$\rho_w Vg$ = $1000 \times 3.06 \times 10^{-5} \times 9.80$ = 0.299 N
	8	The density of the weight	ρ_m = m/v = 104/ = 3399 kg/m^3 (3.399 g/cm^3)
	11	The mass of the weight in air	0.1 kg (100 g)
	12	The elastic force of the weight in air	1N
	13	The elastic force of the weight I water	0.70N
	14	The observed value of the buoyant force	$F_b = F_1 - F_2$ =1.0-070 = 0.30N
(Error of Experiment1)			$(0.29988-0.30) \times 100$ = 0.04%
	15	The mass of a test tube	0.0153 kg (15.3 g)
	16	The volume of solid glass of the tube	ρ_g = m/v 2500 = 0.0143/v v = 5.72×10^{-6} m^3 (5.72 cm^3)
	18	The volume of air inside the test tube (when the tube is in the middle of the bottle)	8.60×10^{-6} m^3 (8.60 cm^3)
	19	Buoyancy by the volume of the solid glass and the volume of	$F_b = (V_g - V_a) \rho_w g$ = $(5.72 \times 10^{-6} + 8.60 \times$

0.0753×9.8 = 0.1488

	air	10^{-6}) × 1000 × 9.80 = 0.1403 N
(Error of Experiment2)		(0.140336-0.14014) ÷ 0.14014 × 100 = (0.14%) ?

DISCUSSION

As you can see in the Table of Results, both experiments have only a few errors (0.04%Error for 1st Experiment and 0.14%Error for 2nd Experiment). I guess that when I put the test tube into the plastic bottle in Experiment 2, the error was created. Thus, I can accept the Hypothesis that is about the Archimedes Principle.

ACCEPT

H_0: An object completely immersed in a fluid experiences an upward buoyant force equal to the weight of fluid displaced by the object.

> *Je pense, donc je suis*
> *(I think, therefore I am.)*
>
> *- Rene Descartes*

(Name Cartesian Diver came from here.)

CONCLUSION

From these two experiments that I did, the weight in water is lighter than the weight in air because of the buoyant force. Also, I proved that the formula $F_b = W = mg$ is right.

OPINION

In this experiment, I could get very close result with the theoretical answer especially in the 1^{st} Experiment. Also, I was surprised at the 2^{nd} Experiment, which is the experiment of Cartesian Diver. I enjoyed observing the movement of the test tube in the plastic bottle filled with water.