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

Laboratory Report

Title Buoyancy

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Summary

We put two weights into water which is in overflow can and examined the relation between the buoyancy (t) force, volume of the weight, and mass. As a result we found that the buoyant force depends on the volume of the object and it can calculate by $F=\rho Vg$.

Also, we ? studied perced the relation between buoyant force and grabity (g) which are appling on an object in water. We found if the object is stopping the two forces are balancing.

in a cartesian diver,

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

Teacher's Comments

A good summary and report with reasonable 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.

3. Introduction

①Objective: Measuring buoyant force on a body in water.

②Past knowledge: ρ water=1.000g/cm^3=1000kg/m^3 ρ ice=917kg/m^3

ρ glass=2500kg/m^3 Density $\rho = m/V$ 〔kg/m^3〕

Buoyant force F 〔N〕 $=\rho Vg$ Gravity 〔N〕 $=mg$

③Hypothesis: An object completely immersed in a fluid experiences an upward buoyant force equal to the weight of fluid displaced by the object.

4. Experiment

① Apparatus

Overflow can, Aluminum foil cup, String, Spring measure, Water, Weight, PET bottle, Glass test tube

② Steps

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.
7) Calculation of the theoretical value ($\rho_w Vg$) of the buoyant force exerted on the weight in water.
8) Calculation of the density of the weight.

11) Zero adjustment of a spring scale.
12) Put water into an overflow cup (Eureka can).
13) The weight is hang with string, and the mass is measured with the spring scale. (the weight is in air)
14) The weight is hang with string, and the elastic force exerted on the weight with the spring scale. (the weight is in air)
15) The weight is hang with string, sank completely in water in the overflow cup, and elastic force exerted on the weight is measured the spring scale. (the weight is in water)
16) The calculation of the observed value ($\rho_w Vg$) of the buoyant force exerted on the weight in water.

Cartesian Diver

21) Measuring the mass of a test tube with a scale (m)
22) Calculation of the volume of solid glass of the (V_g) using the mass and the density of glass

23) 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.

24) 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 (V_a) when it is the intermediate position of the bottle.

25) Discuss about the equilibrium between the buoyant force and gravity.

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

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

Gravity ------ The mass of the test tube $W=mg$ cm^3

5. Results

Results of experiment from step1 to 8

Volume of the weight V	$[cm^3]$ $[m^3]$	21.2 2.12×10^{-5}
Mass of the weight m	[g] [kg]	64.3 0.0643
Buoyant force (theoritical) $\rho_w Vg$	[N]	0.208
Density of the weight $\rho_m=m/V$	$[g/cm^3]$ $[kg/m^3]$	3.03 3.03×10^3

Results of experiment from step 11 to 16

Mass of the weight m	[g] [kg]	60.0 0.0600
Elastic force F_1 (the weight is in air)	[N]	0.62
Elastic force F_2 (the weight is in water)	[N]	0.41
Buyant force (oserved) $F_b=F_1-F_2$	[N]	0.21

Error between theoretical buoyant force and observed buoyant force

$(0.2077-0.21)\div0.2077\times100$

$=-1.1073\cdots\cdots$

$\fallingdotseq -1.1$

$\therefore$1.1% of error

Results of experiment from step 21 to 25

Mass of a testtube	[g] [kg]	14.8 0.0148
Volume of solid glass of the tube	[cm^3] [m^3]	5.92 5.92×10^{-6}
Volume of air	[cm^3] [m^3]	8.6 8.6×10^{-6}
Buoyancy Force F_b Gravity F_g	[N]	F_b=0.142 F_g=0.1450

Error between buoyant force and gravity

$(0.14229-0.1450) \div 0.14229 \times 100$

$= -1.93267\cdots\cdots$

$\fallingdotseq -1.9$

$\therefore$1.9% of error

6. Discussion

~~According to~~ this experiment the error between theoretical buoyant force and observed buoyant force was only 1.1%. So that, $F = \rho Vg$ had been proved. In addition, ~~according to~~ this experiment the error between buoyant force and gravity was only 1.9%. Therefore, we will be able to say that the buoyant force and gravity applied to an object that is stationary in water are almost same.

7. conclusions

We can calculate buoyant force by $F = \rho Vg$.

The buoyant forces depend on Volumes of the objects.

Buoyant force and gravity which are applying to an object that is stationary in water are balancing.

8. Opinions

In this experiment, the error was only about 1%. So that I think our experiments succeed. I'm satisfied with that point. And I ~~had saw~~ cartesian diver before but I didn't know that buoyant force and gravity are related that happening so I surprised when I heard it. During we inserting the test tube by upside-down in the PET bottle, I found that the volume of air in the test tube were changing. I was moved when I saw it.

9. References

A report from Wakana Tanaka (2014)