

Physics 101

Lab 11: Archimedes' principle

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Purpose

The purpose of this eleventh lab is to obtain practical skills in performing an experiment to measure mass of objects in water by using a mechanical beam balance. The goal is to prove that the difference of weights in two mediums is the same as buoyant force caused by displacement of water by said mass.

Members

This lab group consisted of four members who worked together as a team to make the procedure accurate and fair for everyone.

1. Myat Thit Ko Ko (author)
2. Sarah Ruelas
3. Inigo Mikael Dela Vega
4. Hector Torres

Procedure

The lab consisted of the following steps and procedures.

- Measuring mass of the empty beaker.

Case I

- Measuring mass of object in air and water.
- Finding displacement of water by this mass in the wiped beaker.

Case II

- Measuring mass of object in air and water.
- Finding displacement of water by this mass in the wiped beaker.

Case III

- Measuring mass of object in air.
- Finding displacement of water by this mass in the wiped beaker.

Data & Analysis

Case I

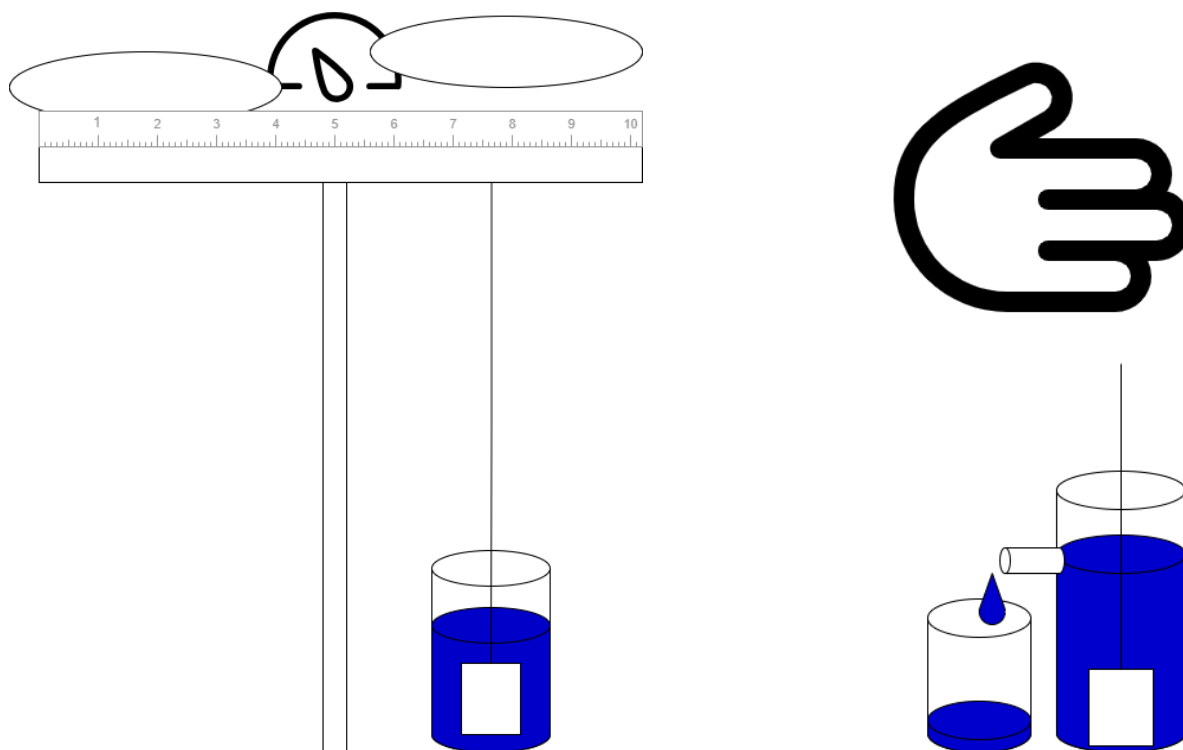
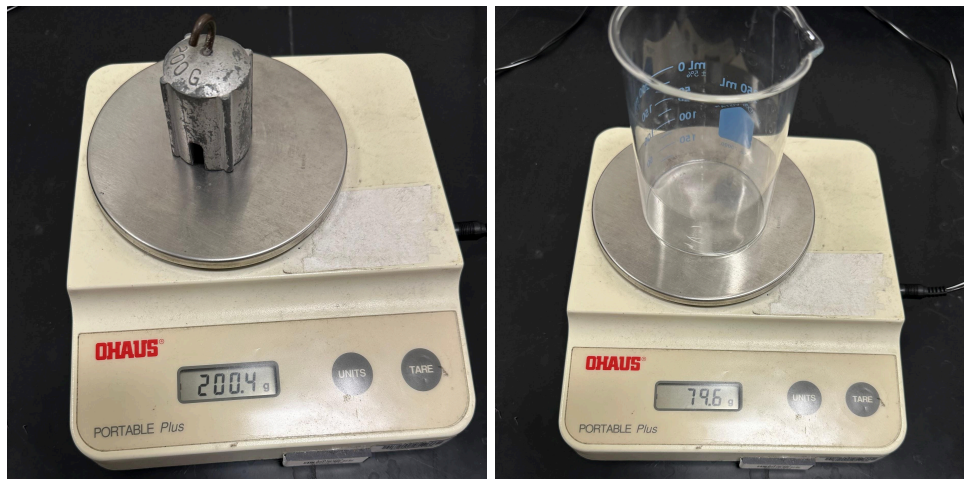


Illustration of case 1 set up



Mass of object (left) and mass of empty beaker (right)

Note that data in calculations can be slightly different from digital balance photos above due to standardizing all measurements with a mechanical beam balance to measure mass inside water.

$$mass_{air} = 0.20017 \text{ kg}$$

$$weight_{air} = 0.20017 \text{ kg} \times 9.8 \frac{m}{s^2} = 1.96 \text{ N (3.s.f)}$$

$$mass_{water} = 0.1677 \text{ kg}$$

$$weight_{water} = 0.1677 \text{ kg} \times 9.8 \frac{m}{s^2} = 1.64 \text{ N (3.s.f)}$$

$$Buoyant_{exp} = weight_{air} - weight_{water} = 1.96 \text{ N} - 1.64 \text{ N} = 0.318 \text{ N (3.s.f)}$$

$$beaker_{mass} = 0.0796 \text{ kg}$$

$$mass_{displaced} = 0.1128 \text{ kg} - 0.0796 \text{ kg} = 0.0332 \text{ kg}$$

$$Buoyant_{theo} = mass_{displaced} \times 9.8 \frac{m}{s^2} = 0.325 \text{ N (3.s.f)}$$

$$error \% = \frac{|Buoyant_{theo} - Buoyant_{exp}|}{\frac{Buoyant_{theo} + Buoyant_{exp}}{2}} \times 100 = \frac{|0.325 \text{ N} - 0.318 \text{ N}|}{\frac{0.325 \text{ N} + 0.318 \text{ N}}{2}} \times 100 = 2.18 \%$$

Case II

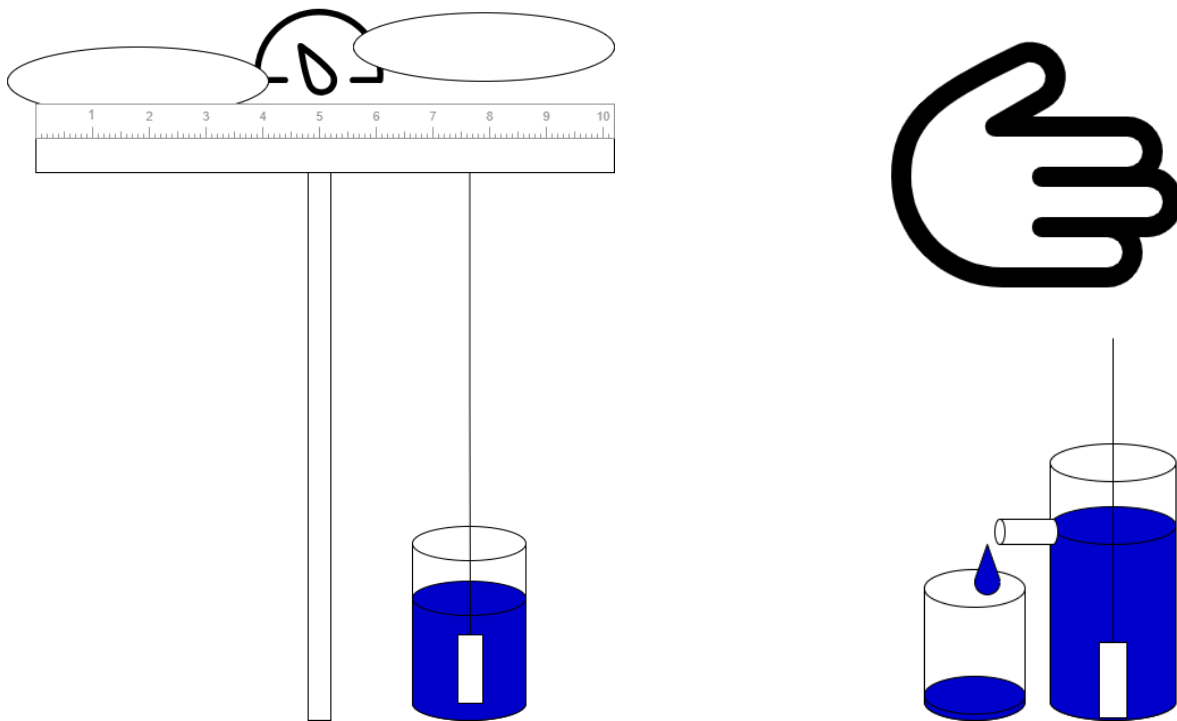
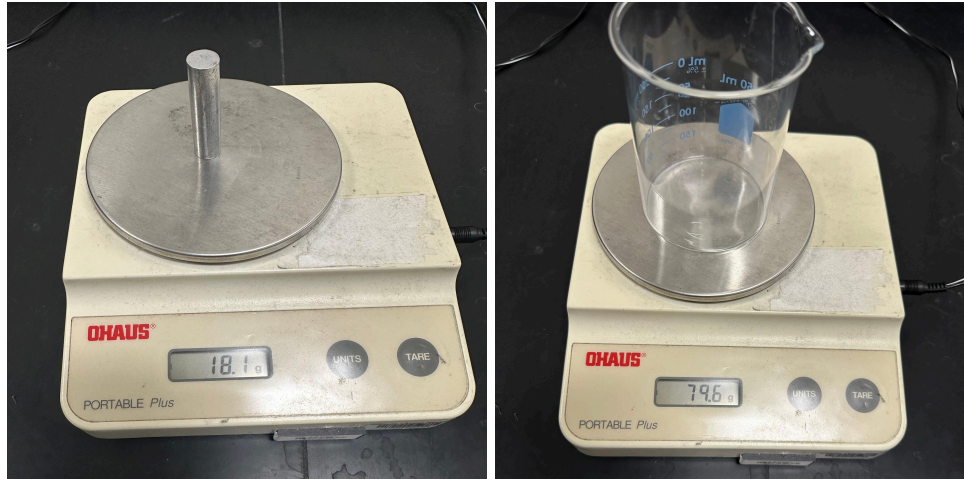


Illustration of case 2 set up



Mass of object (left) and mass of empty beaker (right)

Note that data in calculations can be slightly different from digital balance photos above due to standardizing all measurements with a mechanical beam balance to measure mass inside water.

$$mass_{air} = 0.0171 \text{ kg}$$

$$weight_{air} = 0.0171 \text{ kg} \times 9.8 \frac{\text{m}}{\text{s}^2} = 0.168 \text{ N (3.s.f)}$$

$$mass_{water} = 0.0109 \text{ kg}$$

$$weight_{water} = 0.0109 \text{ kg} \times 9.8 \frac{\text{m}}{\text{s}^2} = 0.107 \text{ N (3.s.f)}$$

$$Buoyant_{exp} = weight_{air} - weight_{water} = 0.168 \text{ N} - 0.107 \text{ N} = 0.061 \text{ N (3.s.f)}$$

$$beaker_{mass} = 0.0796 \text{ kg}$$

$$mass_{displaced} = 0.1434 \text{ kg} - 0.0796 \text{ kg} = 0.0638 \text{ kg}$$

$$Buoyant_{theo} = mass_{displaced} \times 9.8 \frac{\text{m}}{\text{s}^2} = 0.063 \text{ N (3.s.f)}$$

$$error \% = \frac{|Buoyant_{theo} - Buoyant_{exp}|}{\frac{Buoyant_{theo} + Buoyant_{exp}}{2}} \times 100 = \frac{|0.063 \text{ N} - 0.061 \text{ N}|}{\frac{0.063 \text{ N} + 0.061 \text{ N}}{2}} \times 100\% = 3.21 \%$$

Case III

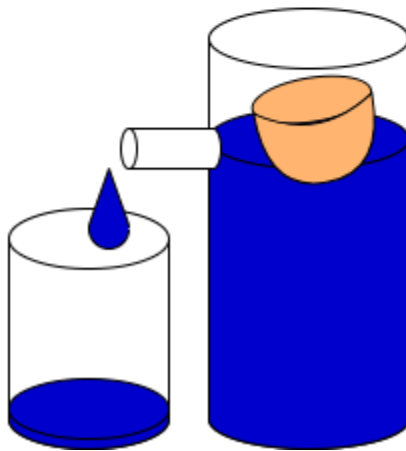
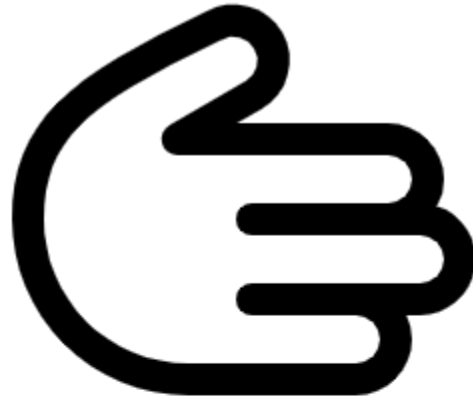
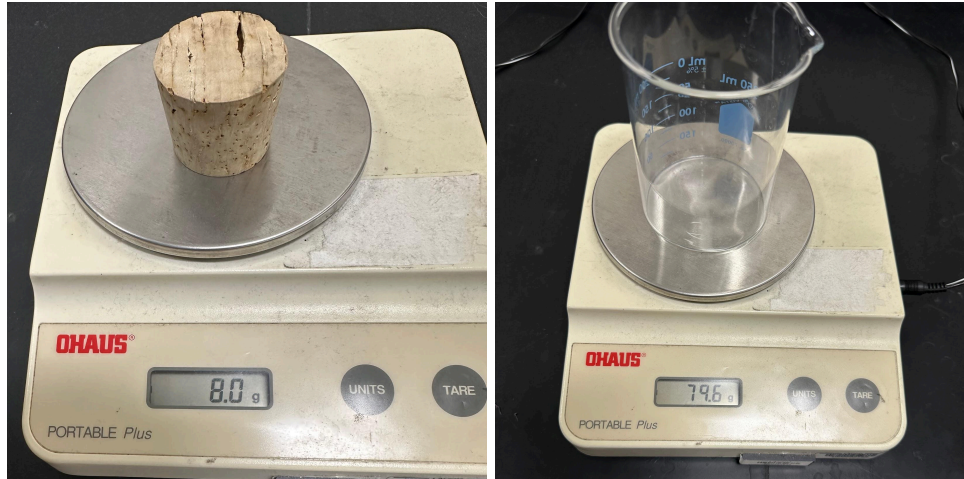


Illustration of case 3 set up



Mass of object (left) and mass of empty beaker (right)

Note that data in calculations can be slightly different from digital balance photos above due to standardizing all measurements with a mechanical beam balance to measure mass inside water.

$$mass_{air} = 0.00819 \text{ kg}$$

$$weight_{air} = 0.00819 \text{ kg} \times 9.8 \frac{\text{m}}{\text{s}^2} = 0.080 \text{ N (3.s.f)}$$

$$Buoyant_{exp} = weight_{air} = 0.080 \text{ N (3.s.f)}$$

$$beaker_{mass} = 0.0796 \text{ kg}$$

$$mass_{displaced} = 0.08771 \text{ kg} - 0.0796 \text{ kg} = 0.00811 \text{ kg}$$

$$Buoyant_{theo} = mass_{displaced} \times 9.8 \frac{\text{m}}{\text{s}^2} = 0.079 \text{ N (3.s.f)}$$

$$error \% = \frac{|Buoyant_{theo} - Buoyant_{exp}|}{\frac{Buoyant_{theo} + Buoyant_{exp}}{2}} \times 100 = \frac{|0.079 \text{ N} - 0.080 \text{ N}|}{\frac{0.079 \text{ N} + 0.080 \text{ N}}{2}} \times 100\% = 1.26 \%$$

Analysis

All error percentages were below 5%. Low error percentage is likely due to accurate measurement of mass values in water and of displaced water.

Conclusion

Since error percentages were found to be less than 10%, this lab is deemed satisfactory. This lab was rather refreshing because of the fluid involved in the experiment.

Summary

Experiment Title: Archimedes' principle

Student's name: Myat Thit Ko Ko

Date: 04/30/2026

Purpose: To compare the values of buoyant force results in two methods

Procedure: Measuring data, wiping beakers, equalizing water levels.

Data: $1 \times 3 = 3$ sets total

Analysis: Error percentages were 2.18 %, 3.21%, and 1.26% respectively.

Conclusion: Satisfactory