Pre-Lab Exercises Using Physlets and the World Wide Web

Steve Mellema

Gustavus Adolphus College

St. Peter, MN 56082

(mellema@gustavus.edu)

Target Course: Classical Physics II

- 2nd-Semester Freshman Physics Majors
- Calculus based
- 5 hours lecture / 2 hours lab per week
- Course Content:
  - Fluids
  - Oscillations, Waves and Sound
  - Thermodynamics
  - Optics

Lab Course Details

- Students purchase a lab manual containing all experiment descriptions
- Read experiment before coming to lab
- Carry out experiment (2 hours)
- Maintain a complete lab notebook
- Analyze results in the lab notebook and hand it in at the next week's lab period

Motivation

- Better prepare the students for lab (Improve student understanding of both experimental procedures and physics concepts involved)

- Better prepare the instructor for lab (JITT)

Innovation: Pre-Lab Exercises

- Due 15 minutes before lab
- Web-based (WebAssign® NT), individual assignments (including multiple-choice, numerical and essay answers)
- Partially a "reading quiz" for lab manual
- Incorporate Physlet animations to provide a "virtual experiment"

Example: Archimedes' Principle

Archimedes' Principle

85 grams

55 grams
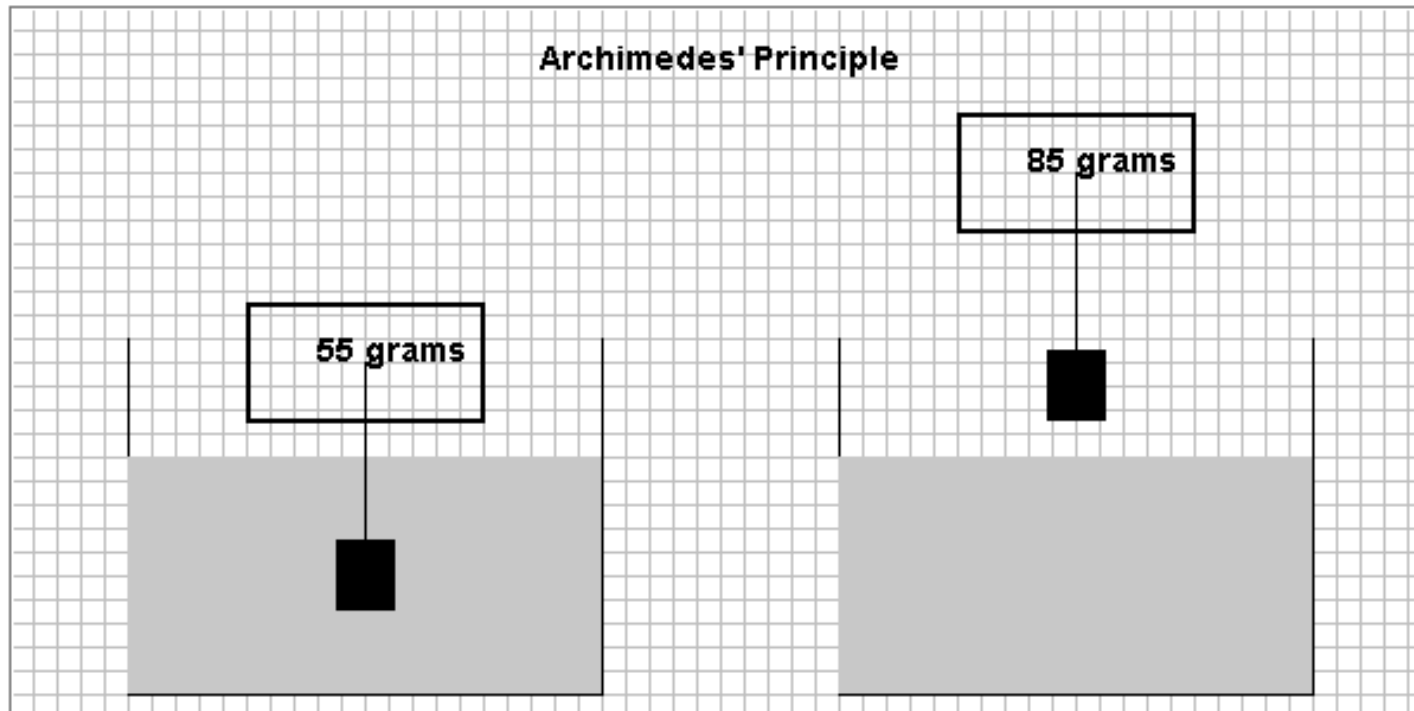
In this simulation. an object, tied to a string, is immersed in water. The other end of the string is attached to a digital balance with a readout in grams. The object is then removed from the water and weighed again. From the readings on the balance, determine the density of the object.
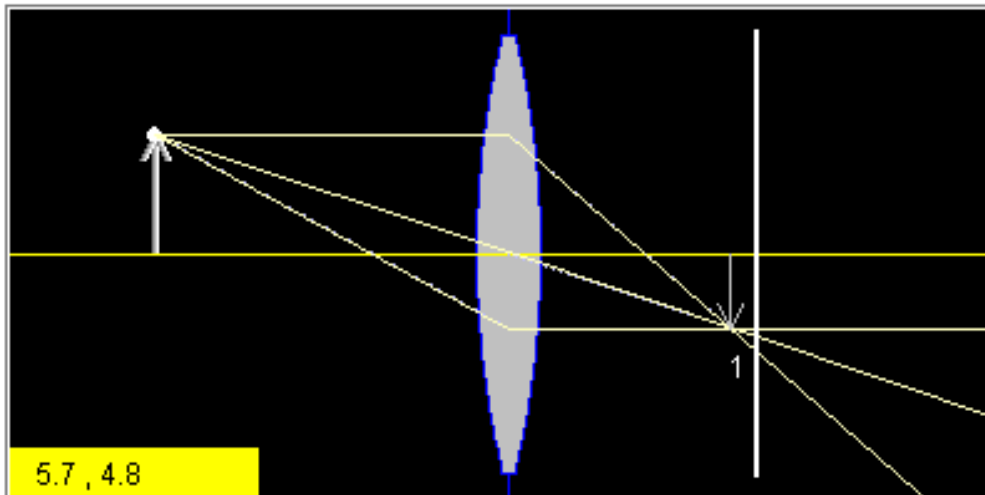
X [2.83] gm/cm^3

Example: Standing Waves
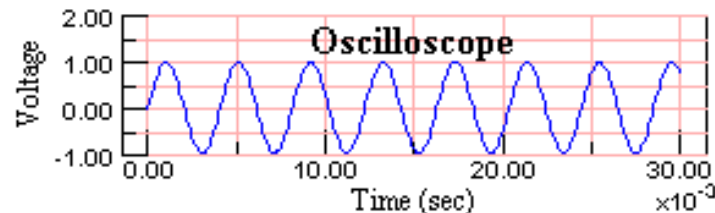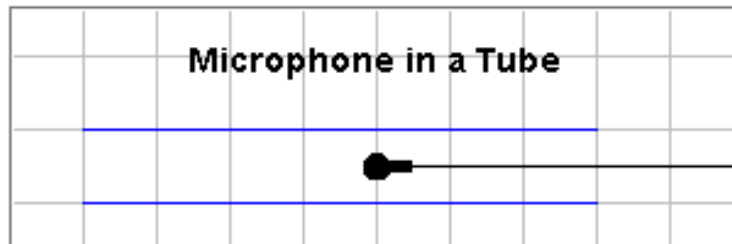
In this simulation, the grid separation is 10 cm per square. A wave is in resonance inside the tube. Move the microphone around inside the tube and determine the wavelength of the standing wave.

[   ] X [1.4] m

How would you use the oscilloscope to determine the frequency of the standing wave?

[   ]

Key: Essay

Example: Lenses

5.7 , 4.8

In the simulation, a converging lens is fixed on the optical bench at x = 20 cm. An object is placed to the left of the lens. Drag the object to make a real image appear on the card that is located at x = 30 cm. What is the focal length of the lens shown?

X [5.5]cm

Outcomes

- Anecdotal
  - Best-prepared students in four years
  - Best lab notebooks in four years
- Written feedback from students
  - Pre-labs too difficult
  - Pre-lab grading too harsh

Modifications for Next Year

- Separate "pre" and "post"-lab quizzes
    - Pre-lab focus on concepts and data taking
    - Post-lab focus on data analysis

- More short essay questions make for better JITT

Acknowledgements

- Physlets© by Wolfgang Christian, Davidson College

- WebAssign© NT by Larry Martin, North Park University