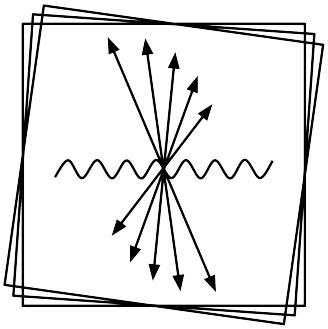
International Physics Competition

The Education Program & Talent Search in Physics

Edition of 2026



Qualification Round

Problem A: Size of Moon's Shadow (5 Points)

On 12 August 2026, a total solar eclipse was visible from parts of Spain. In the town of Chiloeches, the full eclipse began at 20:31:31 and ended at 20:32:32 local time. During totality, the Moon's shadow moved across the ground at about 0.75 km/s.

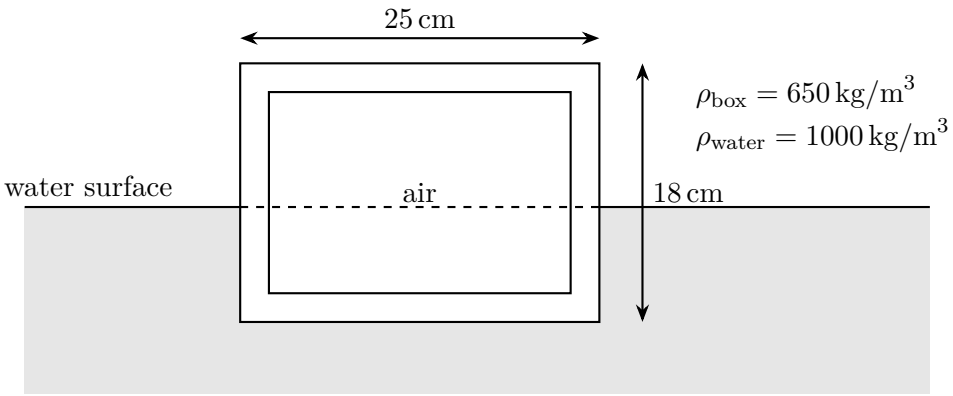
Question: How wide was the Moon's shadow along its path across the ground at Chiloeches during the total eclipse?

Problem B: Floating Box (5 Points)

A small plastic storage box is placed in a calm freshwater pond after a picnic. The box is a uniform rectangular solid made of a material with density 650 kg/m^3 and has outside dimensions 18 cm high, 12 cm wide, and 25 cm long. Its walls are of uniform thickness, and the box is hollow and empty inside, so it contains air.

When it is put on the water, it floats quietly with its long face horizontal. Assume the wall thickness is 1.0 cm and the bottom has the same thickness as the side walls.

Task: How high above the water surface is the top of the box? Take the density of water to be 1000 kg/m^3.



Problem C: Echo Measure

A student stands in front of a large cliff and claps. The student hears an echo 1.24 s after the clap. The air temperature is 20°C. For sound in air, use the approximate relation

$$v = \left(331 + 0.60\,\frac{T}{^\circ\mathrm{C}}\right)\frac{\mathrm{m}}{\mathrm{s}}$$

where v is the speed of sound and T is the temperature in °C. The sound travels to the cliff and back.

(a) Determine the speed of sound in the air.

(b) How far away is the cliff?

(c) The student repeats the experiment on a warmer day when the temperature is 32°C. How much earlier does the echo return?

Problem D: Garden Pipe Split (5 Points)

On a hot afternoon, a student is tuning a backyard irrigation system. A garden hose feeds a splitter that supplies two branches that end in sprinkler heads open to the air. The pressure at the splitter is 180 kPa gauge. The two branches are identical except that one branch is fitted with a valve. The sprinkler heads discharge to open air, so their gauge pressure is approximately zero. Ignore losses in the splitter itself and assume steady flow.

The flow in a branch is modelled by

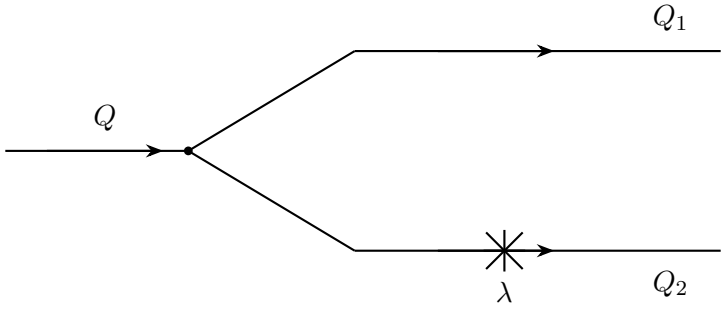
$$\Delta p = kLv^2,$$

where Δp is the pressure drop along that branch, v is the average flow speed in the branch, L is the branch length, and k is a coefficient. For the valve branch, the resistance coefficient becomes $k_2(\lambda) = k_1(1 + 3\lambda^2)$, where k_1 is the coefficient of the unchanged branch and $0 \le \lambda \le 1$ is the opening fraction.

Show that the total flow rate through the splitter is

$$Q_{\mathrm{tot}}(\lambda) = Q_1\left(1 + \frac{1}{\sqrt{1 + 3\lambda^2}}\right),$$

where Q_1 is the flow rate in the unchanged branch.



Problem E: Lightning Rod

Tall buildings are often equipped with sharp metal rods on their roofs. During a thunderstorm, these rods are connected to the ground by a thick conductor. Observers notice that lightning tends to strike the building protection system rather than random parts of the structure.

Task: Explain why a lightning rod helps protect a building, using electric fields, charge separation, and discharge.

Participation Instructions

- ✓ Write your solutions by hand on sheets of paper or type them on a computer.
- ✓ **Submit your solutions online by the deadline shown on the website.** Website: `https://iphyc.org/submission`
- ✓ You do not need to include the problem statements in your solution document.
- ✓ Show your work to receive full marks. Maximum points: **25**.
- ✓ Clearly label each problem and highlight your final answers.
- ✓ You need to score at least **15/17/20 points** as Junior/Youth/Senior to qualify for the Semi-Final Round. See `https://iphyc.org/age-groups` for details.
- ✓ If you have questions, reach out to us at: `info@iphyc.org`

Good Luck!