

PHYSICS OLYMPIAD 2014

University of Minnesota Duluth

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THEORETICAL PART

Problem 1

A chunk of Swiss cheese $10 \times 10 \times 10$ cm has mass 650 g. When you cut a small piece off this chunk, the density of the small piece turns out to be $\rho = 1100$ kg/m³. This is because the big chunk has holes inside it, which are filled with gas and are not visible on the outside. What is the mass of the gas inside the cheese if the density of the gas is known to be $\rho_g = 1.29$ kg/m³?

Problem 2

A road-washing vehicle is moving along a circular track that is $L = 400$ m long. The water sprayed on the road dries up in $\tau = 5$ sec. After each quarter-circle, the water flow is increased so that the drying up time τ increases by one second. Plot the length of the wet portion of the road as a function of time. The speed of the vehicle is $V = 10$ m/s.

Problem 3

Alice and Bob are playing at an airport on a moving walkway, which moves at the speed of 1 m/s. They start at the either end of the walkway and at the same moment of time start running towards each other. Their speeds relative to the walkway are always 2 m/s. When they meet, they each turn around and run to the end of the walkway again, then immediately run towards each other again, and keep doing this over and over. What distances relative to the ground will Alice and Bob each travel in 800 sec? The length of the moving walkway is $l = 100$ m.

EXPERIMENTAL PART

Task 1. The strength of string

Task: Measure the force that is needed to exceed the breaking strength of a string.

Equipment: The string, a small weight of known mass, graph paper, lab stand.

Pencils or pens can be used only for writing.

Writing your lab report:

- Describe briefly the procedure that you used to perform measurements.
- State you data (any numbers that you obtain in your measurements).
- Show calculations and state your final result.

Task 2. The density of modeling clay

Task: Find the density of a piece of modeling clay.

Equipment: Modeling clay, transparent beaker, a small jar, graph paper, thread, water.

Writing your lab report:

- Describe briefly the procedure that you used to perform measurements.
- State you data (any numbers that you obtain in your measurements).
- Show calculations and state your final result.