

# **Physics Olympiad Final Round**

online, 6 June 2020

## Experiment

Duration Total Authorized material

# 1 problem

: 60 minutes 18 points Simple calculator : Writing and drawing material One A4 double-sided handwritten page of notes Computer to access the exam and contact the supervisor Phone for contact with the supervisor Printer to print the exam

Experiment material (see problem)

# Good luck!

#### Supported by :

Staatssekretariat f
ür Bildung, Forschung und Innovation DECTRIS Dectris AG Deutschschweizerische Physikkommission VSMP / DPK EMPA - Materials Science & Technology Ecole Polytechnique Fédérale de Lausanne **ETH** ETH Zurich Department of Physics Fondation Claude & Giuliana ERNST GÖHNER STIFTUNG Ernst Göhner Stiftung, Zug HASLERSTIFTUNG Hasler Stiftung, Bern A Methodam Metrohm Stiftung, Herisau - Neue Kantonsschule Aarau **UNIVARIATIS NOVARTIS** Société Valaisanne de Physique SATW Swiss Academy of Engineering Sciences SATW sc|nat <sup>a</sup> Swiss Academy of Sciences spis> Swiss Physical Society 🗉 Università della Svizzera italiana  $u^{\flat}$  Universität Bern FB Physik/Astronomie Universität Universität Zürich FB Physik Mathematik

## Problem 1 : Syringe (18 points)

We would like to do some simple experiments with a syringe. You can find all the material for the experiment in the envelope that we sent to you. You will need the following material :

- 1 syringe
- 1 plastic block
- 4 sheets of graph paper
- 1 chewing gum

Note : You must ONLY use the 4 items listed above to make measurements for this experiment, so no pencil, no set-square or ruler, nothing else. Also none of the other items in the envelope. For the documentation of the tasks on paper you may of course use writing utensils, set-square, etc.

To solve the problems you get the following information :

- Inside radius of syringe : r = 7.4 mm
- If you need other quantities, make a reasonable assumption and indicate it as such.

### Part A. Friction (9 points)<sup>1</sup>

#### i. (9 pts) Measure the static friction force of the piston in the syringe. Document your solution as follows :

- 1. Describe and do a sketch of your setup and your approach for the measurements.
- 2. Calculate the static friction force (the calculation method must be documented).
- 3. Do an error calculation and use it to justify your approach.

### Part B. Mass (9 points)

#### i. (9 pts) Measure the mass ratio of the piston and the cylinder of the syringe. Document your solution as follows :

- 1. Describe and do a sketch of your setup and your approach for the measurements.
- 2. Display your data points graphically and calculate the mass ratio (the method of your solution must be documented).

<sup>1.</sup> Idea : Estonian Physics Olympiad