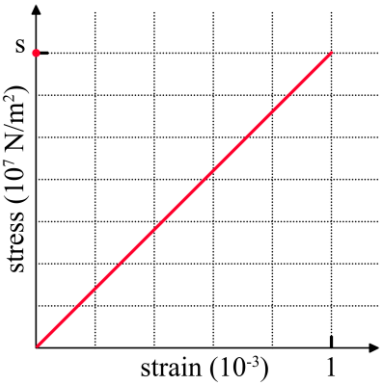
EXPERIMENTAL PHYSICS 1

EXERCISE 8
Date of Issue 6 of December 2022

Lecturer: Prof. Käs
Tutor: Dimitrij Tschodu, MSc
E-Mail: dimitrijtschodu@googlemail.com

Problem 1: Stress and Strain **1+3 Points**

The figure shows the stress versus strain plot for a wire that is stretched by a machine pulling in opposite directions at the two ends of the wire. The scale of the stress axis is set by $s = 7$, in units of $10^7\ \mathrm{N/m^2}$. The wire has an initial length of $l = 0.3\ \mathrm{m}$ and an initial cross-sectional area of $A = 6 \cdot 10^{-6}\mathrm{m}^2$.



a. Calculate Young's modulus.
b. How much work does the force from the machine do on the wire to produce a strain of $1 \cdot 10^{-3} = 0.1\ \%$?

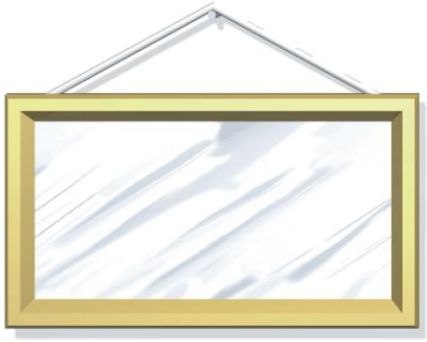
Problem 2: Elasticity of Wire **$1 + 1 + 1 + 2$ Points**

A wire has an original length of $l = 12\ \mathrm{m}$. It is firmly clamped at one end and then set under tension along its length with a force of $205\ \mathrm{N}$, whereby experiencing a length change of $4.3\ \mathrm{mm}$. The wire has a Young's modulus of $1.98 \cdot 10^{11}\ \mathrm{Pa}$ and a shear modulus of $7.4 \cdot 10^{10}\ \mathrm{Pa}$.

a. Determine the original diameter of the wire.
b. What is the Poisson Ratio of this material?
c. How much does the diameter of the wire decrease?
d. By how much does the density of the wire change?

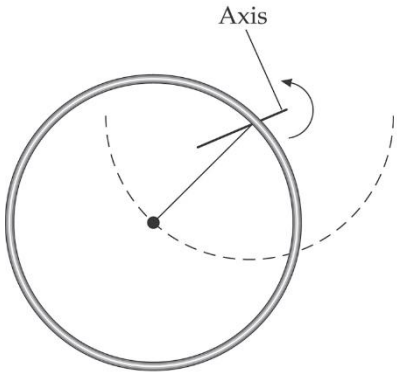
Problem 3: Stress and strain **7 Points**

A large mirror is hung from a nail as shown in the Figure below. The supporting steel wire has a diameter of 0.20 mm and an unstretched length of 1.7 m. The distance between the points of support at the top of the mirror's frame is 1.5 m. The mass of the mirror is 2.4 kg. How much will the distance between the nail and the mirror increase due to the stretching of the wire as the mirror is hung?



Problem 4: Angular speed of a pivoted ring **3 + 3 Points**

A uniform 1,5-m-diameter ring is pivoted at a point on its perimeter so that it is free to rotate about a horizontal axis that is perpendicular to the plane of the ring. The ring is released with the center of the ring at the same height as the axis (see figure, right).



a. If the ring was released from rest, what was its maximum angular speed?
b. What minimum angular speed must it be given at release if it is to rotate a full 360° ?

Tasks to think about: