Friction

(determination of static sliding friction factor)

Workshop 1.

Accept the friction challenge?

(static sliding friction)

Picture 1: Two intertwinted book

Accept the challenge of friction and at the end of this workshop try to separate two books that are intertwined as in the picture 1. (without glue). Enter the hall of fame and win an award!

But before that, let's learn something about friction and perform a few physics experiments.

Tasks:

1. Conduct an experiment for static sliding friction on an inclined tribometer and calculate the static sliding friction factor for the given bodies (cubes or quadar). Perform the same experiment at least several times for each body.
2. Compile the tables for all the experiments of this workshop according to the template at the end of the text, and write the measurement results in the tables. Calculate the arithmetic mean of each set of measurements (mean value of measurements).
3. Answer the questions.
4. Intertwine the given two books by putting the page of the other book on the page of one book, as in picture 1. Try to separate them by pulling. There is a "Friction Challenge" in the corridor, so go out and try it.

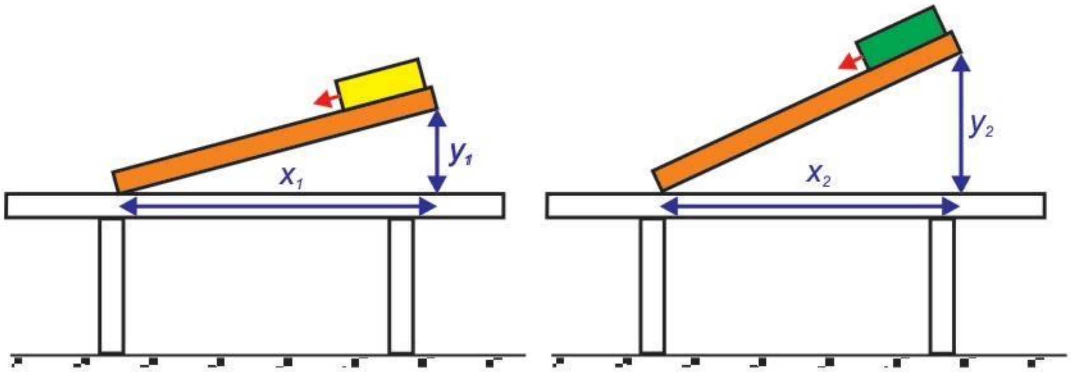
Accessories:

Tribometer with slope, „mufa“, tripod rod, tripod base, friction bodies (wood, sandpaper, rubber,...), tape measure, plumbline, two books with reinforcements, pencil, calculator.

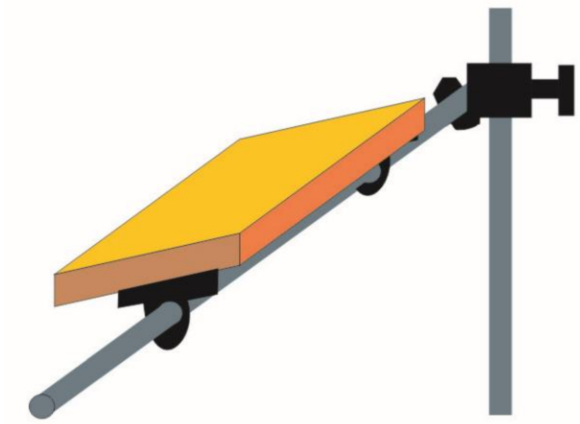
Experiment to determine the static friction factor:

Static friction is usually measured in the laboratory on a slope. In our case, a slope is nothing more than a plank placed diagonally on which we can push or lower a body. A slope is a plane inclined at a sharp angle to the horizontal plane. It enables the load to be lifted to a certain height by a longer path, but with less force than would be required for vertical lifting.
For example, along a steep mountain, the road winds so that cars can overcome the ascent by a longer route and with less force. Historically, along with a hydraulic press, a pulley and a lever, it is considered a simple machine.
We call that board that makes up our slope a tribometer, if we study friction on it, and we can see it on picture 2. You can derive the formula for calculating the coefficient of the static sliding friction factor using simple ratios of the acting forces (at the end of this text), but we will give you ready expression for the calculation.

Picture 2. shows the tribometer, set as a slope, and in the first case the slope (angle) of the slope is smaller than in the second case. Handling the tribometer is very simple.



Picture 2: Slope tribometer



The angle of the slope can be changed using the rods of the tripod with „mufa“ (joint of two rods) which is hinged to the slope, and the detail of this connection is shown at Picture 3.
The experiment is performed by placing the body on the side of the slope that can be lifted and gently lifting that side of the slope until the body begins to slide down the slope. Then you tighten the sleeve and measure the x and y lengths with a measuring tape according to Picture 2.

Picture 3: Slope detail to change the slope

Use a plumbline to determine the position of x at the raised end. From this data, you can calculate the static slip factor according to the expression:

$$\mu = \frac{y}{x}$$

As we said earlier, the calculation expression is already derived. You should perform the experiment with one body several times before you start performing the experiment for the next body. Try to deduce from the formula, does the coefficient of friction have a measurement unit? Enter all data to the given tables.

Table 1: Result of static sliding friction factor measurements

Body 1. ______________________			
measurements	x	y	μ
unit	m	m	?
1.			
2.			

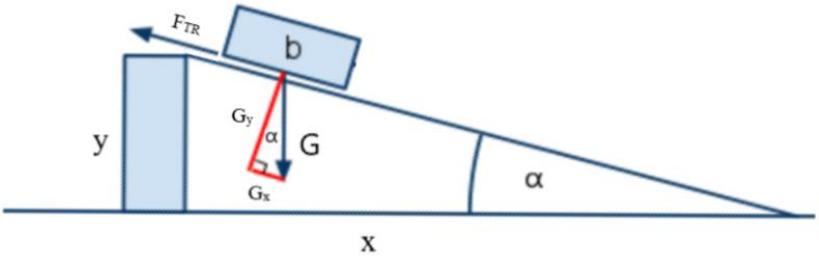
Questions:

1. For which body (for which types of contact surfaces) is the static coefficient of friction the highest?

2. Compare your values for the same bodies with the group that measured the dynamic sliding coefficient. Which group has higher values?

3. Were you able to separate the intertwined books? What do you think is the cause of this?

Derivation of expression:



$$F_{TR} = \eta \cdot N = \eta \cdot G_y \ (1)$$

According to Newton's first law:

$$G_x - F_{TR} = 0 \ \rightarrow \ F_{TR} = G_x \ (2)$$

If we assume that (1)=(2), it follows:

$$\eta \cdot G_y = G_x \ \rightarrow \ \eta = \frac{G_x}{G_y}.$$

From the similarity of the triangles, we can conclude how it is:

$$\eta = \frac{G_x}{G_y} = \frac{y}{x}.$$