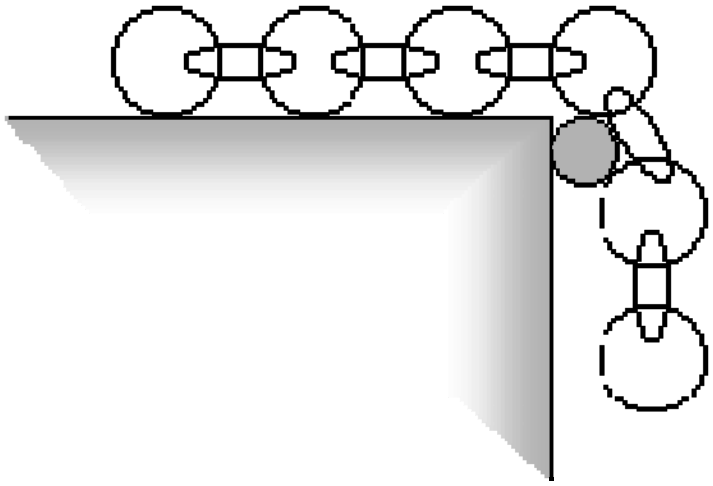
Chain friction

Aim: Determining the coefficient of static friction.

Subjects: 1K20 (Friction)

Diagram:



Equipment:

- Table.
- Chain, (~ 1.20 m).
- Bar.

Safety:

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Chain friction

Presentation: The chain is laid out straight on a table. One end is slowly pulled over the edge until the chain just does not slip. The coefficient of friction (μ_s) between the table top and chain is then $\mu_s = \frac{l_0}{l - l_0}$, where l is the total length of the chain and l_0 the length of the overhanging portion.

Explanation: No slipping means that forces are in equilibrium: $F_1 = F_2$ (see Figure 1).

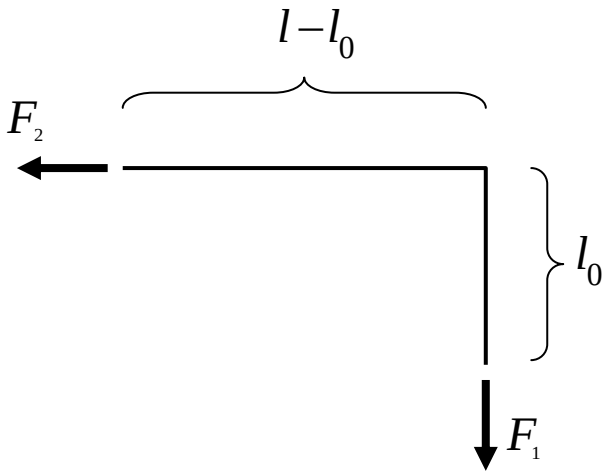

Figure 1

The mass of the part of the chain hanging over the edge equals: $m_1 = \frac{l_0}{l} m$. This makes: l_0 $F_1 = \frac{l_0}{l} mg$.

The mass of the part of the chain still on the table equals: $m_2 = \frac{l - l_0}{l} m$. The normal force of that part of the chain equals: $F_N = \frac{l - l_0}{l} mg$. $F_2 = \mu_s F_N = \mu_s \frac{l - l_0}{l} mg$.

$F_1 = F_2$ now yields: $\frac{l_0}{l} mg = \mu_s \frac{l - l_0}{l} mg$, and so: $\mu_s = \frac{l_0}{l - l_0}$.

Remarks:

- It is advisable to make the corner of the table a low friction surface, e.g. rounding that corner. You can of course also make a special surface for your chain (acrylic plate, bended at one end). We used a stand bar as a low friction surface for the corner of the table.
- Instead of a chain, the demonstration can also be done with a piece of soft cloth or rope.

Sources:

- Meiners, Harry F., Physics demonstration experiments, part I, pag. 152