### Summary
In any elastic body, extension and tension are proportional to one another. This relationship was discovered by Robert Hooke and is frequently demonstrated using a coil spring with weights suspended from it. The change in the length of the spring is proportional to the force of gravity \( F \) on the suspended weight.

For the sake of greater precision, it is first necessary to determine the initial tension which may be exhibited by the spring as the result of its manufacturing process. It is necessary to compensate for this by adding a weight which applies a force \( F_1 \), causing the spring to extend from its natural length without any weight \( s_0 \) to a length \( s_1 \). For weights in excess of \( F_1 \), Hooke’s law applies in the following form:

\[
F - F_1 = k (s - s_0)
\]

This is so as long as the length of the spring \( s \) does not exceed a certain critical length.

The spring constant \( k \) depends on the material and the geometric dimensions of the spring. For a cylindrical coil spring with \( n \) turns of constant diameter \( D \), the following is true:

\[
k = G \left( \frac{d}{D} \right)^4 \frac{1}{n} \frac{1}{8}
\]

\( d \): Diameter of wire coils of spring

The shear modulus \( G \) for the steel wire forming the spring’s coils is 81.5 GPa.

In this experiment, five different coil springs will be measured. Thanks to a suitable choice of wire diameter and coil diameter, the spring constants all span one order of magnitude. In each case, the validity of Hooke’s law will be demonstrated for forces in excess of the initial tension.

### Evaluation
The force of gravity \( F \) can be determined to sufficient precision from the mass \( m \) of the weight as follows:

\[
F = m \cdot 10 \, \text{m/s}^2
\]