Worksheet: Solids

Name: ____ Group name: _____________________

In this lab you will study solids.

1. Hang a piece of thread about 15 cm long from the ring stand with loops tied at both ends. Then hang a small mass (50 or 100 g) from the thread. Measure the length of the string and consider this to be **zero** displacement.
   - Next add masses in 100 or 200 g increments up to 700-800 g and measure the strain (elongation of the string). Convert the masses into forces (remember the springs lab) and graph the force F over the strain.
   - Determine the elastic constant (*k* from Hooke's law) for the thread.

   k = ________________________ _______

2. Using a spring scale, slowly increase the force to the string in small increments until the string ruptures ("destructive testing"). The force needed to break the string is called **ultimate tensile strength**.
   - Ultimate tensile strength: F_{UT} = ___________________ _____
   - Estimate the error of your measurement: ____________ ____

3. Next make a doubled thread and hang it from the ring stand. How do you expect the spring constant to change? (Recall the spring experiments)
   - Doubling the thread _________________________ the spring constant *k*.
   - By what factor does the displacement change for 500 g?

4. Place a ring and s-hook on the wood "beam" and lay it between two wood blocks so that it is flat. Hang loads of 100, 200 and 400 g from the beam and measure the deflection *x* for the and the force applied:
   - m = 100 g: F = _______________ ____ x = __________________ _____
   - m = 200 g: F = _______________ ____ x = __________________ _____
   - m = 400 g: F = _______________ ____ x = __________________ _____

5. Draw the observed shape and explain what part of the beam is in compression, tension, shear and torsion (not all may apply).

6. Turn the beam sideways so that it fits into the slots in the end blocks. Now repeat the deflection measurement for the 400 g mass. Be careful not to let it twist.

- m = 400 g: F = ________________ _____ x = ____________________ ______
- Why does the beam deflect so much less?

7. Repeat the deflection experiment for 100 g mass using a flat brass beam and a flat stainless beam of the same thickness (there are two of each for the whole class set up for you.) Which material is stronger (resists deflection more) due to the metal structure?

8. Repeat the deflection experiment for the 100 g mass using the brass profiles (box and C-profile). Note how less material can produce similar results when clever shapes are used.