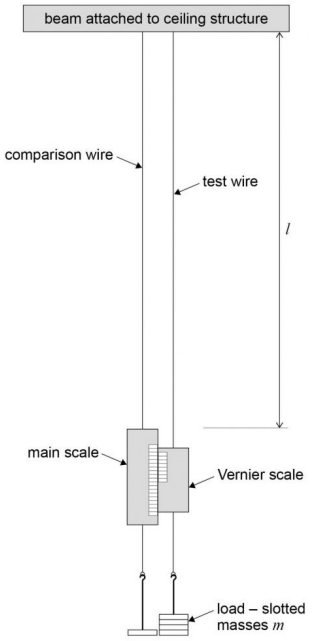
AQA Physics A-level

Required Practical 4

Determination of the Young modulus by a simple method

- Equipment:
  - 2 1.5m long steel wires
  - Main scale and vernier scale
  - 1kg masses and 2 1kg holders
  - Micrometer
  - Metre ruler



- Method:
  - Set up the apparatus as shown in the diagram.
  - Measure the initial length l of the test wire with the metre ruler.
  - Add a 1kg mass holder to both wires so they are taut and record the initial scale reading.
  - Add an additional 1kg mass to the test wire and record the new scale reading. Find its extension e by subtracting the initial scale reading from this and record it.
  - Add another 1kg mass and repeat this, adding 1kg each time up to around 8kg.
  - Repeat the experiment twice more and find and record the mean e for each m, where m is the mass of the 1kg masses on the test wire's holder.
  - Measure the diameter d of the test wire at various points along it using the micrometer and find and record the mean diameter.
- Graphs and calculations:
  - Calculate the cross-sectional area A of the wire by $A = \frac{\pi d^2}{4}$
  - Find the force F on the test wire for each m by calculating mg and tabulate this.
  - Plot a graph of F against e and draw a line of best fit. The young modulus E will be l multiplied by the gradient divided by A.
  - $E = \frac{stress}{strain} = \frac{F/A}{e/l} = \frac{Fl}{Ae} = \frac{lG}{A}$ where G is the gradient.
- Safety:
  - The wire will be stretched very tightly and could break and injure eyes, so safety goggles must be worn.
  - If the wire breaks, the masses could fall and cause injuries, so a sand tray should be placed beneath them to catch them.
- Improvements and notes:
  - The comparison wire compensates for sagging of the beam and thermal expansion effects and provides a reference point against which to measure the extension.
  - The original length l of the test wire should be as long as possible to reduce uncertainty in its measurement.