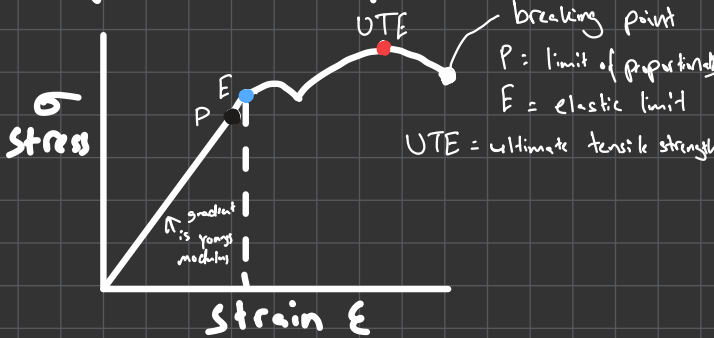


Ductile material - a material which can easily be drawn into wires

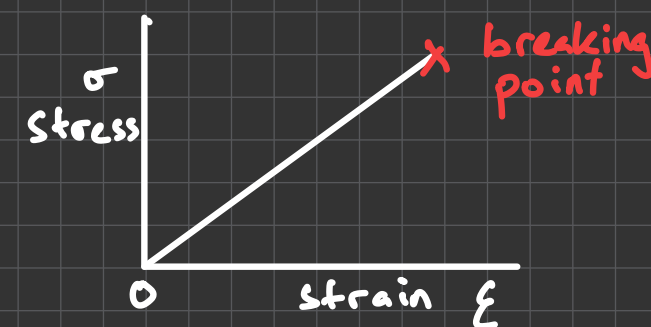
Elastic deformation - the material returns to its original shape after the force is removed

Plastic deformation - the material does not return to its original shape after the force is removed.



Up to P stress is proportional to strain
Elastic deformation occurs up to the elastic limit
Plastic deformation occurs beyond point E
The material is permanently deformed

Brittle material e.g. glass



- Stress is proportional to strain
- Hooke's law is obeyed
- Elastic deformation occurs up to its breaking point

Tensile forces produce extension. (stretch)

Compressive forces reduce the length of a material

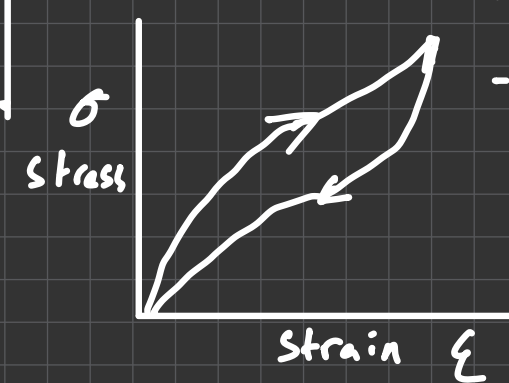
Hooke's law: for a material within its elastic limit the applied force is directly proportional to the extension.

$F = kx$
 applied force (N) extension (m)
 force constant

$k = \frac{F}{x} \rightarrow \text{Nm}^{-1}$

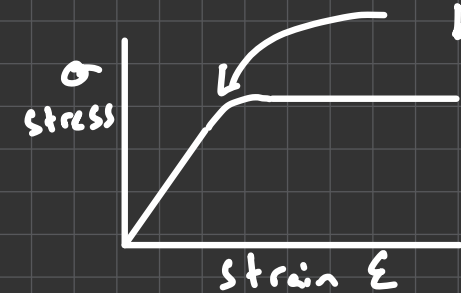
Chapter 6 Material

Rubber

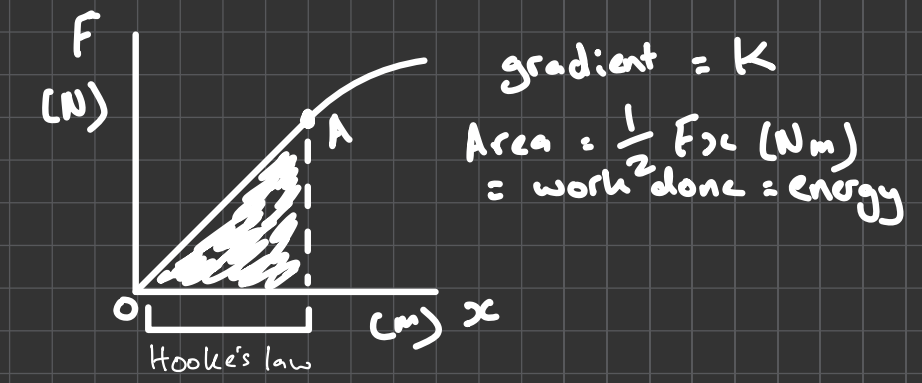
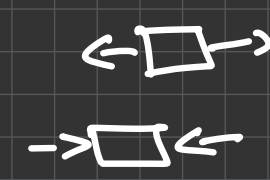


- Elastic behaviour
- Hooke's law not obeyed

Polythene



plastic behaviour



Elastic PE = $\frac{1}{2} Fx$
 so $= \frac{1}{2} kx \times x = \frac{1}{2} kx^2$
 Also $F = kx$

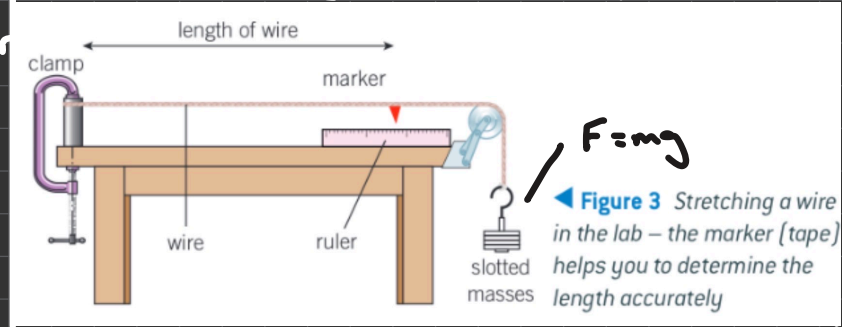
Young's Modulus $E = \frac{\text{tensile strength}}{\text{tensile strain}} = \frac{\sigma}{\epsilon} = \frac{F/L}{x/L} = \frac{F}{A} \times \frac{L}{x}$

Stress $\sigma = \frac{F}{A} \text{ (Nm}^{-2}\text{), (Pa)}$

Strain $\epsilon = \frac{x}{L}$ - extension / original length
 e.g. $\frac{0.1}{1} = 10\%$

Ultimate tensile strength - the greatest amount of stress that a material can withstand before reaching breakpoint

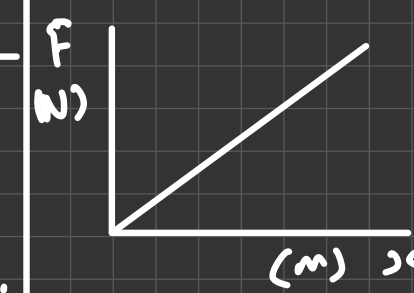
Experiment to determine Young's Modulus



Vary the force and measure the extension
 Measure diameter of wire with micrometer (several readings avg). Use to calculate CSA
 $A = \frac{\pi d^2}{4}$
 Measure original length with a ruler

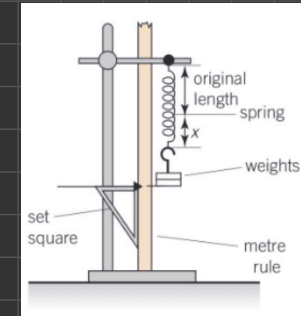
Measure the extension x with a marker and a ruler or with a travelling microscope to reduce % uncertainty

Plot a graph of F against x



$E = \frac{\sigma}{\epsilon} = \frac{F/A}{x/L} = \frac{F}{A} \times \frac{L}{x}$
 $F = \frac{E \times A}{L} \times x + c$
 $y = mx + c$
 $m = \frac{E \times A}{L}$
 $E = \frac{mL}{A}$

Hooke's law experiment:



Suspend masses from the spring
 Vary the mass and record the extension
 Calculate the extension (f - il)
 Find the force acting for each mass by using $F = mg$ then plot a graph of the force against the extension
 take readings at eye level to reduce parallax error