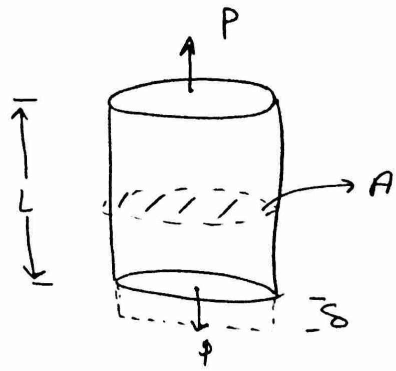
Tensile test

P: Load (force)

A: Cross-sectional area

L: Length



Stress (σ) sigma

$$\sigma = \frac{P}{A} \qquad (Pa)$$

Deflection (δ) delta

$$\delta = \frac{PL}{AE}$$

$\rightarrow$ E: Elastic modulus

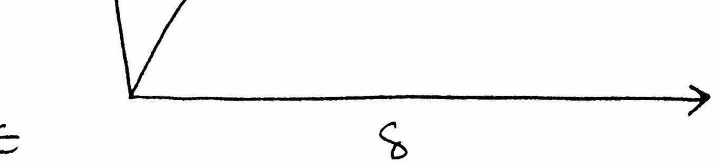
Strain (ϵ) epsilon

$$\epsilon = \frac{\text{change of length}}{\text{original length}} = \frac{\delta}{L}$$

Increase P

$\Rightarrow \delta \uparrow$

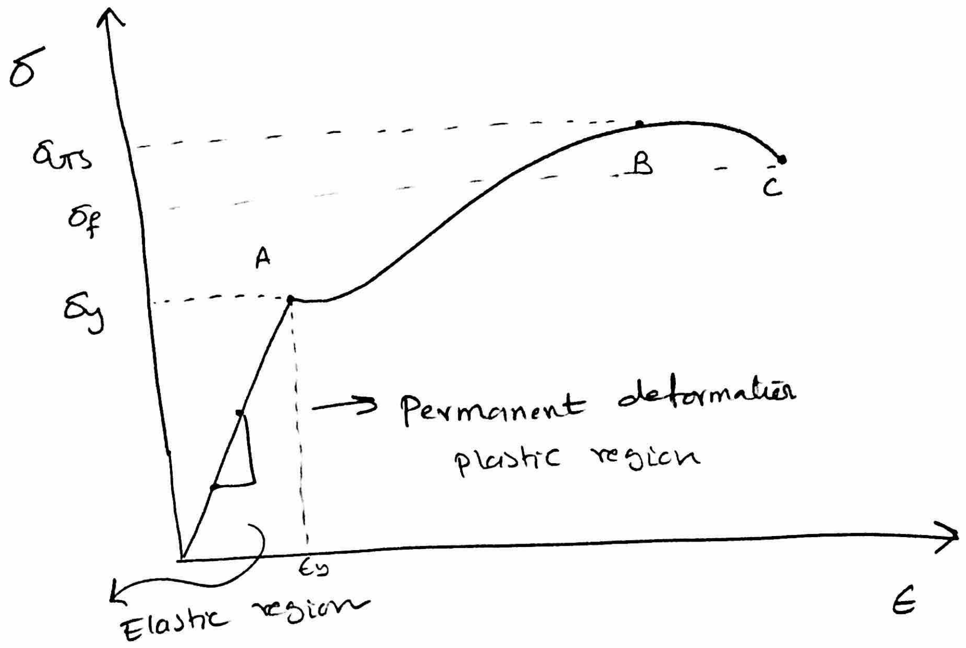
Load-deflection curve



divide P by A $\Rightarrow \sigma$

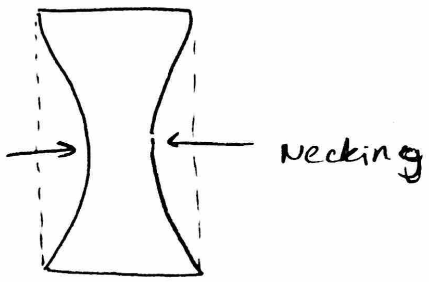
divide δ by L $\Rightarrow \epsilon$

stress-strain curve



<u>point A</u> → Yield point (yield stress = σ_y)

<u>point B</u> → Ultimate tensile Stress (σ_{UTS}) → at UTS ⇒ Necking

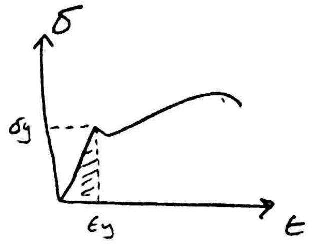


<u>point C</u> → Fracture (rupture) stress (σ_f).

<u>Slope of linear part</u> ⇒ E: Elastic modulus

$$E = \frac{\sigma}{\epsilon}$$

Modulus of resilience U_R : energy stored in the material in the elastic region

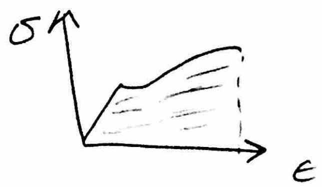


U_R = area under elastic region

$= \frac{1}{2} \sigma_y \epsilon_y$, $\sigma_y = E \epsilon_y$

$= \frac{\sigma_y^2}{2E}$

Modulus of toughness (U_T) : Total energy absorbed to failure (fracture)

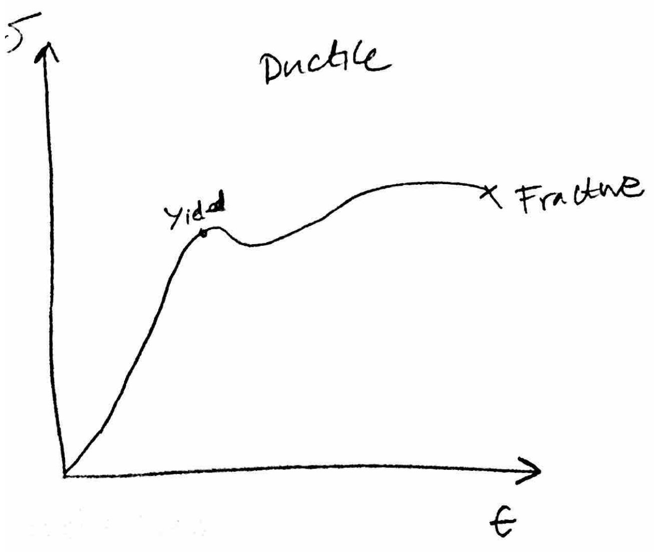


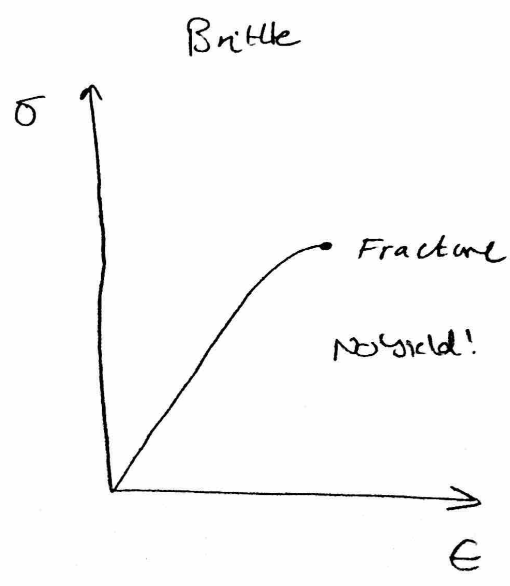
U_T = Area under σ-ε curve

Two types of materials

① Ductile materials

② Brittle materials





* What we will do in that lab

- Perform tensile test → $\sigma-\epsilon$ curve

- obtain
  1. σ_y
  2. σ_{UTS}
  3. σ_f
  4. U_T
  5. U_R
  6. E