Quiz n°1

Name:

1/ Give the symbol and the formula for the normal stress in a prismatic bar under an axial load. 
   \[ \sigma = \frac{F}{A} \] ( /1)
   Give the unit of stress and verify it with the above formula's method. 
   \[ P_a = \frac{N}{m^2} = \frac{Force}{Area} \] ( /0.5)

2/ Give the symbol and the formula for the axial strain in a prismatic bar under an axial load. 
   \[ \varepsilon = \frac{\delta}{L} \] ( /1)

3/ Give the formula that links the axial strain to the lateral strain. 
   \[ \nu = -\frac{\varepsilon_l}{\varepsilon_a} \] ( /1)
   What is the name of the material property involved? 
   Poisson's Ratio ( /0.5)

4/ What is an approximate value for the above material property for metals? 
   For cork? 
   0.0 ( /0.5)
   For rubber? 
   0.49 ( /0.5)

5/ On the diagram, denote the plastic deformation region and the elastic deformation region. 
   (write down your work/derivation)

   Determine the ultimate tensile strength: \(~ 410 \text{ MPa}\) ( /1)
   Determine the facture stress: \(~ 375 \text{ MPa}\) ( /0.5)
   Determine the Young's modulus: \(~ 350 \text{ MPa}/0.075\) ( /1)
   Determine the yield stress: \(~ 350 \text{ MPa}\) ( /1)
   For point A, determine:
   - the total strain: \(\varepsilon_{\text{total}} = \varepsilon_{\text{el}} + \varepsilon_{\text{pl}}\) \(~ 0.18\) ( /1)
   - the elastic strain: \(\varepsilon_{\text{el}} = \frac{\sigma}{E}\) \(~ 0.086\) ( /1)
   - the plastic strain: \(\varepsilon_{\text{pl}} = \varepsilon_{\text{total}} - \varepsilon_{\text{el}}\) \(~ 0.09\) ( /1)

Chapter 2 & uncertainty

J.-B. le Graverend
6/ What is a prismatic bar?

7/ Which one of the schematics below represents shear forces correctly?

8/ What is the relation between the axial strain given the displacement field $\bar{U}(x) = u(x) \hat{i}$?

What is the relation between the shear strain (in the xy plane) given the displacement field $\bar{U}(x,y) = u(x,y) \hat{i} + v(x,y) \hat{j}$?

\[ \nabla \times \bar{U}(x,y) = \nabla \times (u(x,y) \hat{i} + v(x,y) \hat{j}) \Rightarrow \gamma_{xy} = \frac{\partial u(x,y)}{\partial y} + \frac{\partial v(x,y)}{\partial x} \]
9/ Draw and name (symbol) the shear strain on the schematic below.

\[ \gamma = \tan^{-1} \frac{\delta}{a} \]

\[ \gamma = \frac{\delta}{a} \]

\[ \theta = \frac{\pi}{2} - \gamma \]

\( \gamma \) is the change in angle from \( \frac{\pi}{2} \).

10/ Which one of the equations below is correct whenever reporting the length of a bar?

- \[ L = 52.3mm \pm 1mm \]
  - No

- \[ L = 62.56mm \pm 1.00mm \]
  - No

- \[ L = 62mm \pm 1mm \]
  - Yes

For the correct one, give the absolute uncertainty and the relative uncertainty in percent:

- absolute uncertainty = 1mm

- relative uncertainty = \( \frac{1}{62} \times 100 = 1.61\% \)