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Solid Deformation

1 Applications

1. **(PSPS 08/09)**
   A 4.0 m iron rod with cross-sectional area 0.5 cm2 extends by 1.0 mm when a 225 kg mass is suspended from one of its ends. Calculate the

   (a) Young's modulus of the rod. [**Ans:** $Y = 1.77(10^{11})Pa$]

   (b) elastic energy stored in the rod.[**Ans:** $U = 1.11J$]

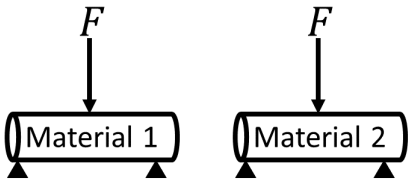
2. **(PSPS 10/11)**
   A steel wire AB, of length $150cm$ and diameter $1mm$ is fixed at both ends. A force F pulls the wire at the midpoint and causes a displacement of $5cm$ as shown in the figure above. If the Young modulus of the steel is $2GPa$, calculate the

   (a) magnitude of F. [**Ans:** $F = 0.155N$]

   (b) energy stored in the wire. [**Ans:** $U = 8.38(10^{-3})J$]

3. **(PSPS 11/12)**
   A $20.0kg$ mass is hung from a $2.0m$ long vertical wire. If the wire is elongated by $3.0mm$, calculate the strain energy stored in the wire. [**Ans:** $U = 0.294$**J**]

4. **(PSPS 13/14)**



   The figure above shows an identical force, F, acting on two identical rods but made of different materials. What concept will be used to determine which rod will bend more? Explain your answer. [2 marks]

5. **(PSPS 14/15)**

   (a) Explain plastic deformation of an elastic material.

   (b) A wire of diameter $0.5mm$ has Young's modulus of $2 \times 10^{11}Nm^{-}1$. Calculate the strain if it is extended by $150N$ load.

6. **(PSPS 16/17)**
   A solid cylinder $10m$ high and $10cm$ in diameter is compresses by a $1 \times 10^5\ kg$ load. Calculate the strain energy stored in the cylinder. The Young's modulus of cylinder is $1.9 \times 10^{11}Pa$.

7. **(PSPS 17/18)**
   A $20cm$ cylindrical brass rod with diameter $6cm$ is held vertically on its one circular flat end. A load of $5kg$ is placed on its upper end. Given the Young's modulus of brass is $9.1 \times 10^{10}Nm^{-2}$, calculate the strain energy of the rod.

8. **(PSPS 18/19)**
   An aluminium wire, initially $2.45m$ long and diameter of $1.5mm$ is suspended from a rigid support with a load of $15kg$ attached to its lower end. Young's modulus of aluminium is $7 \times 10^{10}Nm^{-2}$. Calculate the

   (a) extension of the wire

   (b) strain energy stored in the wire