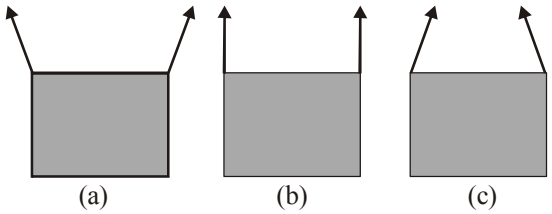
8 Mechanical Properties of Solids

Diagram Based Questions :

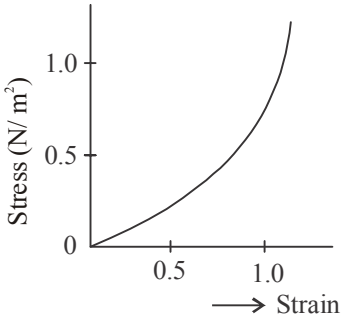
1. A rectangular frame is to be suspended symmetrically by two strings of equal length on two supports . It can be done in one of the following three ways



The tension in the strings will be

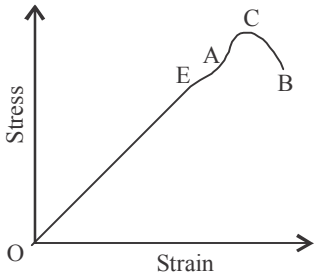
(a) the same in all cases
(b) least in (a)
(c) least in (b)
(d) least in (c)

2. The graph given is a stress-strain curve for



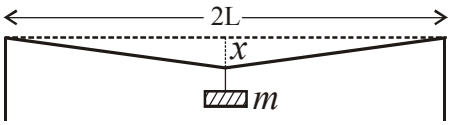
(a) elastic objects (b) plastics
(c) elastomers (d) None of these

3. For the given graph, Hooke's law is obeyed in the region



(a) OA (b) C
(c) OE (d) OB

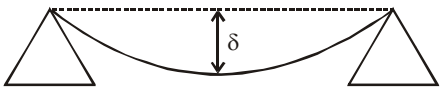
4. A mild steel wire of length 2L and cross-sectional area A is stretched, well within elastic limit, horizontally between two pillars. A mass m is suspended from the mid point of the wire. Strain in the wire is



(a) $\frac{x^2}{2L}$ (b) $\frac{x}{L}$

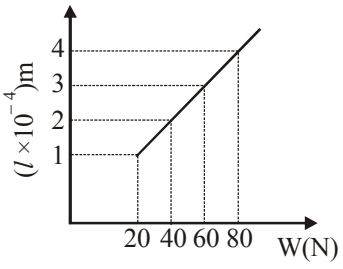
(c) $\frac{x^2}{L}$ (d) $\frac{x^2}{2L}$

5. A beam of metal supported at the two edges is loaded at the centre. The depression at the centre is proportional to



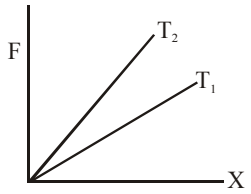
(a) Y^2 (b) Y
(c) 1/Y (d) $1/Y^2$

6. The adjacent graph shows the extension (Δl) of a wire of length 1m suspended from the top of a roof at one end with a load W connected to the other end. if the corss-sectional area of the wire is $10^{-6}m^2$, calculate the Young's modulus of the material of the wire



(a) $2 \times 10^{11}\ N/m^2$ (b) $2 \times 10^{-11}\ N/m^2$
(c) $2 \times 10^{-12}\ N/m^2$ (d) $2 \times 10^{-13}\ N/m^2$

7. The diagram below shows the change in the length X of a thin uniform wire caused by the application of stress F at two different temperatures T_1 and T_2. The variation shown suggests that



(a) $T_1 > T_2$ (b) $T_1 < T_2$
(c) $T_2 > T_1$ (d) $T_1 \geq T_2$

Solution

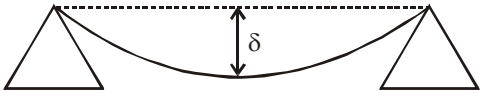
1. **(c)**

2. **(c)** The given graph does not obey Hooke's law. and there is no well defined plastic region. So the graph represents elastomers.

3. **(c)** Since OE is a straight line so, stress $\propto$ strain. $\therefore$ Hooke's law is obeyed in the region OE of the graph.

4. **(a)**

5. **(c)**



For a beam, the depression at the centre is given by,

$$\delta = \left(\frac{f\,L}{4Ybd^3}\right)$$

[f, L, b, d are constants for a particular beam]

i.e. $\delta \propto \frac{1}{Y}$

6. **(a)** From the graph $l = 10^{-4}$m, $F = 20$ N
$A = 10^{-6}m^2$, $L = 1$m

$$\therefore \quad Y = \frac{FL}{Al} = \frac{20 \times 1}{10^{-6} \times 10^{-4}}$$

$$= 20 \times 10^{10} = 2 \times 10^{11}\,N/m^2$$

7. **(a)** When same stress is applied at two different temperatures, the increase in length is more at higher temperature. Thus $T_1 > T_2$.