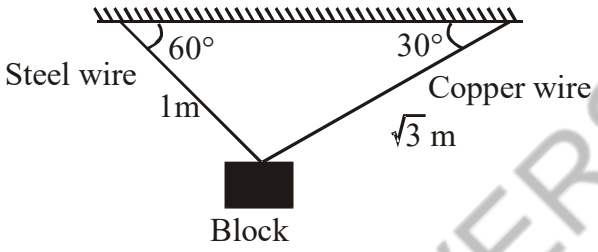
ELASTICITY

1. A block of weight 100 N is suspended by copper and steel wires of same cross sectional area 0.5 cm^2 and, length $\sqrt{3}$ m and 1 m, respectively. Their other ends are fixed on a ceiling as shown in figure. The angles subtended by copper and steel wires with ceiling are 30° and 60°, respectively. If elongation in copper wire is ($\Delta\ell_C$) and elongation in steel wire is ($\Delta\ell_S$), then the ratio $\frac{\Delta\ell_C}{\Delta\ell_S}$ is _____.

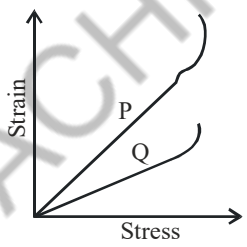
[Young's modulus for copper and steel are 1×10^{11} N/m^2 and 2×10^{11} N/m^2 respectively]

[JEE(Advanced) 2019]



2. In plotting stress versus strain curves for two materials P and Q, a student by mistake puts strain on the y-axis and stress on the x-axis as shown in the figure. Then the correct statement(s) is (are) :-

[JEE(Advanced) 2015]



(A) P has more tensile strength than Q

(B) P is more ductile than Q

(C) P is more brittle than Q

(D) The Young's modulus of P is more than that of Q

SOLUTIONS

1. Ans. (2.00)

Sol. Let T_S = tension in steel wire

T_C = Tension in copper wire

in x direction

$T_C\cos30° = T_S\cos60°$

$$T_C \times \frac{\sqrt{3}}{2} = T_S \times \frac{1}{2}$$

$$\sqrt{3}T_C = T_S \qquad \text{....(i)}$$

in y direction

$T_C\sin30° + T_S\sin60° = 100$

$$\frac{T_C}{2} + \frac{T_S\sqrt{3}}{2} = 100 \qquad \text{....(ii)}$$

Solving equation (i) & (ii)

$T_C = 50$ N

$T_S = 50\sqrt{3}$ N

We know

$$\Delta L = \frac{FL}{AY} \quad = \frac{\Delta L_C}{\Delta L_S} = \frac{T_C L_C}{A_C Y_C} \times \frac{A_S Y_S}{T_S L_S}$$

On solving above equation

$$\frac{\Delta L_C}{\Delta L_S} = 2$$

2. Ans. (A, B)

Sol. Slope of this graph represents the reciprocal of Young's modulus.

since Slope of P > Slope of Q

Hence Y of P < Y of Q