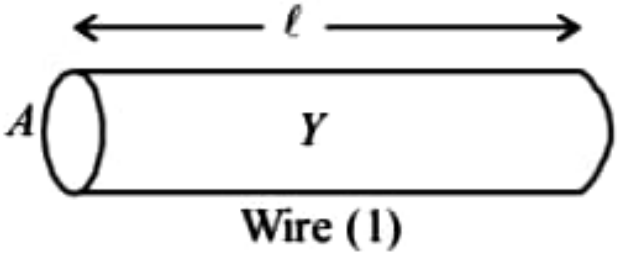
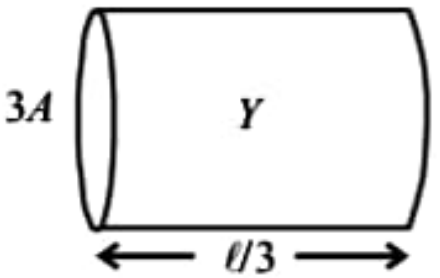
20. Two wires are made of the same material and have the same volume. However wire 1 has cross-sectional area A and wire 2 has cross-sectional area $3A$. If the length of wire 1 increases by Δx on applying force F, how much force is needed to stretch wire 2 by the same amount? **[2009]**

(a) $4F$ (b) $6F$ (c) $9F$ (d) F

20. (c)



Wire (1)



Wire (2)

For wire 1

Length, $L_1 = 1$

Area, $A_1 = A$

For wire 2

$$\text{Length, } L_2 = \frac{\ell}{3}$$

Area, $A_2 = 3A$

As the wires are made of same material, so they will have same young's modulus.

For wire 1,

$$Y = \frac{F/A}{\Delta x/\ell} \qquad \text{...(i)}$$

For wire 2 ,

$$Y = \frac{F'/3A}{\Delta x/(\ell/3)} \qquad \text{...(ii)}$$

From (i) and (ii) we get,

$$\frac{F}{A} \times \frac{\ell}{\Delta x} = \frac{F'}{3A} \times \frac{\ell}{3\Delta x} \Rightarrow F' = 9F$$