15. A uniform wire (Young's modulus $2 \times 10^{11}\ Nm^{-2}$) is subjected to longitudinal tensile stress of $5 \times 10^{7}\ Nm^{-2}$. If the overall volume change in the wire is 0.02%, the fractional decrease in the radius of the wire is close to :

[Online April 22, 2013]

(a) 1.0×10^{-4} (b) 1.5×10^{-4}

(c) 0.25×10^{-4} (d) 5×10^{-4}

15. **(c)** Given, $y = 2 \times 10^{11}\ Nm^{-2}$

$$\text{Stress}\left(\frac{F}{A}\right) = 5 \times 10^{7}\ Nm^{-2}$$

$$\Delta V = 0.02\% = 2 \times 10^{-4}\ m^3$$

$$\frac{\Delta r}{r} = ?$$

$$\gamma = \frac{\text{stress}}{\text{strain}} \Rightarrow \text{strain}\left(\frac{\Delta \ell}{\ell_0}\right) = \frac{\gamma}{\text{stress}} \qquad \ldots(i)$$

$$\Delta V = 2\pi r \ell_0 \Delta r - \pi r^2 \Delta \ell \qquad \ldots(ii)$$

From eqns (i) and (ii) putting the value of $\Delta \ell$, ℓ_0 and ΔV and solving we get

$$\frac{\Delta r}{r} = 0.25 \times 10^{-4}$$