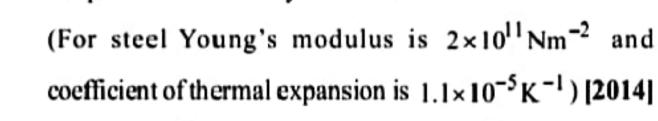12. The pressure that has to be applied to the ends of a steel wire of length 10 cm to keep its length constant when its temperature is raised by $100°C$ is:

(For steel Young's modulus is $2 \times 10^{11} \, Nm^{-2}$ and coefficient of thermal expansion is $1.1 \times 10^{-5} K^{-1}$) [2014]

(a) $2.2 \times 10^8 \, Pa$

(b) $2.2 \times 10^9 \, Pa$

(c) $2.2 \times 10^7 \, Pa$

(d) $2.2 \times 10^6 \, Pa$

12. (a) Young's modulus $Y = \dfrac{\text{stress}}{\text{strain}}$

stress = Y × strain

Stress in steel wire = Applied pressure

Pressure = stress = Y × strain

Strain = $\dfrac{\Delta L}{L} = \alpha \Delta T$

(As length is constant)

$= 2 \times 10^{11} \times 1.1 \times 10^{-5} \times 100 = 2.2 \times 10^8$ Pa