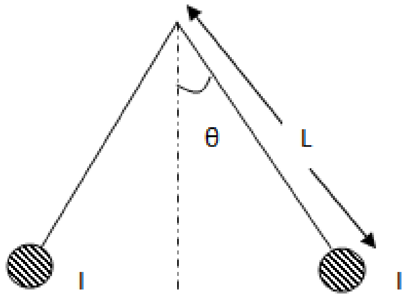
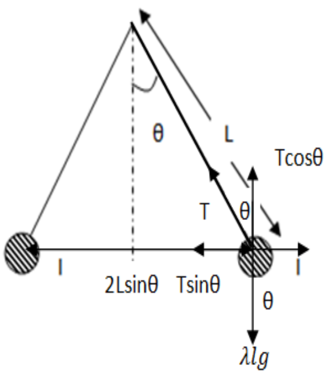
20. Two long current carrying thin wires, both with current I, are held by insulating threads of length L and are in equilibrium as shown in the figure, with threads making an angle 'θ' with the vertical. If wires have mass λ per unit length then the value of I is : (g = gravitational acceleration)



(1) $\sin\theta\sqrt{\frac{\pi\lambda gL}{\mu_0 Cos\theta}}$ (2) $2\sin\theta\sqrt{\frac{\pi\lambda gL}{\mu_0 Cos\theta}}$ (3) $2\sqrt{\frac{\pi gLtan\theta}{\mu_0}}$ (4) $\sqrt{\frac{\pi\lambda gLtan\theta}{\mu_0}}$

Answer:



$\frac{\mu_0 I_1 I_2}{2\pi d} l = \frac{\mu_0 I^2}{2\pi 2L\sin\theta} l$

Resolving Tension T on the wire into two mutually perpendicular components
Vertical component balances Gravity
Horizontal component balances force due to current

If we consider small element of size *l then*

$T\cos\theta = \lambda lg \rightarrow (1)$

$T\sin\theta = \frac{\mu_0 I^2}{2\pi 2L\sin\theta} l \rightarrow (2)$

Eliminating θ we get

$\tan\theta = \frac{\mu_0 I^2}{4\pi\lambda gL\sin\theta}$

$or\ I = 2\sin\theta\sqrt{\frac{\pi\lambda gL}{\mu_0\cos\theta}}$

Correct option is (2) $\mathbf{2\sin\theta\sqrt{\frac{\pi\lambda gL}{\mu_0 Cos\theta}}}$