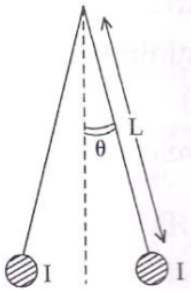
7.



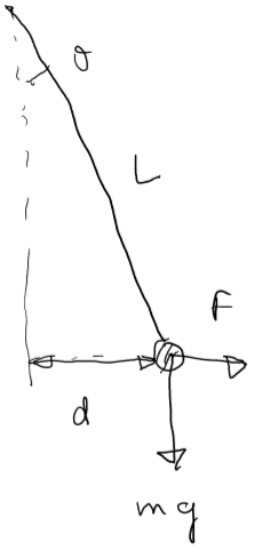
Two long current carrying thin wires, both with current I, are held by insulating threads of length L and are in equilibrium as shown in the figure, with threads making an angle 'θ' with the vertical. If wires have mass λ per unit length then the value of I is :
(g =gravitational acceleration)

(1) $2\sqrt{\frac{\pi g L}{\mu_0}\tan\theta}$

(2) $\sqrt{\frac{\pi\lambda g L}{\mu_0}\tan\theta}$

(3) $\sin\theta\sqrt{\frac{\pi\lambda g L}{\mu_0\cos\theta}}$

(4) $2\sin\theta\sqrt{\frac{\pi\lambda g L}{\mu_0\cos\theta}}$ ← Correct



$\frac{F}{mg} = \tan\theta$ If 'l' is length of the wires, then

$\frac{F/l}{m/l\,g} = \tan\theta \quad \frac{m}{l} = \lambda$

and $\frac{F}{l} = \frac{\mu_0 I^2}{4\pi d}$ — (1)

$\frac{F}{l} = \lambda g \tan\theta$ — (2)

$\frac{\mu_0 I^2}{4\pi d} = \lambda g \tan\theta$ From (1) & (2)

Also, $d = L\sin\theta$

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

$\Rightarrow I^2 = 2\sin\theta\sqrt{\frac{\pi\lambda L g}{\mu_0\cos\theta}}$

(4) is correct