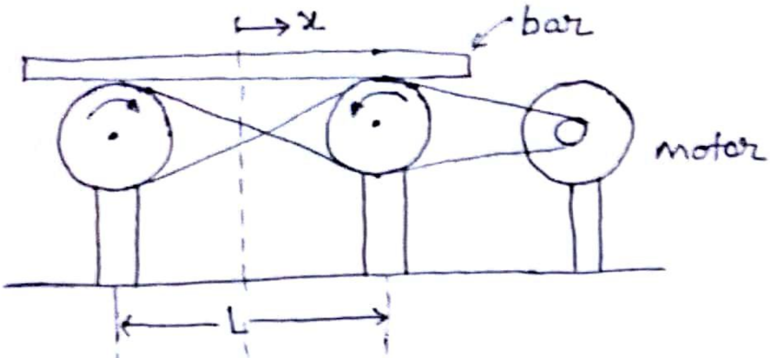
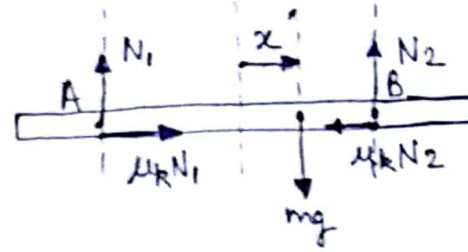
Quiz (1)
Soln.





FBD of bar

$\Sigma F_y = 0$

$N_1 + N_2 = mg \quad -(1)$

$\Sigma M_A = 0$

$N_2 L = mg\left(\frac{L}{2} + x\right) \quad -(2)$

$N_2 = \dfrac{mg\left(\frac{L}{2}+x\right)}{L}$

Substituting, N_2 in eq (1), we get

$N_1 = mg - \dfrac{mg\left(\frac{L}{2}+x\right)}{L}$

$N_1 = \dfrac{mg}{L}\left[L - \left(\frac{L}{2}+x\right)\right] = \dfrac{mg}{L}\left(\frac{L}{2} - x\right)$

$\Sigma F_x = ma_x$

$\mu_k N_1 - \mu_k N_2 = m\ddot{x}$

$\dfrac{\cancel{m}g\mu_k}{L}\left[\frac{L}{2} - x - \frac{L}{2} - x\right] = \cancel{m}\ddot{x}$

$\ddot{x} + \dfrac{2xg\mu_k}{L} = 0$

$\ddot{x} + \left(\dfrac{2g\mu_k}{L}\right)x = 0$ Comparing with

$\ddot{x} + \omega_0^2 x = 0$

we get, $\omega_0^2 = \dfrac{2g\mu_k}{L}$

$\omega_0 = 2\pi f$

$\boxed{\mu_k = \dfrac{\omega^2 L}{2g}}$

$4\pi^2 f^2 = \dfrac{2g\mu_k}{L} \Rightarrow \boxed{\mu_k = \dfrac{2\pi^2 f^2 L}{g}}$