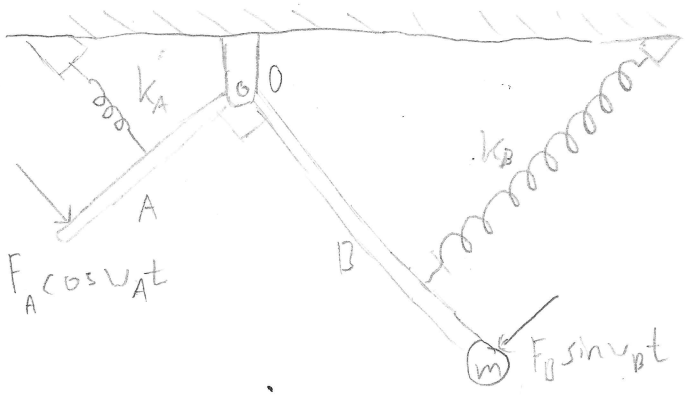
20-R-VIB-04-32

A L-shaped bar of negligible mass is pinned to the ceiling by its at point O. Arm A, length $\ell = 2m$, has a spring $k_A = 10$ N/m attached and a force $F_A = 2\cos 3t$ applied at the end of the bar. Arm B, length 3m, has a spring $k_B = 20$ N/m attached $\frac{2}{3}$ of the length down the bar and force $F_B = 4\sin 2t$ applied at the end of the bar. Given that initially the bar is at rest, find the angle at $t = 10s$.

5kg mass at end of arm B



Solution: $F_k = ks \quad s = r\theta$

$\Sigma M_O : I_A \alpha \quad I_A = 0$

$$(F_A \cos w_A t)\ell_A - k_A\left(\frac{\ell_A}{2}\right)^2\theta - k_B\left(\frac{2\ell_B}{3}\right)^2\theta - (F_B \cos w_B t)\ell_B - \ell_B^2 m\ddot{\theta} = 0$$

$$\frac{(F_A \cos w_A t)\ell_A - (F_B \sin w_B t)\ell_B}{\ell_B^2 m} = \ddot{\theta} + \frac{\left(k_A\left(\frac{\ell_A}{2}\right)^2\right) + k_B\left(\frac{2\ell_B}{3}\right)^2}{\ell_B^2 m}\theta$$

$\theta_p = A\cos w_A t + B\sin w_B t$

$\ddot{\theta}_p = -Aw_A^2 \cos w_A t - Bw_B^2 \sin w_B t$

@ $t = 0$ $\quad \frac{F_A \ell_A}{\ell_B^2 m} = \frac{\left(k_A\left(\frac{\ell_A}{2}\right)^2\right) + k_B\left(\frac{2\ell_B}{3}\right)^2}{\ell_B^2 m} A - Aw_A^2$

$$A = \frac{\frac{F_A \ell_A}{\ell_B^2 m}}{\frac{k_A\left(\frac{\ell_A}{2}\right)^2 + k_B\left(\frac{2\ell_B}{3}\right)^2}{\ell_B^2 m} - w_A^2}$$

$\dot{\theta}_p = Aw_A \sin w_A t - Bw_B \cos w_B t \quad @\ t = 0$

$0 = -Bw_B \quad w_B \neq 0 \quad B = 0$?