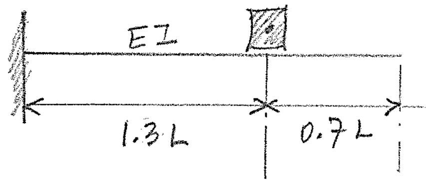
2.1)



$m = 1.5\,m$

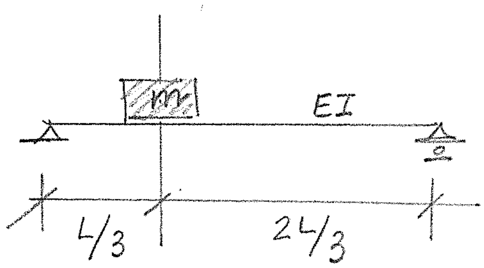
$K = \frac{3EI}{(1.3L)^3} = 1.37\,\frac{EI}{L^3}$ ⇒ condensed stiffness

$\omega_n = \sqrt{\frac{K}{m}} = \sqrt{\frac{1.37EI}{1.5mL^3}} = 0.96\sqrt{\frac{EI}{mL^3}}$

eqn. of motion.

$\ddot{x} + 0.61\frac{EI}{mL^3}x = 0$

2.2)



flexibility @ mass

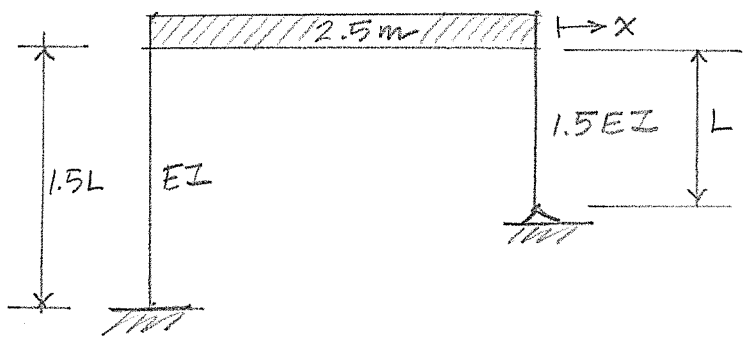
$\delta = P\cdot\left(\frac{L}{3}\right)^2\cdot\left(\frac{2L}{3}\right)^2 \Big/ 3EI\cdot L$

$\delta = \frac{4PL^4}{243EIL} = \frac{4PL^3}{243EI}$ = flex $(P=1)$

$K = \frac{1}{flex} = \frac{243EI}{4L^3}$ $\qquad \omega_n = \sqrt{\frac{243EI}{4mL^3}} = 7.79\sqrt{\frac{EI}{mL^3}}$

$m\ddot{x} + \frac{243EI}{4L^3}x = 0$ eqn. of motion

2.3)



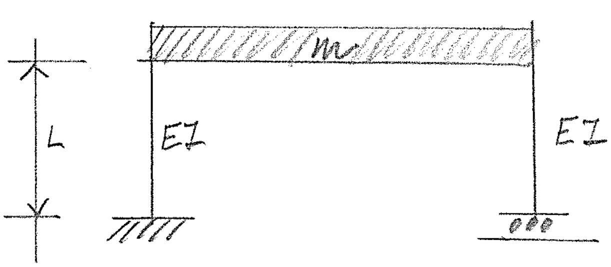
$$K = \frac{12EI}{(1.5L)^3} + \frac{3(1.5EI)}{L^3} = 3.56\frac{EI}{L^3} + 4.50\frac{EI}{L^3}$$

$$K = 8.06\frac{EI}{L^3} \qquad \omega_n = \sqrt{\frac{8.06EI}{2.50mL^3}} = 1.80\sqrt{\frac{EI}{mL^3}}$$

$$M = 2.5m$$

$$\ddot{x} + 1.80\sqrt{\frac{EI}{mL^3}}\,x = \frac{F(t)}{2.5m} \Rightarrow \text{equ. of motion.}$$

2.4)

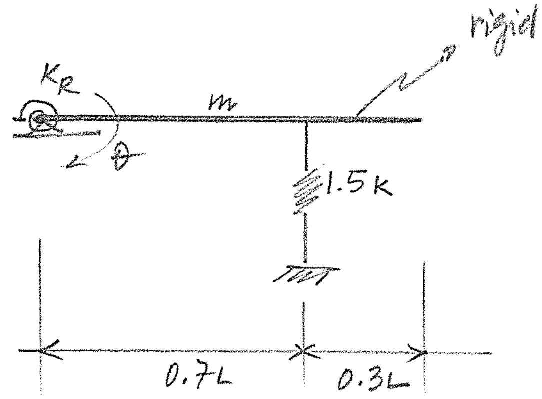


$$K = \frac{12EI}{L^3}$$

$$\omega_n = \sqrt{\frac{12EI}{mL^3}}$$

$$\ddot{x} + \frac{12EI}{mL^3}x = 0 \Rightarrow \text{equ. of motion.}$$

2.5)



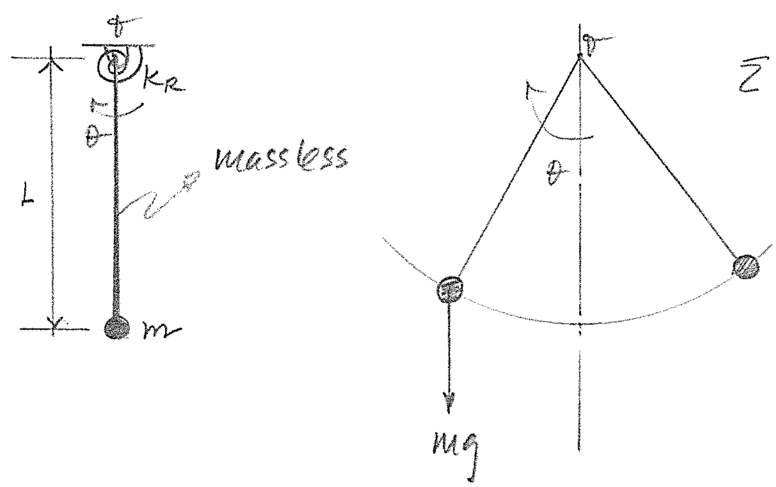
$$K_\theta = K_R + (1.5k)(0.7L)^2$$

$$K_\theta = K_R + 0.735\,kL^2$$

$$\frac{1}{3}mL^2\ddot{\theta} + K_\theta \cdot \theta = 0$$

$$\frac{1}{3}mL^2\ddot{\theta} + \left[K_R + 0.735\,kL^2\right]\theta = 0 \quad \Rightarrow \text{eqn. of motion.}$$

2.7)



$$\Sigma M^{\theta} = mgL\sin\theta + K_R\theta + mL^2\ddot{\theta} = 0$$

$$mgL\sin\theta + K_R\theta + mL^2\ddot{\theta} = 0$$

for small oscillations:

$$(mgL + K_R)\theta + mL^2\ddot{\theta} = 0 \quad \Rightarrow \text{eqn. of motion.}$$