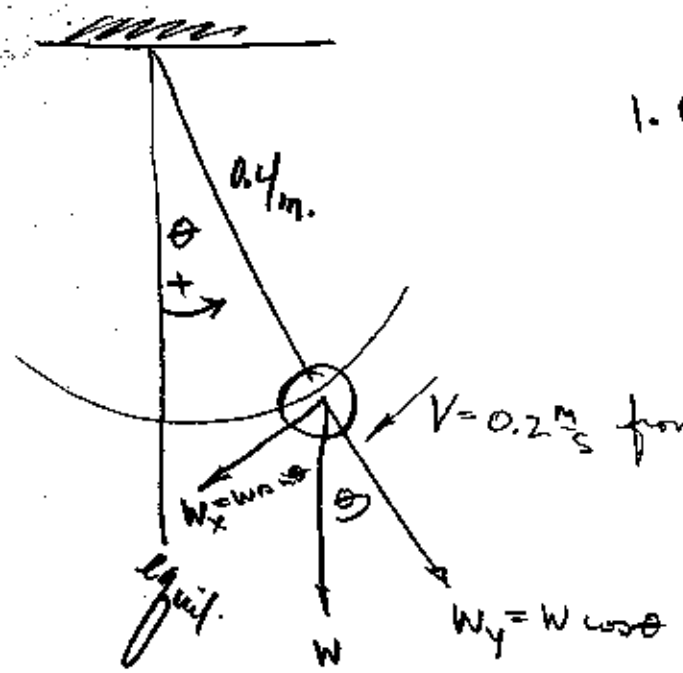
Pendulum



I.C.

$\theta = 0.3$ rad

$V^T = 0.2 \frac{m}{s} = l\dot{\theta} = l\omega$

$\dot{\theta} = \frac{0.2 \text{ m/s}}{0.4 \text{ m}}$

$\dot{\theta} = .5 \text{ rad/s}$

$$\Sigma \vec{F} = m\vec{a}$$

$$-W \sin\theta = m\ddot{x} = ml\ddot{\theta}$$

$$-mg\theta = ml\ddot{\theta}$$

$$\ddot{\theta} + \frac{g}{l}\theta = 0 \qquad \text{where } \omega_n = \sqrt{\frac{g}{l}} = \sqrt{\frac{9.81 \text{ m/s}^2}{0.4 \text{ m}}}$$

$$\boxed{\omega_n = 4.95 \text{ rad/sec}}$$

$$D^2 + \frac{g}{l} = 0 \quad \text{imag roots}$$

$$\theta(t) = A \cos\omega_n t + B \sin\omega_n t$$

I.C. $\boxed{0.3 \text{ rad} = A}$

$\frac{d}{dt}$ = $\dot{\theta} = -A\omega_n \sin\omega_n t + B\omega_n \cos\omega_n t$

$-.5 \frac{\text{rad}}{s} = 0 + B(4.95 \frac{\text{rad}}{s})1 \qquad \therefore \boxed{B = -.101}$

Gen'l Eq. of motion

$\theta(t) = 0.3 \cos\omega_n t - .101 \sin\omega_n t$

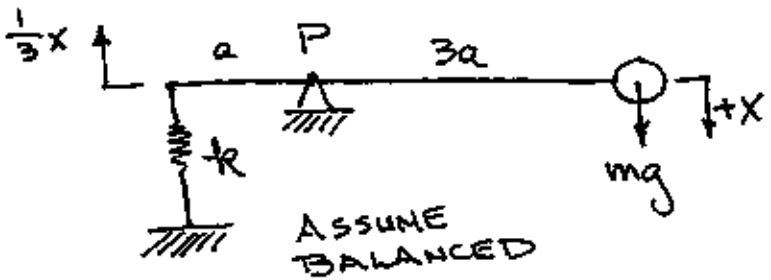
$= 0.3 \cos(4.95 \frac{\text{rad}}{s})t - .101 \sin(4.95 \frac{\text{rad}}{s})t$

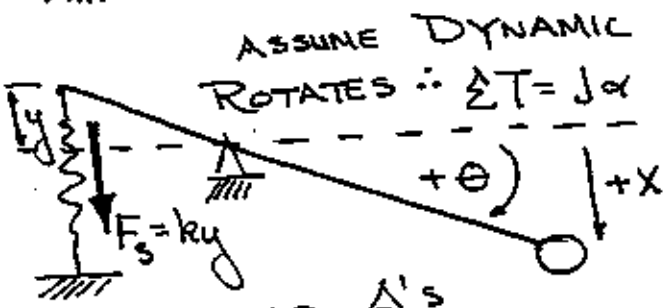
B3-10

Fig. 3-56

GIVEN: $mg = 5N$

$k = 400\ N/m.$





SIMILAR Δ's

for deflection

$\frac{y}{a} = \frac{x}{3a}$

$\therefore y = \frac{ax}{3a} = \frac{1}{3}x$ ok checks ✓

$\Sigma T = J\alpha \curvearrowright +$

$-F_s a = J\ddot{\theta}$

WHERE: $F_s = ky = k\frac{1}{3}x$

$x = r\theta = (3a)\theta$

$J = mr^2 = m(3a)^2$

$-k\frac{1}{3}x\,a = m\,9a^2\ddot{\theta}$

$-k\frac{1}{3}(3a\theta)\,a = m\,9a^2\ddot{\theta}$

$9m\,a^2\ddot{\theta} + ka^2\theta = 0$

$\ddot{\theta} + \left(\frac{k}{9m}\right)\theta = 0$

or $x = 3a\sin\theta \approx 3a\theta$

$\ddot{x} = 3a\ddot{\theta} \Rightarrow \ddot{\theta} = \frac{\ddot{x}}{3a}$

SUB. IN TERMS of X

$-k\frac{1}{3}x\,a = m\,9a^2\ddot{\theta}$

$-k\frac{1}{3}x\,a = m\,9a^2\left(\frac{\ddot{x}}{3a}\right)$

$-\frac{1}{3}kx = 3m\ddot{x}$

$3m\ddot{x} + \frac{1}{3}kx = 0$

$\ddot{x} + \left(\frac{k}{9m}\right)x = 0$

same results

$\omega_n = \sqrt{\frac{k}{9m}} = \sqrt{\frac{400\ N/m.}{9\left(5N./9.8\ m/s^2\right)}} = 9.33\ \frac{rad}{sec.}$