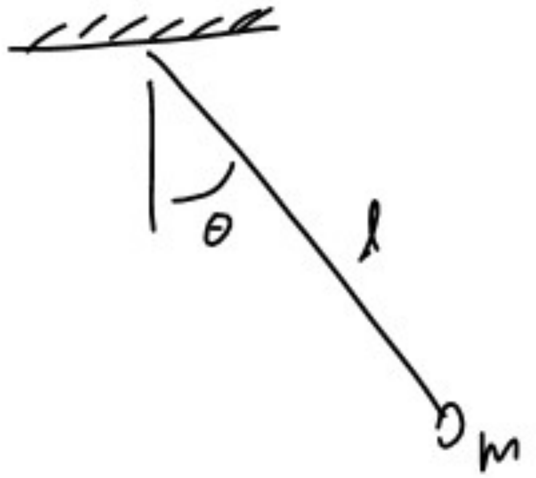
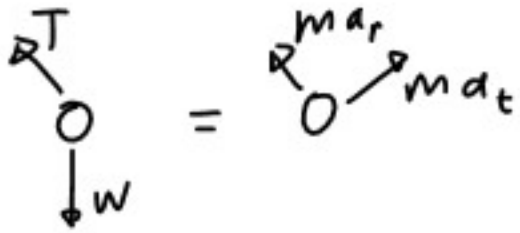




$$\sum F_t = m a_t$$

$$-W \sin\theta = m a_t$$

$$-w \sin\theta = m \ddot{\theta} l$$

$$-mg \sin\theta = m l \ddot{\theta}$$

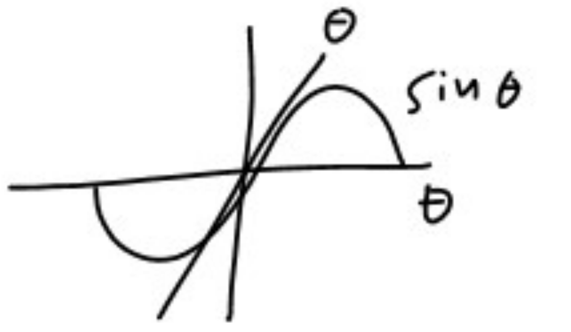
$$-g \sin\theta = l \ddot{\theta}$$

$$l\ddot{\theta} + g\sin\theta = 0$$

$$l\ddot{\theta} + g\theta = 0$$

$$\theta = \theta_m \sin(\omega_n t)$$

$$\tau_n = \frac{2\pi}{\omega_n} = 2\pi\sqrt{\frac{l}{g}} \qquad \omega_n = \sqrt{\frac{g}{l}}$$



$\sin\theta \approx \theta$ if θ small

small angle theorem

Eact sol'n

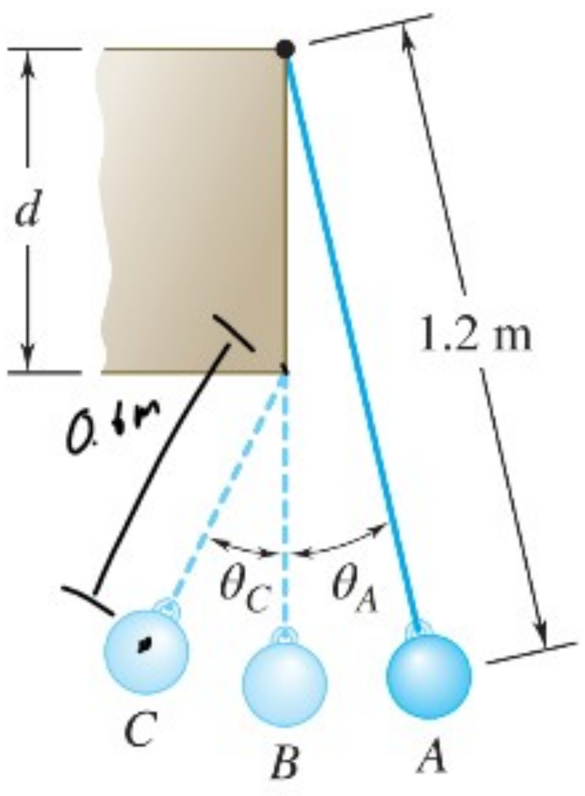
$$\tau_n = \frac{2K}{\pi}\left(2\pi\sqrt{\frac{l}{g}}\right)$$

Rigid Body Vibration

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

$$\Sigma M_o = \dot{H}_o$$

19.16 A small bob is attached to a cord of length 1.2 m and is released from rest when $\theta_A = 5°$. Knowing that $d = 0.6$ m, determine (*a*) the time required for the bob to return to point *A*, (*b*) the amplitude θ_C.



$$\tau_A = 2\pi\sqrt{l_A/g}$$

$$\tau_C = 2\pi\sqrt{l_C/g}$$

$$\tau = \frac{1}{2}\tau_A + \frac{1}{2}\tau_C$$

$$= \pi\sqrt{l_A/g} + \pi\sqrt{l_C/g} = \frac{\pi}{\sqrt{g}}\left(\sqrt{l_A} + \sqrt{l_C}\right)$$

$$= \frac{\pi}{\sqrt{9.8}}\left(\sqrt{1.2} + \sqrt{0.6}\right) = \boxed{1.88\ s}$$

$$\theta_A(t) = 5°\cos(\omega_n t)$$

$$\omega_n = \sqrt{g/l} = \sqrt{\frac{9.8}{1.2}} = 2.86\ 1/s$$

$$\dot{\theta}_A(t) = -5°\omega_n\sin(\omega_n t)$$

$$\dot{\theta}_B = -5°\omega_n = -5°\cdot 2.86\ 1/s = -14.3\ °/s$$

$$\theta_C(t) = \theta_m\cos(\omega_n t)$$

$$\dot{\theta}_C(t) = -\theta_m\omega_n\sin(\omega_n t)$$

$$\dot{\theta}_B = -\theta_m\omega_n = -\theta_m\ 4\ 1/s$$

$$\omega_n = \sqrt{g/l} = \sqrt{\frac{9.8}{0.6}} = 4\ 1/s$$

$$-14.3\ °/s = -\theta_m\ 4\ 1/s$$

$$\frac{-14.3\ °/s}{-4\ 1/s} = \boxed{3.57°} = \theta_m = \theta_C$$