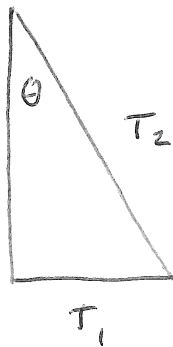


1973 M3

a.



Y-DIMENSION

$$F = ma$$

$$T_2 \cos \theta - mg = 0$$

$$T_2 \cos \theta = mg$$

$$T_2 = \frac{mg}{\cos \theta}$$

X-DIMENSION

$$F = ma$$

$$T_1 + T_2 \sin \theta = m \cdot \omega^2 R$$

$$T_1 = m\omega^2 R - T_2 \sin \theta$$

$$= m\omega^2 R - \left[\frac{mg}{\cos \theta} \right] \sin \theta$$

$$= m\omega^2 R - mg \tan \theta$$

b. LET $T_1 = 0$

$$0 = m\omega^2 R - mg \tan \theta$$

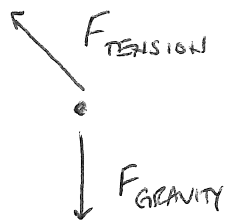
$$mg \tan \theta = m\omega^2 R$$

$$\omega^2 = \frac{g \tan \theta}{R}$$

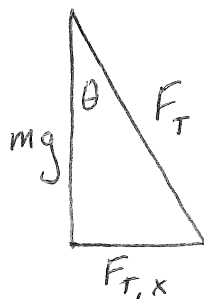
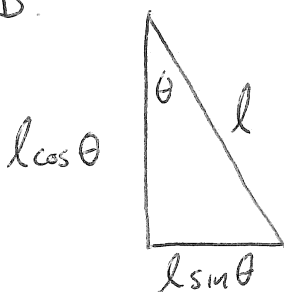
$$\omega = \sqrt{\frac{g \tan \theta}{R}}$$

1978 M1

a.



b.



$$m\omega^2 R = F_{T,x}$$

$$m\omega^2 [A + l\sin\theta] = mg \tan\theta$$

$$\omega^2 = \frac{g \tan\theta}{A + l\sin\theta}$$

$$\omega = \sqrt{\frac{g \tan\theta}{A + l\sin\theta}}$$

c.

$$W = \Delta K$$

$$W_m + W_g = \Delta K$$

$$W_m + [-\Delta U_g] = \Delta K$$

$$W_m = \Delta K + \Delta U_g$$

$$= 6 \left[\frac{1}{2} m v^2 \right] + 6 [mgh]$$

$$= 3m [v^2] + 6mg l [1 - \cos\theta]$$

WHERE $v = \omega R = \omega (A + l\sin\theta)$

$$h = l(1 - \cos\theta)$$

1979 M3

a. $m\omega^2 R = k(l_2 - l_1)$

$$m\omega^2 l_2 = k(l_2 - l_1)$$

$$m\omega^2 l_2 - kl_2 = -kl_1$$

$$l_2(m\omega^2 - k) = -kl_1$$

$$l_2 = \frac{kl_1}{k - m\omega^2}$$

b. $E = K + U$

$$= \frac{1}{2}mv^2 + \frac{1}{2}k(l_2 - l_1)^2$$

$$= \frac{1}{2}m(l_2\omega_0)^2 + \frac{1}{2}k[l_2 - l_1]^2$$

$$= \frac{1}{2}m\left[\frac{kl_1}{k - m\omega_0^2}\right]^2\omega_0^2 + \frac{1}{2}k\left[\left(\frac{kl_1}{k - m\omega_0^2}\right) - l_1\right]^2$$

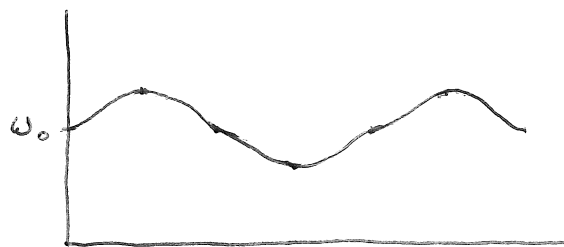
c. $L = rmv$

$$= l_2 m (\omega_0 l_2)$$

$$= m\omega_0 l_2^2$$

$$= m\omega_0 \left[\frac{kl_1}{k - m\omega_0^2}\right]^2$$

d.



1983 m3

a. i. $K = mgh$

$$= mg(R - R \cos \theta)$$

$$= mgR(1 - \cos \theta)$$

ii. $a_c = \frac{v^2}{R} = \frac{2K}{mR}$

$$= 2g(1 - \cos \theta)$$

iii. AS FOR AN INCLINE,

$$a = g \sin \theta$$

b. IT LEAVES WHEN THE RADIALY INWARD COMPONENT OF GRAVITY IS LESS THAN THE CENTRIFUGAL FORCE.

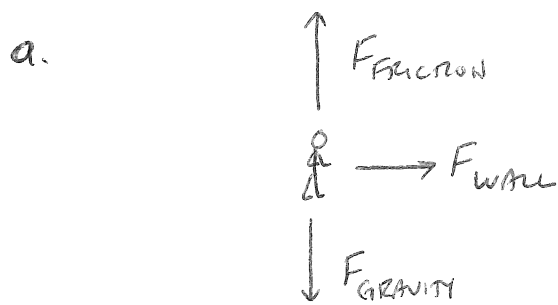
$$mg \cos \theta < m \cdot 2g(1 - \cos \theta)$$

$$mg \cos \theta < 2mg - 2mg \cos \theta$$

$$3mg \cos \theta < 2mg$$

$$\theta < \cos^{-1} \left(\frac{2}{3} \right)$$

1984 M1



b.

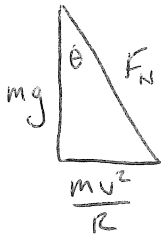
$$F_c = m \cdot \omega^2 R$$
$$= (50)(2^2 \cdot 5)$$
$$= 1000 \text{ N FROM THE WALL}$$

c.

$$F_{\text{upward}} = mg$$
$$= (50)(10) = 500 \text{ N FROM STATIC FRICTION}$$

d. No, THE GRAVITATIONAL FORCE WOULD DOUBLE, BUT SO WOULD THE NORMAL FORCE AND THUS THE FORCE OF STATIC FRICTION.

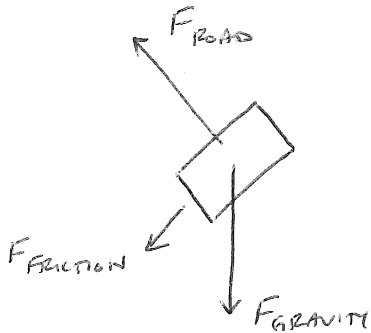
a.



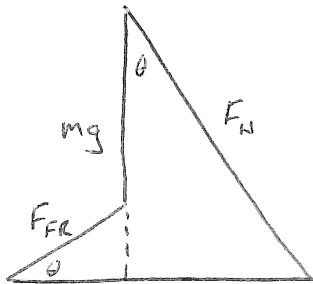
$$\tan \theta = \frac{mv^2/R}{mg} = \frac{v^2}{Rg}$$

$$v = \sqrt{Rg \tan \theta} = 16.2 \text{ m/s}$$

b.



c.



$$F_{FR} \cdot \cos \theta + F_N \sin \theta = \frac{mv^2}{R}$$

$$mg + F_{FR} \sin \theta = F_N \cos \theta$$

$$0.966 F_{FR} + 0.26 F_N = 6.25 \text{ m}$$

$$9.8 \text{ m} + 0.26 F_{FR} = 0.966 F_N$$

$$1.515 F_{FR} + 0.408 F_N = 9.8 \text{ m} = 0.966 F_N - 0.26 F_{FR}$$

$$1.775 F_{FR} = 0.558 F_N$$

$$F_{SF} \leq \mu F_N$$

$$1.775 (\mu F_N) = 0.558 F_N$$

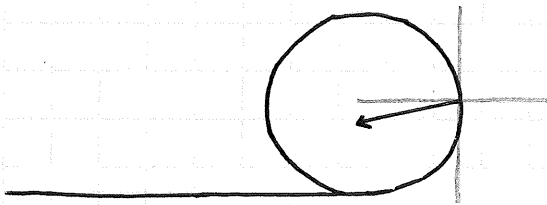
$$\mu = 0.31$$

2014 M2

a. $mgh = \frac{1}{2}mv_0^2$
 $h = \frac{v_0^2}{2g}$

b. i. ZERO, IT IS NOT ACCELERATING VERTICALLY

ii.



THE WALL PUSHES THE BLOCK TOWARDS THE CENTER OF THE CIRCLE WITH A CENTRIPETAL FORCE. IT ALSO APPLIES A DRAG FORCE OF FRICTION ANTIPARALLEL TO THE VELOCITY.

c. $N = \frac{mv^2}{R}$

d. $a_T = \frac{\mu N}{m} = \frac{\mu v^2}{R}$

$$\left. \frac{-1}{v} \right]_{v_0}^v = \left. \frac{-\mu}{R} \right]_0^t$$

e. $\frac{dv}{dt} = \frac{-\mu v^2}{R}$

$$-\frac{1}{v} + \frac{1}{v_0} = \frac{-\mu t}{R}$$

$$\frac{1}{v^2} dv = \frac{-\mu}{R} dt$$

$$v = \frac{Rv_0}{R + \mu v_0 t}$$

$$\int v^{-2} dv = \int \frac{-\mu}{R} dt$$