1

$r = 8000\,km$

$w = 12\ rev/day$

$= 24\pi/day$

$= \pi/hr$

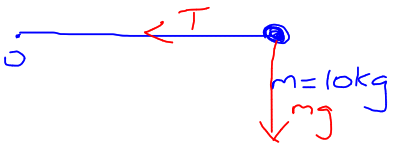
$V = rw$

$= 8000 \times \pi$

$= 8000\pi\,km/h$

$= 25133\,km/h$

4



$\omega = 60$ rev/min

$= 120\pi$ rad/min

$= 2\pi$ rad/s

horizontal $F = mr\omega^2$

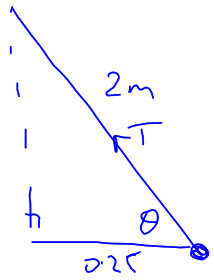
$T = mr\omega^2$

$= (10)(1)(2\pi)^2$

$= 40\pi^2$ N

$= \underline{395\text{ N}}$

7



horizontal forces $= mr\omega^2$

$T\cos\theta$ ←

$T\cos\theta = mr\omega^2$

$\omega^2 = \dfrac{T\cos\theta}{mr}$

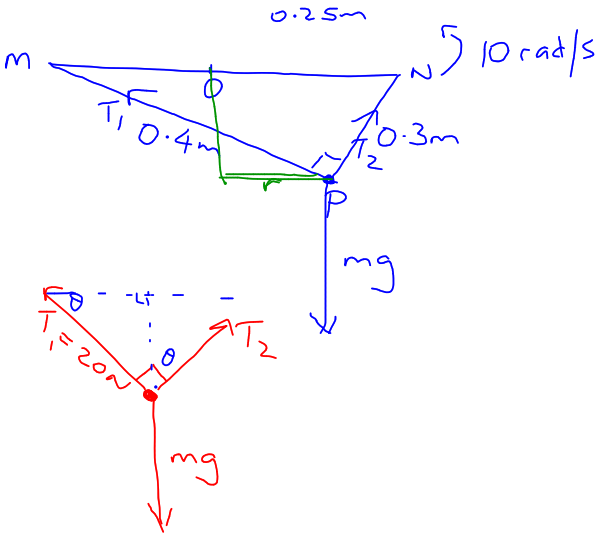
$= \dfrac{(5000)\left(\frac{1}{8}\right)}{(10)\left(\frac{1}{4}\right)}$

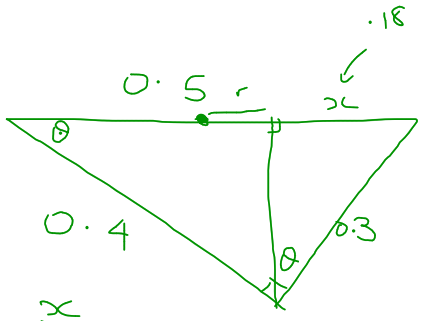
$= 250$

$\omega = 15.8$ rad/s

$= 151$ rev/min

8/





$\frac{x}{0.3} = \sin\theta$

$= \frac{3}{5}$

$x = \frac{3}{5} \times 0.3$

$= 0.18$

$r = 0.25 - 0.18$

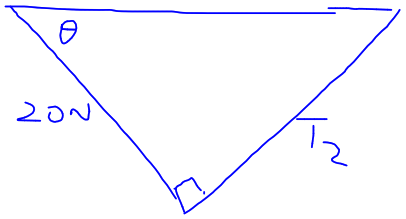
$= 0.07$

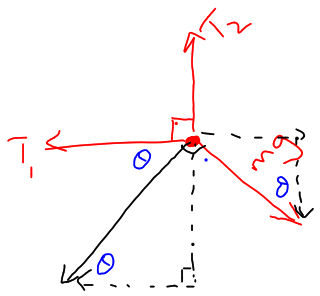
horizontal $F = mr\omega^2$

$$T_1\cos\theta - T_2\sin\theta = mr\omega^2$$

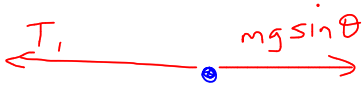
$$20\left(\frac{4}{5}\right) - T_2\left(\frac{3}{5}\right) = (10)(0.07)(10)^2$$

$$\frac{3}{5}T_2 = -(10^3)(0.07) + 20\left(\frac{4}{5}\right)$$


θ
20N
T2



horizontal $F = mr\omega^2\cos\theta$



$$mr\omega^2\cos\theta = T_1 - mg\sin\theta$$

$$m(r\omega^2\cos\theta + g\sin\theta) = T_1$$

$$m = \frac{T_1}{r\omega^2\cos\theta + g\sin\theta}$$

$$= \frac{20}{(0.07)(10^2)\left(\frac{4}{5}\right) + (10)\left(\frac{3}{5}\right)}$$

$$= \frac{50}{29}.$$

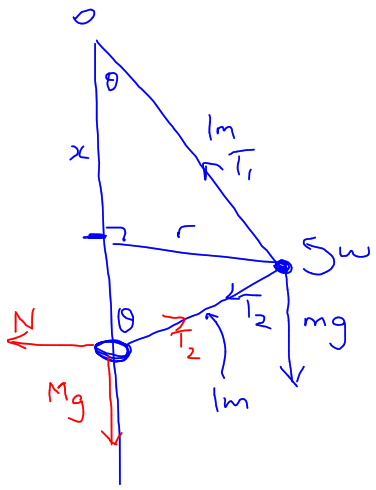
Vertical $F = mr\omega^2 \sin\theta$

$$mr\omega^2 \sin\theta = mg\cos\theta - T_2$$

$$T_2 = mg\cos\theta - mr\omega^2 \sin\theta$$

$$= \left(\frac{50}{29}\right)(10)\left(\frac{4}{5}\right) - \left(\frac{50}{29}\right)(0.07)(10^2)\left(\frac{3}{5}\right)$$

9



RING

horizontal $F = Mr\omega^2$

N ← $T_2 \sin\theta$ →

$N - T_2 \sin\theta = Mr\omega^2$

$= 0$

$N = T_2 \sin\theta$

vertical $F = 0$

$T_2 \cos\theta$ ↑

Mg ↓

$T_2 \cos\theta - Mg = 0$

$T_2 = \dfrac{Mg}{\cos\theta}$

BOB

horizontal $F = mr\omega^2$

$T_2 \sin\theta$ ←

$T_1 \sin\theta$ ←

$(T_1 + T_2)\sin\theta = mr\omega^2$

vertical $F = 0$

$T_1 \cos\theta$ ↑

mg ↓ $T_2 \cos\theta$ ↓

$mg + T_2 \cos\theta - T_1 \cos\theta = 0$

$(T_1 - T_2)\cos\theta = mg$

$T_1 \sin\theta + Mg\tan\theta = mr\omega^2$ $\qquad$ $T_1\cos\theta - Mg = mg$

$T_1 \sin\theta = mr\omega^2 - Mg\tan\theta$ $\qquad$ $T_1\cos\theta = Mg + mg$

$$\tan\theta = \frac{mr\omega^2 - Mg\tan\theta}{Mg + mg}$$

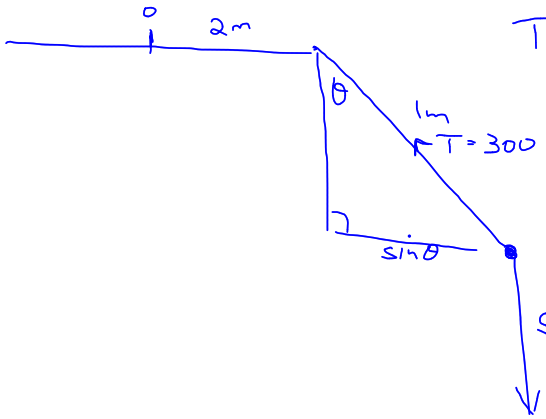
$$\frac{r}{x} = \frac{mr\omega^2 - \frac{Mr}{x}g}{Mg + mg}$$

$$Mg + mg = m\omega^2 x - Mg$$

$$2Mg + mg = m\omega^2 x$$

$$x = \frac{(2M + m)g}{m\omega^2}$$

12



horizontal $F = 5r\omega^2$

$T\sin\theta$

$T\sin\theta = 5r\omega^2$

$\omega^2 = \dfrac{T\sin\theta}{5r}$

$= \dfrac{\left(300 \times \frac{\sqrt{35}}{6}\right)}{5\left(2 + \frac{\sqrt{35}}{6}\right)}$

$\omega = 4.45 \text{ rad/s}$

vertical $F = 0$

$T\cos\theta$

$5g$

$5g - T\cos\theta = 0$

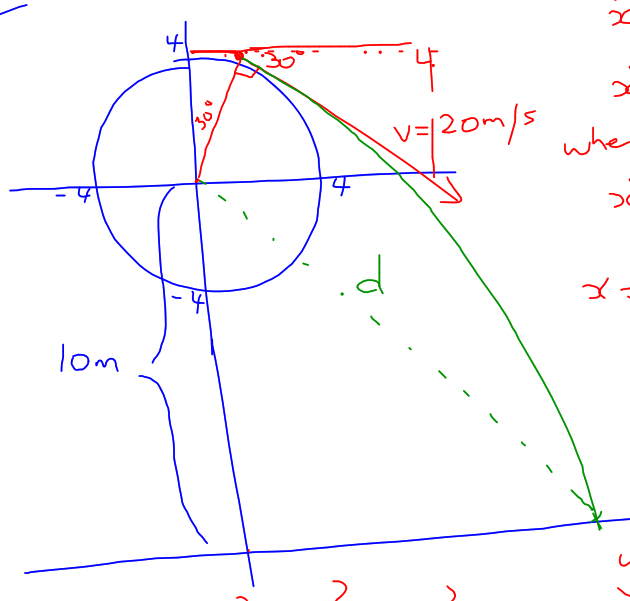
$T\cos\theta = 5g$

$\cos\theta = \dfrac{g}{60}$

$= \dfrac{1}{6}$

$\theta = 80.4^\circ$

14



$\ddot{x} = 0$

$\dot{x} = c$

when $t=0, \dot{x} = 10\sqrt{3}$

$\dot{x} = 10\sqrt{3}$

$x = 10\sqrt{3}t + c$

when $t=0, x=2$

$c = 2$

$x = 10\sqrt{3}t + 2$

$\ddot{y} = -10$

$\dot{y} = -10t + c$

$\dot{y} = -10$

$c = -10$

$\dot{y} = -10t - 10$

$y = -5t^2 - 10t + c$

$y = 10 + 2\sqrt{3}$

$c = 10 + 2\sqrt{3}$

$y = -5t^2 - 10t + 2\sqrt{3} + 10$

$y = 0, \quad 5t^2 + 10t - 10 - 2\sqrt{3} = 0$

$t = \dfrac{-10 \pm \sqrt{100 + 20(10 + 2\sqrt{3})}}{10}$

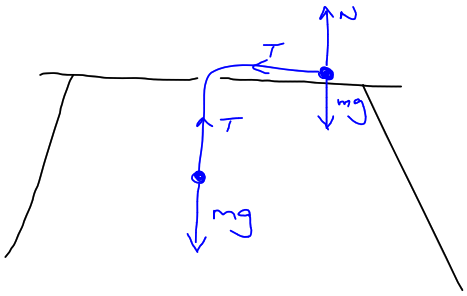
$= 0.92$

$\therefore x = 17.96$

$d^2 = 10^2 + x^2$

$d = 20.6\text{m}$

16



BOB 1

Vertical $F = 0$

$T - mg = 0$

$T = mg$

BOB 2

horizontal $F = \frac{mv^2}{r}$

$T = \frac{mv^2}{r}$

$mg = \frac{mv^2}{r}$

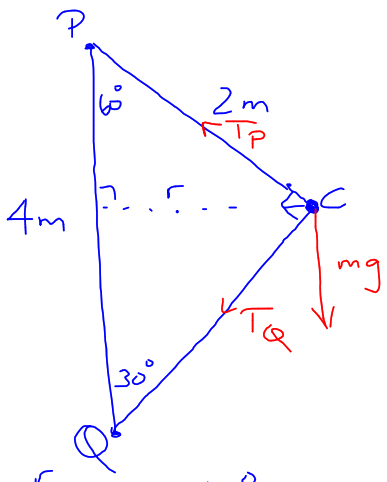
$v^2 = gr$

$= (10)(2)$

$v^2 = 20$

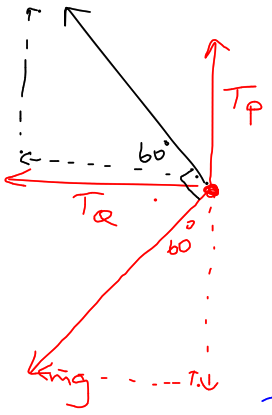
$v = 2\sqrt{5}\ m/s$

20

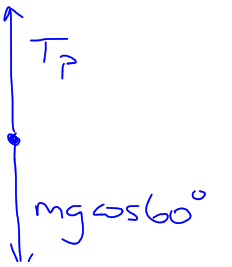


$\frac{r}{2} = \sin 60°$

$r = \sqrt{3}$



Vertical $F = mr\omega^2 \sin 60°$



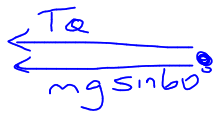
$T_P - mg\left(\frac{1}{2}\right) = mr\omega^2\left(\frac{\sqrt{3}}{2}\right)$

$T_P = \frac{m}{2}\left(g + \sqrt{3}r\omega^2\right)$

$= \frac{12}{2}\left(10 + \sqrt{3}\left(\sqrt{3}\right)(4\pi)^2\right)$

$= 2902\ N$

horizontal $F = mr\omega^2 \cos 60°$



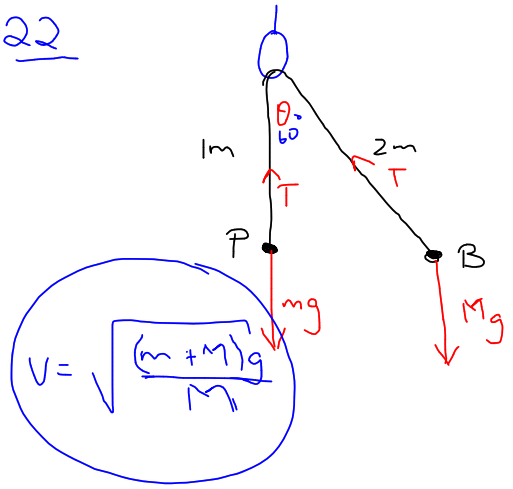
$$T_Q + mg\left(\frac{\sqrt{3}}{2}\right) = mr\omega^2\left(\frac{1}{2}\right)$$

$$T_Q = \frac{m}{2}\left(r\omega^2 - \sqrt{3}g\right)$$

$$= \frac{12}{2}\left(\sqrt{3}(4\pi)^2 - \sqrt{3}(10)\right)$$

$$= 1540\ N$$

22



horizontal F on B $= \frac{Mv^2}{r}$

$T\sin 60°$ ←

$\frac{\sqrt{3}T}{2} = \frac{Mv^2}{\sqrt{3}}$

$\frac{\sqrt{3}mg}{2} = \frac{Mv^2}{\sqrt{3}}$

$v^2 = \frac{3mg}{2M}$

$v = \sqrt{\frac{3mg}{2M}}$

$= \sqrt{\frac{3Mg}{M}}$

$= \sqrt{\frac{(m+M)g}{M}}$

vertical F = 0

$T\cos 60°$ ↑

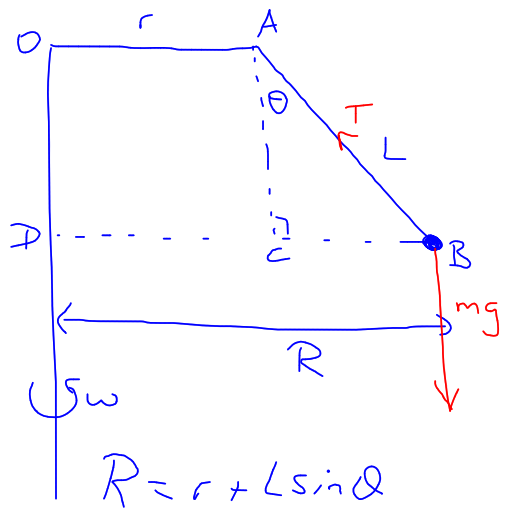
Mg ↓

$Mg = \frac{mg}{2}$

$M = \frac{m}{2}$

$m = 2M$

25



horizontal F = $mR\omega^2$

$T\sin\theta$ ←

$T\sin\theta = mR\omega^2$

Vertical F = 0

↑ $T\cos\theta$

↓ mg

$T\cos\theta - mg = 0$

$T\cos\theta = mg$

$$\tan\theta = \frac{mR\omega^2}{mg}$$

$$g\tan\theta = R\omega^2$$

$$g\tan\theta = (r + L\sin\theta)\omega^2$$

$$v = r\omega$$

$$v^2 = R^2\omega^2$$

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

$$= Rg\tan\theta$$

$$= (r + L\sin\theta)g\tan\theta$$