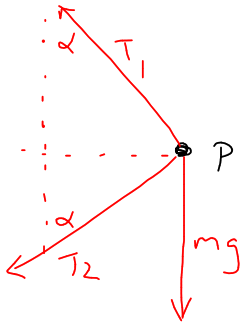
1b)



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

$T_1 \sin\alpha$

$T_2 \sin\alpha$

$T_1 \sin\alpha + T_2 \sin\alpha = \frac{mv^2}{r}$

F vertically = 0

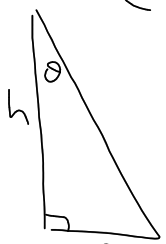
$T_1 \cos\alpha$

$T_2 \cos\alpha$ mg

$T_1 \cos\alpha - T_2 \cos\alpha - mg = 0$

(ii) $\omega = 3\sqrt{\frac{g}{h}}$

$(T_1+T_2)\sin\theta = \frac{9mrg}{h}$ $\qquad$ $(T_1-T_2)\cos\theta = mg$



$$\frac{(T_1+T_2)\sin\theta}{(T_1-T_2)\cos\theta} = \frac{9mrg}{h} \times \frac{1}{mg}$$

$$\frac{(T_1+T_2)r}{(T_1-T_2)h} = \frac{9r}{h}$$

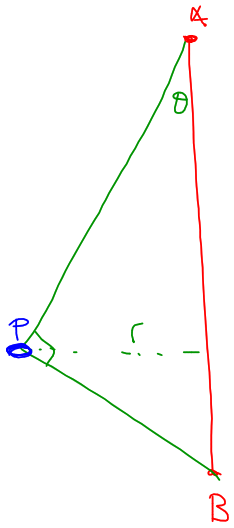
$$\frac{T_1+T_2}{T_1-T_2} = 9$$

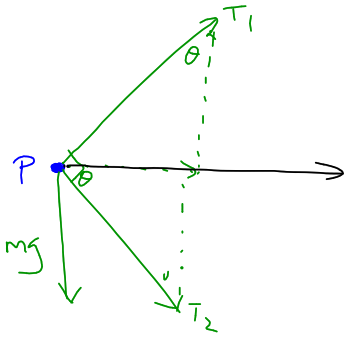
$$T_1+T_2 = 9T_1-9T_2$$

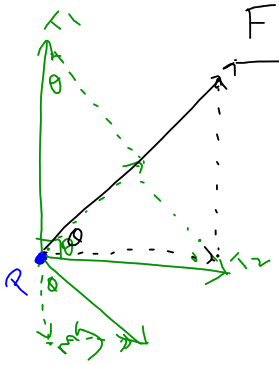
$$8T_1 = 10T_2$$

$$\frac{T_1}{T_2} = \frac{5}{4}$$

4/

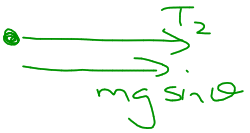






F in direction T_1 $= mr\omega^2 \sin\theta$

F in direction T_2 $= mr\omega^2 \cos\theta$



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

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

$T_2 = m(r\omega^2\cos\theta - g\sin\theta)$

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

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

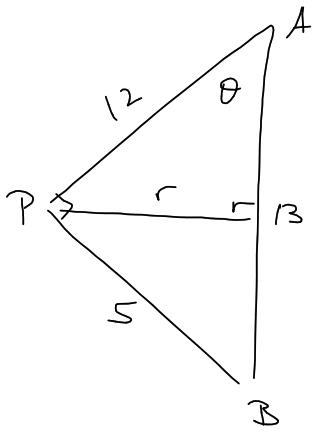
$T_2 > 0$

$m(r\omega^2 \cos\theta - g\sin\theta) > 0$

$12\left(\frac{5}{13}\right)\omega^2\left(\frac{12}{13}\right) - g\left(\frac{5}{13}\right) > 0$

$\frac{144\omega^2}{13} > g$

$144\omega^2 > 13g$



$\frac{r}{12} = \sin\theta$

$r = 12\sin\theta$

$$T_1 = T_2$$

$$g\cos\theta + r\omega^2\sin\theta = r\omega^2\cos\theta - g\sin\theta$$

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

$$12\left(\frac{5}{13}\right)\omega^2\left(\frac{12}{13} - \frac{5}{13}\right) = g\left(\frac{12}{13} + \frac{5}{13}\right)$$

$$\frac{420}{13}\omega^2 = 17g$$

$$420\omega^2 = 221g$$