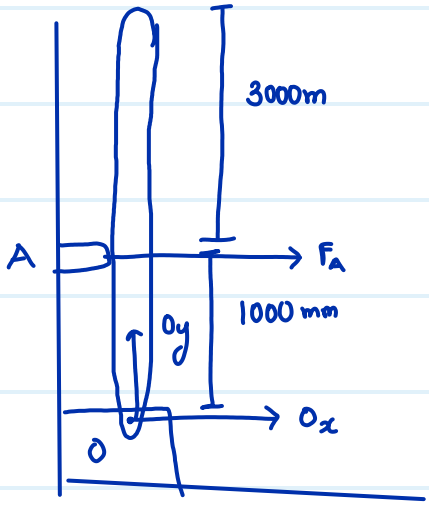
Tutorial-8 (2) (3)

1)

$m = 30kg$

$\bar{a} = 20 m/s^2$



F_A

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

$$\vec{I}_p\vec{\alpha} + \vec{PG} \times m\vec{a}_p = \vec{M}_p$$

$$(F_A + O_x)\hat{i} = m(a\hat{i})$$

$$F_A + O_x = 30(20) = 600$$

$$\left(\frac{l}{2}\hat{j}\right) \times \left((30)(a\hat{i})\right) = -F_A\hat{k}$$

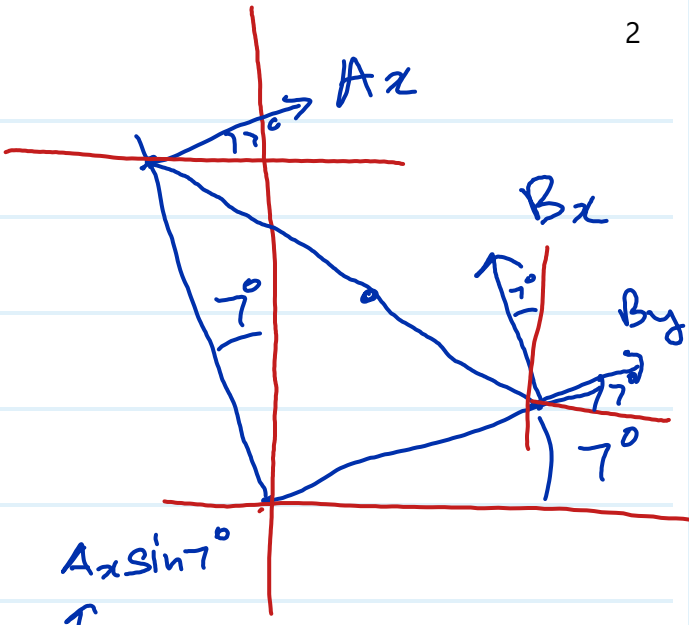
$$-\frac{30la}{2} = -F_A$$

$$F_A = 15al = 15(20)(4)$$

$$F_A = 1200N\,\hat{i}$$

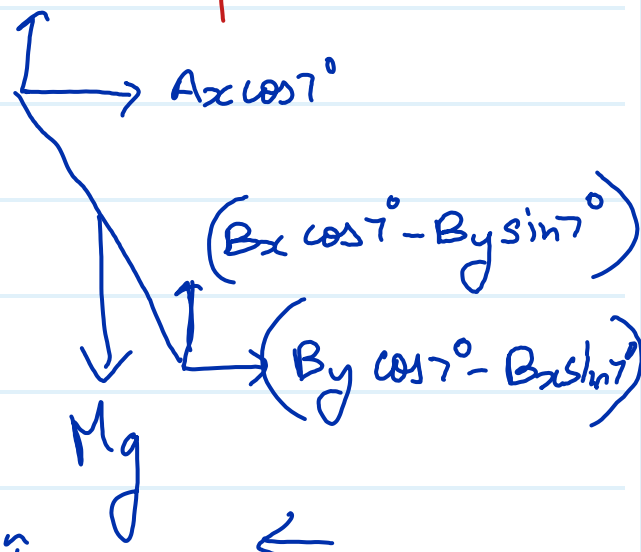
$$O_x = -600N\,\hat{i}$$

2)



$$\overrightarrow{F} = m\overrightarrow{a_G}$$

$$I_P\alpha + \overrightarrow{PG} \times m\overrightarrow{a_P} = \overrightarrow{M_P}$$



$$A_x \sin 7^\circ + B_x \cos 7^\circ - B_y \sin 7^\circ = Mg$$

$$B_x \cos 7^\circ - B_y \sin 7^\circ = Mg$$

$$B_y \cos 7^\circ - B_x \sin 7^\circ = Ma.$$

$$A_x \hat{i} + (B_y \cos 7^\circ - B_x \sin 7^\circ)(-\hat{i}) = -Ma\hat{i}$$

$a \leftarrow$

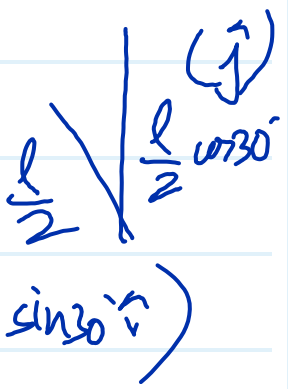
$y \downarrow$

$\rightarrow x$

$$A_x \cos 7^\circ - B_y \cos 7^\circ + B_x \sin 7^\circ = -Ma.$$

$$(B_y - A_x)\cos 7^\circ - B_x \sin 7^\circ = Ma$$

$$\cancel{I_B\alpha}^{\,0} + \overrightarrow{BG} \times m\overrightarrow{a_B} = \overrightarrow{M_B}$$



$$\left(\frac{\ell}{2}\cos 30^\circ \hat{j} - \frac{\ell}{2}\sin 30\,\hat{i}\right) \times m\left(-a\,\hat{i}\right)$$

$$= +Mg\frac{\ell}{2}\sin 30^\circ \hat{k}$$

$$- A_x(\cos 7^\circ)\,\ell\cos 30^\circ \hat{k}$$

$$- A_x(\sin 7^\circ)\,\ell\sin 30^\circ \hat{k}$$

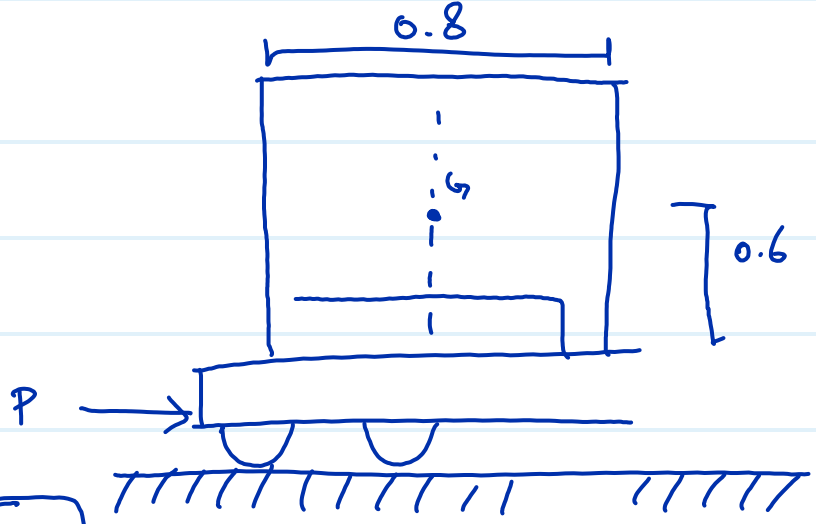
$$B_x\cos 7^\circ - B_y\sin 7^\circ = Mg$$

$$B_y\cos 7^\circ - B_x\sin 7^\circ = Ma.$$

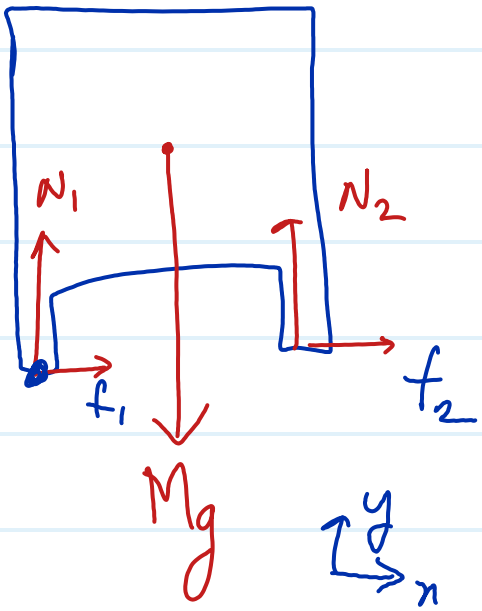
$$a\cos 30^\circ = g\sin 30^\circ$$

$$\boxed{a = g\tan(30^\circ) \simeq 5.66\ ms^{-2}}$$

3)



$$a = \frac{P}{60}\hat{i}$$



$$N_1 + N_2 = 50g$$

$$f_1 + f_2 = \frac{5}{6}P$$

$$I_A\alpha^{\nearrow 0} + \overrightarrow{AG} \times m\vec{a}_A = \vec{M}_A$$

$$(0.4\hat{i} + 0.6\hat{j}) \times \left(50\left(\frac{P}{60}\hat{i}\right)\right) = \left(-Mg(0.4)\hat{k} + N_2(0.8)\hat{k}\right)$$

$$-\frac{P}{2} = \left(\frac{8N}{10} - \frac{4}{10}Mg\right)$$

$$\frac{P}{2} = \frac{4Mg}{10} - \frac{8N_2}{10}$$

$N_2 = 0$

$$P \geq \frac{8}{10}Mg \geq \frac{4}{5} \times \frac{10}{50} \times 98$$

$$P \geq 392\,N$$

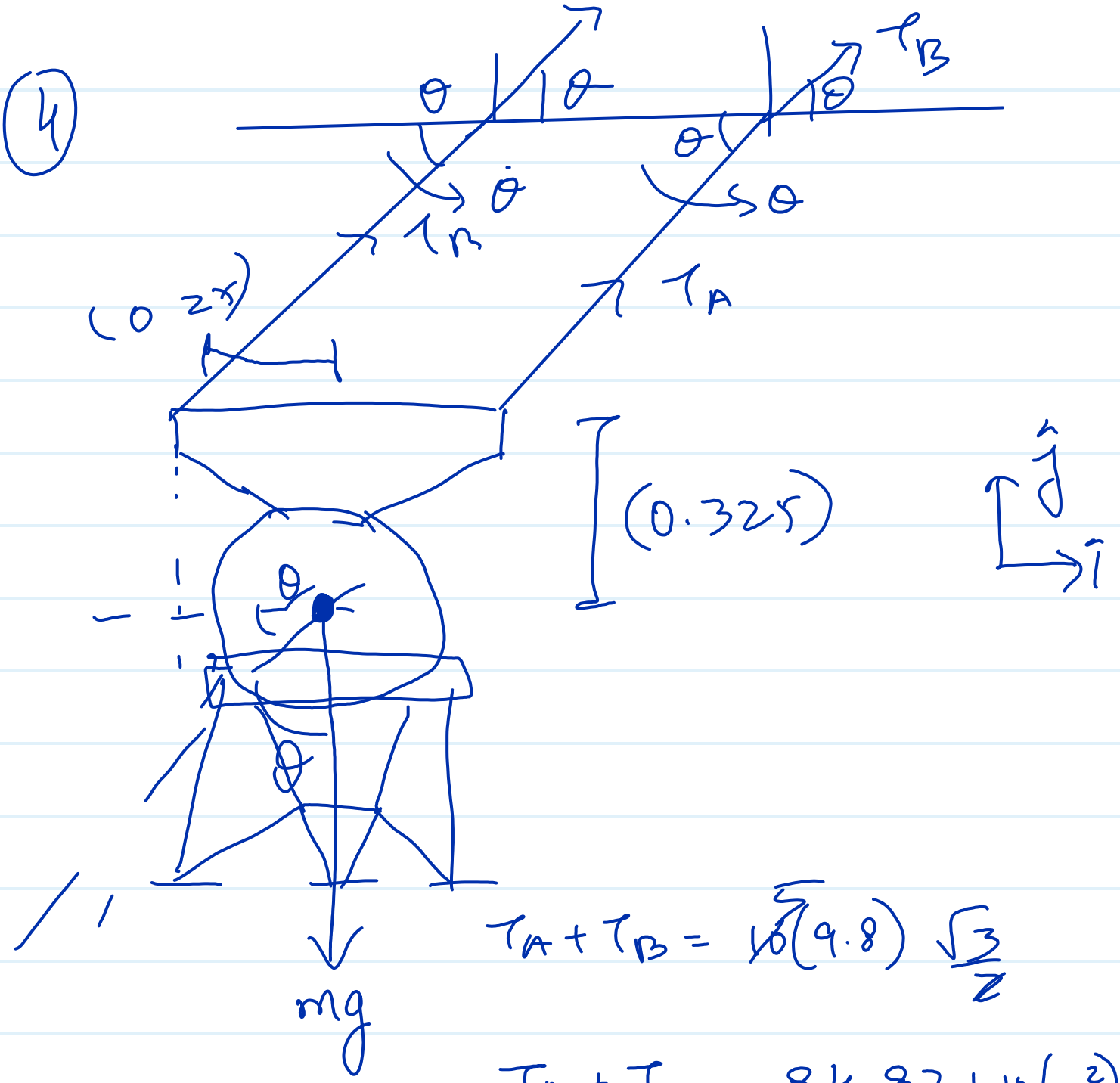
$N_1 = 50g \qquad f_1 \geq \frac{5}{6}(392)$

$\mu N_1 = f_1$

$\mu = \frac{f_1}{N_1} \qquad \mu \geq \frac{\frac{5}{6}(392)}{50g}$

$\mu \geq \frac{2}{3}$

(4)



$$T_A + T_B = 16(9.8)\frac{\sqrt{3}}{2}$$

$$T_A + T_B = 84.87 + 10(\omega^2)r$$

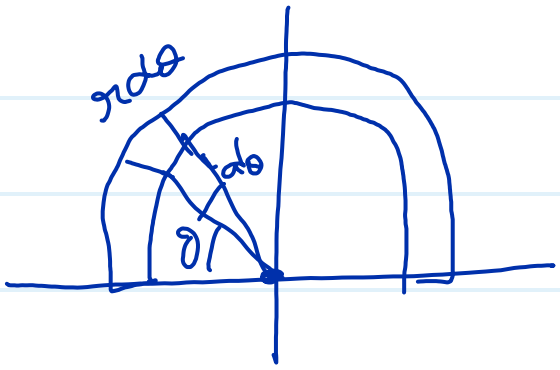
$$T_A + T_B = 168.87$$

$$\overline{M}_n = 0$$

$$0.379\,T_B = 0.054\,T_A$$

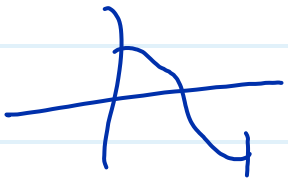
$$T_A = 147.81 \qquad T_B = 24.06N$$

5)



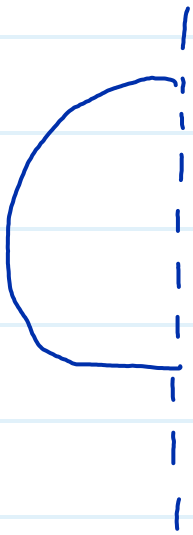
$dm = \rho r d\theta$

$$\frac{\int dm\, r \sin\theta}{\int dm}$$



$$= \frac{\int \rho \sin\theta\, r^2 d\theta}{\int \rho r d\theta} \quad 2\left[-\cos\theta\right]_0^{\frac{\pi}{2}}$$

$$= \frac{2r}{\pi}$$



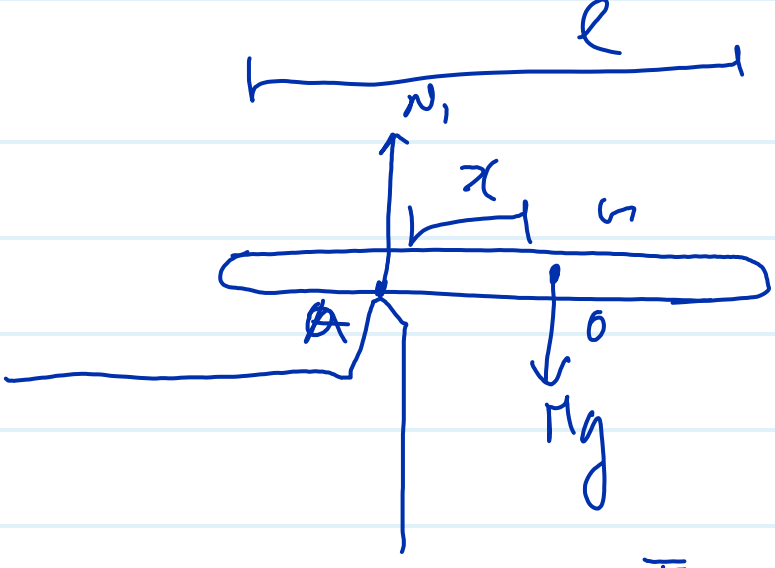
$I_O \alpha = \vec{M_O}$

$I_O \alpha = M$

$\frac{mr^2}{2}\alpha = M$

$$\boxed{\alpha = \frac{2M}{mr^2}}$$

6)



$$\bar{F} = M\bar{a}$$

$$N_1 - Mg = 0$$

$$\boxed{N_1 = Mg}$$

$$I_A = \frac{ml^2}{12} + mx^2$$

$$\left(\frac{ml^2}{12} + mx^2\right)\alpha = Mgx$$

$$\alpha = \frac{gx}{\left(\frac{l^2}{12} + x^2\right)}$$

$$\frac{d\alpha}{dx} = \frac{\left(\frac{l^2}{12} + x^2\right)g - (gx)(2x)}{\left(\frac{l^2}{12} + x^2\right)^2} = 0$$

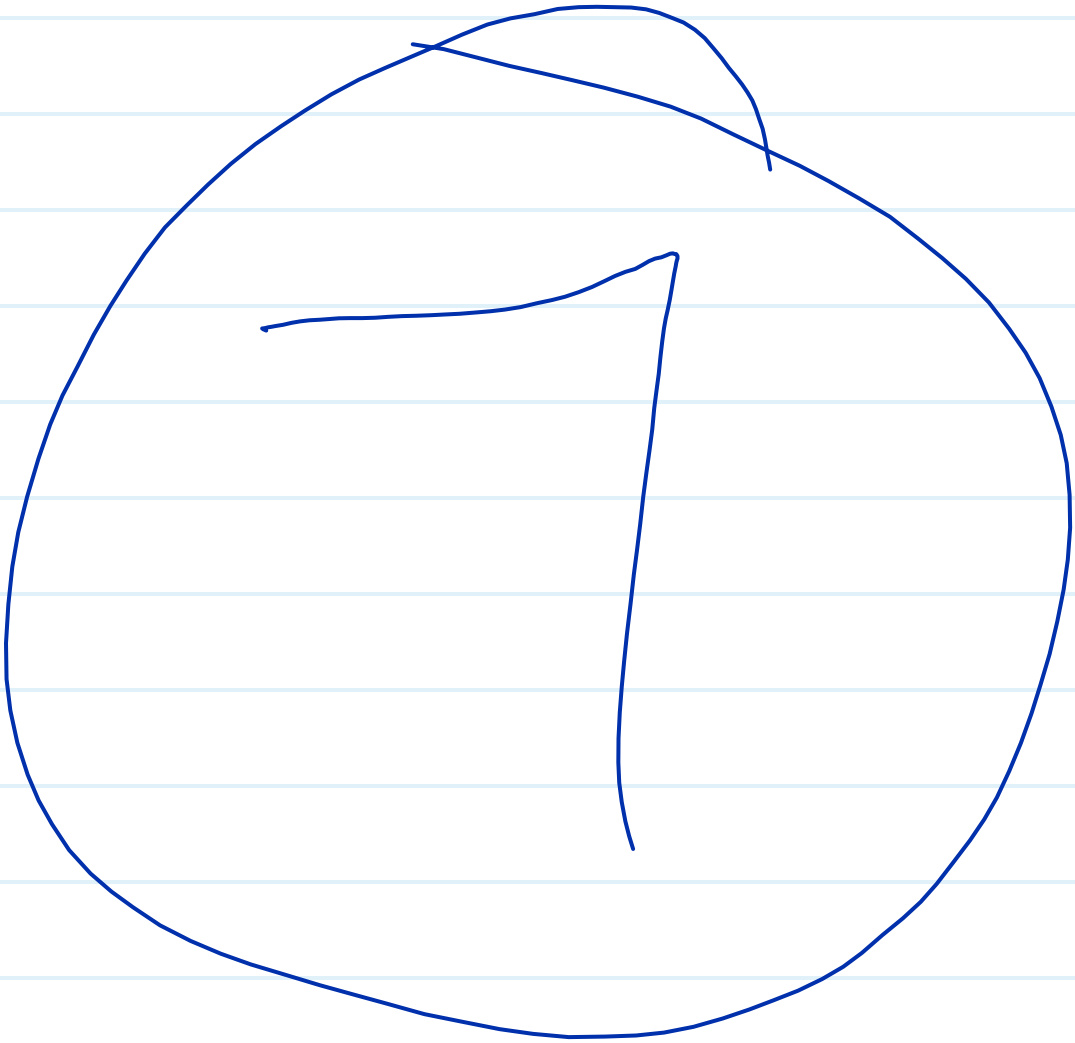
$$2gx^2 = \frac{gl^2}{12} + gx^2$$

$$gx^2 = \frac{gl^2}{12}$$

$$x = \frac{l}{\sqrt{12}} = \frac{l}{2\sqrt{3}}$$

$$\alpha = \frac{\frac{gl}{\sqrt{12}}}{\frac{l^2}{6}} = \frac{g\sqrt{3}}{l}$$

$$\alpha = \frac{g\sqrt{3}}{l}$$

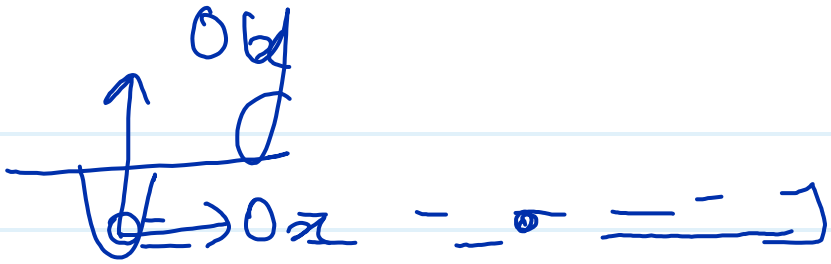


8 Doubted

$\mu = \tan\theta$

$\theta = 16.6^\circ$

9)

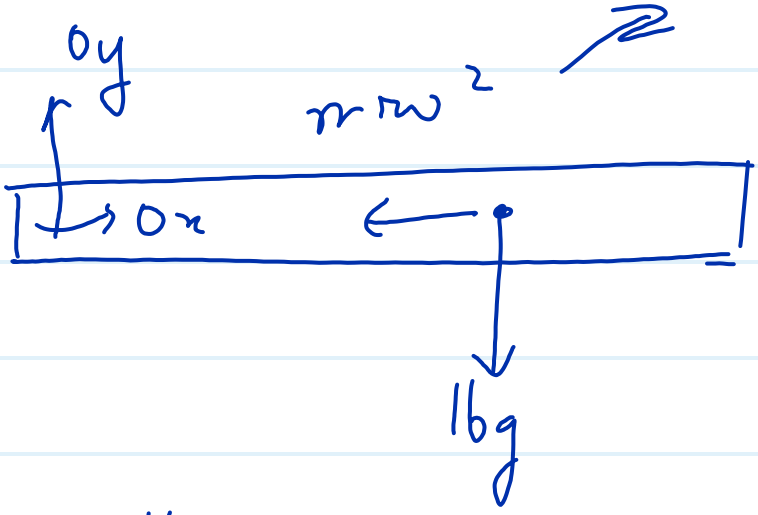


$8(0.25) + 8(0.5)$

0.3

$0.75 = 0.37$

2



$Oy = 16g$

$Ox = 16rw^2$

$16\sqrt{g^2 + r^2w^4}$

$16\sqrt{}$