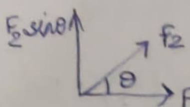
Unit 1: 1. Mechanics

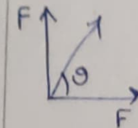
type 1: resolution of forces

$R = \sqrt{\Sigma H^2 + \Sigma V^2}$



$R = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta}$

$\tan\theta = \frac{\Sigma F_y}{\Sigma F_x}$ (for direction)



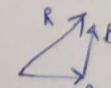
$R = 2F\cos\frac{\theta}{2}$

resultant

$\Sigma H = (+)$ 0° to 90°
270° - 360°

$\Sigma H = (-)$ 90° - 270°

triangle law

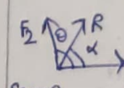


$\bar{A} + \bar{B} = \bar{R}$

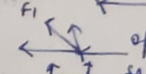
parallelogram law of forces:

$R = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta}$

$\tan\alpha = \frac{F_2 \sin\theta}{F_1 + F_2\cos\theta}$



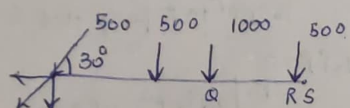
same sense



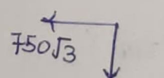
opp sense

principle of transmissibility

(1)



→



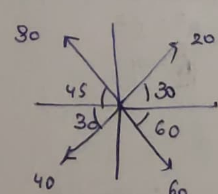
so $R = \sqrt{(2750)^2 + (750\sqrt{3})^2}$

$\boxed{R = \sqrt{7564750}}$

$\tan\theta = \frac{2750}{750\sqrt{3}} = \frac{11}{3\sqrt{3}}$

$\boxed{\theta^{-1} = \tan\left(\frac{11}{3\sqrt{3}}\right)}$

(2)



coplanar concurrent

$\Sigma V = 20\sin 30 + 30\sin 45 - 40\sin 30 - 60\sin 60$
$= -40.7$

$\Sigma H = 20\cos 30° + 60\cos 60° - 30\cos 45° - 40\cos 30°$
$= -18.5$

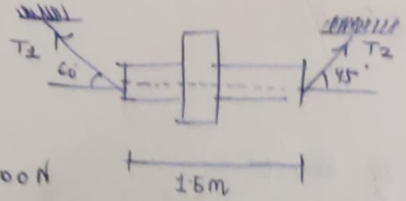
$R = \sqrt{(-40.7)^2 + (-18.5)^2}$

$\boxed{R = 44.07 \text{ kN}}$

$\tan\theta = \frac{-40.7}{-18.5} = 2.2$

$\boxed{\theta = \tan^{-1}(2.2) = 66°}$

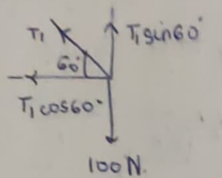
3.



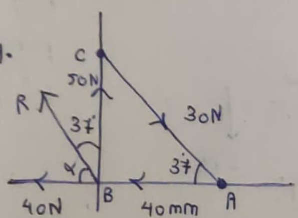
$w = 1000\,N$

$T_2 \sin 60^\circ = 1000\,N$
$T_2 \sin 45^\circ = 1000\,N$

$T_1 = 1154.7\,N.$



4.

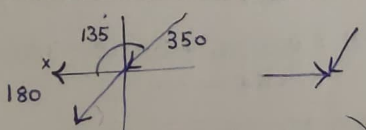


$R = \sqrt{2500 + 1600}$
$R = \sqrt{4100}$

$\sin\theta = \frac{30}{50} = \frac{3}{5}$
$\theta = 37^\circ$

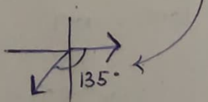
$\tan\alpha = \frac{50}{40} = \frac{5}{4}$

5.



$R = \sqrt{(350)^2 + (180)^2 + \left[2 \times 180 \times 350 \times \frac{1}{\sqrt{2}}\right]}$

$R = 493.69.$



6. $\frac{P^2}{4} = P^2 + P^2 + 2P^2\cos\theta$

$\frac{P^2}{4} = 2P^2(1+\cos\theta)$

$\frac{1}{8} = 1 + \cos\theta$

$\cos\theta = -\frac{7}{8} = 0.88.$

$\theta = \cos^{-1}\left(-\frac{7}{8}\right) = 151^\circ$

equal forces P when their resultant is $\to P \longrightarrow 120^\circ$, $\to P/2 \longrightarrow 151^\circ$

7.

The resultant of 2 forces P & Q is R if Q is doubles the resultant is $\perp^{rd}$ to P proof that $\boxed{Q=R}$.

1. $P \cdot R = 0$

$P \cdot \sqrt{4Q^2 + P^2 + 4PQ\cos\theta} = 0$

$P^2 + 4Q^2 + 4PQ\cos\theta = 0$ —— (1)

2. $\to R = \sqrt{P^2 + Q^2 + 2PQ\cos\theta}$

$\tan 90^\circ = \frac{2Q\sin\theta}{P + 2Q\cos\theta} = \frac{1}{0}$

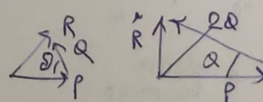
$P = -2Q\cos\theta$ put in (1)

$R^2 = 4Q^2\cos^2\theta + Q^2 - 4Q\cos\theta \cdot Q\cos\theta$

$R^2 = Q^2$

$\boxed{R = \theta}$

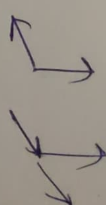
Other method



$R^2 = P^2 + Q^2$ $\quad \cos\theta = \frac{P}{2Q}$

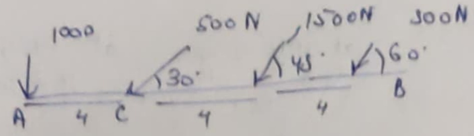
$\cos\theta = \frac{Q^2 + P^2 - R^2}{2PQ} = \frac{P}{2Q}$

$Q^2 = R^2$
$Q = R.$



Type 2: Moment and their application

(1)



1. $F_H = 1500 \times \frac{\sqrt{3}}{2} + \frac{1500F}{\sqrt{2}} + 500\frac{1}{2} = 0$

$= 2605$

$F_V = 1000 + \frac{1500}{\sqrt{2}} + 1500\frac{1}{2} + 500\frac{\sqrt{3}}{2} = 0$

2. $F_V = 3243.6$

$F_{net} = \sqrt{F_H^2 + F_V^2}$

$\tan\theta = \frac{F_V}{F_H} \Rightarrow \frac{3243.6}{2609}$

$\theta = 51.18'$

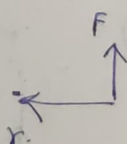
determinant member → analyse using eq^n condition → ΣH ΣM ΣV.

indeterminant member → eq^n insufficient

3. $\Sigma M = 0$

$250\sqrt{3} \times 12 + 1500 \sin 45 \times 8 + 1500 \sin 30 \times 4 + 0$

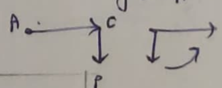
mor. → $F \times r L$



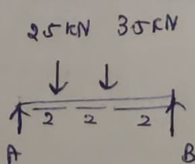
moments. $500 \cos 30$

$500 \sin 30 = P$

P x distance = M from A



P x d ⇒ anticlockwise (+)



(2)

$\Sigma H = 0$

$\Sigma V = 0$ $R_B - 3.5 - 2.5 + R_A = 0$

$R_A + R_B = 6N$ —(1)

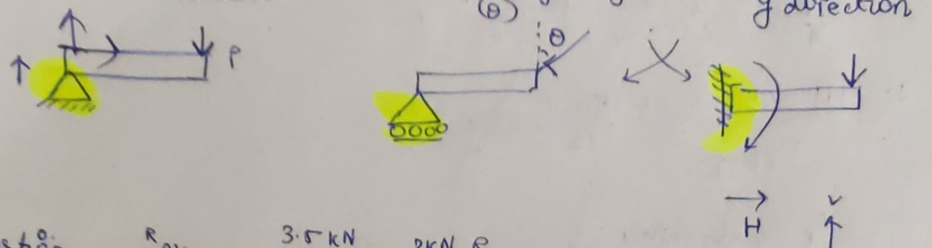
$\Sigma M = 0$ $R_B \times 6 - 3.5 \times 4 - 2.5 \times 2 + R_A \times 0 = 0$

$R_B = 19/6$

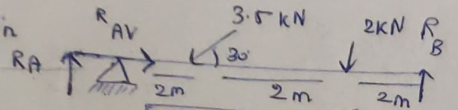
put in (1) to find RA

① Pin or hinged support ② Fixed support ③ Roller support

movement in x & y direction | at any angle (θ) | at only in y direction



Question



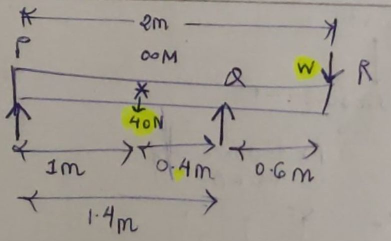
1. $\Sigma H = 0$ $\boxed{= \frac{\sqrt{3}}{2}(3.5) = R_{AV}}$ — (i)

2. $\Sigma V \rightarrow R_A + R_B - \frac{\cancel{1}}{2}(3.5) - 2 = 0$

$$\boxed{R_A + R_B - \frac{3.5}{2} - 2 = 0} \text{ — (ii)}$$

3. $\Sigma M = 0$ $\boxed{R_A \times 0 + R_B \times 6 - 2 \times 4 - \frac{3.5}{2} \times 2 = 0}$ — (iii)

type ④

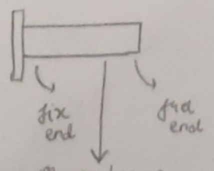


$0.4 \times 40 = 0.6 \times W$

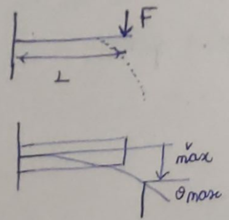
$W = 26.66 N.$

Ques. A uniform plank PQR of weight 40 N and length 2 metre is support at one end 'P' and at 'Q' 1.4 m from P. shown fig. find 'maximum' that can be placed at R should plank does not topple.

-cantilever beam



for eg'



$$\theta_{max} = \frac{-PL^2}{2EI}$$

$$v_{max} = \frac{-PL^3}{3EI}$$

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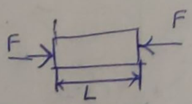
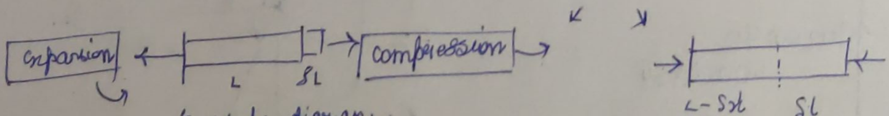
tensile strength.

Stress

Strain = $\frac{\text{Force}}{\text{area}}$.



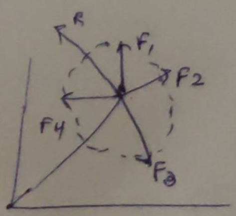


free body diagram.

Stress value ⊏ tensile / compressive

You have to consider all the forces.

Varignon's theorum



→ $\Sigma M = \rho\theta$ this is momement.

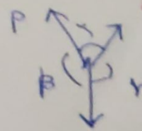
→ $M_o = F_1 \times r + F_2 \times r + F_3 \times r + F_4 \times r$

$M_o = r(F_1 + F_2 + F_3 + F_4)$

$\boxed{M_o = r \cdot R}$

if no. of coplanar forces are acting simultaniously on a particle the algebraic sum of mom

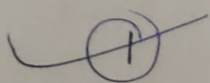
Lami's theorem

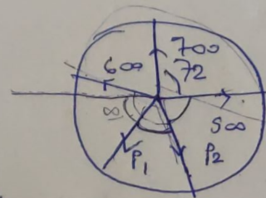


$$\frac{P}{\sin\gamma} = \frac{R}{\sin\beta} = \frac{Q}{\sin\alpha}.$$

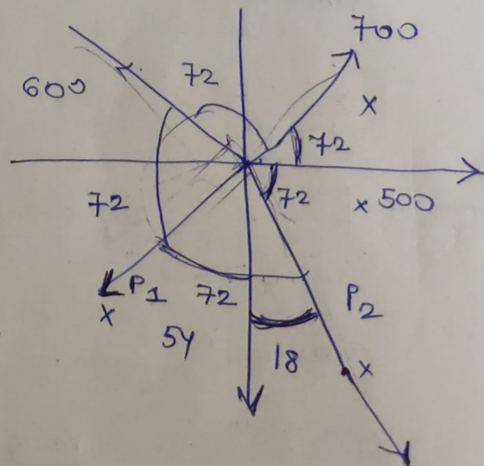
A wheel has 5 equally radial spoken all in tension.
If the tension of three consequtive spoke
500 700 600

#1.





P_1



$700 \sin 72 + 600 \cos 54$

$P_1 \sin 54 + 600 \sin 54$

$700 \cos 72 + 500 + P_2 \cos 72$

$P_2 \sin 72 + P_1 \cos 54$

$\sin 54 = \frac{y}{\delta}$

$1018.41 = P_2 \sin 72 + P_1 \cos 54.$

$485.41 + P_1 \frac{y}{\delta} = 716.31 + P_2 \cos 72$

$$P_1 \cos 54 + P_2 \sin 72 = 1018.41$$
$$P_1 \sin 54 - P_2 \cos 72 = 230.89$$

P_1

$$x \cos 54 + y \sin 72 = 1018.41$$
$$x \sin 54 - y \cos 72 = 230.89$$

$$0.8x + 0.309y = 230.89$$
$$0.58x - 0.95y = 1018.41$$

$$0.58x - 0.95\left(\frac{230.89 - 0.8x}{0.309}\right) = 1018.41$$

$$-3.074(230.89 - 0.8x)$$

$$0.58x - 709.85 + 2.45x = 1018.41$$

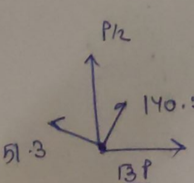
$$\cancel{187x = 308.56}$$

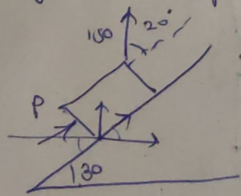
$P_1 = 560\ \mathrm{N}$
$P_2 = 723\ \mathrm{N}$

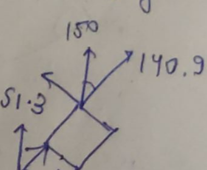
$$\boxed{\cancel{x = 165}}$$

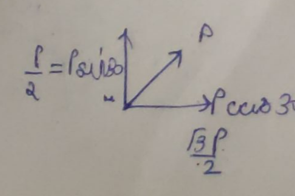
$$3.03x = 1728.26$$
$$x = 570\ \mathrm{N}$$

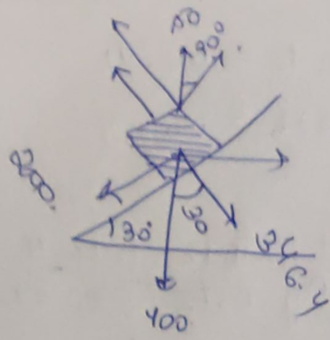
Q2. A block varing 400 N on an inclined plane in an eq^m condition then subjected to mag of force + react from plane.

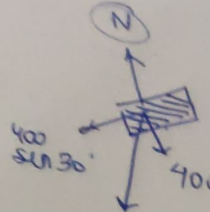




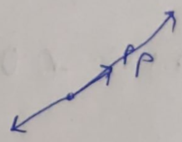








$400 \cos 30 = \frac{\sqrt{3}}{2} 400$



\# $\boxed{P + 140.95 = 200}$ ans(1)

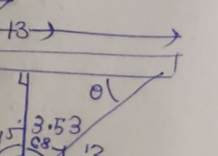
$\Rightarrow P = 59°$

295N. \# $51.3 + N = 346.4$

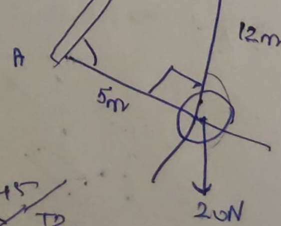
$\boxed{N = 295.11}$, ans(2)

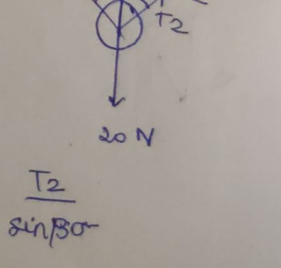
\#3. A body of weight is suspen by 2 strings 5m and 12m long and other ends beings fastens. to the extrems. of the rod 13m rod to be held that the body hangs immediately below its midpoint find out the tension in the strings

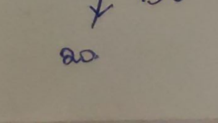
20



28.79. x

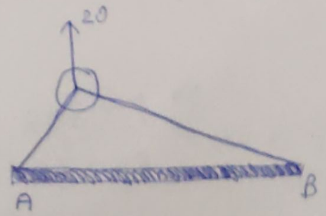


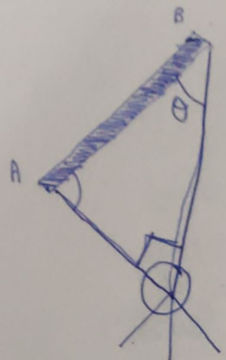


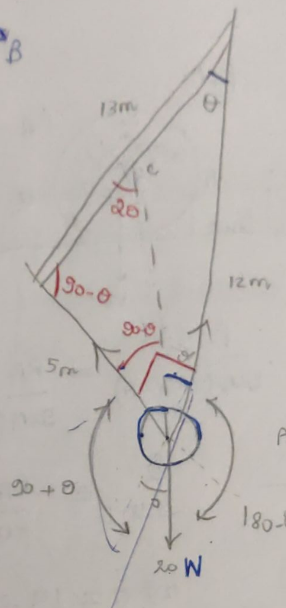


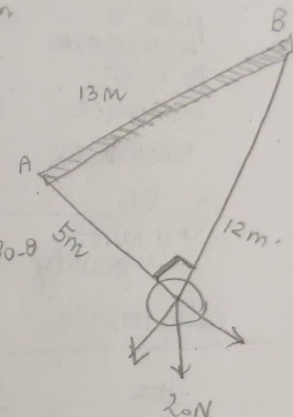
$\frac{T_1}{\sin 135} = \frac{20}{\sin 90} = \frac{T_2}{\sin 180}$

$\boxed{T_1 = 14.14N}$









$$\frac{T_1}{\sin(180-\theta)} = \frac{T_2}{\sin(90+\theta)} = \frac{W}{\sin 90}$$

$$\frac{T_1}{\sin\theta} = \frac{T_2}{\cos\theta} = \frac{20}{1}$$

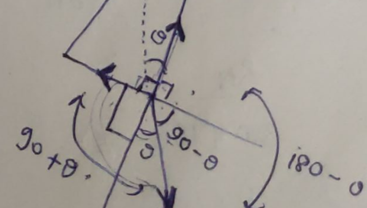
$\hookrightarrow \frac{5}{13}$ $\quad \hookrightarrow \frac{12}{13}$

$T_1 = 7.69$ kgf

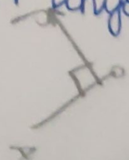
$T_2 = 18.46$ kgf

699 N

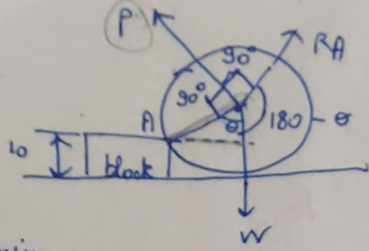
400 N



A uniform wheel



so $P = 692$
$R_A = 400$



pull to be minimum it must be applied normal to
↳ OA against gravity

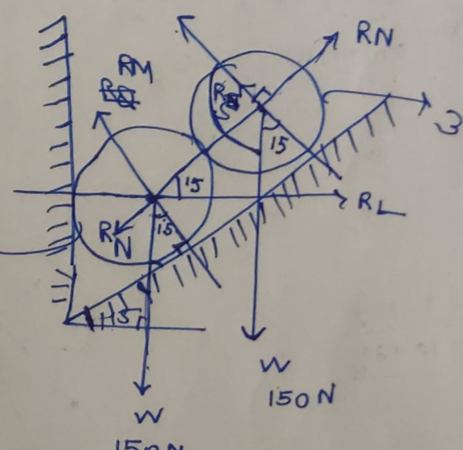
Pull : tensile

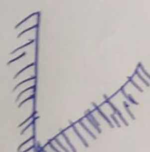
$$\frac{P}{\sin(180-\theta)} = \frac{R_A}{\sin(90+\theta)} = \frac{W}{\sin 90}$$

$$\frac{P}{\sin\theta} = \frac{R_A}{\cos\theta} = 800$$

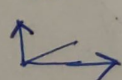
$$\cos\theta = \frac{10}{20} \Rightarrow \theta = 60^\circ$$

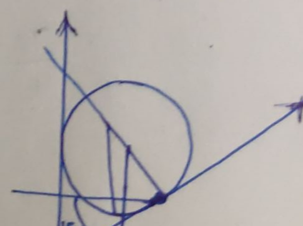
#





res





2nd ball

$$\frac{R_N}{\sin(180-15)} = \frac{R_S}{\sin(90+15)} = \frac{W_2}{\sin 90}$$

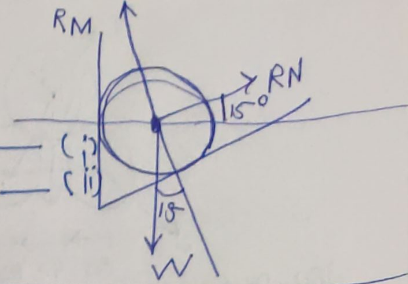
↳ R_N & R_S.

1st ball.

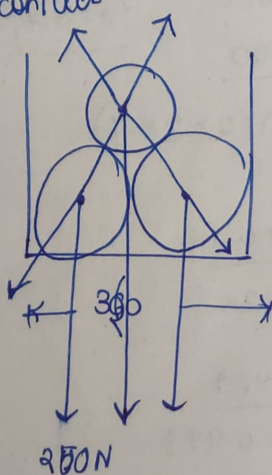
$R_L \cos 15 - W_1 \sin 15 - RN = 0$ — (i)

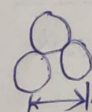
$R_M - R_L \sin 15 - W_1 \cos 15 = 0$ — (ii)

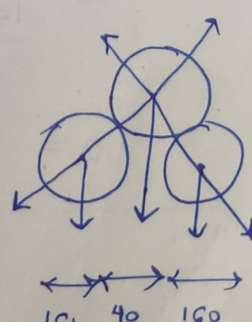
R_L

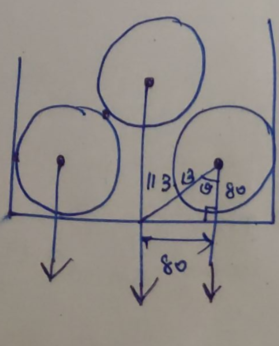


\# 3 cylinders of 250 N each 160 mm dia in a channel of 360 mm breadth determine the pressure exerted by cylinder l on m at the point of contact

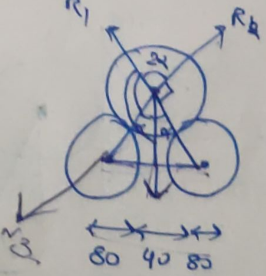




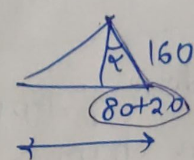




$\sin\theta = \frac{100}{60} = \frac{5}{8}$



$180 - 2\alpha + \alpha$
$180 - \alpha$



$$\frac{R_1}{\sin(90+\alpha)} = \frac{R_2}{\sin(180-\alpha)} = \frac{W}{\sin 2\alpha}$$

$\cancel{\cos\alpha}\ \sin\alpha$

$\frac{5}{8} = \sin\theta$

$\theta = \sin^{-1}(5/8)$

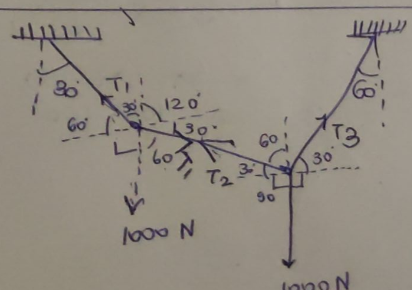
$\boxed{\theta = 38.7}$

$$\frac{R_1}{\cancel{s}\ \cos\alpha} = \frac{200}{\sin(2 \times 38.7)}$$

$$R_1 = \frac{200 \times \cos\alpha}{\sin 2\alpha}$$

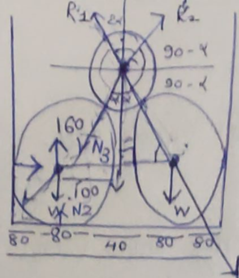
$$= \frac{155.429}{\cancel{1.3}\ 0.978}$$

$$R_1 = 160\,N. \quad \times$$



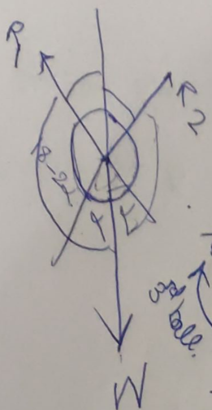
$$\frac{T_1}{\sin 60} = \frac{T_2}{\sin 150} = \frac{1000}{\sin 150}$$

$$\frac{T_2}{\sin 150} = \frac{T_3}{\sin 150}.$$



30

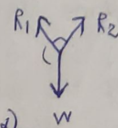
$R_1 = 128^{\circ}$



$\frac{5}{8}$ or $\frac{100}{160} = \sin\theta$

$\boxed{\theta = 38.7^{\circ}}$

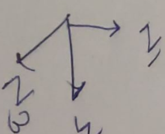
on ball



$\frac{R_1}{\sin(180-2\alpha)} = \frac{W}{\sin(2\alpha)} = \frac{R_2}{\sin(180-\alpha)}$

$180 - 2\alpha + \alpha$

$180 - \alpha$



$\frac{R_1}{\sin\alpha} = \frac{W}{\sin 2\alpha}$

$R_1 = \frac{W}{\sin 2\alpha} \times \sin\alpha.$

$\boxed{R_1 = 128.13 \text{ and } R_2.}$

$N_1 = N_3 \sin\alpha$

$128.205 \times \sin \Rightarrow 80\,N$

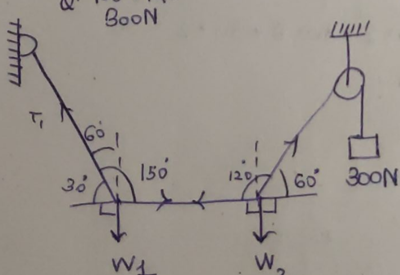
$N_2 = W + N_3\cos\theta.$

300N

on 1st ball

ask R_2 : 128.

Q. 150 & 120°
300N



$$\boxed{\frac{T_1}{\sin 90} = \frac{W_1}{\sin 150} = \frac{T_2}{\sin 120}}$$

$$\boxed{\frac{T_3}{\sin 90} = \frac{W_2}{\sin 120} = \frac{T_2}{\sin 150}}$$

couples :-

1. moment produced by two equals and non collinear forces

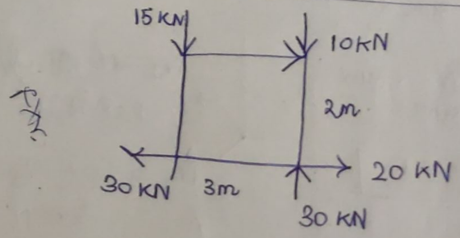
2. it doe's n+ produce only translation but only rotation

3. moment of a couple is product of mag. of the forces and perpendicular dis b/w their line of action

4. the mag. of the moment couple is same for all point in plane of couple

5. the mag. of the couple is independ. of the reference point and its tendency to create a rotation will remain constant.

#

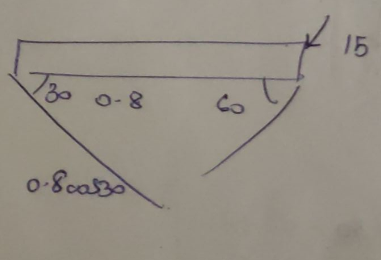


$m_B \to ?$

$\Sigma M_B \to 10 \times 3 - 20 \times 2 - 30 \times 3 + 30 \times 2$

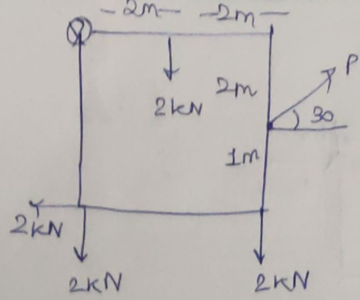
$= -40$ kN.

~~a~~ clock.



$M = 15 \sin 60 \times 0.8$

$M = 15 \times 0.8 \cos 30$.

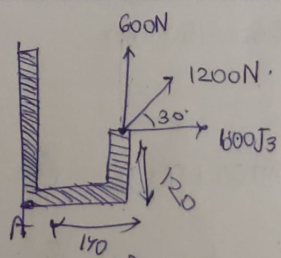


find $\boxed{M_A = 0}$

$$2\times 2 - \frac{P}{2}\times 4 - \frac{P\sqrt{3}}{2}\times 2 + 2\times 4 + 2\times 3 = 0$$

$$\boxed{4 - 2P - \sqrt{3}P + 8 + 6 = 0}$$

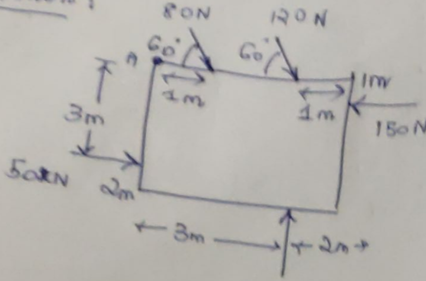
$$\rightarrow P = \frac{18}{2+\sqrt{3}}$$

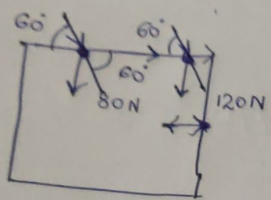


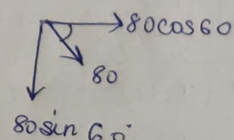
$$+\circlearrowleft : \Sigma M_A = +600\sqrt{3}\times 120 - 600\times 140$$

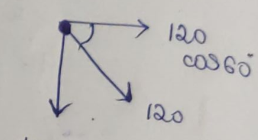
$$= 40707.658$$

Question :

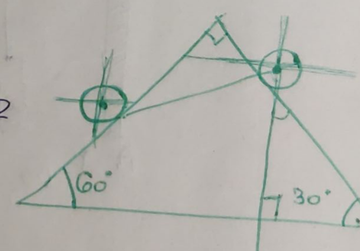






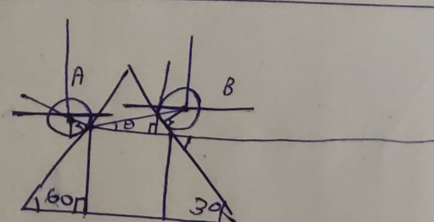


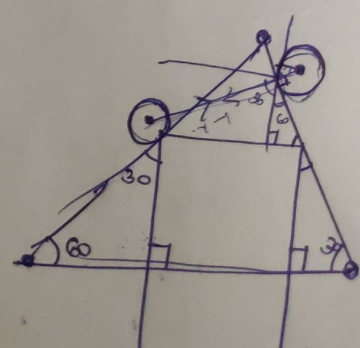
$$\Sigma P_x = 80 \cos 60 + 120 \cos 60 - 150 + 50$$
$$= 0.$$



$$\Sigma P_y = -80 \sin 60 - 120 \sin 60 + 173.2$$
$$= 0$$

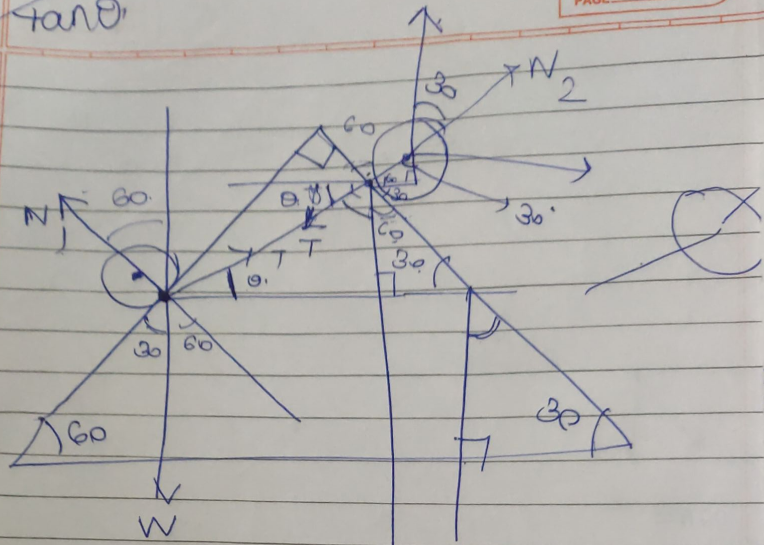
$$R = \sqrt{(\Sigma P_x)^2 + (\Sigma P_y)^2}$$





~~$N_2 < N_1$~~

~~$\tan\theta$~~



I.

V. $\boxed{N_1 \cos 60 + T\sin\theta = W} \quad \text{(1)}$

$W = 60N$

H. $T\cos\theta = N \sin 60$

$\boxed{T\cos\theta = \frac{\sqrt{3}}{2} N_1} \quad \text{(2)}$

II.

V. $\boxed{N\cos 30 = W + T\sin\theta}$

$\frac{\sqrt{3}}{2}$ $\quad$ 100 N

(↑) $\quad$ (↓)

$N_2 \sim N_1$

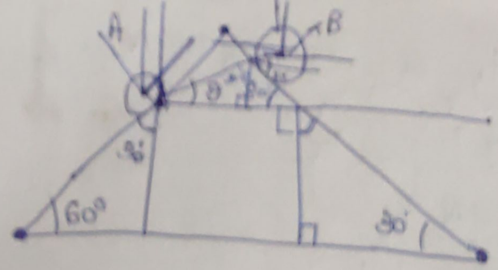
N_2

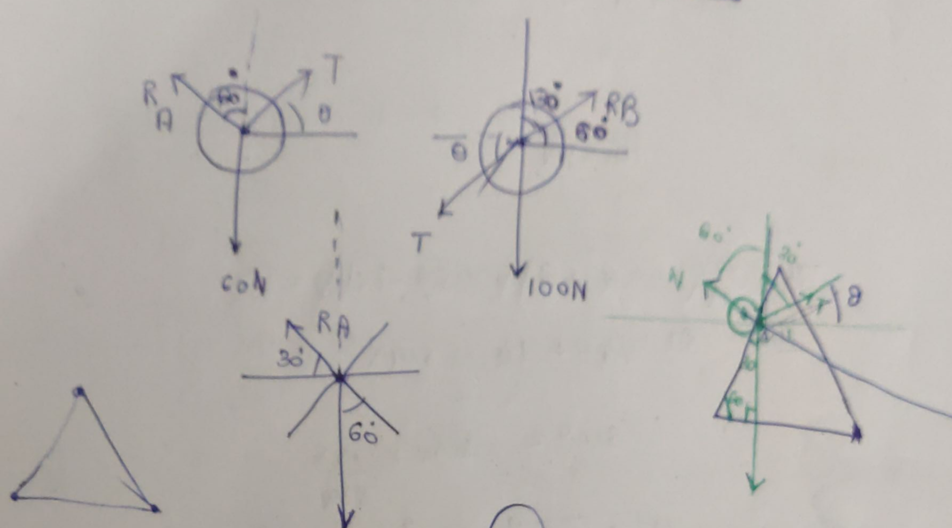
H. $N_2 \sin 30 = T\cos\theta$

$\frac{N_2}{2} = T\cos\theta$

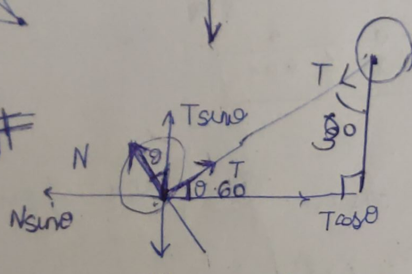
$\boxed{\frac{N_2}{2} = \frac{N_1\sqrt{3}}{2}}$

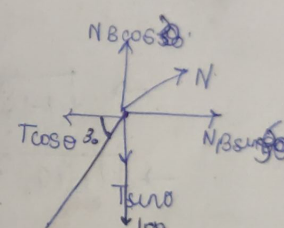
Question :





#





$\cancel{30} \times 2$

$T\sin\theta - N_A\cos\theta = 60A.$

~~[illegible]~~

** $\boxed{60 = \frac{N_A}{2} + T\sin\theta}$

** $\boxed{T\cos 30 = \frac{\sqrt{3}}{2}N_A = N\sin\theta \quad N\sin 60}$

$T\cos\theta = \frac{1}{2}N_B = N\sin 30$

N.

$N_B\cos 30 = T\sin\theta + 100$

$N_B \cos 30$

$\frac{\sqrt{3}N_A}{2} = 60 - \frac{N_A}{2} + 100$

$\sqrt{3}\, N_A = N_B$

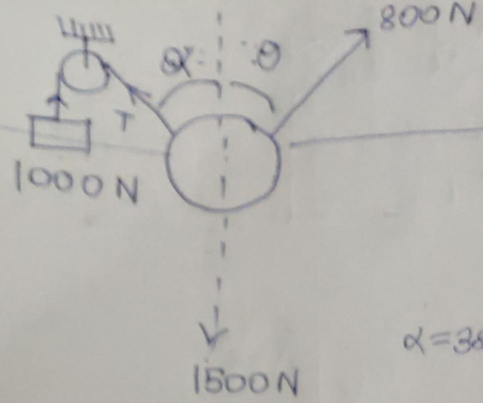
$N_B = \frac{160}{\sqrt{3}}$ $\quad N_A = \frac{160}{3}$

$T\sin\theta + \frac{160}{6} = 60$

$\frac{80}{\sqrt{3}} = T\cos\theta$

$\boxed{\tan\theta = \frac{30}{80}\sqrt{3}}$

÷



$\alpha = 38^\circ$

I. $10\cancel{00}\cos\alpha + 8\cancel{00}\cos\theta - 15\cancel{00} = 0$

II. $800\sin\theta + 1000\sin\alpha = 0$

$\sin\theta = -\sin\alpha \times \frac{10\cancel{00}}{8\cancel{00}}$

$\boxed{+0.8\sin\theta = \sin\alpha}$

$\boxed{\sin\alpha = \frac{4}{5}\sin\theta}$

$\rightarrow \sqrt{1+\sin^2\alpha} = \cos\alpha.$

$\rightarrow \sqrt{1+(+0.8\sin\theta)^2} = \cos\alpha.$

$\rightarrow \sqrt{1-+0.8^2\sin^2\theta} = \cos\alpha.$

$\cos\alpha = \sqrt{1-\frac{16}{25}\sin^2\theta}$

$8\cos\theta + 2\sqrt{25-16\sin^2\theta} = 15.$

squaring

$4(25-16(1-\cos^2\theta)) = (15-8\cos\theta)^2$

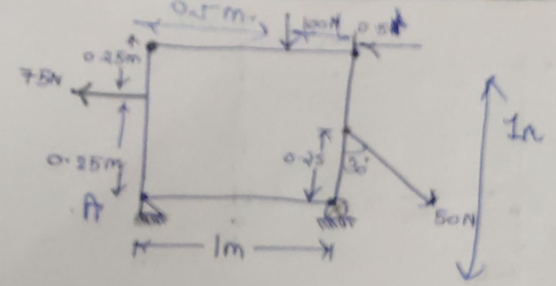
$4(9+16\cos^2\theta) = 225 + 64\cos^2\theta - 240\cos\theta$

$240\cos\theta = 216 + 48\cos^2\theta \quad \div 3 \times 2$

$40\cos\theta = 36 + 8\cos^2\theta. \quad \div 4$

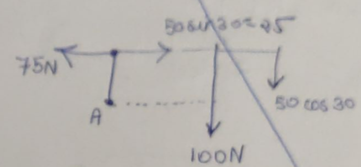
$\boxed{10\cos\theta = 9 + 2\cos^2\theta.}$

$10\cos(38) + 9 + 2\cos^2(38)$



→ mechanics

green,



← around the point →

#

$\Sigma M_A = 0,$

$50 \sin 30 \times 0.25 +$

$50 \cos 30 \times 1 +$

$100 \times 0.5 -$

75×0.25

$R \Rightarrow 80.8 NM.$

→ $\frac{75}{4} = \frac{25}{4} + 25\sqrt{3} + 50$

80.8 resultant

$50 \times \frac{1}{2} = 25$

$50\frac{\sqrt{3}}{2} = 25\sqrt{3}$

→ $\frac{75}{4} = \frac{25}{4} + 25\sqrt{3} + 50.$

around.

100

hard & fast rule nahi toh make ANTI CLOCK ⊕

Mor
r×F →

$225 + \cancel{64\cos^2\theta} - 240\cos\theta = 36 + \cancel{64\cos^2\theta}$

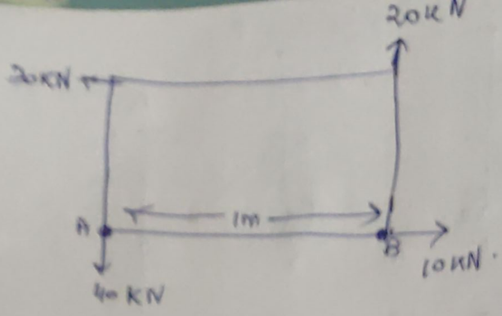
$189. = 240\cos\theta$

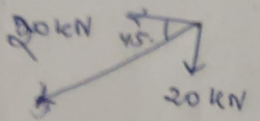
$\boxed{0.7875 = \cos\theta}$

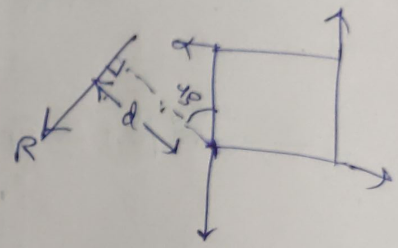
$\theta = \cos^{-1}(0.7875)$

$\boxed{\theta = 38^0}$

#







$\sqrt{20^2+20^2}$

$\sqrt{2} \times 20$

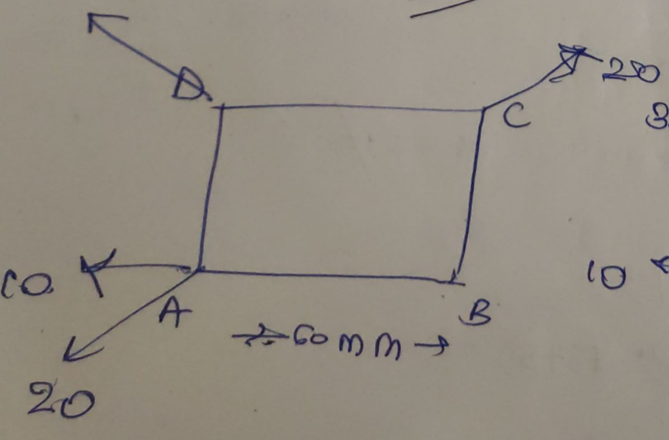
≈ 28.20 N

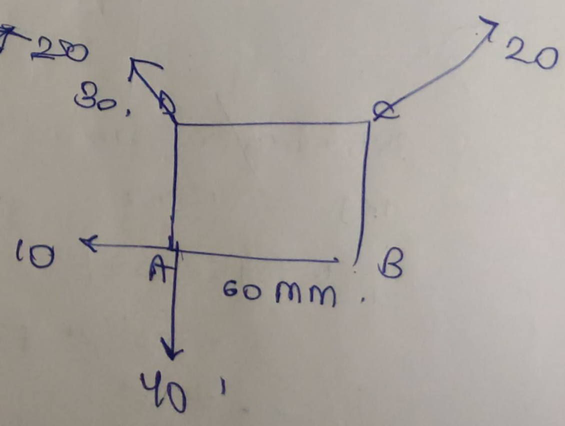
$\approx 45^\circ = \tan\theta = \frac{\Sigma F_y}{\Sigma F_x}$

$\Sigma M_A = 0$

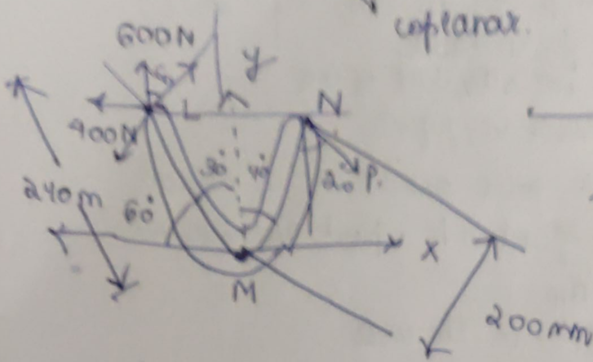
$R \times d = 20 \times 1 + 30 \times 1$

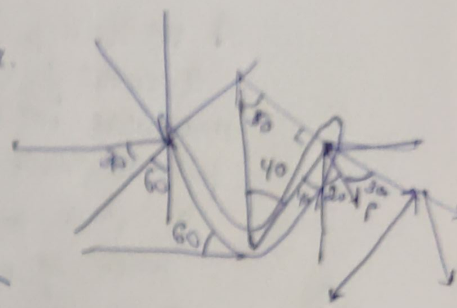
$\boxed{d = 1.76\ m.}$



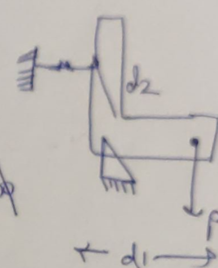


lever → no friction
→ subjected to M.
→ coplanar.





Value → 895.7 N



$(600\cos 60 + 400\cos 30) \times 240 = P\cos 30 \times 200$

$\left(\frac{600}{2} + 400\frac{\sqrt{3}}{2}\right) \times 240 = P \cos 30 \times 20$

$(300 + 200\sqrt{3}) = P\cos 30 \times \frac{20}{24}$

$\boxed{895 = P}$

$\boxed{\theta = 86.3}$

$\sqrt{R_N^2 + R_{M_x}^2} = \boxed{1444.7}$

$\tan\theta = \frac{\Sigma R_{Ny}}{\Sigma R_x}$

600

400

600

$P\sin 20$

$P\cos 20$

$\sqrt{93^2 + (1441.7)^2}$

93

$\sqrt{2087097}$

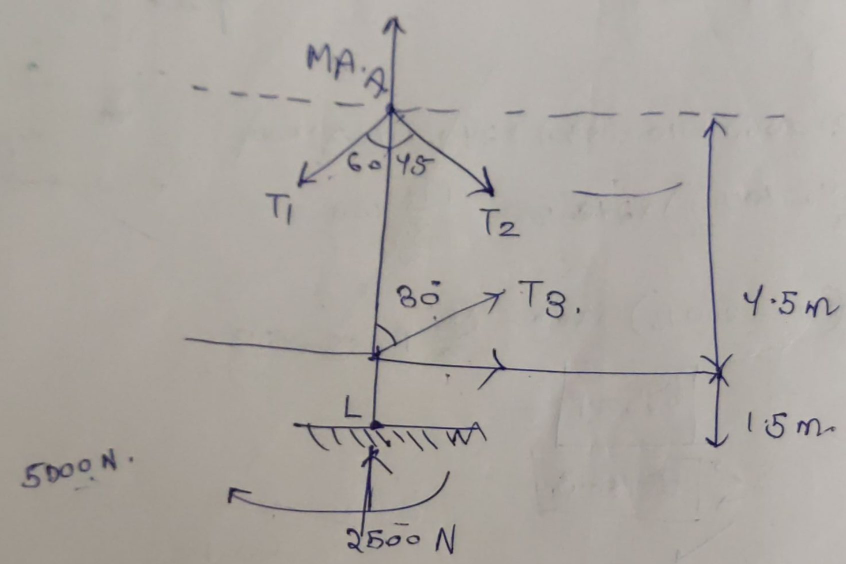
$60 + P\cos 20 = 1441.68$

#

A verticle pole is anchored in a cement foundation. three wire are attached to the pole as shown in figure

if r^n @ point consist in a vertical. force of 2500 N upward and moment of 5000 Nm

find tension in the wire



$\Sigma M_A = 0$

tension 3.

$T_3 \sin 30 \times 4.5 = 0.$
$+ 5000 N$

$T_3 \sin 30 = \frac{5000}{4.5}$

$\boxed{T_3 = 2222.22}$

$$T_2 \cos 45 + T_1 \cos 60 = 2500$$

$$T_2 \sin 45 = T_1 \sin 60$$

$$\frac{T_2}{\sqrt{2}} = T_1 \frac{\sqrt{3}}{2}$$

$$T_1 = T_2 \sqrt{\frac{3}{2}}$$

$$\frac{T_2}{\sqrt{2}} + \frac{T_2}{2} \times \sqrt{\frac{3}{2}} = 2500$$

$$\frac{T_2}{\sqrt{2}}\left[1 + \frac{\sqrt{3}}{2}\right] = 2500$$

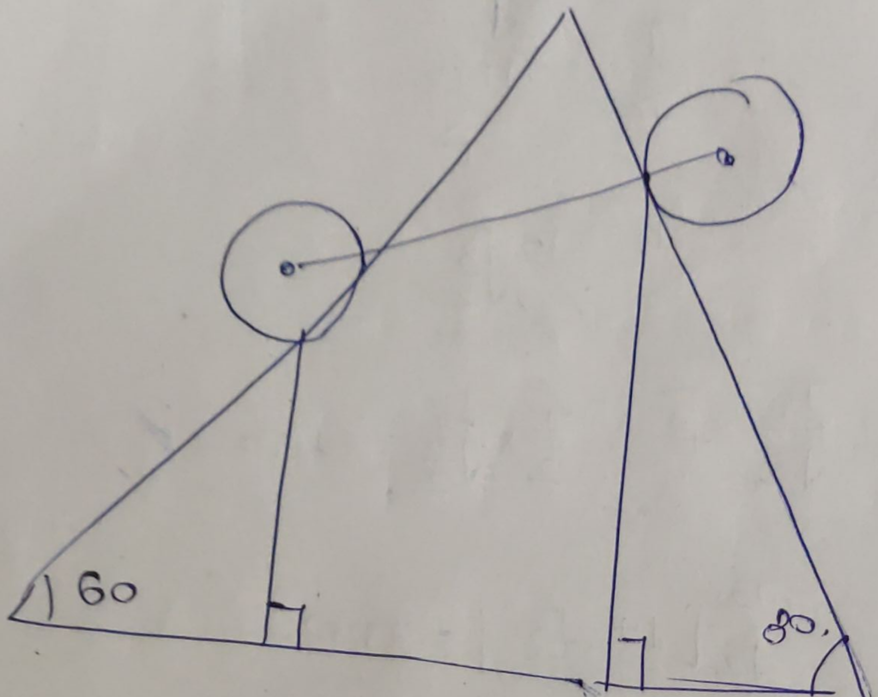
$$T_2\left(\frac{2+\sqrt{3}}{2\sqrt{2}}\right) = 2500$$

$$3.732 =$$

$$\boxed{\begin{array}{l} T_2 = \text{[illegible]} \\ T_1 = \text{[illegible]} \end{array}}$$

$$T_2 = 4054.2$$

$$T_1 \; 3392$$



$\overset{}{a} + y + \overset{120}{z} = 180$

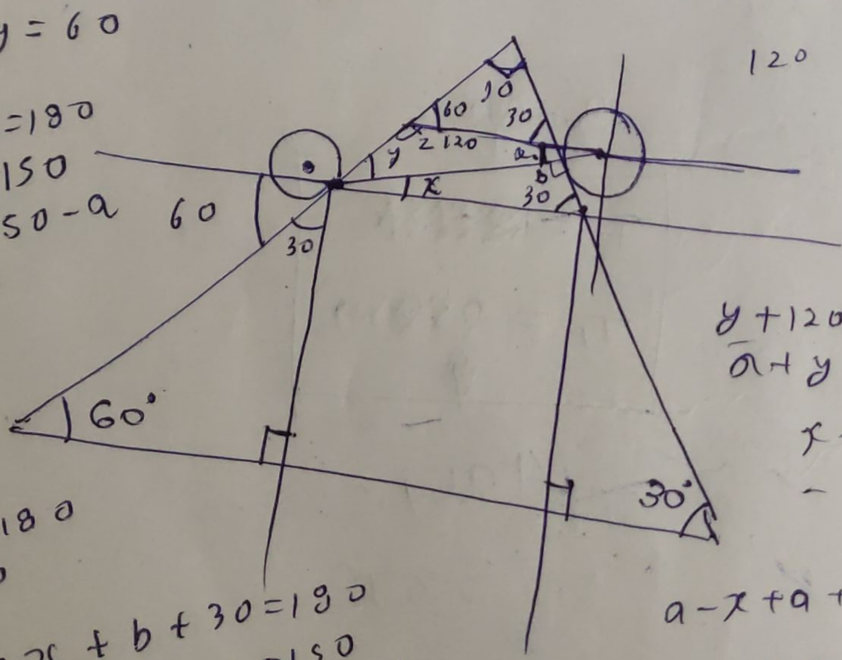
$x + y = 60$

$a + y = 60$

$y = 60 - a$

$x + y = 60$

120



$30 + a + b = 180$

$a + b = 150$

$b = 150 - a$

$x + y = 60$

$150 - b$

$15\cancel{0 - b} + a$

$x + b + 30 = 180$

$a + b = 180$

$x + b = 150$

$x + 180 - a = 150$

$x - a = -30$

$a - x = 30$

$x + b + 30 = 180$

$x + b = 150$

$x = 150 - b$

$x = 150 - 150 + a$

$x = a$

$y + 120 + a = 180$

$a + y = 60$

$x + y = 60$

$-(60 - b)$

$a - x + a + y = 60 + 30$

$2a - x + y = 90$

$2a - 60 + y + y$

$\Rightarrow 90$

$2a + 2y = 90$

$a + y = 45$

$$5000 = \frac{\sqrt{3}}{2} * 4.5$$

$$\Rightarrow$$

$$** \quad \boxed{T_3 = \frac{10000}{4.5} = 2222.22}$$

$$\Rightarrow \quad T_1 \times \frac{\sqrt{3}}{2} = T_2 * \frac{1}{\sqrt{2}} + T_3 \times \frac{1}{2}$$

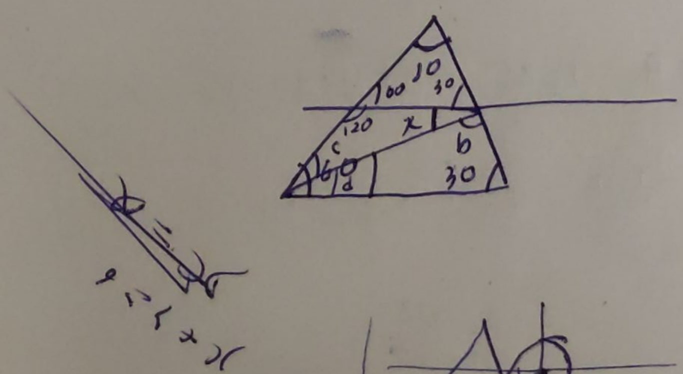
$$(\overrightarrow{\text{vertical}}) ** \quad \boxed{\sqrt{3}T_1 = \sqrt{2}T_2 + T_3}$$

$$\Rightarrow \quad T_1 \times \frac{1}{2} + T_2 \times \frac{1}{\sqrt{2}} = 2500 + \frac{\sqrt{3}}{2} \times \cancel{2500} \; T_3.$$

$$(\text{horizontal}) \uparrow \quad T_1 + \sqrt{3}T_1 - T_3 = 5000 + \sqrt{3}(\sqrt{3}).$$

$$T_1(1+\sqrt{3}) = 5000 + (1+\sqrt{3}) \times 2222.22$$

$$T_1 = 4052.38N.$$

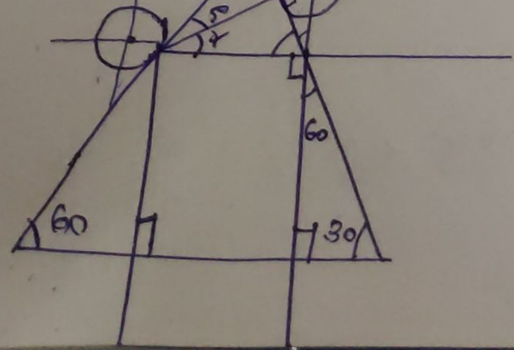


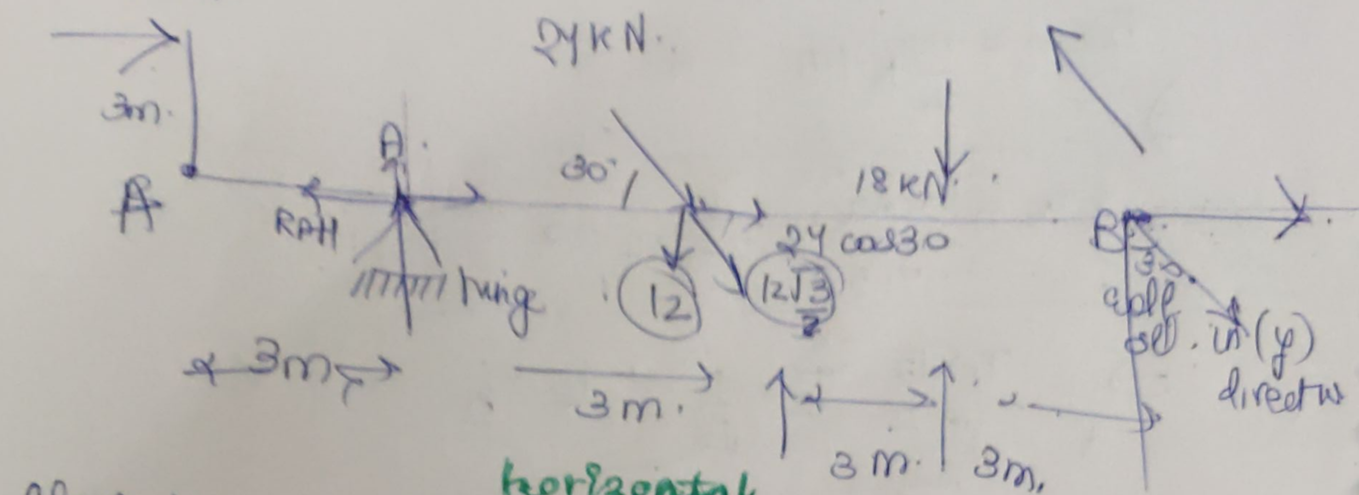
$x + b = 120$

$x + 120 + c = 180$

$c + d = 60$

$b + d + 30 = 150$





Clockwise.
θ.

horizontal

① $-R_B \sin 30 + 12\sqrt{3} + R_{AH} + 6 = 0$.

find R.

at A.

$\boxed{-20.8 \times \frac{1}{2} + 12\sqrt{3} + 6 = R_{AH}}$

16.38

② momentum about A.

$\Rightarrow 9 \times \frac{\sqrt{3}}{2} R_B - 18 \times 6 - 24 \times \frac{1}{2} \times 3 - 6 \times 3 = 0.$

$R = \frac{\cancel{30}\,54 + 18 \times 6}{9} \times \frac{2}{\sqrt{3}}$

$36 + 18 = 54$

$\boxed{R = 20.78\,kN}$

~~$R_B = 33.36\,kN$~~
~~$R_A = 15\,kN$~~

about A

hinge point
↳ moment = 0

$\boxed{R_B \cos 30 \times 9 - 18 \times 6 - 3 \times 24 \sin 30 - 6 \times 3 = 0}$

$\frac{\sqrt{3}}{2} \times 9 R_B - 108 - 3 \times \overset{12}{24} \times \frac{1}{2} - 18.$

$= 36 + 18$

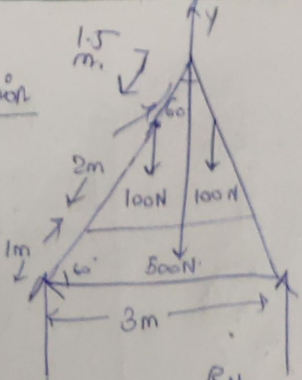
$\boxed{R_B = 20.8\,kN.}$

$\boxed{R_A = 20.3.}$

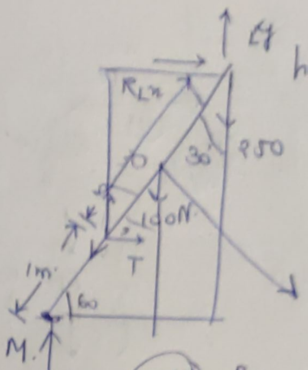
across B. # $+R_A \times 9 - 6 \times 3 + 24 \times \frac{1}{2} \times 6 + 18 \times 3$.

$R_A =$

Question



hinge point

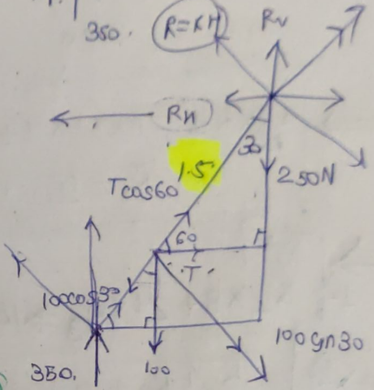


① vertical R_M R_N.

$\Sigma = 100 - 100 - 500$

$T = 259.98$ $R = 350$

$T \approx 260\,N$



$100\,N \cdot \cos 30$

ΣM across M.

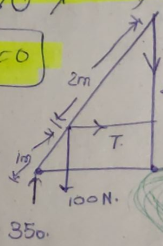
② $= 350 \sin 30 \times 3 + 100 \sin 30 (1.5)$

$T\cos 60 = 100 \cos 30$

$T = \dfrac{100 \times \frac{\sqrt{3}}{2}}{1/2}$

$R_V + 350 - 100 - 250 = 0$ $T(2\cos 30.) = 0$.

④ $\boxed{R_V = 0}$



$\frac{3}{2} \times 350 = 100 + \frac{50 + \sqrt{3}T}{(1.5)}$

$75 + \sqrt{3}T = 525$

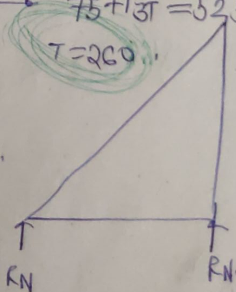
$T = 260$.

$\boxed{T = 260\,N.}$

③ $R_H = T$

$2\cos 30 T + \frac{1.5}{2} \times 100 = \frac{3}{2} \times 350.$

$T = 259.$

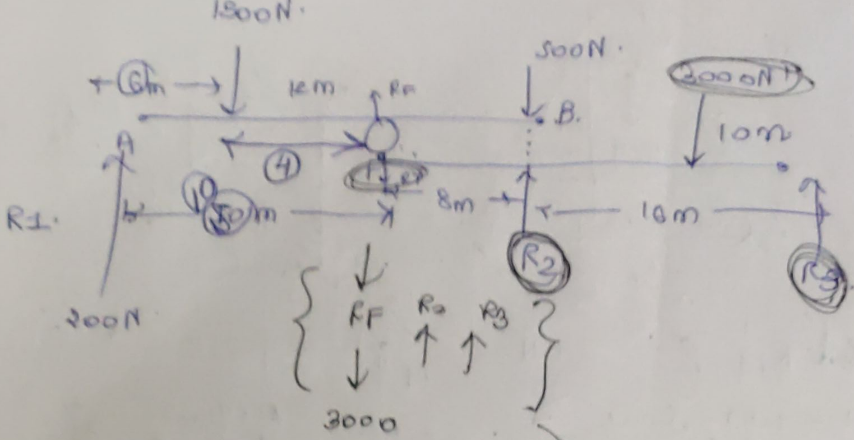


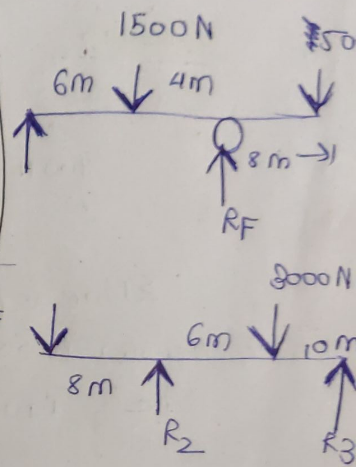
$\Sigma F_H = 0$

$R_{LH} \to 259$

$R_{LV} = 0$

$\Sigma F_V = 0$





$50 \times R_1 = 1500 \times 4 + 500 \times 8$

$\boxed{R_1 = 200N}$

(at F)

1. $R_2 \times 8 + 24 \times R_3 = 14 \times 3000$

2. $R_2 + R_3 + = 3000 + R_F$

$R_F + R_A = 2000$

200

1:) $\boxed{R_F = 1800}$

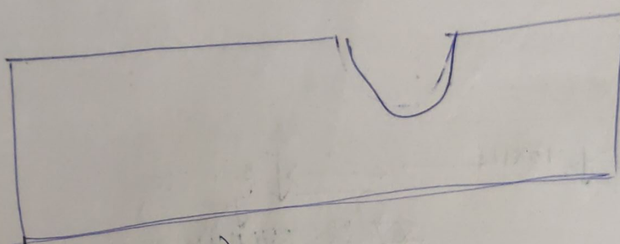
2.) $R_2 + R_3 = 4800$

3.) $3R_3 + R_2 = 5250$

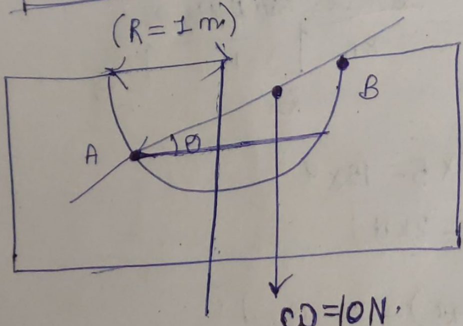
$$\boxed{\begin{aligned} R_2 &= 4575 \\ R_3 &= 225 \end{aligned}}$$

20 Lakh
DSA + Comm

A rod of uniform cross-section of 3m length rest
recives 1m the wy is 10N.
determine the eqn cond.
aksme by rod in clindon θ of rod.
Measure with respect to horizontal angle.



#



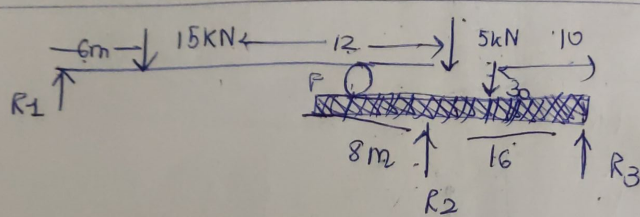
$18\times3 \downarrow + 24\sin30^\circ\times6 \downarrow - 9\times R_{AV} - 3\times6 = 0$

$54 + 72 - 9R_{AV} - 18 = 0$

$\boxed{R_{AV} = 12}$ 3 momentum abt B.

$R \rightarrow \sqrt{12^2 + (16.38)^2}$

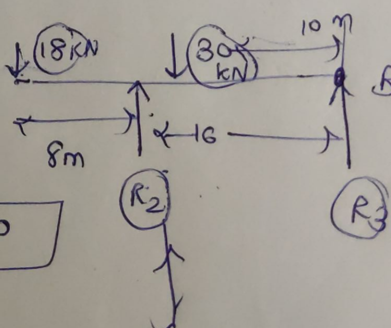
$\boxed{R \rightarrow 20.3 \cdot R}$



across F) $R_1\times10 + 8\times5 = 15\times4$

$\boxed{R_1 = 2kN.}$

$20(15+5) - 2 = 18\,kN$



across B)

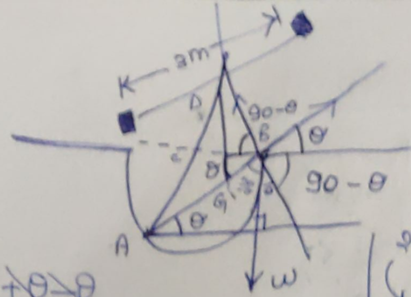
$\boxed{R_2\times16 = 18\times24 + 30\times10}$

$R_2 = \cancel{45.765\,kN}$

$\boxed{R_2 + R_3 = 18 + 30}$

$\cancel{R_3 = 2.25\,kN}$

#



$180-90+\theta > \theta$

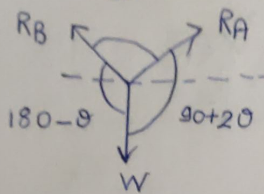
90

$90-\theta$

$2(90-\theta)+\theta$

$180-2\theta+\theta$

$180-\theta$



$$\boxed{\frac{R_B}{\sin(90+2\theta)} = \frac{R_A}{\sin(180-\theta)} = \frac{\omega}{\sin(90+\theta)}}$$

$R_A = 10\tan\theta$

$R_B = \frac{10}{\cos\theta} \times \cos 2\theta$

$\Sigma M_A = 0 \longrightarrow -R_B \times AB + W \times AG\cos\theta$

$\theta = 23.2^\circ$

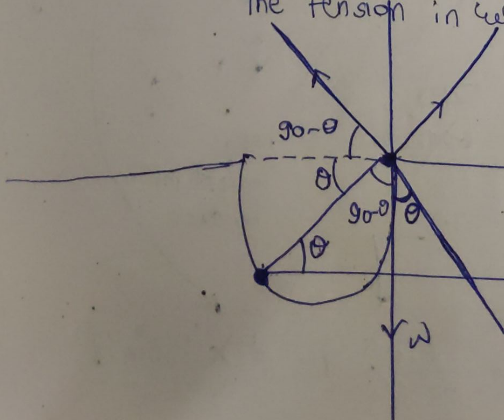
$\angle CBD = 180-(90+\theta) = 90-\theta$

$\angle FAB = \angle CBA = \angle BDG = \theta$

$\angle ADB = 180-(90+\theta) = (90-\theta)$

#

A sealed cylinder 1 m diameter and weight 20 N is placed b/w the two cross ~~st~~ arms as shown in figure. A rope is attached to the arm nearer to their upper ends and prevent them before slipping if the included angle b/w the arms is 60° determine the tension in rope assum spoon.



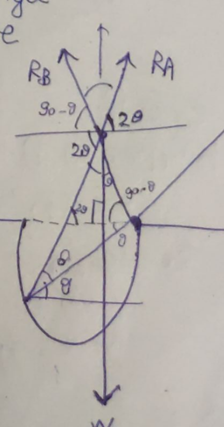
$180-\theta$

$90+2\theta$

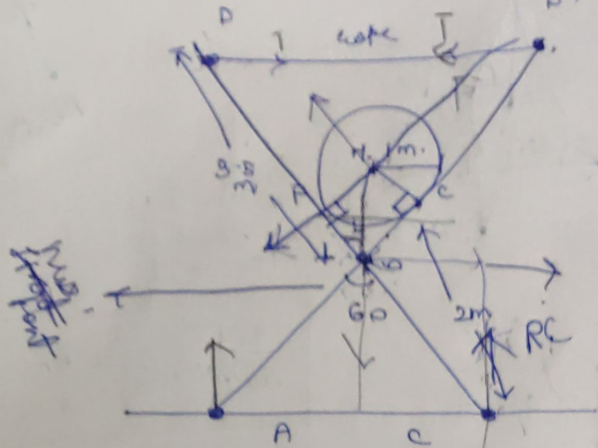
$90-2\theta+2\theta$

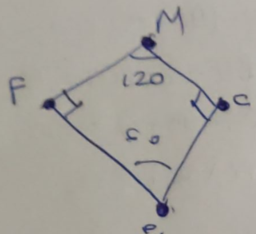
$+90-\theta$

$180-\theta$

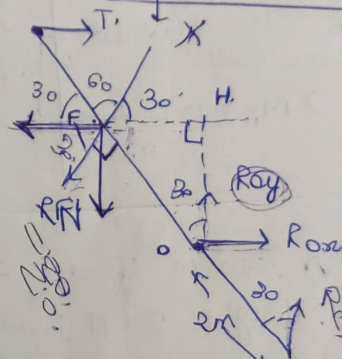


$180-90+\theta-2\theta = 90-\theta$



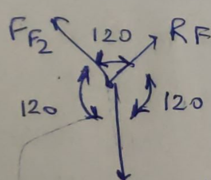


$$\boxed{2R_C - \theta\, R_N \sin 30 = 210}$$



vertical comp.

$R_N \sin 30 = R_C$
$= 105$



by symmetry

$R_F \stackrel{?}{=} R_C = 210\,N$

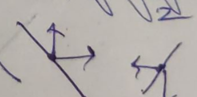
$\cancel{R_N = \frac{210}{2} \neq 105}$

vertical

1. $R_N \sin 30\,(\downarrow) + 2R_C\,(\uparrow) + R_{ay}\,(\uparrow)$

$$\frac{R_N}{\sin 120} = \frac{210}{\sin 120}$$

$R_N = 210$



hinge reaction balance.

2. Moment across T.

R_c & R_{ay} anti. $\Sigma M_o = 0$

$$\boxed{T \times 3.5 \cos 30^\circ = R_N \times O_F + R \times 2 \sin 30^\circ}$$

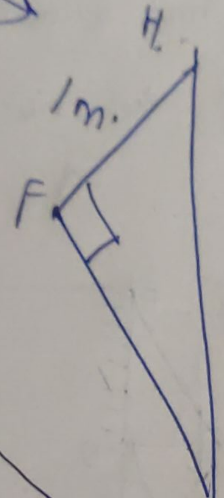
$T = 94.6$

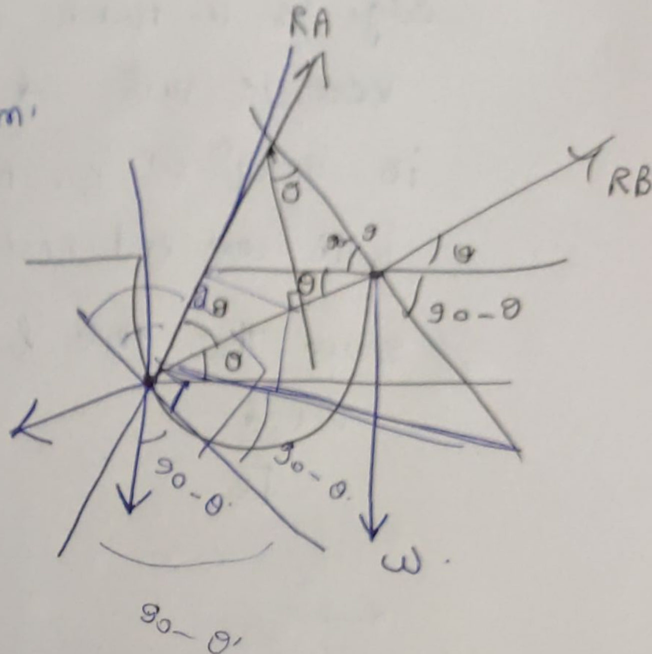
$T \times 3.03 =$.

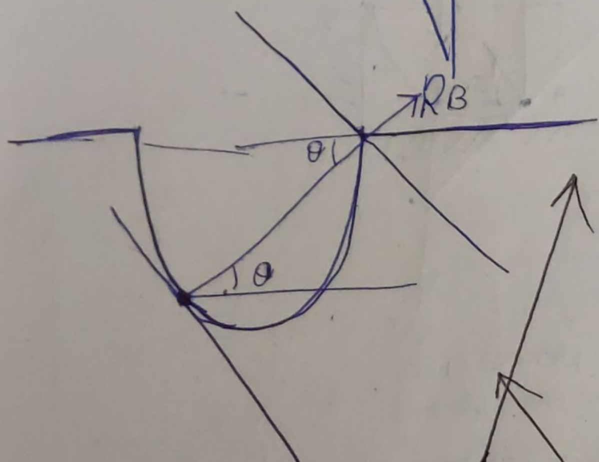
In ΔOFH.

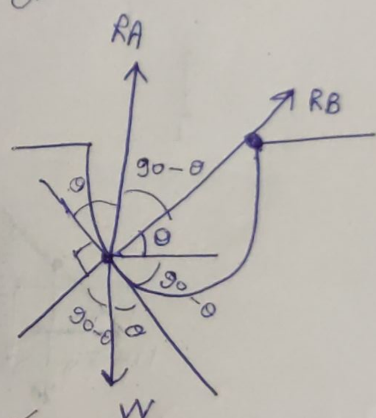
$$\frac{FH}{OF} = \tan 30^\circ$$

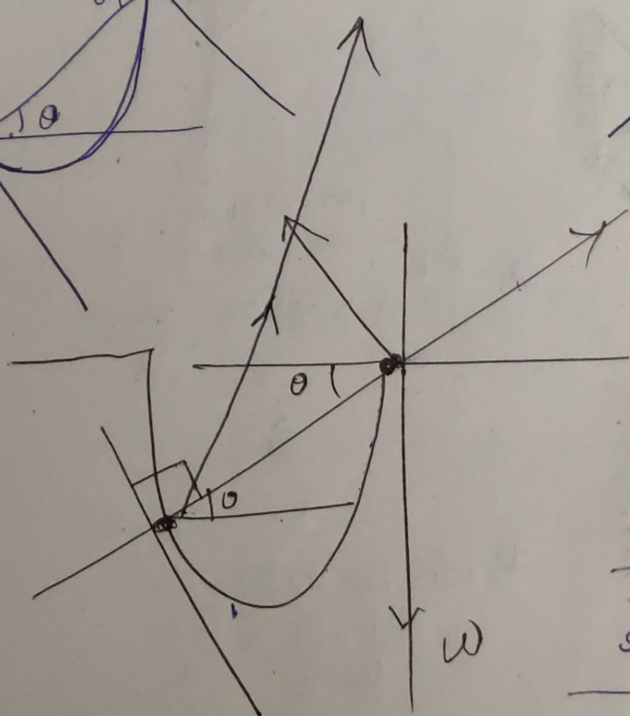
or $OF = 0.866 m$

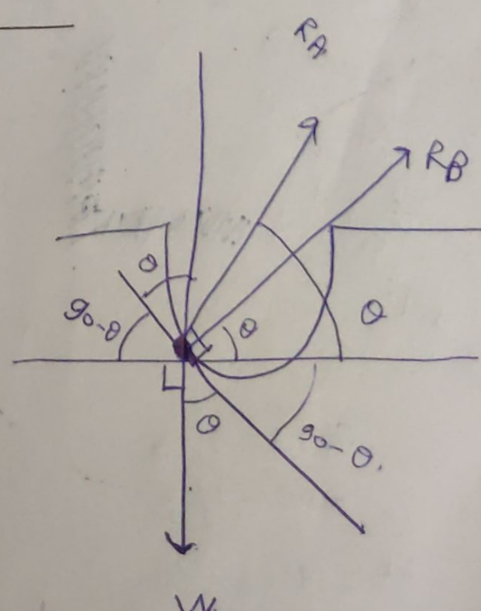






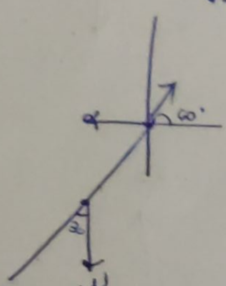


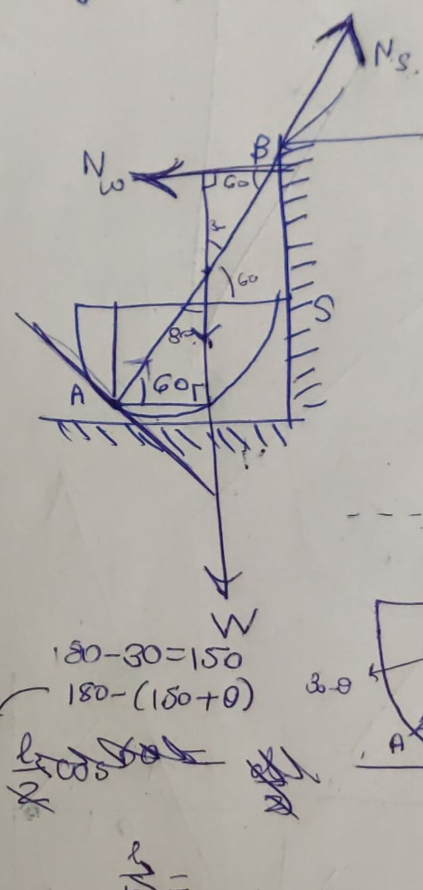


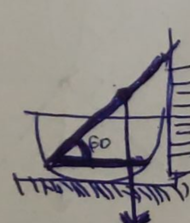


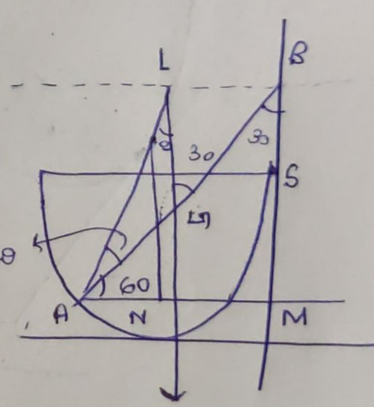
A smooth hemisphereical bowl of diameter d is placed so that its edge is in touch with smooth verticle wall, & heavy uniform rod is in eq^m @ 60° to the horizontal with one end resting against a wall show that the length of rod must be

$d + \frac{d}{\sqrt{3}}$.









$180 - 30 = 150$

$180 - (150 + \theta)$

$(30 - \theta)$

$2(OA\sin\theta + OS)$

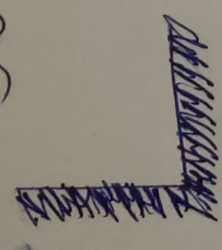
$2\left(\frac{d}{2}\sin\theta + \frac{d}{2}\right)$

$d(\sin\theta + 1)$

$d\left(\frac{1}{\sqrt{3}} + 1\right)$

$\boxed{\frac{d}{\sqrt{3}} + d}$

ans.



$\frac{l}{2} =$

1- $LG = BG\cos 30$

$LG = \frac{L}{2} \times \frac{\sqrt{3}}{2} = \frac{\sqrt{3}L}{4}$

$\cot\theta = 2/\sqrt{3}$

$\sin\theta = 1/\sqrt{3}$

$AB = AM/\sin 30$.

$(AN + NM)/1/2$

2- $\frac{AG}{\sin\theta} = \frac{LG}{\sin(30-\theta)}$

$\frac{AG}{LG} = \frac{\sin\theta}{\sin(30-\theta)} = \frac{L/2}{\sqrt{3}L/4} = \frac{\sin\theta}{\sin 30\cos\theta - \cos 30\sin\theta}$