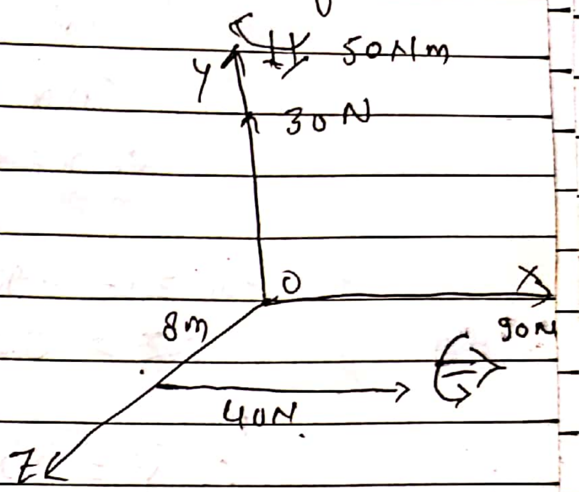
Test-1

Q.N.5)

Sol'n

First find resultant of force & moment at origin.



$\vec{R} = 40\vec{i} + 30\vec{j}$

M_{OR}

$= -50\vec{j} + 90\vec{i} + (8\vec{k} \times 40\vec{i})$

$= -50\vec{j} + 90\vec{i} + 320\vec{j}$

$= 90\vec{i} + 270\vec{j}$

pitch $p = \dfrac{\vec{R} \cdot \vec{M}_{OR}}{R^2}$

$= \dfrac{(40\vec{i} + 30\vec{j})(90\vec{i} + 270\vec{j})}{(\sqrt{40^2 + 30^3})^2}$

$= \dfrac{3600 + 8100}{2500}$

$= \dfrac{11700}{2500}$

$P = 4.68$

couple vector $\vec{M}_1 = p.\vec{R}$

$= 4.68 \times (40\vec{i} + 30\vec{j})$

$= 187.2\vec{i} + 140.4\vec{j}$

To find line of action

$\vec{M}_1 + \vec{r} \times \vec{R} = \vec{M}_{OR}$

$187.2\vec{i} + 140.4\vec{j} + (x\vec{i} + y\vec{j} + z\vec{k}) \times (40\vec{i} + 30\vec{j}) = 90\vec{i} + 270\vec{j}$

For xz plane $y = 0$

$187.2\vec{j} + 140.4\vec{j} + (x\vec{i} + z\vec{k})(40\vec{i} + 30\vec{j}) = 90\vec{i} + 270\vec{j}$

$$30x\vec{k} + 40z\vec{j} - 30z\vec{i} = -97.2\vec{i} + 129.6\vec{j}$$

Equating the cooff.

$$30x = 0$$
$$\therefore x = 0$$

$$-30z\vec{i} = -97.2\vec{i}$$
$$\therefore z = 3.24$$

$$\therefore \vec{r} = 3.24\vec{k}$$

$$\therefore \vec{M}_1 = 187.2\vec{i} + 140.4\vec{j}$$

Q.1) ans

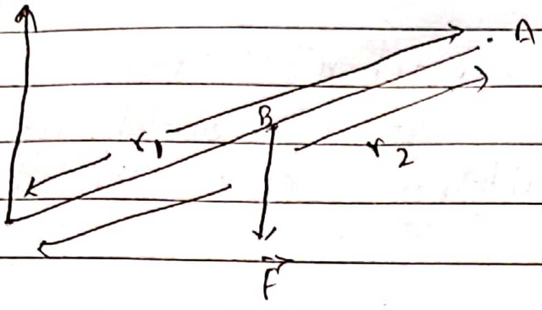
The sub division of mechanics that is concerned with the force that act on bodies at rest under equilibrium condition is called static

The subdivision of mechanics that is concerned with the motion of material object in relation to the physical factor that after them too.

$$\vec{v} = \vec{v}_r + \vec{v}_\theta$$
$$= \dot{r}e_r + r\dot{\theta}.e_\theta$$
$$a_r = \ddot{r} - r\dot{\theta}^2 a\theta$$
$$= r\ddot{\theta} + 2\dot{r}\dot{\theta}$$
$$\vec{a} = \vec{a}_r + \vec{a}_\theta$$
$$(\ddot{r} - \dot{r}\theta^2)e_r + (r\ddot{\theta} + 2\dot{r}\dot{\theta})e_\theta$$

Q.N. 3) (a)

=> Force is called a sliding vector if force produce different effects if its is moved to different line of action, even if its magnitude direction & sence are kept equal. The vector with specific ~~heat~~ line of action are called sliding vector. The point where they are applied is not important as long as its is in their line of action.



At A (moment)

$M_A = \vec{r_1}\,\vec{F} + \vec{r_2}\,\vec{F}$

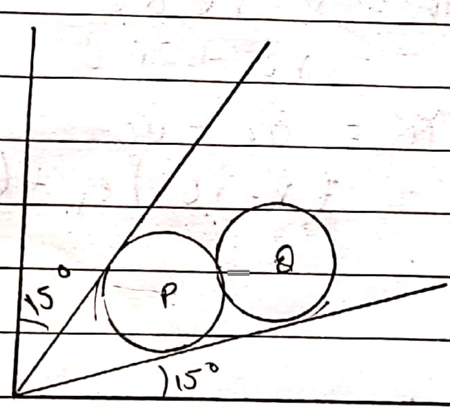
$= (\vec{r_2} - \vec{r_1})\,\vec{F}$

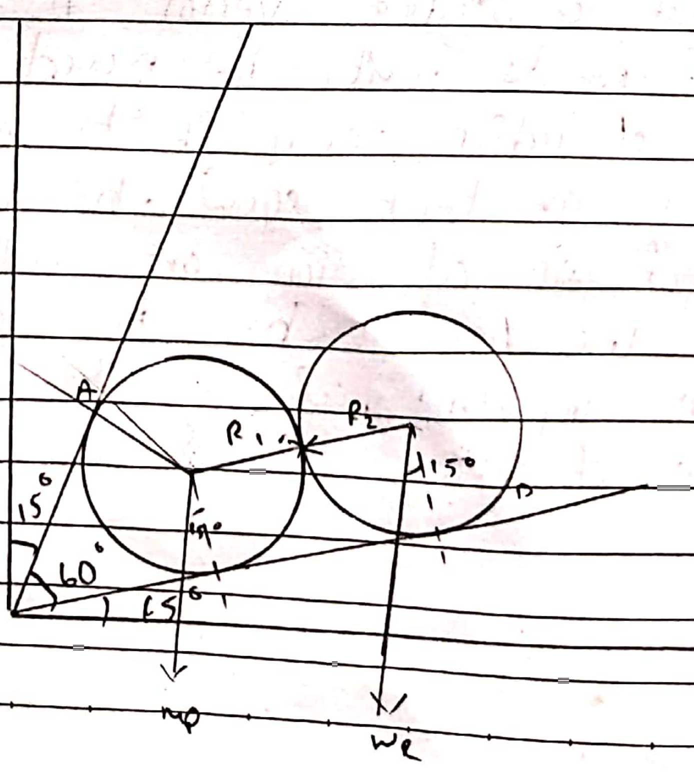
$= \vec{d}\,\vec{F}$ —(1)

At Mid point B

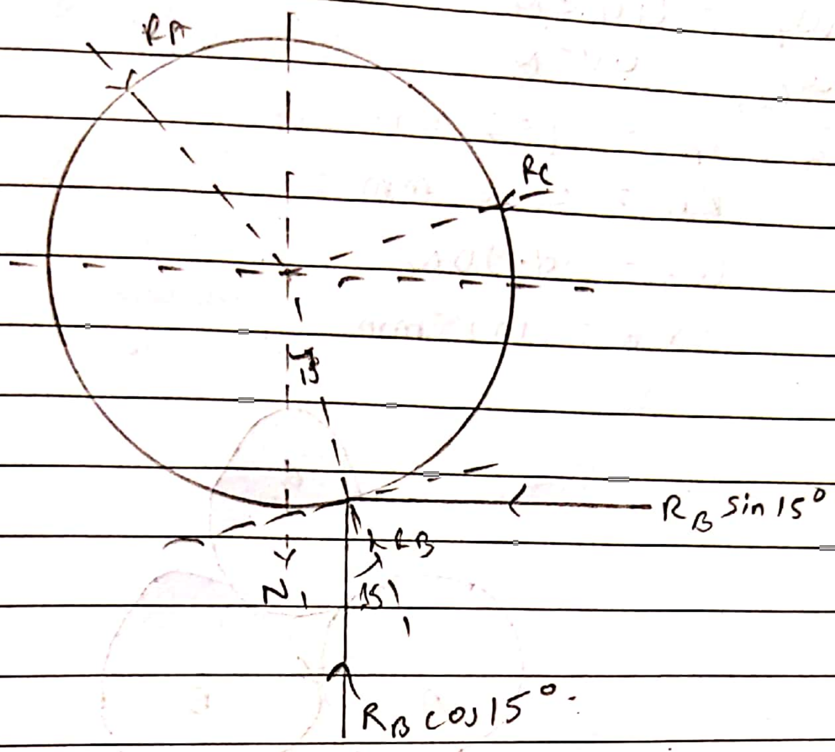
$M_B = \vec{d} \times \vec{F}$ —(2)

3 (b)

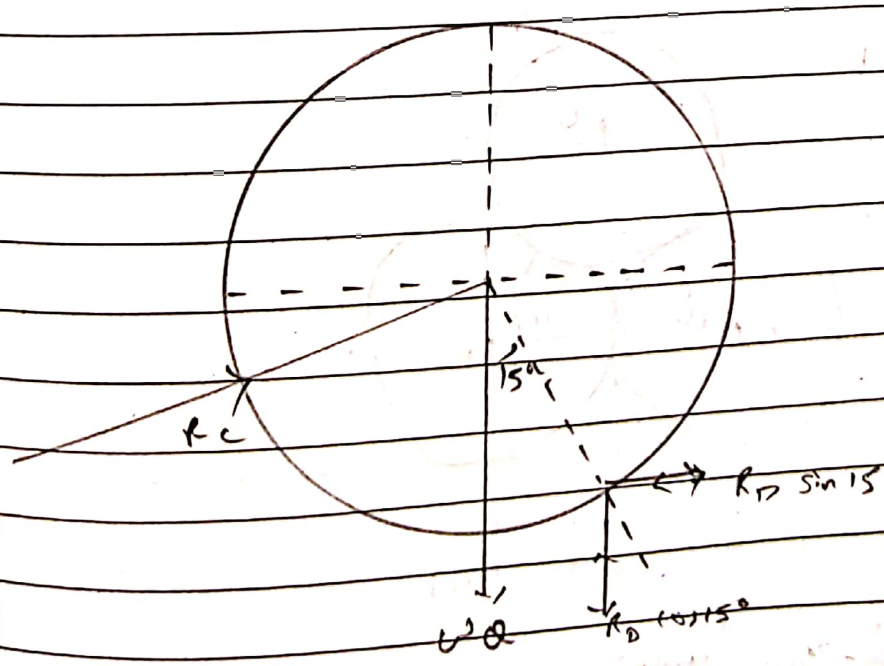




Roller P



Roller Q.



Q (4) Sol^n.

$W_A = 445 N$

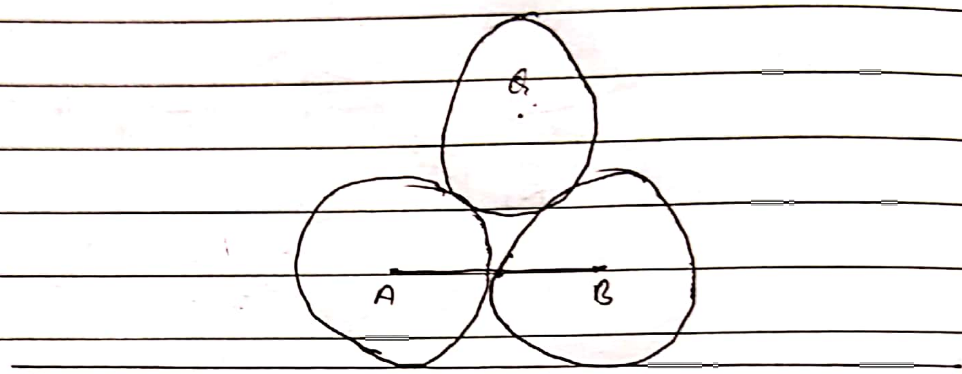
$W_B = 445 N$

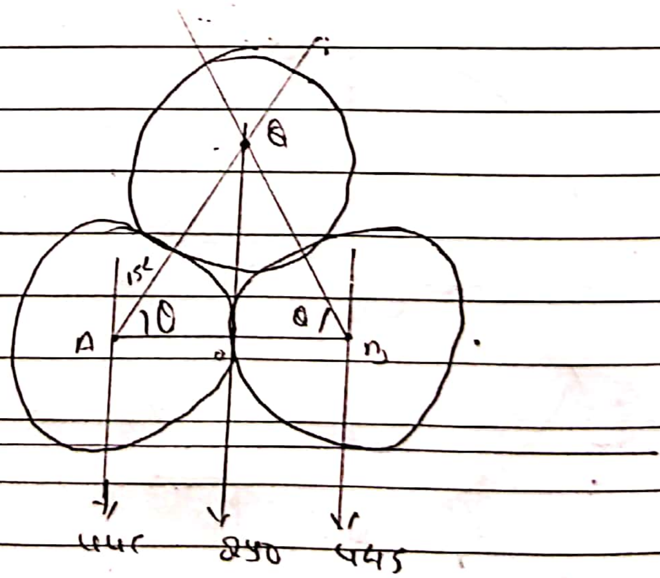
$r_B = r_A = 152$ mm

$AB = 406$ mm

$W_Q = 8.90 N$

$r_Q = 152$ mm.





Taking right angle triangle AOQ

$AO = \frac{406}{2} = 203$

$\cos\theta = \frac{b}{h} = \frac{203}{304}$

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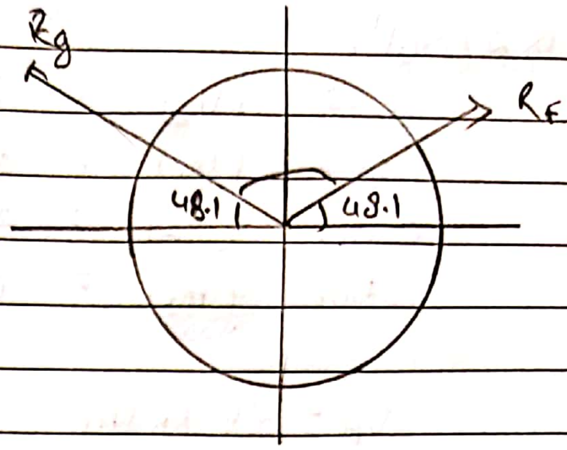
~~Q.7~~ Sol^n, $\theta = 48.1^\circ$



by lamis theorem

$$\frac{R_g}{\sin 138.1} = \frac{R_F}{\sin 138.1} = \frac{Q}{\sin 83.8}$$

$R_G = R_f = 597.6N.$

now, $\Sigma f_x = 0$

$-597.8 \cos 48.1 + 597.8 \cos 48.1 = 0$

$f_y = 0$

$R_A + R_B - 597.8 \sin 48.1 - 597.8 \sin 48.1 -$
$445 - 445 = 0$

$\boxed{\therefore R_A = R_B}$. $\quad 2R_A = 890 + 444.94$

$R_A = 667.47\,N = R_B$

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Q.2) Sol^n,

speed (V_a) = 24 km/hr

length (m_1) = 39 m

circle (m_2) = 2.7 m/s^2

time (m_3) = 8 sec

$V_A = 24$ km/hr
$= 6.67$ m/s.

$\vec{a_A} = 0$ (since velocity const.)

Now,

$$x_A = (x_A)_0 + V_A t$$
$$= 0 + 6.67 \times 8$$
$$= 53.36 \text{ m}$$

ie:

$$\vec{x_A} = \vec{r_A} = 53.36 \ (\rightarrow)$$

For automobile 'B'

$$a_B = -2.7 \text{ m/s}^2 = 2.7 \text{ m/s}^2 \ (\downarrow)$$

$$V_B = (V_B)_0 + at = 0 + (-2.7) \times 8$$
$$= 21.6 \text{ m/s} \ (\downarrow)$$

Now,

$$y_B = (y_B)_0 + (V_B)_0 t + \frac{1}{2} a_B t^2$$

$$= \cancel{16.67} + 0 \times 8 + \frac{1}{2} \times (-2.7) \times 8^2$$

$$= -93.07 \text{ m}$$

$$\vec{y_B} = \vec{r_B} = 93.07 \text{ m} \ (\downarrow)$$

motion of B relative to A

$\vec{r}_{B/A} = \vec{r}_B - \vec{r}_A = -93.07\vec{i} - 53.36\vec{j}$

$\vec{r}_{B/A} = \sqrt{(93.07)^2 + (-53.36)^2}$
$= 107.28\ m$

&

$\alpha = \tan^{-1}\left(\frac{93.07}{53.36}\right)$

$= 60.17^\circ$

again,

$\vec{v}_{B/A} = \vec{v}_B - \vec{v}_A = -21.6\vec{j} - 6.67\vec{i}$

$|\vec{v}_{B/A}| = \sqrt{(-21.6)^2 + (6.67)^2}$
$= 22.60\ m/s.$

& $\beta = \tan^{-1}\left(\frac{21.6}{6.67}\right)$

$= 72.83^\circ$

also,

$\vec{a}_{B/A} = \vec{a}_B - \vec{a}_A = 2.7\ m/s^2$

&

$\nu = \tan^{-1}\left(\frac{2.7}{0}\right) = 90^\circ.$