ASANSOL ENGINERING COLLEGE
MECHANICAL ENGINEERING DEPERTMENT
ASSIGNMENT FOR CA2

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SEMESTER- 3RD

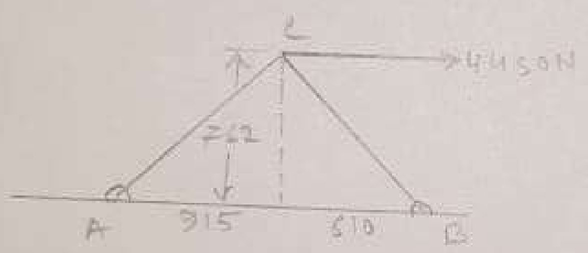
SUBJECT NAME - ENGINEERING MECHANICS
SUBJECT CODE - ES-ME301

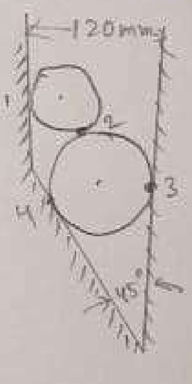
ENGINEERING MECHANICS (ES-ME 301)

Q1 ⇒ A Raller of weight 20kN rest on a smooth horizontal floor and is connected to the floor by the cable. Determine the force in the cable and the reaction from the floor. If the roller is subjected to a horizontal force of 8kN and an inclined force of 5kN with inclination to the verticle is 30°.

Q2 ⇒ A roller of Radius 300 mm and weight 1500 N is to be pulled over a carb of height 150 mm by a horizontal force 'p' applied to the end of a string wound tightly arround the circumference of the roller. Find the magnetude of P regenrated to start the roller to move over the curb.

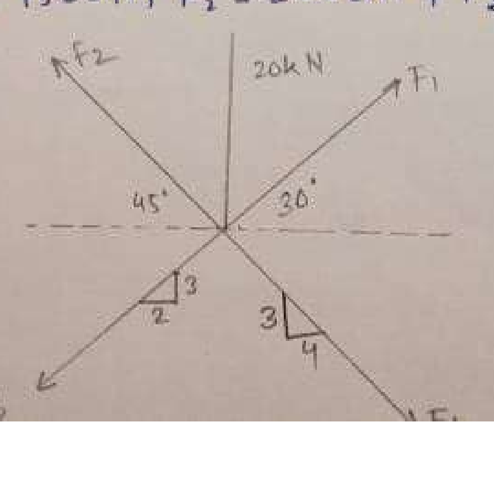
Q3 ⇒ Two cylinder of diameter 100mm and 50mm weight 200N and 50N are placed in a trough. Neglecting friction. Find the reaction at the contact surface 1, 2, 3, 4.

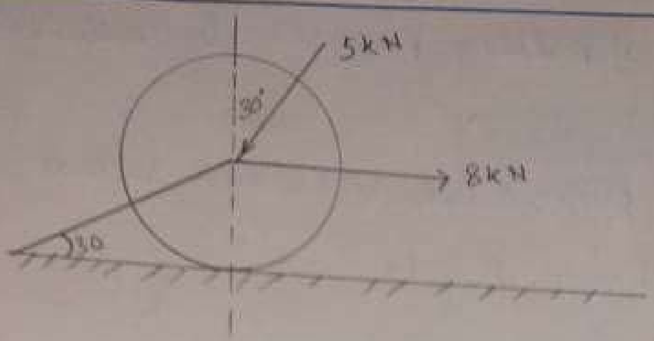


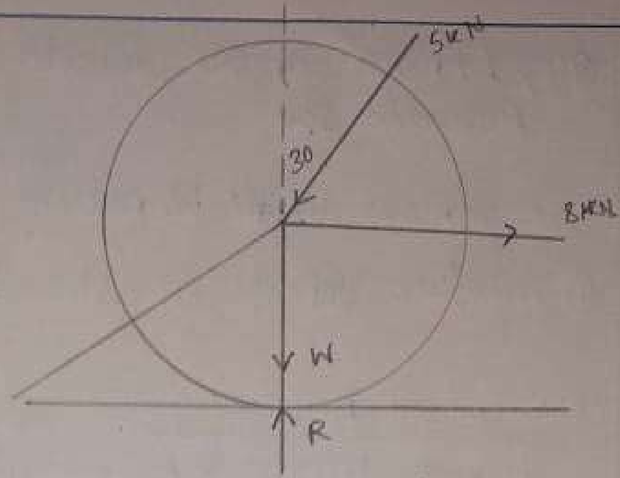


Q4 ⇒ Draw the Free Body diagram of the beam AC and BC

Q5 ⇒ Find the magnetute and direction of the resultant 'R' of the four Concurrent forces and having a magnitudes $F_1 = 1500N$, $F_2 = 2000N$, $F_3 = 3500N$ and $F_4 = 1000N$







We know a cable can develop tensile or compressive force(F) If the value of 'F' become positive then it will be compresive ie push and if the value of F become negative then it will be tensile ie pull

with the help of FBD and equilibrium of forces

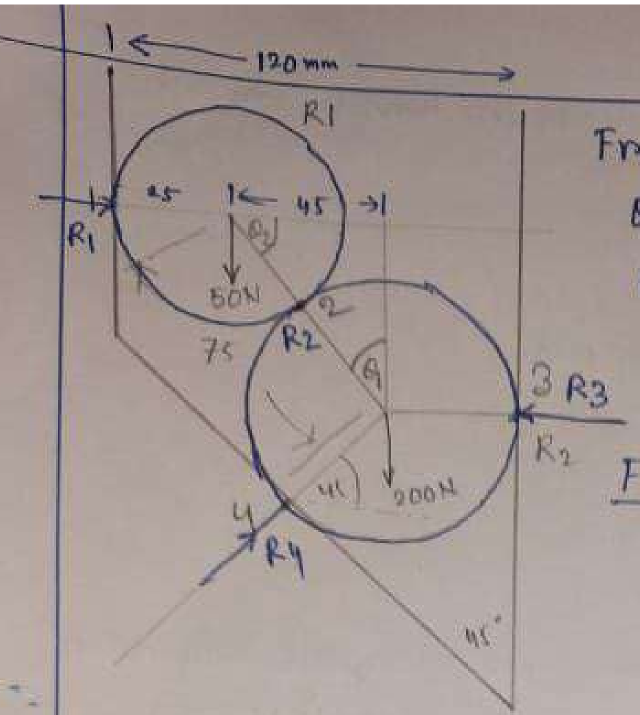
$\Sigma F_x = 0$ and $\Sigma F_y = 0$

$8 - 5\sin 30^\circ + F\cos 30^\circ = 0$ and $R - W - 5\cos 30^\circ + F\sin 30^\circ = 0$

$F = \dfrac{5\sin 30^\circ - 8}{\cos 30^\circ}$ or, $R = 20 + 5\cos 30^\circ + (-6.35)\sin 30^\circ = 0$

$= -6.35\ kN$ — (1) $R = 21.16\ kN$

As the value of F is negative, The force exerted in the cable will be tensile i-e pull i-e the cable is under tension.



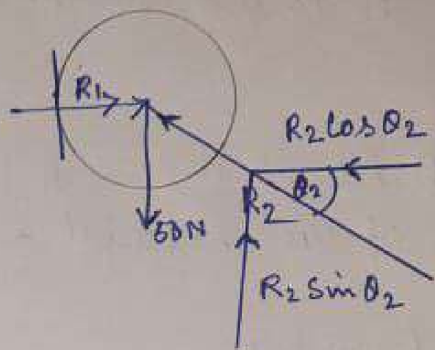
From the figure

$\theta_1 = \sin^{-1} \frac{45}{75}$

$\theta_1 = 36.86$

$\theta_2 = 53.13$

For Roller 1



we know $\Sigma F_x = 0$ and $\Sigma F_y = 0$

$R_1 - R_2 \cos\theta_2 = 0$

or, $R_1 = 62.5 \cos 53.15$

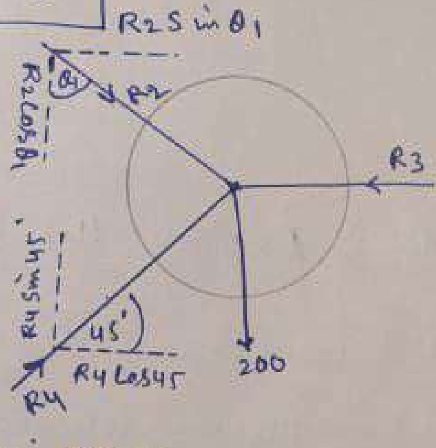
or, $\boxed{R_1 = 37.5 N}$

$R_2 \sin\theta_2 - 50 = 0$

$R_2 = \frac{50}{\sin 53.13}$

$\boxed{R_2 = 62.5 N}$

For Roller 2



$\Sigma F_x = 0$ and $\Sigma F_y = 0$

$R_2 \sin\theta_1 + R_4 \cos 45° - R_3 = 0$

or, $R_3 = R_2 \sin\theta_1 + R_4 \cos 45$

or, $R_3 = 62.5 \sin 36.86 + 353.56 \cos 45°$

or, $R_3 = 37.491 + 250$

or, $\boxed{R_3 = 287.491}$

$-R_2 \cos\theta_1 + R_4 \sin 45° - 200 = 0$

or, $R_4 \sin 45 = R_2 \cos\theta_1 + 200$

or, $R_4 \times 0.7071 = 62.5 \times \cos 36.86 + 200$

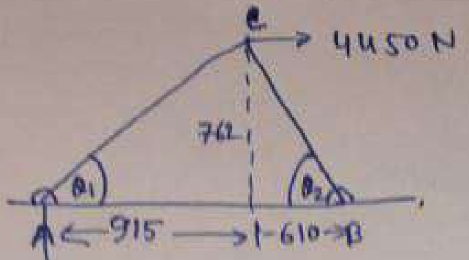
or, $R_4 = \frac{250}{0.7071}$

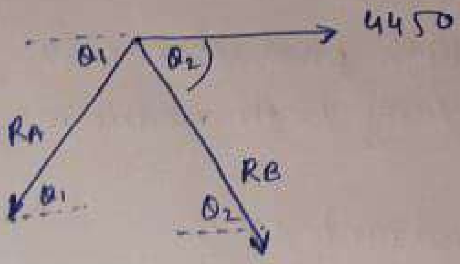
$\boxed{R_4 = 353.56 N}$

The Reaction at point 1, 2, 3, 4 are

37.5N, 62.5N, 287.491N and 353.56 N

Sol 4.





FBD

From the Given figure

$\tan\theta_1 = \frac{762}{915}$, or, $\theta_1 = \tan^{-1}\frac{762}{915}$

or, $\boxed{\theta_1 = 39.787^\circ}$

$\tan\theta_2 = \frac{762}{610}$ or, $\theta_2 = \tan^{-1}\frac{762}{610}$

$\boxed{\theta_2 = 51.321}$

~~usi~~ Applying Lami's theory

$$\frac{R_A}{\sin\theta_2} = \frac{4450}{\sin(180^\circ - \theta_1 - \theta_2)} = \frac{R_B}{\sin(180^\circ + \theta_1)}$$

or, $$\frac{R_A}{\sin 51.321^\circ} = \frac{4450}{\sin(180^\circ - 39.787^\circ - 51.321^\circ)} = \frac{R_B}{\sin(180^\circ + 39.787^\circ)}$$

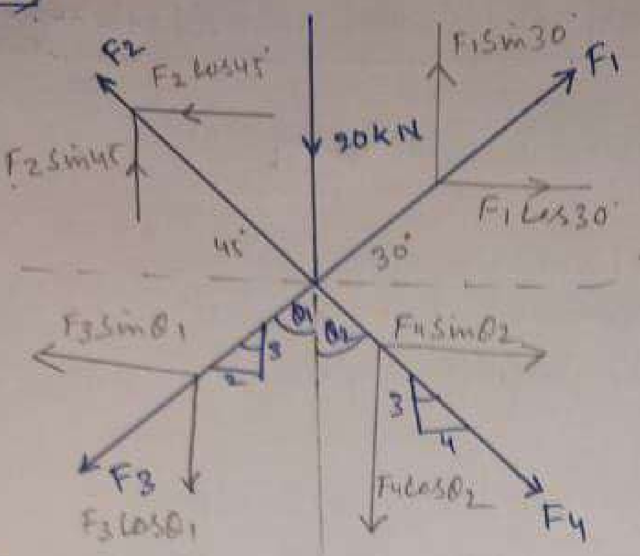
or, $$\frac{R_A}{0.780} = \frac{4450}{0.999} = \frac{R_B}{-0.639}$$

or, $\boxed{R_A = \cancel{374}3474 \text{ N}}$ $\boxed{R_B = -2846 \text{ N}}$

Member AC Facing tensile force of 3474 N

Member CB Facing compressive force of 2846 N

Sol 5)



$F_1 = 1500N$
$F_2 = 2000\ N$
$F_3 = 3500N$
$F_4 = 1000N$

Now, $\theta_1 = \tan^{-1}\frac{2}{3}$

$\boxed{\theta_1 = 33.69}$

$\theta_2 = \tan^{-1} 4/3$

$\boxed{\theta_2 = 53.13}$

Net Forces Towards x- Axis

$F_x = F_1 \cos 30° + F_4 \sin 53.13 - F_3 \sin 33.69 - F_2 \cos 45°$

$= 1500 \times \cos 30° + 1000 \sin 53.13 - 3500 \sin 33.69 - 2000 \cos 45°$

$= -1256.62\ N$

Net Forces Towards y- Axis

$F_y = -20 \times 1000 + F_1 \sin 30 - F_4 \cos 53.13 - F_3 \sin 33.69 + F_2 \sin 45°$

$= -20{,}000 + 1500 \sin 30 - 1000 \cos 53.13 - 3500 \sin 33.69 + 2000 \sin 45$

$= -20377\ N$

Resultant Force $R = \sqrt{(-20377)^2 + (-1256.62)^2}$

$= \sqrt{415222129 + 1579093.82}$

$= \sqrt{416801222.8}$

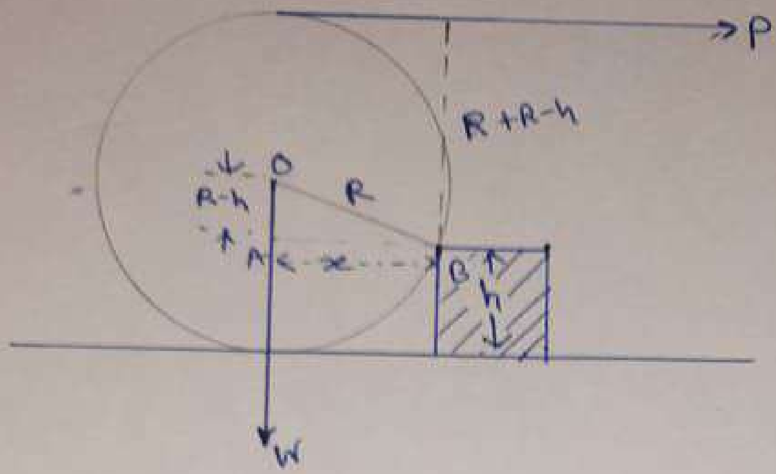
$= 20415.7\ N$

$\theta = \tan^{-1} \frac{-1256.62}{-20377}$

$\theta = 86.47° + 180°$

$\theta = 266.47°$

Sol2



As per the question $R = 300$ mm, $W = 1500$ N and $h = 150$ mm

As per figure $x = \sqrt{R^2 - (R-h)^2}$ or, $x = \sqrt{\cancel{R^2} - \cancel{R^2} + 2Rh - h^2}$

or, $x = \sqrt{2Rh - h^2}$

or, $x = \sqrt{2 \times 300 \times 150 - 150^2}$

$= 259.80$

For equilibrium of figure Net moment is 0. Now Net moment about point B & ~~eq~~ equation is

$$-P \times (2R - h) + W \times x = 0$$

or, $-P \times (2 \times 300 - 150) = -1500 \times 259.80$

or, $P \times 450 = 389700$

$P = 866$ N.