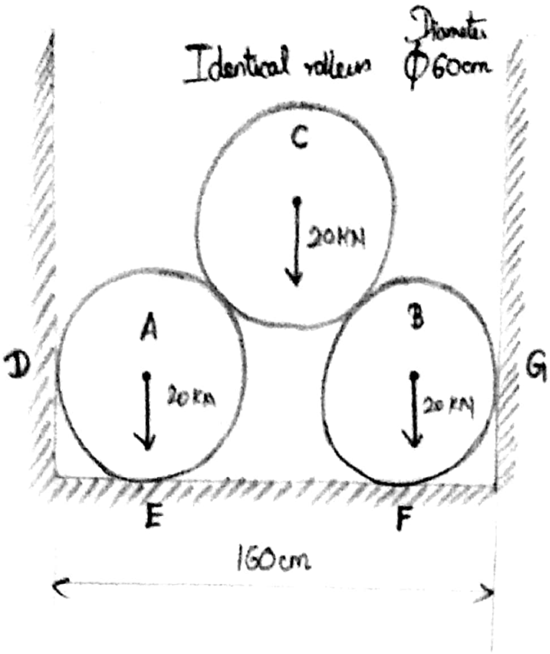
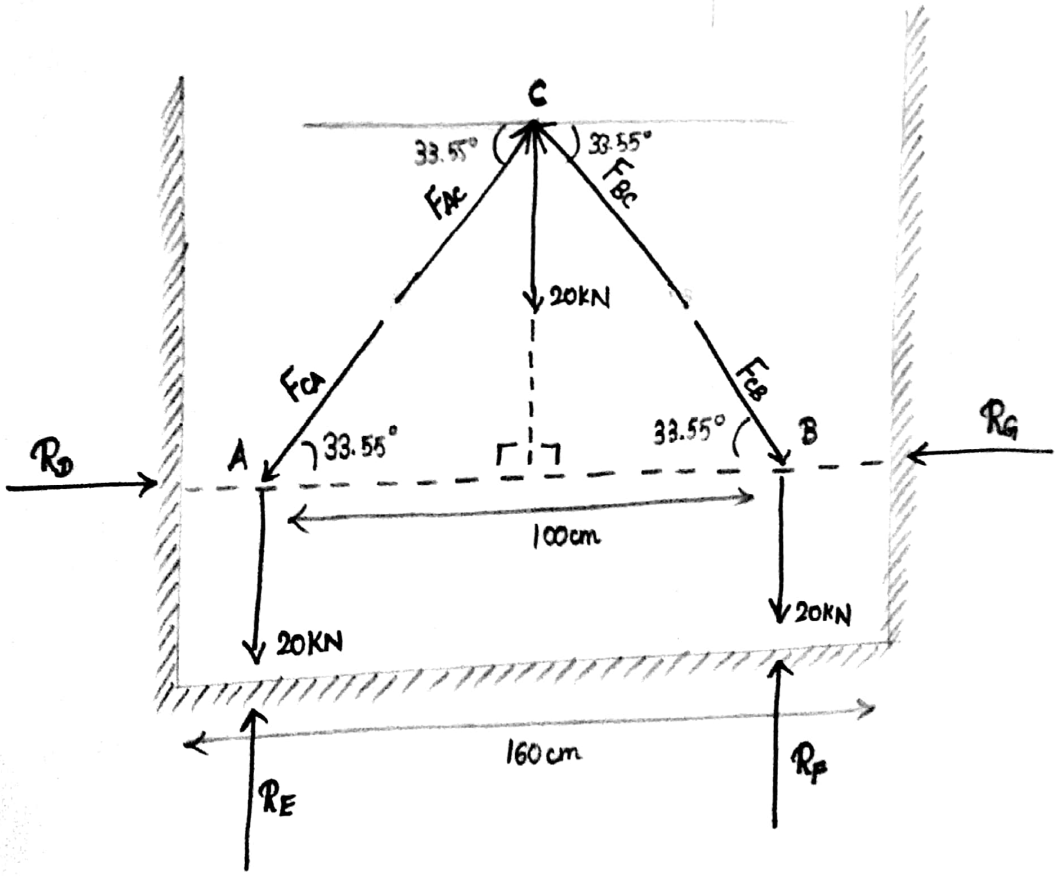
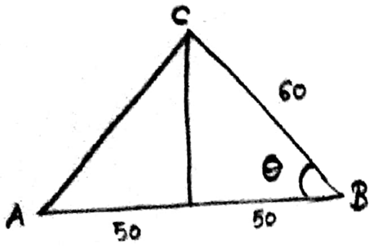
21-1-16 Problem No: 19:







$$\cos\theta = \frac{50}{60}$$

$$\theta = \cos^{-1}\left(\frac{50}{60}\right)$$

$$\boxed{\theta = 33.55^\circ}$$

DG = 160 cm

AB = DG - Radius of A - Radius of B

= 160 - 30 - 30

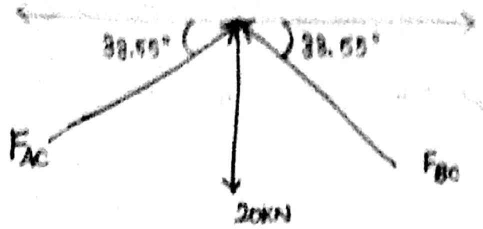
= 100 cm

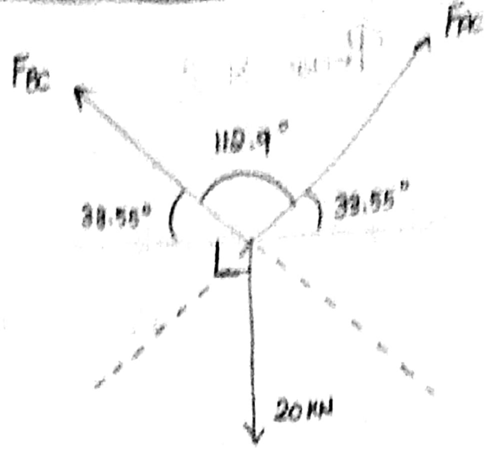
AB = 100 cm

CB = 60 cm

(Radius of C + Radius of B

FBC at C





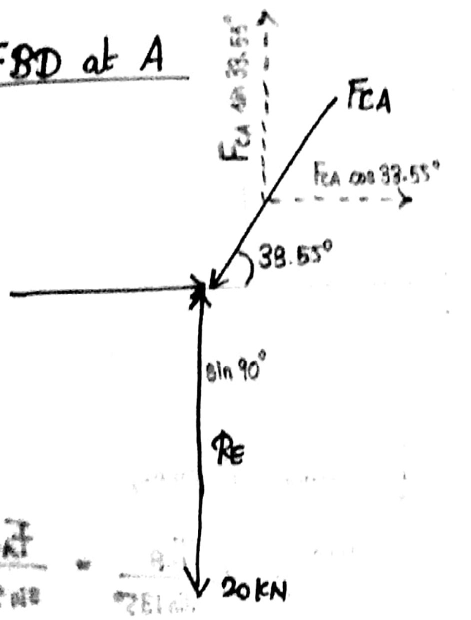
By Lami's Theorem,

$$\frac{20}{\sin 112.9^\circ} = \frac{F_{AC}}{\sin 123.55^\circ} = \frac{F_{BC}}{\sin 123.55}$$

$$F_{AC} = F_{BC} = \frac{20 \times \sin 123.55^\circ}{\sin 112.9^\circ}$$

$$\boxed{F_{AC} = F_{BC} = 18.09 \text{ KN}}$$

FBD at A



Apply conditions of Equilibrium $\Sigma H = 0$ and $\Sigma V = 0$

$$\Sigma H = -18.09 \cos 33.55^\circ + R_D$$

$$\boxed{R_D = 15.07 \text{ KN}}$$

$$\Sigma V = -20 + R_E - 18.09 \sin 33.55^\circ$$

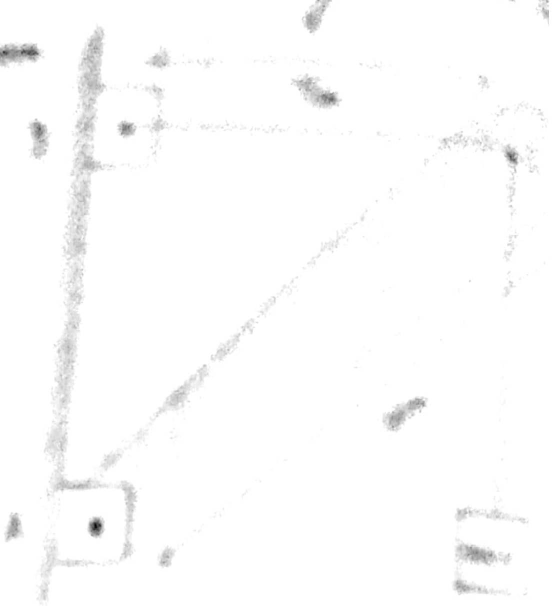
$$\boxed{R_E = 30 \text{ KN}}$$

Since Identical rollers,

$$R_E = R_F$$
$$R_G = R_D$$

[illegible]

FBD at C

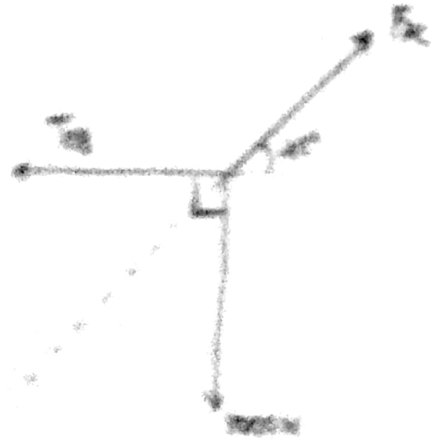


From $\triangle ABC$

$\sin\theta = $ [illegible]

$\theta = \sin^{-1}($[illegible]$)$

$\boxed{\theta = 45^\circ}$



By Lami's theorem,

$$\frac{1000}{\sin 135^\circ} = \frac{T_{CB}}{\sin 135^\circ} = \frac{F_{AC}}{\sin 90^\circ}$$

$T_{CB} = \frac{1000 \times \sin 135^\circ}{\sin 135^\circ}$ [illegible]

$\boxed{T_{CB} = 1000\ N}$

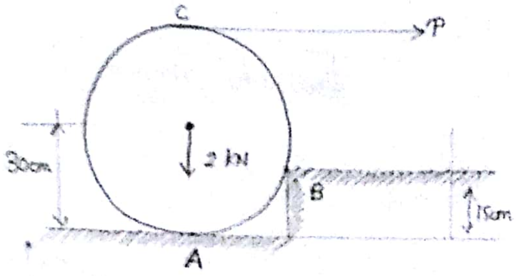
$F_{AC} = \frac{1000 \times \sin 90^\circ}{\sin 45^\circ}$ [illegible]

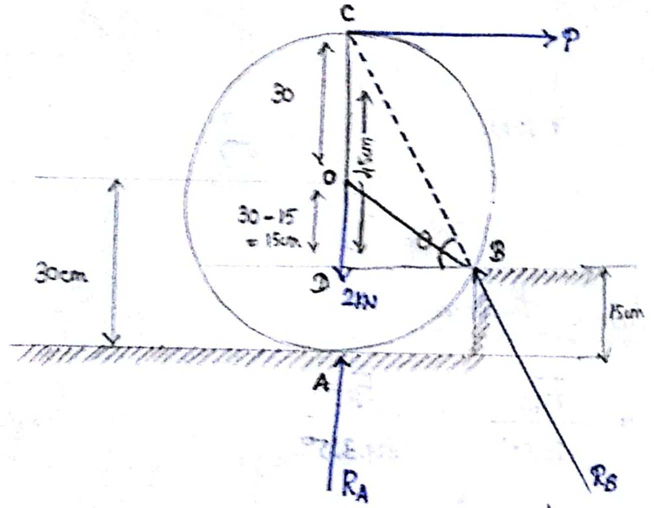
$\boxed{F_{AC} = 1414.21\ N}$

22-1-16

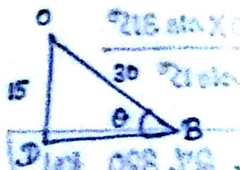
Problem No: 21

A roller of radius 30 cm and weight 2 KN is to be pulled over a rectangular obstruction of height 15 cm as shown in fig by a force P applied tangentially at its crest C through a string wound around the circumference of the roller. Find the force P required just to turn the wheel over the corner of the obstruction, also determine the magnitude and direction of the reactions at A and B. Surfaces may be taken as smooth.





Method 1 : Lami's Theorem.



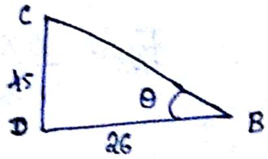
In $\triangle OBD$,

$OB^2 = OD^2 + DB^2$

$DB^2 = OB^2 - OD^2$

$DB^2 = 30^2 - 15^2$

$\boxed{DB = 26cm}$



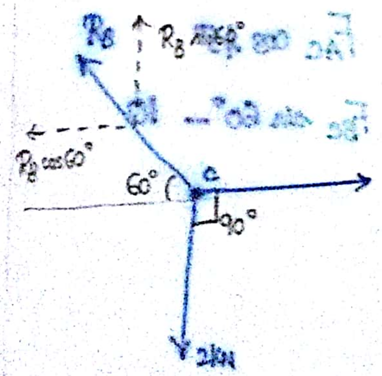
In $\triangle DBC$,

$\tan\theta = 45/26$

$\theta = \tan^{-1}\left(\frac{45}{26}\right)$

$\boxed{\theta = 60°}$

Method 2: Resolving of forces



Apply condition of equilibrium,

$\Sigma H = 0$; $0 = P - R_B \cos 60°$ —— (1)

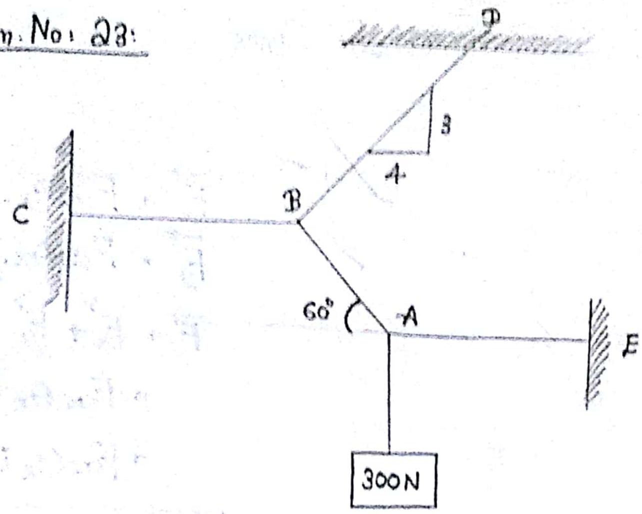
$\Sigma V = 0$; $0 = -2 + R_B \sin 60°$

$R_B = 2/\sin 60° \Rightarrow \boxed{2.309\ KN = R_B}$

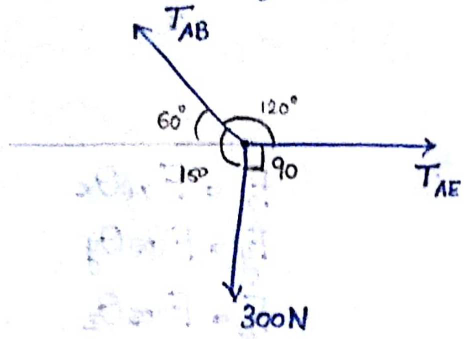
Sub R_B in (1) we get $P = 2.309 \sin 60°$

$\boxed{P = 1.154\ KN}$

Problem. No: 23:



Free Body Diagram at A:



Applying Lami's theorem:

$$\frac{300}{\sin 120^\circ} = \frac{T_{AE}}{\sin 150^\circ} = \frac{T_{AB}}{\sin 90^\circ}$$

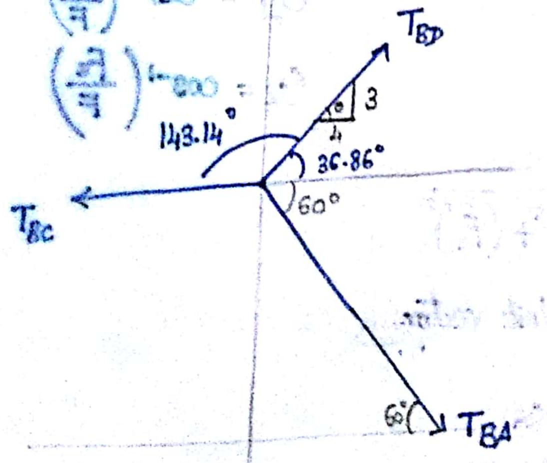
$$T_{AE} = \frac{300 \times \sin 150^\circ}{\sin 120^\circ}$$

$$\boxed{T_{AE} = 173.20 \text{ N}}$$

$$T_{AB} = \frac{300 \times \sin 90^\circ}{\sin 120^\circ}$$

$$\boxed{T_{AB} = 346.41 \text{ N}}$$

Free Body Diagram at B:



$\tan\theta = 3/4$

$\theta = \tan^{-1}(3/4)$

$\boxed{\theta = 36.86^\circ}$

Applying Lami's theorem,

$$\frac{T_{BA}}{\sin 143.14^\circ}$$

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