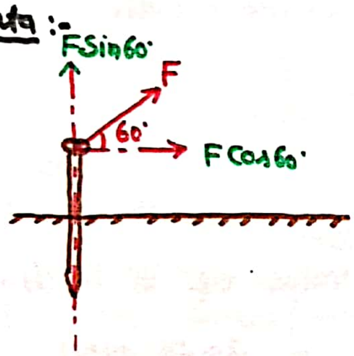
B.T.E.U.P. – 1979

Question :- A steel nail is pulled out with the force (F) through an inclined rope which makes an angle of 60° from horizontal. Then find-

(1) Effective force required to pull out the nail.

(2) What is the other element.

Given data :-



F Sin 60° → Along the nail.

F Cos60° → ⊥ʳ or Normal to the nail.

To find :- (i) effective force.

F Sin 60° is the along the nail so it is effective force to pull the nail out.

$$\left\{ F_{eff} = F \sin 60° = F \frac{\sqrt{3}}{2} \right\}$$

(ii) Other Component = ⊥ʳ to the nail

$= F \cos 60°$

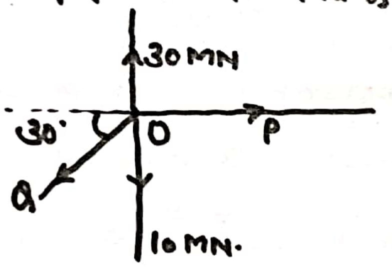
$= F \times \frac{1}{2}$

$$\left\{ \text{Other Component} = \frac{F}{2} \right\}$$

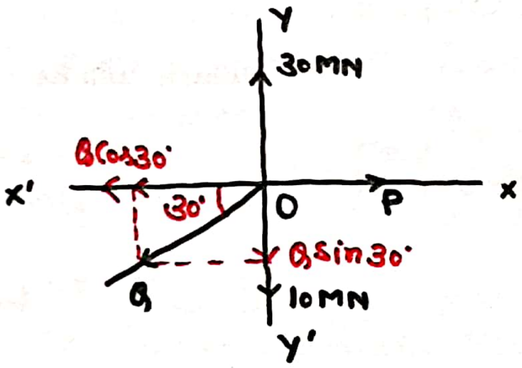
which will be inactive.

B.T.E.U.P. 2005

Question:- Particle. 'O' is in equilibrium under the acting forces P, 30 MN, Q and 10 MN as shown in figure. Find the Value of forces 'P' and 'Q'.



Solve:-



There are 2- Components of force 'Q'-

Horizontal Component = $Q \cos 30°$

Vertical Component = $Q \sin 30°$

$\because$ 'O' is in equilibrium.

$\therefore \quad P = Q \cos 30°$

$P = Q \cdot \frac{\sqrt{3}}{2} \quad — ①$

$30\ MN = Q \sin 30 + 10\ MN$

$30 - 10 = Q \times \frac{1}{2}$

$20 = \frac{Q}{2}$

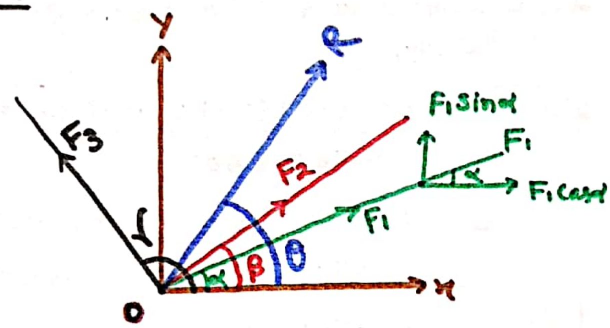
$[Q = 40\ MN]$ Ans.

putting the value of 'Q' in (i)-

$[P = 40 \times \frac{\sqrt{3}}{2} = 20\sqrt{3}\ MN]$ Ans.

$\therefore \{P = 40\ MN;\quad Q = 20\sqrt{3}\ MN\}$

RESULTANT OF COPLANAR CONCURRENT FORCES :-



Let, the resultant of all these forces is 'R' which makes an angle 'θ' from ox.

Now, from theorem of Resolved parts-

{Alzebraic sum of Resolved parts of all these forces in any direction} = {Resolved part of Resultant in that part}

Along ox direction:-

$$R\cos\theta = F_1\cos\alpha + F_2\cos\beta + F_3\cos\gamma + \dots = X \quad \text{--- (1)}$$

Along oy- direction-

$$R\sin\theta = F_1\sin\alpha + F_2\sin\beta + F_3\sin\gamma + \dots = Y \quad \text{--- (2)}$$

from (1) & (2) - Square on both the sides and adding them-

$$R^2(\cos^2\theta + \sin^2\theta) = X^2 + Y^2$$

$$\boxed{R = \sqrt{X^2+Y^2}}$$

Magnitude of Resultant of all the forces.

Now, Equ^n (2) ÷ by equ^n (1)-

$$\frac{Y}{X} = \frac{R\sin\theta}{R\cos\theta} = \tan\theta$$

$$\tan\theta = \frac{Y}{X}$$

$$\boxed{\theta = \tan^{-1}\left(\frac{Y}{X}\right)}$$

Direction of Resultant of all the forces, from ox.

NOTE:- if R = 0

∴ then, it is possible only when [X = 0, Y = 0]