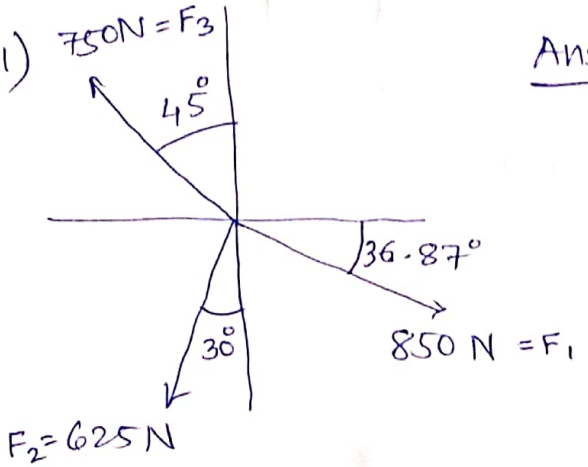
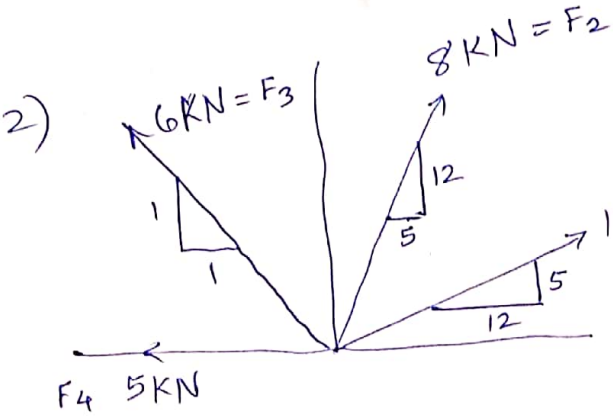
Tut Qs

1) 

Ans: 545.79 N ∠ -107.36°

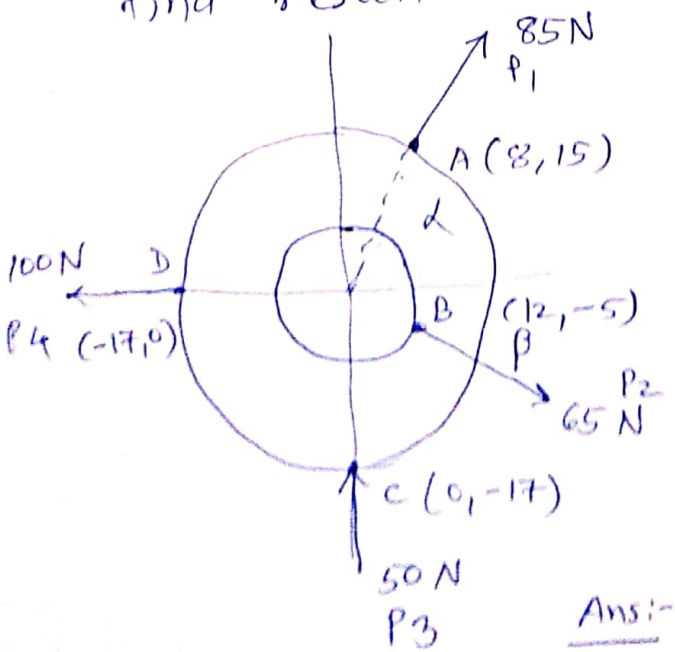
Find the resultant of the 3 Forces

2) 

Ans: 15.76 N ∠ 78.80°

Find the resultant of the 4 Forces

3) Four concurrent forces are acting on a ring ID & OD are 26 cm & 34 cm resply. Application points are shown below. Check whether system is in ≡m otherwise find resultant.



$\Sigma F_x = P_1 \cos\alpha + P_2 \cos\beta - P_4$

$= 0$ N

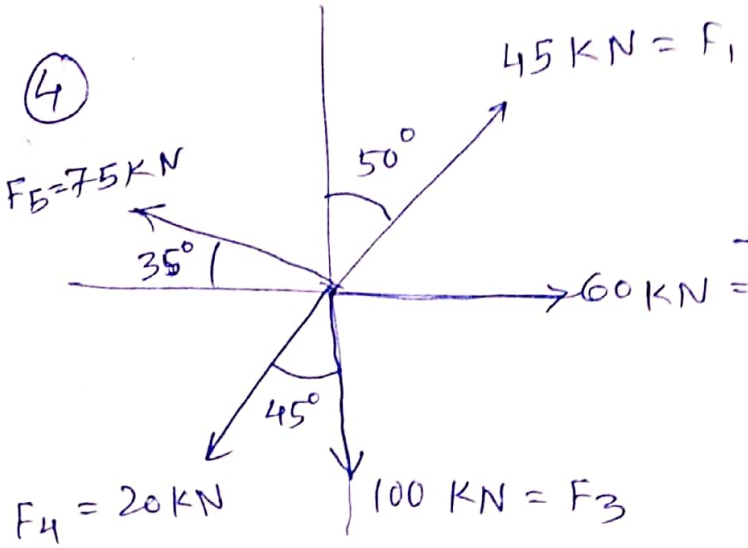
$\Sigma F_y = P_1 \sin\alpha + P_2 \sin\beta + P_3$

$= 100$ N

∴ No ≡m

Ans:- R = 100 N ↑ ∠ +90°

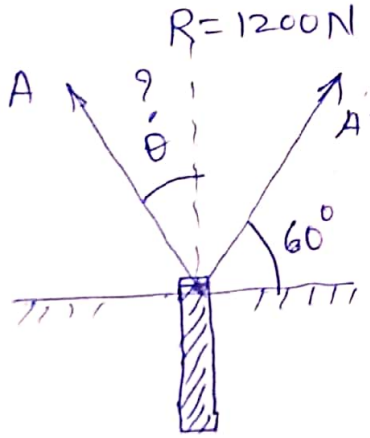
(4)



Find Resultant of all 5 Forces.

Ans:- R = 46.23 KN ∠ 65.88°

(5) A pole is buried below ground. It is to be pulled upwards using two ropes A & B. Find the pull at B and the angle also such that the resultant verticall pull is 1200 N.



Sol^{n} : $\Sigma X = 0$

$\therefore 600 \cos 60 - B \sin\theta = 0$

$\therefore B \sin\theta = 300$ —(1)

Also, $\Sigma Y = 1200$

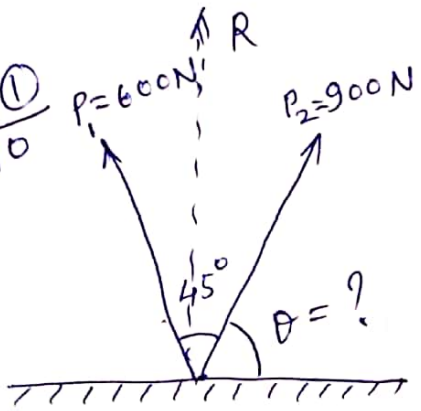
$\therefore 600 \sin 60 + B \cos\theta = 1200$

$\therefore B \cos\theta = 680.38$ —(2)

$\therefore \tan\theta = 0.4411$ $\therefore \theta = 23.79°$

& $B = 743.70$ N] Ans.

Ex ① 4.5.10

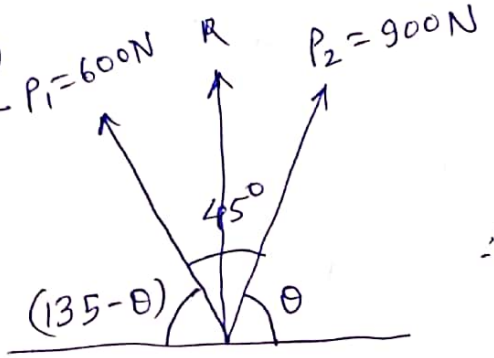


$P_1 = 600\,N$ & $P_2 = 900\,N$

find θ such that R is vertical.

find magnitude of R also.

Soln



For R to be vertical

$\Sigma X = 0$ & $\Sigma Y = R$

Resolving,

$$900\cos\theta = 600\cdot\cos(135-\theta)$$

$$= 600\cdot[\cos 135\cos\theta + \sin 135\cdot\sin\theta]$$

$$1.5\cos\theta = -0.707\cos\theta + 0.707\sin\theta$$

$$2.207\cos\theta = 0.707\sin\theta$$

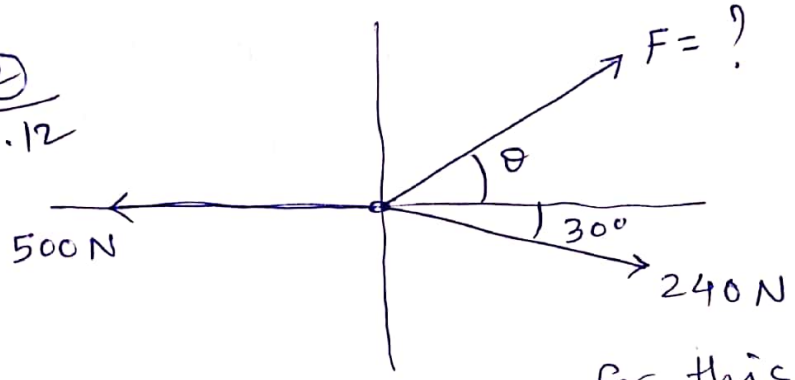
$$\therefore \tan\theta = 3.1216 \quad \therefore \boxed{\theta = 72.2374^\circ}$$

Now $R = 900\sin\theta + 600\sin(135-\theta)$

$$= 857.096 + 533.4706$$

$$\boxed{R = 1390.5666\ N}$$

Ex ②
4.5.12



expected Resultant R should be along +Y of 200 N.

for this find F∠θ

Soln - $\Sigma X = 0$ & $\Sigma Y = 200$ N (condition)

$F\cos\theta + 240\cos(-30) - 500 = 0$

$\therefore F\cos\theta = +292.1539$ N. — ①

$\Sigma Y = 200$

$\therefore F\sin\theta + 240\sin(-30) + 0 = 0$

$\therefore F\sin\theta = 120$ N — ②

$\therefore \frac{②}{①} = \tan\theta = \frac{120}{292.1539} = 0.4107$

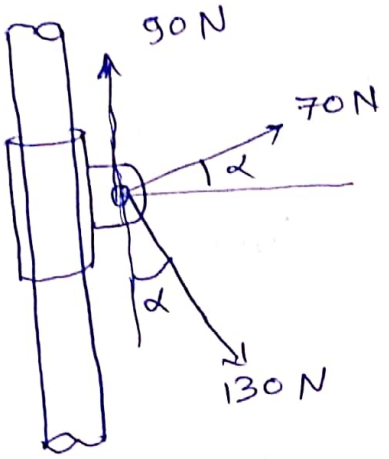
$\therefore \boxed{\theta = 22.33^\circ}$

& $F\sin 22.33 = 120$

$\therefore \boxed{F = 315.8388 \text{ N}}$

Ex ③
4.5.21

A collar slides over a vertical pipe. The slide is subjected to 3 forces as shown.



Find angle α such that there is no vertical movement.

Find the x component also.

Soln - $\Sigma X = R$ & $\Sigma y = 0$ (for equilibrium)

$90 + 70 \sin\alpha - 130 \cos(+\alpha) = 0 \rightarrow (\Sigma y = 0)$

$7 \sin\alpha = 13 \cos\alpha - 9$ → (This can be solved by many ways) square both sides.

$49 \sin^2\alpha = 169 \cos^2\alpha + 81 - 234 \cos\alpha$

$49(1 - \cos^2\alpha) = 169 \cos^2\alpha + 81 - 234 \cos\alpha$

$\therefore 218 \cos^2\alpha - 234 \cos\alpha + 32 = 0$

$\alpha = 80.75°$ or $24.21°$ ($\Sigma y = 0$ is the condition)

$80.75°$ ✗ invalid

$24.21°$ ✓ valid

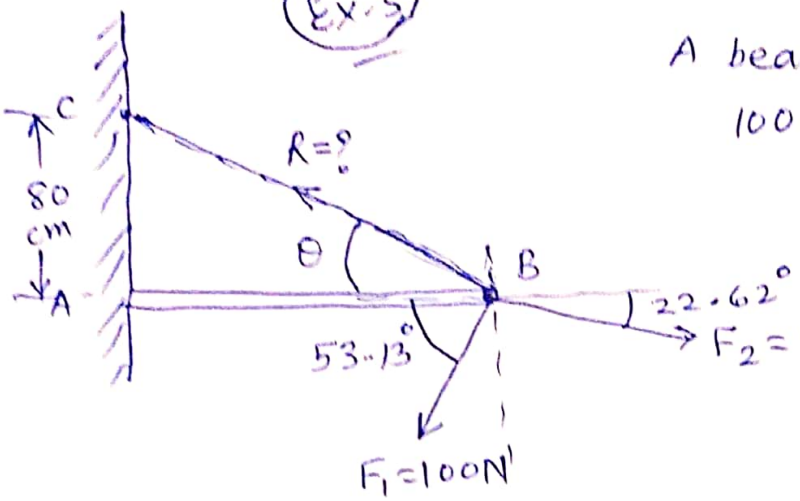
$\therefore \Sigma X = R$

$= 70 \cos 24.21 + 130 \sin 24.21$

$X = 117.04$ N Answer

X compo.

Ex-5



A beam AB has length of 100 cm is subjected to two forces F_1 & F_2 as shown. Find the tension required to be given to a cable CB located at a distance of 80 cm from A so that the beam AB remains horizontal.

Sol^n - $F_1 = (-60, -80)$ resolved

& $F_2 = (144, -60)$ resolved

For AB to remain horizontal, Σy of F_1, F_2 and R should be = 0.

$\Sigma y = -140$ → to be compensated by R

$\angle\theta = \tan^{-1}\frac{80}{100} = 38.6598^\circ$

Now $R \cdot \sin(38.6598) = 140$

$\therefore R = 224.1093 \text{ N} \angle(38.6598^\circ)$ Answer

will do the required job. There is no restriction on X component.