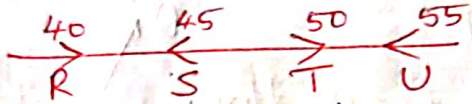
Problems:

① Forces R, S, T, U are collinear. Forces R & T act from left to right. Forces S & U acts from right to left. Magnitude of the forces R, S, T, U are 40N, 45N, 50N & 55N respectively. Find the resultant force of R, S, T & U.

Soln:

Given: $R = 40N \rightarrow$; $S = 45N \leftarrow$

$T = 50N \rightarrow$; $U = 55N \leftarrow$



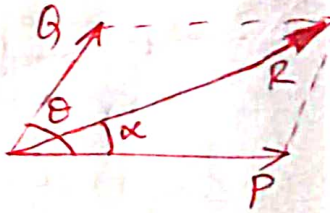
Magnitude of Resultant = R + S + T + U

$= 40 - 45 + 50 - 55$

$= -10N$

Resultant Force = 10N acting towards left.

② Two forces 30N & 40N act at a point O. The included angle between them is 60°. Find magnitude & direction of the resultant.



Soln: Given: Horizontal force $P = 30N$

other force $Q = 40N$

Included angle $\theta = 60°$

Resultant force $R = \sqrt{P^2 + Q^2 + 2(PQ\cos\theta)}$

$= \sqrt{30^2 + 40^2 + (2 \times 30 \times 40 \times \cos 60°)}$

$R = 60.83N$

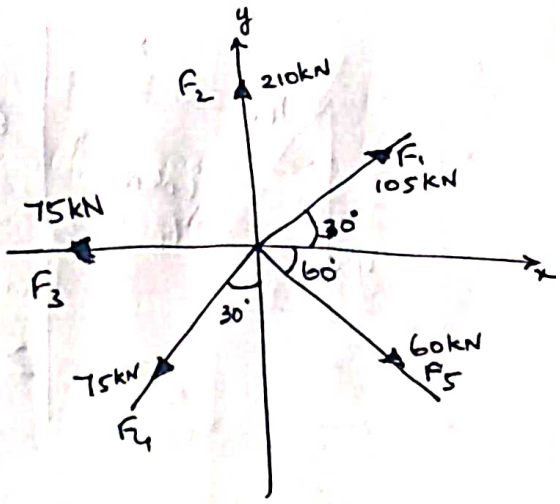
Direction of resultant $\alpha = \tan^{-1}\left[\frac{Q\sin\theta}{P + Q\cos\theta}\right]$

$= \tan^{-1}\left[\frac{40\sin 60}{30 + 40\cos 60}\right]$

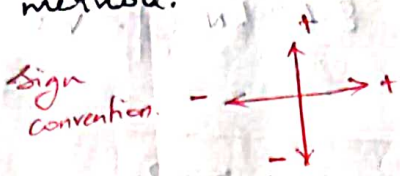
$= \tan^{-1}[0.6928]$

$\alpha = 34.72^\circ$

⑥ If five forces act on a particle as shown in figure determine the R.f using analytical method.



Sign convention



Given:

$F_1 = 105kN$ $\theta_1 = 30°$

$F_2 = 210kN$ $\theta_2 = 90°$

$F_3 = 75kN$ $\theta_3 = 0°$

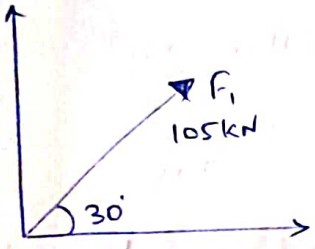
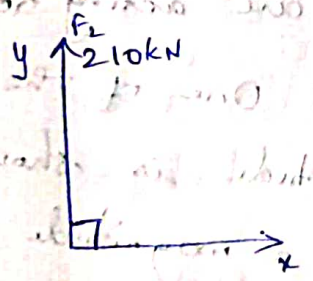
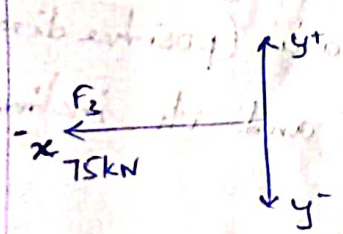
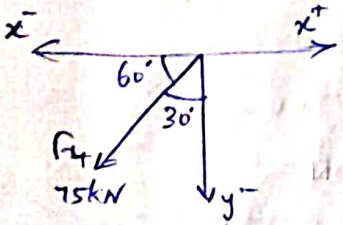
$F_4 = 75kN$ $\theta_4 = 90° - 30° = 60°$

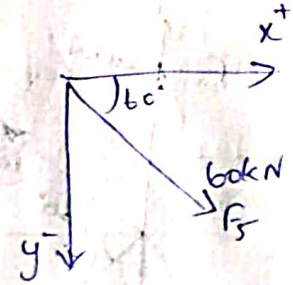
$F_5 = 60kN$ $\theta_5 = 60°$

Vertical Component $F \sin\theta$

Horizontal Component $F \cos\theta$

{ Taking value of θ wrt to the horizontal. }

S.No.	Force (kN)	Horizontal component H	Vertical component V
1		$F_1 \cos\theta_1$ $105 \cos 30° = 90.93$	$F_1 \sin\theta_1$ $105 \sin 30° = 52.5$
2.		$F_2 \cos\theta_2 =$ $210 \cos 90° = 0$	$F_2 \sin\theta_2$ $210 \sin 90° = 210$
3.		-75	0
4.		$-75 \cos 60°$ $= -37.5$	$-75 \sin 60° = -64.95$

5		$60\cos 60^\circ = 30$	$-60\sin 60^\circ = -51.96$
		$\Sigma H = 8.43\,kN$	$\Sigma V = 145.59\,kN$

Resultant force, $R = \sqrt{\Sigma V^2 + \Sigma H^2}$

$= \sqrt{(145.59)^2 + (8.43)^2}$

$\boxed{R = 145.8\,kN}$

$\tan\alpha = \frac{\Sigma V}{\Sigma H} = \frac{145.59}{8.43} = 17.63$

$\alpha = \tan^{-1}(17.63)$

$\boxed{\alpha = 86.686^\circ}$

(7) The three coplanar forces are acting at a point as shown in figure. One of the forces is unknown and its magnitude is shown as P. The resultant is having a magnitude of 500N and is acting along y-axis (positive direction) Determine the unknown force P and its inclination with x-axis.