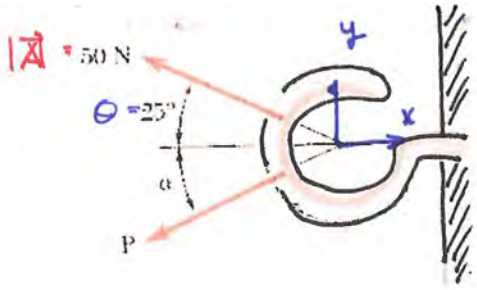
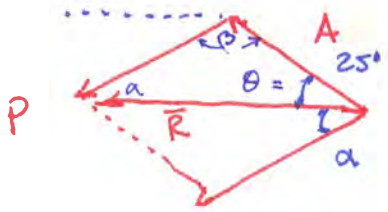
Example

Two forces are applied to a hook as shown. The magnitude of **P** 35 N. Using trigonometry,

a) find the required angle a such that the resultant R is horizontal, and
b) the magnitude of R
c) Repeat a) and b) using vector components.





LAW of SINES

$$\frac{\sin 25^\circ}{P} = \frac{\sin\alpha}{50\ N}$$

$$\alpha = \sin^{-1}\left[\frac{50\ N}{P}\cdot\sin 25^\circ\right]$$

$$= \sin^{-1}\left[\frac{50}{35}\cdot\sin 25^\circ\right]$$

$$= " \left[1.429 \cdot 0.4226\right] = 37.2^\circ$$

LAW of COSINES

b) $R^2 = A^2 + P^2 - 2AP\cos\beta$

$\beta = (\alpha + 25^\circ) + 180^\circ = 180^\circ - (37.2 + 25) = 117.9^\circ$

$R^2 = 50^2 + 35^2 + - 2\cdot 50\cdot 35\cos(117.9^\circ)$

$= 5361\ N^2$

$R = 73.2\ N$

c) $\vec{A} = -50\cdot\cos 25^\circ\,\hat{i} + 50\cdot\sin 25^\circ\,\hat{j}$

$\vec{P} = -35\cos\alpha\,\hat{i} \quad 35\sin\alpha\,\hat{j}$

$$\vec{R} = \vec{A} + \vec{P}$$

$$R_x = A_x + P_x = -50\cos 25^\circ - 35\cos\alpha = R_x \qquad (1)$$

$$R_y = A_y + P_y = 50\sin 25^\circ - 35\sin\alpha = 0 \qquad (2)$$

$$\rightarrow \sin\alpha = \frac{50}{35}\sin 25^\circ \Rightarrow \boxed{\alpha = 37.2^\circ}$$

FROM (1)

$$R_x = -50\cos(25^\circ) - 35\cos(37.2^\circ) = -73.2\ \text{N}$$

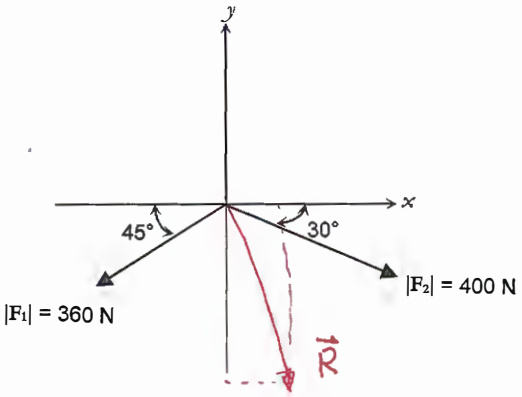
$$|\vec{R}| = \left(R_x^2 + \underbrace{R_y^2}_{0}\right)^{1/2}$$

$$= \boxed{73.2\ \text{N}}$$

Example

Given vectors $\mathbf{F}_1$ and $\mathbf{F}_2$ as shown, find the *resultant*. Express your answer

a) in Cartesian vector form, and
b) as a magnitude and an angle measured from the horizontal.



a) $\vec{F}_1 = -360 \cos 45° \hat{i} - 360 \sin 45° \hat{j}$

$\vec{F}_2 = 400 \cos 30 \hat{i} - 400 \sin 30° \hat{j}$

$\vec{R} = \vec{F}_1 + \vec{F}_2$

$= (\underbrace{-360 \cos 45°}_{-255} + \underbrace{400 \cos 30°}_{346}) \hat{i}$

$(\underbrace{-360 \sin 45°}_{-255} - \underbrace{400 \sin 30°}_{-200}) \hat{j}$

$= \boxed{91 \hat{i} - 455 \hat{j}}$

b) $|\vec{R}| = (R_x^2 + R_y^2)^{1/2} = (91^2 + (-455)^2)^{1/2} =$

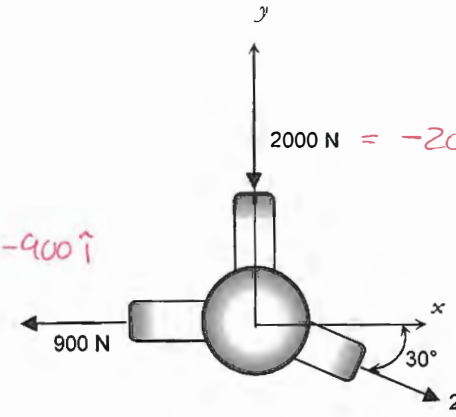
$= 464 \text{ N}$

$\tan\theta = R_y / R_x = -455/91 \qquad \theta = -78.7°$

$\boxed{\vec{R} = 464 \text{ N} \angle -78.7°}$

Example

Three forces act on the member as shown. Find the resultant, expressing it in Cartesian vector form.



$\vec{F}_2 = -2000\,\hat{j}$ N

$\vec{F}_3 = -900\,\hat{i}$

$\vec{F}_1 = \cos 30° \, 2500\,\hat{i} - \sin 30 \, 2500\,\hat{j}$

$\vec{R} = \Sigma R_x \hat{i} + R_y \hat{j}$

$R_x = +2500\,\text{N} \cos 30° - 900\,\text{N} = 1265\,\text{N}$

$R_y = -2000\,\text{N} - 2500\,\text{N} \cdot \sin 30° = -3250\,\text{N}$

$\vec{R} = 1265\,\hat{i} - 3250\,\hat{j}$