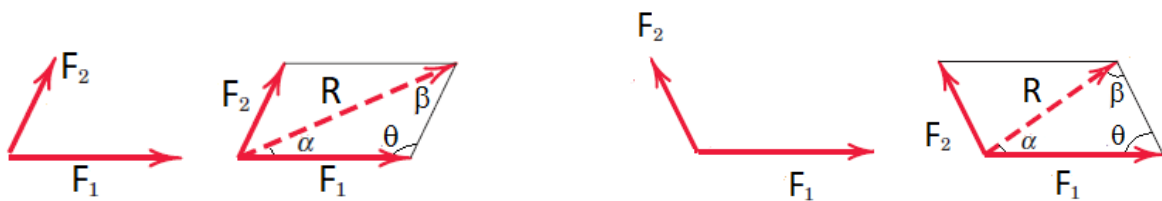




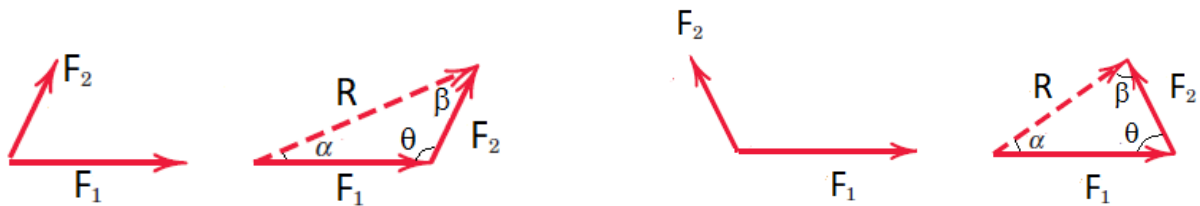
1.2 Composition & Resolution of Forces

Composition is the process of replacing a force system by its resultant.

a. Parallelogram Law



b. Triangle Law



The resultant of a pair of concurrent forces can be determined by:

$$R = \sqrt{F_1^2 + F_2^2 - 2F_1F_2 \cos \theta}$$

Also, it can be found the direction of R or unknown one of forces by:

$$\frac{R}{\sin \theta} = \frac{F_1}{\sin \beta} = \frac{F_2}{\sin \alpha}$$

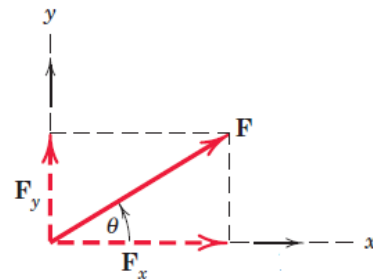
Resolution is the process of replacing a single force by its components.

If a force (F) lies in the $x - y$ plane. The force (F) may be resolved into two rectangular components. The component of a force parallel to the x -axis is called the Horizontal component (F_x), and parallel to y -axis the is called Vertical component (F_y).

For Example:

$$\cos \theta = \frac{F_x}{F} \rightarrow F_x = F \cos \theta \rightarrow$$

$$\sin \theta = \frac{F_y}{F} \rightarrow F_y = F \sin \theta \uparrow$$



$$F = \sqrt{F_x^2 + F_y^2}$$

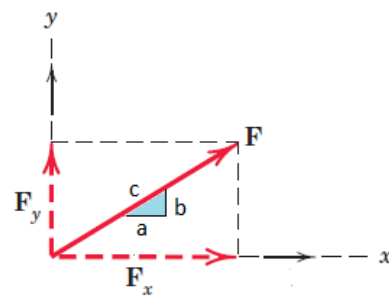
$$\theta_x = \tan^{-1} \left(\frac{F_y}{F_x} \right)$$

The direction of F can also be defined using a small "slope" triangle. Given the slope of the line of action of the force as

$$c = \sqrt{a^2 + b^2}$$

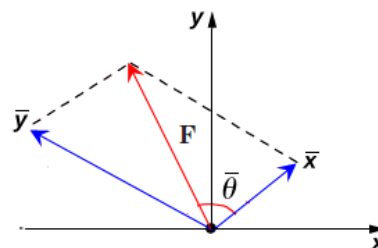
$$F_x = F \cos \theta \rightarrow F_x = F \cdot \frac{a}{c} \rightarrow$$

$$F_y = F \sin \theta \rightarrow F_y = F \cdot \frac{b}{c} \uparrow$$

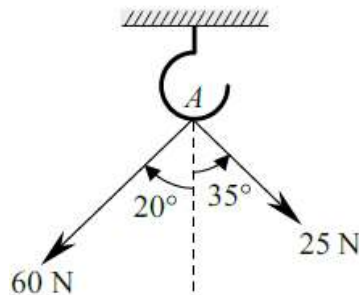


$$F_{\bar{x}} = F \cos \bar{\theta} \nearrow$$

$$F_{\bar{y}} = F \sin \bar{\theta} \nwarrow$$



Example No. 1: Two forces are applied at the point A of a hook support as shown in Figure. Determine the magnitude and direction of the resultant force by using (i) parallelogram law, and (ii) triangle law.



Solution:

i. Parallelogram law

$$F_1 = 25 \text{ N}, \quad F_2 = 60 \text{ N}$$

$$\theta = 70 + 55 = 125^\circ$$

To find the value of resultant:

$$R = \sqrt{F_1^2 + F_2^2 - 2F_1F_2 \cos \theta}$$

$$R = \sqrt{25^2 + 60^2 - 2 \times 25 \times 60 \times \cos 125} = 77.11 \text{ N}$$

To find the direction of resultant:

$$\frac{R}{\sin \theta} = \frac{F_2}{\sin \alpha}$$

$$\frac{77.11}{\sin 125} = \frac{60}{\sin \alpha} \rightarrow \sin \alpha = \frac{60 \times \sin 125}{77.11} = 0.637$$

$$\alpha = \sin^{-1} 0.637 = 39.597^\circ$$

The direction of R from the vertical axis = $39.597 - 35 = 4.597^\circ$

ii. Triangle Law

by the same above equations to get:

$R = 77.11 \text{ N}$ inclined 4.597° with vertical direction

