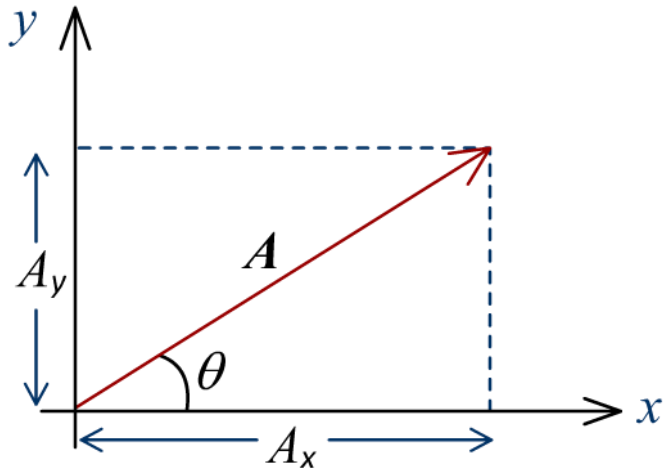
Resolution of vectors

Resolution of vectors is a technique to obtain the "*effect*" or "*contribution*" of a vector in specific direction(s).

The "*effect*" or "*contribution*" of a vector in a specific direction is called component of the vector in that direction.

Consider a vector $\boldsymbol{A}$ of magnitude $|A|$ making an angle of θ w.r.t. the x-axis as shown in the figure.



A_x : x-component A_y : y-component

Click here for simulation

$$\cos(\theta) = \frac{A_x}{|A|}$$

$$\Rightarrow A_x = |A|\cos(\theta) \quad \text{— i}$$

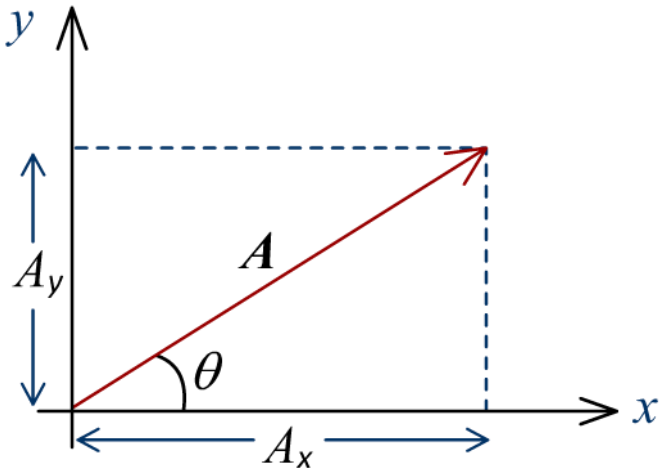
$$\sin(\theta) = \frac{A_y}{|A|}$$

$$\Rightarrow A_y = |A|\sin(\theta) \quad \text{— ii}$$

Using equations (i) & (ii) a vector is represented in its component form as

$$\boldsymbol{A} = A_x\,\hat{i} + A_y\,\hat{j}$$

Resolution of vectors



Click here for simulation

$$A_x = |A|\cos(\theta) \quad \text{i}$$

$$A_y = |A|\sin(\theta) \quad \text{ii}$$

Equations (i) and (ii) are used to obtain components if magnitude (A) and direction (θ) are known

$$|\boldsymbol{A}| = \sqrt{A_x^{\,2} + A_y^{\,2}} \quad \text{iii}$$

$$\tan(\theta) = \frac{A_y}{A_x} \quad \text{iv}$$

Equations (iii) and (iv) are used to obtain magnitude (A) and direction (θ) if components (A_x and A_y) are known

A vector may be resolved into 2 (or 3) components in any direction. The directions in which a vector is resolved depends on the problem. You will use different vector resolutions in projectile motion, motion on a inclined plane, movement of charged particle in $\boldsymbol{E}$ and $\boldsymbol{B}$ etc.

Resolution of vectors

- In three dimensions, a vector is given by $\boldsymbol{A} = A_x \hat{i} + A_y \hat{j} + A_z \hat{k}$
- Unit vector in the direction of a given vector is obtained by dividing a vector by its own magnitude.

$$\hat{A} = \frac{A_x \hat{i} + A_y \hat{j}}{|A|}$$

- Component of a vector may be positive, negative or zero
- Magnitude of a vector is always positive
- For a vector of 2 or 3 dimensions, algebraic sum of components of a vector is NOT equal to the magnitude of the vector
- Each component of a *unit vector* is not 1
- A vector may be resolved into components other than x, y and z components