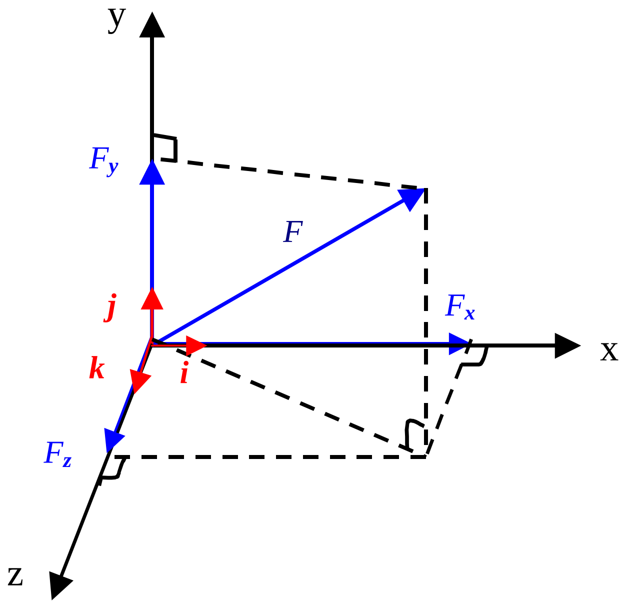
Vectors in three dimensional space

$$\boldsymbol{F} = F_x\boldsymbol{i} + F_y\boldsymbol{j} + F_z\boldsymbol{k}$$

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

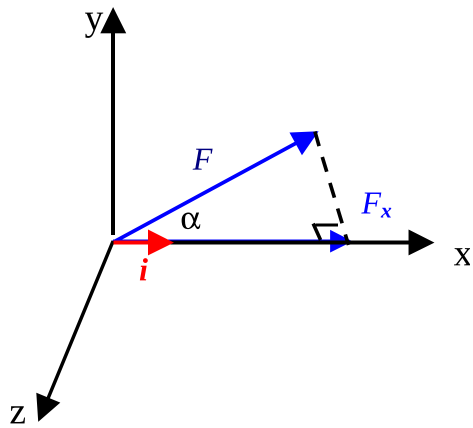
where $|\boldsymbol{F}|$ is the magnitude of vector $\boldsymbol{F}$



This figure shows the **Right handed system**, which is a coordinate system represented by base vectors which follow the right-hand rule (four fingers from *x* to *y*, and thumb will be along *z* direction).

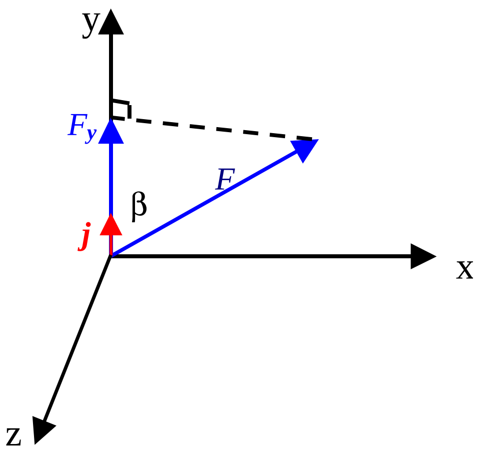
Base vectors for a rectangular coordinate system: A set of three mutually orthogonal unit vectors

Rectangular component of a Vector: The projections of vector ***F*** along the *x*, *y*, and *z* directions are F_x, F_y, and F_z, respectively.



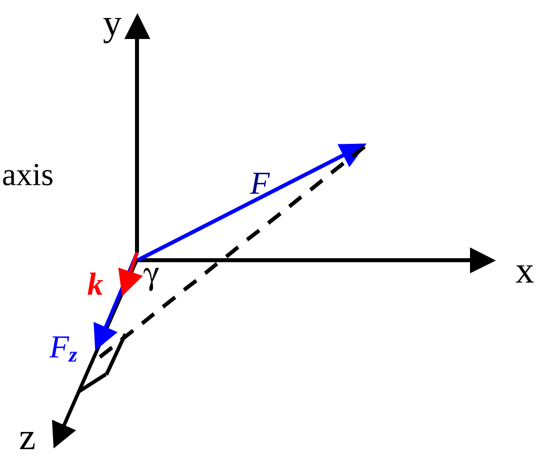
If the angle between *F* and its components (F_x) on axis *x* is α, then

$$\cos\alpha = \frac{F_x}{|\boldsymbol{F}|} = \frac{F_x}{\sqrt{F_x^2 + F_y^2 + F_z^2}}$$



Also, if the angle between *F* and its components (F_y) on axis *y* is β, then

$$\cos\beta = \frac{F_y}{|\boldsymbol{F}|} = \frac{F_y}{\sqrt{F_x^2 + F_y^2 + F_z^2}}$$



Similarly, if the angle between *F* and its components (F_z) on axis *z* is γ, then

$$\cos\gamma = \frac{F_z}{|\boldsymbol{F}|} = \frac{F_z}{\sqrt{F_x^2 + F_y^2 + F_z^2}}$$

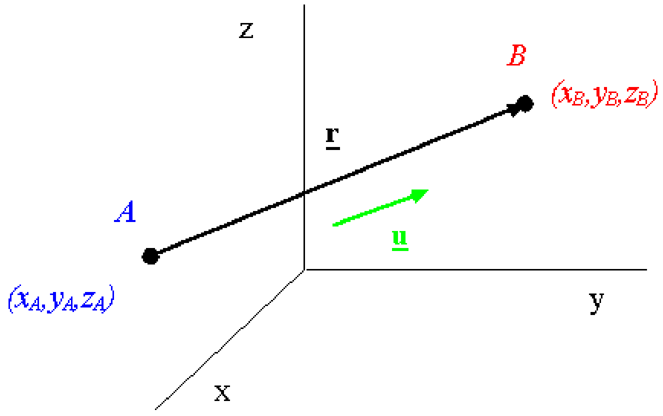
cosα, cosβ and cosγ are called: **Direction cosines**

$$\cos^2(\alpha) + \cos^2(\beta) + \cos^2(\gamma) = 1$$

Coordinates of points in space: The triplet (x,y,z) describes the coordinates of a point.

The vector connecting two points: The vector connecting point A to point B is given by

$$\boldsymbol{r} = (x_B - x_A)\boldsymbol{i} + (y_B - y_A)\boldsymbol{j} + (z_B - z_A)\boldsymbol{k}$$



A unit vector along the line A-B: A unit vector along the line A-B is obtained from

$$\boldsymbol{u} = \frac{\boldsymbol{r}}{r} = \frac{(x_B - x_A)\boldsymbol{i} + (y_B - y_A)\boldsymbol{j} + (z_B - z_A)\boldsymbol{k}}{\sqrt{(x_B - x_A)^2 + (y_B - y_A)^2 + (z_B - z_A)^2}}$$