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Vectors and Two Dimensions Motion

1-Physical Quantities

(Scalar Quantities)

(Vector Quantities)

2- (Vectors)

(Unit Vector)

(Basic Unit Vectors) ($\hat{i}, \hat{j}, \hat{k}$)

(Addition and Subtraction of Vectors)

(Graphical Method)

(Analytic Method)

(Equality of Vectors)

(Multiplication of Vectors)

(Dot or Scalar product of Vectors)

(Cross or Vector product of Vectors)

Physical Quantities

In general, the physical quantities are divided into two types:

1- Scalar Quantities

These are quantities that are defined only by their magnitude, such as work, time, and mass. Examples include regular algebra operations when adding and subtracting.

2- Vector Quantities

These are quantities that are defined by their magnitude and direction together, such as velocity, strength, and acceleration. These quantities are not subject to simple algebraic operations but are subject to directional algebra when added, subtracted, and multiplied

Vectors

Unit Vector

The unit vector ($\hat{u}_{\vec{A}}$) is defined in the direction of the vector ($\vec{A}$) as follows: -

$$\boxed{\hat{u}_{\vec{A}} = \frac{\vec{A}}{|\vec{A}|} \text{.......................}(1-1)}$$

Where:

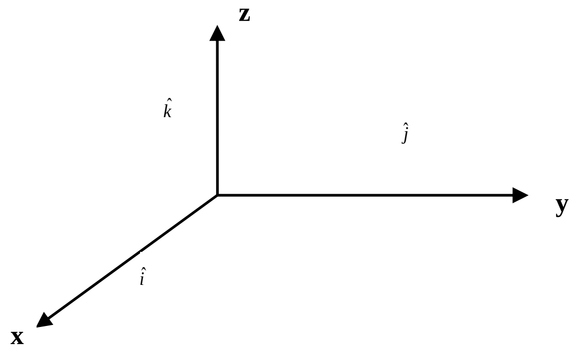
$\hat{u}_{\vec{A}}$ ($\vec{A}$) : direction of unit vector

$\vec{A}$. ($\vec{A}$) : vector

$|\vec{A}|$. ($\vec{A}$) : magnitude of unit vector

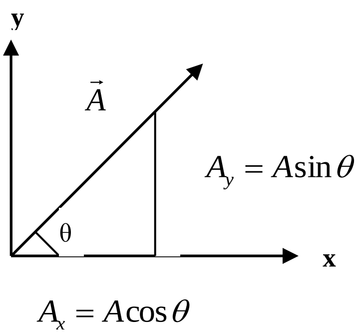
Basic Unit Vectors ($\hat{i}, \hat{j}, \hat{k}$)

They are unit-value vectors and operate in positive directions of the axes (x, y, z) respectively, as in figure (1-1). Therefore, these three vectors are orthogonal.



(1-1)

Now to find the magnitude of the vector in the state of the vector is two-dimensional, as in Figure (1-2).



(2-1)

From figure (2-1), we get:

$$\boxed{\left|\vec{A}\right| = \vec{A} = \sqrt{A_x^{\ 2} + A_y^{\ 2}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(2-1)}$$

Whereas:

$A_x = A\cos\theta$

$A_y = A\sin\theta$

θ: The angle that obtained by result with the positive (x, y) axis, and is calculated from the following equation:

$$\boxed{\theta = \tan^{-1}\frac{A_y}{A_x} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3-1)}$$

Now this can be rewriting to the vector in space (with three dimensions) as follows: -

$$\boxed{\left|\vec{A}\right| = \sqrt{A_x^{\ 2} + A_y^{\ 2} + A_z^{\ 2}} \ldots\ldots\ldots\ldots\ldots\ldots(4-1)}$$

Ex: Let a vector $\vec{A} = 3\hat{i} + 4\hat{j}$

1- Calculate the magnitude of the vector ($\vec{A}$)

2- Calculate the direction of the vector ($\vec{A}$)

$$|\vec{A}| = \sqrt{A_x{}^2 + A_y{}^2}$$

$$A_x = 3$$

$$A_y = 4$$

$$|\vec{A}| = \sqrt{(3)^2 + (4)^2}$$

$$|\vec{A}| = \sqrt{9 + 16}$$

$$\boxed{\text{units}\ |\vec{A}| = 5} \quad \text{magnitude of } (\vec{A})$$

$$\hat{u}_{\vec{A}} = \frac{\vec{A}}{|\vec{A}|}$$

$$\hat{u}_{\vec{A}} = \frac{1}{5}(3\hat{i} + 4\hat{j})$$

$$\hat{u}_{\vec{A}} = \frac{3}{5}\hat{i} + \frac{4}{5}\hat{j}$$

$$\boxed{\hat{u}_{\vec{A}} = 0.6\hat{i} + 0.8\hat{j}} \ \text{direction of } (\vec{A})$$