Theorem :- If p_1, p_2 are points in $\mathbb{R}^2$ and $\overrightarrow{P_1P_2}$ is a vector in $\mathbb{R}^2$ with initial point $p_1(x_1, y_1)$ and terminal point $p_2(x_2, y_2)$ then

$$\overrightarrow{P_1P_2} = (x_2 - x_1, y_2 - y_1)$$

Similarly, if we are talking in $\mathbb{R}^3$ i.e.

$$\overrightarrow{P_1P_2} = (x_2 - x_1, y_2 - y_1, z_2 - z_1)$$ where

$p_1(x_1, y_1, z_1)$ & $p_2(x_2, y_2, z_2)$ are two points in $\mathbb{R}^3$

Example :- a) In $\mathbb{R}^2$ find the components of the vector from $p_1(1, 3)$ to $p_2(4, -2)$

Sol $\overrightarrow{P_1P_2} = (4-1, -2-3) = (3, -5)$

b) And in $\mathbb{R}^3$ find the coordinates of the vector starts in $a(0, -2, 5)$ and ends in $b(3, 4, -1)$

Sol $\overrightarrow{ab} = (3-0, 4-(-2), -1-5) = (3, 6, -6)$

Theorem :- For any vectors $\vec{u}, \vec{v}$ and $\vec{w}$ and any scalars l and m in $\mathbb{R}$, the following are true :

1. $\vec{u} + \vec{v} = \vec{v} + \vec{u}$ comutative law
2. $(\vec{u} + \vec{v}) + \vec{w} = \vec{u} + (\vec{v} + \vec{w})$ associative law