

# 1.1.10.31

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## Question:

A vector  $\mathbf{r}$  has magnitude 14 and direction ratios 2,3,-6. Find the direction cosines and components of  $\mathbf{r}$ , given that  $\mathbf{r}$  makes an acute angle with X axis

## Solution

Symbol	Description
$\mathbf{r}$	given vector with magnitude=14
$\mathbf{r}_X$	component of r along X axis
$\mathbf{r}_Y$	component of r along Y axis
$\mathbf{r}_Z$	component of r along Z axis
k	scaling factor

TABLE 0: Variables Used

$$\mathbf{r} = k \begin{pmatrix} 2 \\ 3 \\ -6 \end{pmatrix} \quad (1)$$

$$\|\mathbf{r}\| = |k| \left\| \begin{pmatrix} 2 \\ 3 \\ -6 \end{pmatrix} \right\| \quad (2)$$

$$\|\mathbf{r}\| = |k| 7 \quad (3)$$

$$14 = |k| 7 \quad (4)$$

$$|k| = 2 \quad (5)$$

$$\Rightarrow \mathbf{r} = \begin{pmatrix} 4 \\ 6 \\ -12 \end{pmatrix} \quad (6)$$

(but k=2 not -2 because given that vector r makes an acute angle with X axis)

The unit vector in the direction of  $\mathbf{r}$  is

$$\frac{\mathbf{r}}{\|\mathbf{r}\|} = \frac{1}{14} \begin{pmatrix} 4 \\ 6 \\ -12 \end{pmatrix} = \begin{pmatrix} \frac{2}{7} \\ \frac{3}{7} \\ -\frac{6}{7} \end{pmatrix} \quad (7)$$

(8)

$$\text{The component of } \mathbf{r} \text{ along X axis } = \mathbf{r}_X = \begin{pmatrix} 4 \\ 0 \\ 0 \end{pmatrix}$$

$$\text{The component of } \mathbf{r} \text{ along Y axis } = \mathbf{r}_Y = \begin{pmatrix} 0 \\ 6 \\ 0 \end{pmatrix}$$

$$\text{The component of } \mathbf{r} \text{ along Z axis } = \mathbf{r}_Z = \begin{pmatrix} 0 \\ 0 \\ -12 \end{pmatrix}$$

### 3D Vector Representation with Components & Angles

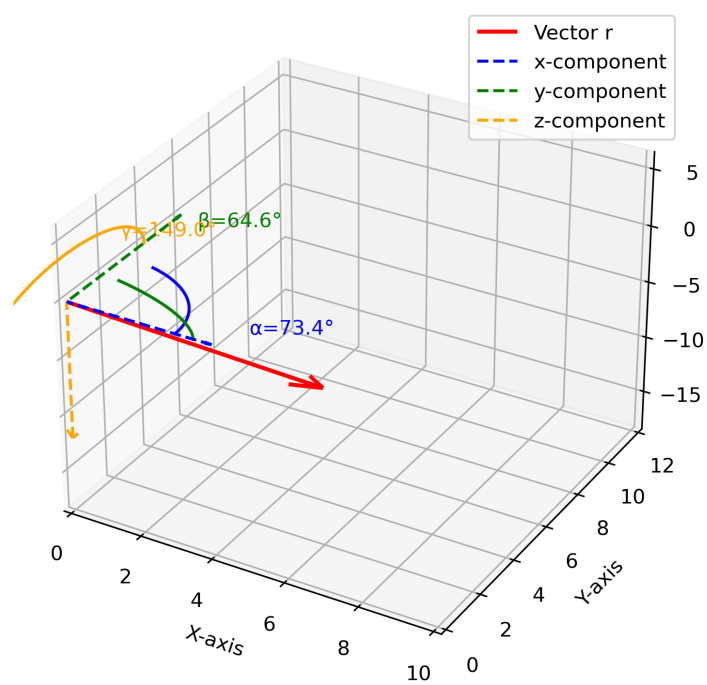


Fig. 0