1.1.10.31

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Question:
A vector **r** has magnitude 14 and direction ratios 2,3,−6.Find the direction cosines and components of **r**, given that **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

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

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

$$\|\mathbf{r}\| = |k|\,7 \tag{3}$$

$$14 = |k|\,7 \tag{4}$$

$$|k| = 2 \tag{5}$$

$$\implies \mathbf{r} = \begin{pmatrix}4\\6\\-12\end{pmatrix} \tag{6}$$

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

The unit vector in the direction of **r** is

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

(8)

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

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

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

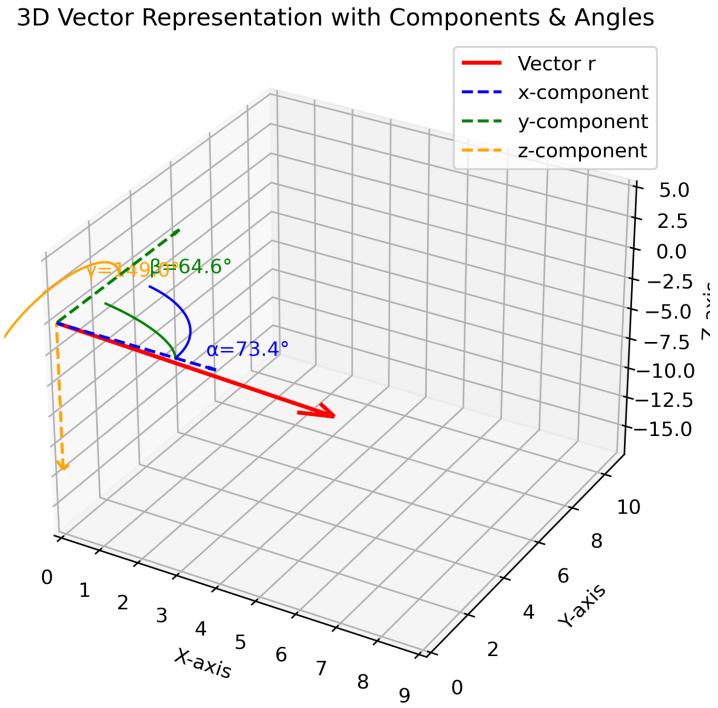
3D Vector Representation with Components & Angles
Vector r
x-component
y-component
z-component
β=64.6°
α=73.4°
X-axis
Y-axis
Z-axis

Fig. 0