12.582

EE25BTECH11049 - Sai Krishna Bakki

Question:

The position vector *OP* of point **P** = (20,10) is rotated anti-clockwise in the X-Y plane by an angle $\theta = 30°$ such that point **P** occupies position **Q**. The coordinates (x,y) of **Q** is

Solution:

Given

$$\mathbf{P} = \begin{pmatrix} 20 \\ 10 \end{pmatrix}, \theta = 30° \tag{1}$$

we use

$$\mathbf{x_n} = \mathbf{R}\mathbf{x_o} \tag{2}$$

where **R** is Rotation matrix

$$\mathbf{Q} = \begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix} \mathbf{P} \tag{3}$$

$$\mathbf{Q} = \begin{pmatrix} \cos 30° & -\sin 30° \\ \sin 30° & \cos 30° \end{pmatrix} \begin{pmatrix} 20 \\ 10 \end{pmatrix} \tag{4}$$

$$\mathbf{Q} = \begin{pmatrix} \frac{\sqrt{3}}{2} & \frac{-1}{2} \\ \frac{1}{2} & \frac{\sqrt{3}}{2} \end{pmatrix} \begin{pmatrix} 20 \\ 10 \end{pmatrix} \tag{5}$$

$$\mathbf{Q} = \begin{pmatrix} 10\sqrt{3} - 5 \\ 10 + 5\sqrt{3} \end{pmatrix} \tag{6}$$

Using approximation, the coordinates of **Q** is

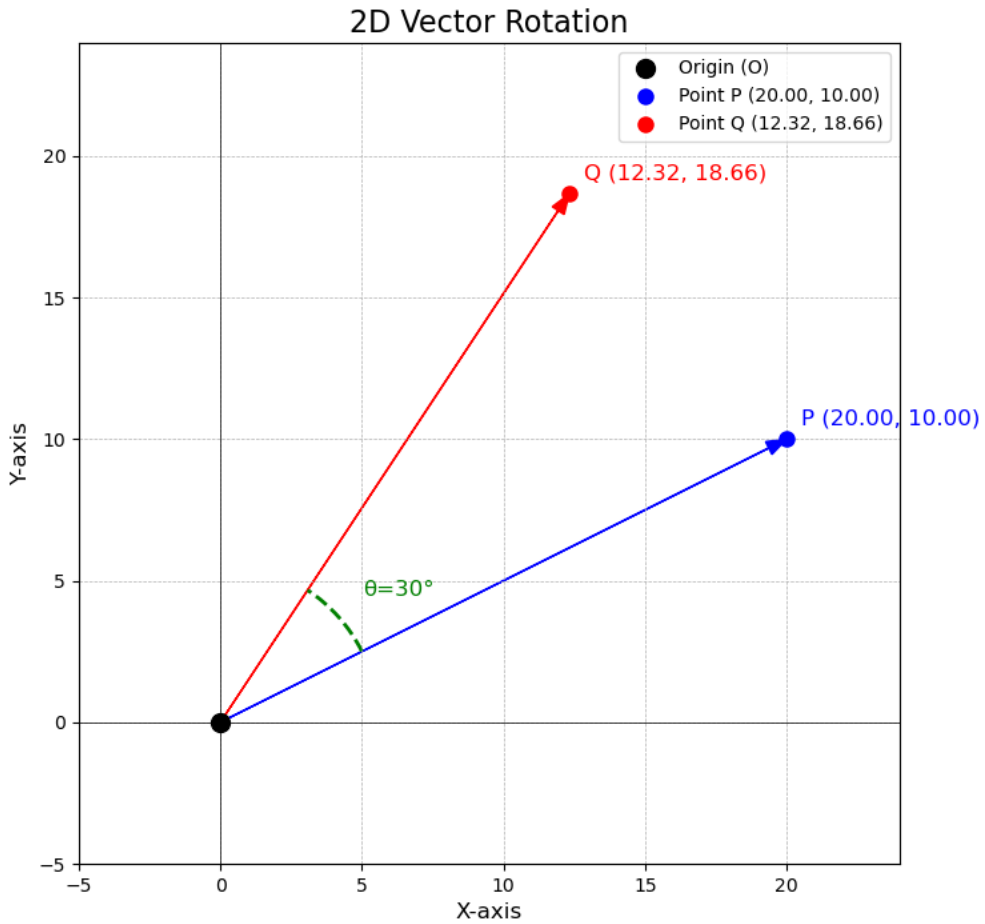$$\mathbf{Q} = \begin{pmatrix} 12.32 \\ 18.66 \end{pmatrix} \tag{7}$$

Fig. 1