1.11.7

EE24BTECH11001 - Aditya Tripathy

Question:
Construct an equilateral triangle ABC with each side 5cm.

Solution:
Let $\mathbf{A} = \mathbf{0}$, and $\mathbf{B} = \begin{pmatrix} 5 \\ 0 \end{pmatrix}$. $\mathbf{C}$ is the required vertex.

Since the triangle is equilateral,

$$\mathbf{C} = R\,(\mathbf{B} - \mathbf{A}) \tag{1}$$

$$R = \begin{pmatrix} \cos\frac{\pi}{3} & -\sin\frac{\pi}{3} \\ \sin\frac{\pi}{3} & \cos\frac{\pi}{3} \end{pmatrix} \tag{2}$$

where R is the rotation matrix which rotates the vector $\mathbf{B} - \mathbf{A}$ by angle $\frac{\pi}{3}$. On calculation,

$$\mathbf{C} = \begin{pmatrix} \frac{1}{2} & -\frac{\sqrt{3}}{2} \\ \frac{\sqrt{3}}{2} & \frac{1}{2} \end{pmatrix} \begin{pmatrix} 5 \\ 0 \end{pmatrix} \tag{3}$$

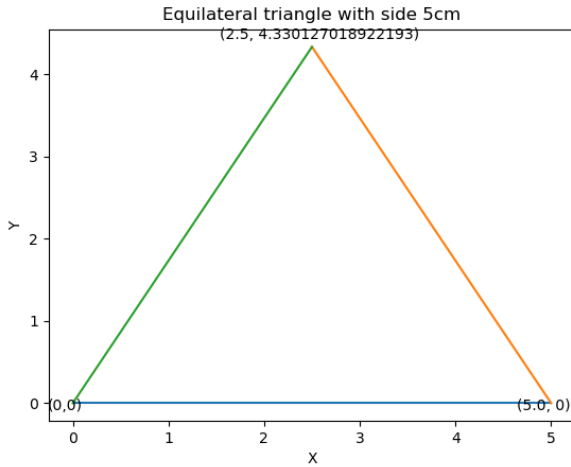$$\mathbf{C} = \begin{pmatrix} \frac{5}{2} \\ \frac{5\sqrt{3}}{2} \end{pmatrix} \tag{4}$$

Fig. 0: equilateral triangle of side 5cm