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1 Problem statement:

Construct a triangle PQR in which QR=6cm, $\angle Q = 60^0$ and PR - PQ = 2cm.

Law of Cosines

The law of Cosines relates the length of the triangle to the cosines of one of its angles. It states that, if the length of two sides and the angle between them is known for a triangle, then we can determine the length of the third side. It is given by:

$$\mathbf{b}^2 = \mathbf{a}^2 + \mathbf{c}^2 - 2ac\cos B \tag{1}$$

SOLUTION:

Steps of Construction:
1.Draw a line segment of base QR = 6 cm
2. Measure and draw $\angle Q = 60^0$ and let the ray be QX
3. Using a compass measure PR-PQ = 2cm.
4. As PQ-PR is negative, QD will below the line QR.
5. With Q as a centre and draw an arc with radius 2cm at the point be D on the ray QX
6. Join DR
7. Draw the perpendicular bisector of the line DR and the intersection point is taken as P.
8. Join PR
9. PQR is the required triangle.

By Law of Cosines :

To Construct

Let P,Q and R be the vertices of the triangle with coordinates.
STEP-1

Then coordinates of vertices Q,R and P are :

$$\mathbf{Q} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \mathbf{R} = \begin{pmatrix} 6 \\ 0 \end{pmatrix} \mathbf{P} = \mathbf{r} \begin{pmatrix} \sin\theta \\ \cos\theta \end{pmatrix}$$

By using the Cosine formula in ΔPQR

$$\mathbf{q}^2 = \mathbf{p}^2 + \mathbf{r}^2 - 2pr\cos B \tag{2}$$

$$0 = \mathbf{p}^2 + \mathbf{r}^2 - \mathbf{q}^2 - 2pr\cos Q$$

$$0 = (r+q)(r-q) + 6^2 - 2 \times 6 \times .5r$$

After simplification

$$2r - q = 18 \tag{3}$$

Given that,

$$r - q = 2 \tag{4}$$

Using equation (3) and (4),

$$\begin{pmatrix} 2 & -1 \\ 1 & -1 \end{pmatrix} \begin{pmatrix} r \\ q \end{pmatrix} = \begin{pmatrix} 18 \\ 2 \end{pmatrix} \tag{5}$$

Let,

$$\mathbf{A} = \begin{pmatrix} 2 & -1 \\ 1 & -1 \end{pmatrix} \tag{6}$$

$$\mathbf{X} = \begin{pmatrix} r \\ y \end{pmatrix} \tag{7}$$

$$\mathbf{B} = \begin{pmatrix} 18 \\ 2 \end{pmatrix} \tag{8}$$

We know that,

$$\mathbf{AX} = \mathbf{B} \tag{9}$$

And,

$$\mathbf{A^{-1}A} = \mathbf{I} \tag{10}$$

multiplying A^{-1} on both sides in equation (9)

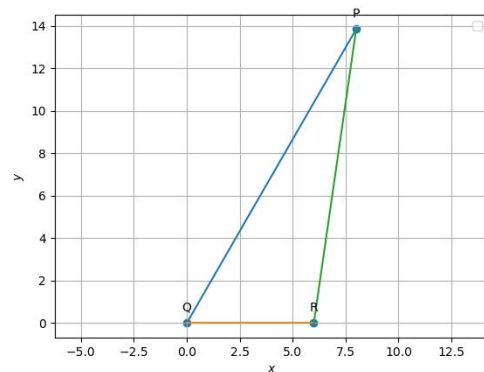$$\mathbf{X} = \mathbf{A^{-1}B} \tag{11}$$

Using equation (11) we get ,

$$r = 16 \tag{12}$$

$$q = 14 \tag{13}$$

The vertices of Δ PQR are

$$P = 16 \begin{pmatrix} \cos 45 \\ \sin 45 \end{pmatrix}, Q = \begin{pmatrix} 0 \\ 0 \end{pmatrix}, R = \begin{pmatrix} 6 \\ 0 \end{pmatrix} \tag{14}$$

Result

Implementation

Equation no	Role
1	law of Cosines
5	Matrix form of Linear equation
10	Results Identity matrix
12	Length of r
13	Length of q

Download the code
https://github.com/Gangagopinath/ASSIGNMENT/tree/main/assignment4