BASICS OF PROGRAMMING ASSIGNMENT - 1

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CHAPTER II EX-II Q.9-II

Find the Area of Quadrilateral when four points are given

$$\mathbf{P} = \begin{pmatrix} 2 \\ 1 \end{pmatrix}, \mathbf{Q} = \begin{pmatrix} 3 \\ 5 \end{pmatrix}, \mathbf{R} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}, \mathbf{S} = \begin{pmatrix} -2 \\ -2 \end{pmatrix} \tag{1}$$

SOLUTION

Area of a Quadrilateral PQRS is

$$Area(\Delta PQR) + Area(\Delta PRS) \tag{2}$$

$$Area(\Delta PQR) = \frac{1}{2}\|(\mathbf{Q} - \mathbf{P}) \times (\mathbf{Q} - \mathbf{R})\| \tag{3}$$

For two vectors

$$\mathbf{a} = \begin{pmatrix} a_1 \\ a_2 \end{pmatrix} and \mathbf{b} = \begin{pmatrix} b_1 \\ b_2 \end{pmatrix} \tag{4}$$

$$\|\mathbf{a} \times \mathbf{b}\| = |(a_1 b_2 - a_2 b_1)| \tag{5}$$

$$\mathbf{Q} - \mathbf{P} = \begin{pmatrix} 1 \\ 4 \end{pmatrix} \tag{6}$$

$$\mathbf{Q} - \mathbf{R} = \begin{pmatrix} 6 \\ 1 \end{pmatrix} \tag{7}$$

$$Area(\Delta PQR) = \frac{1}{2}\|(\mathbf{Q} - \mathbf{P}) \times (\mathbf{Q} - \mathbf{R})\| \tag{8}$$

$$\frac{1}{2}|(-23)| \tag{9}$$

Similarly

$$Area(\Delta PRS) = \frac{1}{2}\|(\mathbf{S} - \mathbf{P}) \times (\mathbf{S} - \mathbf{R})\| \tag{10}$$

$$\mathbf{S} - \mathbf{P} = \begin{pmatrix} -4 \\ -3 \end{pmatrix} \tag{11}$$

$$\mathbf{S} - \mathbf{R} = \begin{pmatrix} 1 \\ -6 \end{pmatrix} \tag{12}$$

$$Area(\Delta PRS) = \frac{1}{2}\|(\mathbf{S} - \mathbf{P}) \times (\mathbf{S} - \mathbf{R})\| \tag{13}$$

$$= \frac{1}{2}|(27)| \tag{14}$$

So total area of Quadrilateral PQRS is

$$Area(\Delta PQR) + Area(\Delta PRS) \tag{15}$$

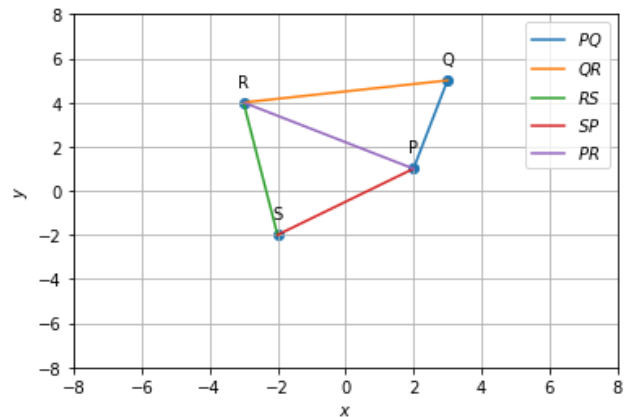$$= \frac{1}{2}|(-23)| + \frac{1}{2}|(27)| \tag{16}$$

$$= \frac{1}{2}(23 + 27) \tag{17}$$

$$= 25 sq.units \tag{18}$$

Fig. 0: Quadrilateral PQRS