

# Linear Algebra and Matrices

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**Abstract**—This document provides a beginner's latex template for math.

## 1 POINTS AND VECTORS

1.1. Name the type of quadrilateral formed, if any, by the following points, and give reasons for your answer.

$$\mathbf{P} = \begin{pmatrix} -1 \\ -2 \end{pmatrix}, \mathbf{Q} = \begin{pmatrix} 1 \\ 0 \end{pmatrix}, \mathbf{R} = \begin{pmatrix} -1 \\ 2 \end{pmatrix}, \mathbf{S} = \begin{pmatrix} -3 \\ 0 \end{pmatrix} \quad (1.1.1)$$

**Solution:** In Fig. 1.1

$$\mathbf{P} - \mathbf{S} = \mathbf{Q} - \mathbf{R} = \begin{pmatrix} 2 \\ -2 \end{pmatrix} \quad (1.1.2)$$

$$\mathbf{R} - \mathbf{S} = \mathbf{Q} - \mathbf{P} = \begin{pmatrix} 2 \\ 2 \end{pmatrix} \quad (1.1.3)$$

Hence  $PQRS$  is a ||gm  $\because$  opposite sides are parallel. Also,

$$\|\mathbf{P} - \mathbf{S}\| = \|\mathbf{Q} - \mathbf{R}\| \quad (1.1.4)$$

$$= \|\mathbf{R} - \mathbf{S}\| = \|\mathbf{Q} - \mathbf{P}\| = 2\sqrt{2} \quad (1.1.5)$$

$\because$  all sides are equal, the ||gm is a rhombus. The angle between  $PS$  and  $RS$  is given by

$$\cos \theta = \frac{(\mathbf{S} - \mathbf{P})^\top (\mathbf{S} - \mathbf{R})}{\|\mathbf{S} - \mathbf{P}\| \|\mathbf{S} - \mathbf{R}\|} \quad (1.1.6)$$

$\because$

$$(\mathbf{S} - \mathbf{P})^\top (\mathbf{S} - \mathbf{R}) = \begin{pmatrix} 2 & -2 \end{pmatrix} \begin{pmatrix} 2 \\ 2 \end{pmatrix} = 0 \quad (1.1.7)$$

upon substituting from (1.1.2) and (1.1.3),

$$\cos \theta = 0 \implies PS \perp RS \quad (1.1.8)$$

Thus, the rhombus is actually a square.

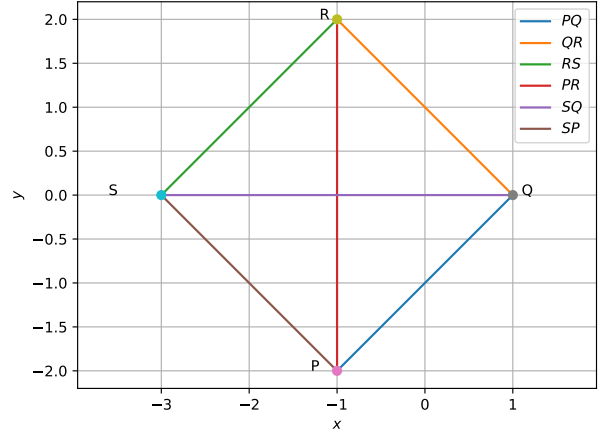


Fig. 1.1. The given points form a square

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