

MATRICES USING PYTHON

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1 Problem

Let A be the centre of the circle $x^2 + y^2 - 2x - 4y - 20 = 0$. Suppose the tangents at the points B(1,7) and D(4,-2) on the circle meet at the point C. Find the area of the quadrilateral ABCD.

2 Construction

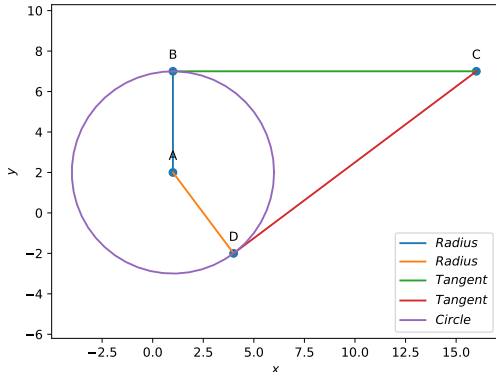


Figure of construction

3 Solution

The input parameters for this construction are

Symbol	Value	Description
r	5	Radius
A	$\begin{pmatrix} 1 \\ 2 \end{pmatrix}$	Centre
B	$\begin{pmatrix} 1 \\ 7 \end{pmatrix}$	Point B
D	$\begin{pmatrix} 4 \\ -2 \end{pmatrix}$	Point D

Circle equation : $x^2 + y^2 - 2x - 4y - 20 = 0$

Equations of tangents at B, D are given by

$$1 \quad x + 7y - (x + 1) - 2(y + 7) - 20 = 0 \quad (1)$$

$$1 \quad 4x - 2y - (x + 4) - 2(y - 2) - 20 = 0 \quad (2)$$

1 The above equations result in the system

$$y = 7 \quad (3)$$

$$3x - 4y = 20 \quad (4)$$

From (3),(4) let

$$\mathbf{Z} = \begin{pmatrix} 0 & 1 \\ 3 & -4 \end{pmatrix} \quad (5)$$

$$\mathbf{X} = \begin{pmatrix} 7 \\ 20 \end{pmatrix} \quad (6)$$

Solve (5) and (6)

\therefore Coordinates of C is $\mathbf{C} = \begin{pmatrix} 16 \\ 7 \end{pmatrix}$

Length of BC is

$$\mathbf{B} - \mathbf{C} = \begin{pmatrix} -15 \\ 0 \end{pmatrix} \quad (7)$$

$$\|\mathbf{B} - \mathbf{C}\| = \left\| \begin{pmatrix} -15 \\ 0 \end{pmatrix} \right\| \quad (8)$$

$$= \sqrt{\begin{pmatrix} -15 & 0 \end{pmatrix} \begin{pmatrix} -15 \\ 0 \end{pmatrix}} \quad (9)$$

$$= 15 \quad (10)$$

Letting,

$$\mathbf{v1} = \mathbf{A} - \mathbf{B} \quad (11)$$

$$\mathbf{v2} = \mathbf{A} - \mathbf{C} \quad (12)$$

Area of the $\triangle ABC$ is given by

$$= \frac{1}{2} \|\mathbf{v1} \times \mathbf{v2}\| \quad (13)$$

Area of the of quadrilateral ABCD is given by

$$= 2 \times \frac{1}{2} \|\mathbf{v1} \times \mathbf{v2}\| \quad (14)$$

\therefore The area of quadrilateral ABCD=75 sq.units

termux commands :

```
bash sh2.sh.....using shell command
```

Below python code realizes the above construction:

```
https://github.com/velicharlagokulkumar/FWC_module1/
blob/main/matrices/circle/codes/matrix.py
```