ASSIGNMENT-2

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Download all python codes from

https://github.com/behappy0604/Summer−Internship−IITH/tree/main/Assignment−2

and latex-tikz codes from

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1 Question No. 2.39

Construct a quadrilateral MORE where $MO = 6, OR = 4.5, \angle M = 60^\circ, \angle O = 105^\circ$ and $\angle R = 105^\circ$.

2 SOLUTION

For this quadrilateral MORE we have,

$$\angle M + \angle O + \angle R = 60^\circ + 105^\circ + 105^\circ = 270^\circ, \tag{2.0.1}$$

1) Now on calculating, we get

$$\implies \angle E + 270^\circ = 360^\circ, \tag{2.0.2}$$
$$\implies \angle E = 90^\circ \tag{2.0.3}$$

2) Now taking sum of all the angles given and (2.0.3) we get

$$\angle M + \angle O + \angle R + \angle E = 360^\circ \tag{2.0.4}$$

So construction of given quadrilateral is possible as sum of all the angles is equal to 360°.

3) Now,Using cosine formula in $\triangle MOR$ we can find RM:

$$\implies \|\mathbf{R} - \mathbf{M}\|^2 = \|\mathbf{M} - \mathbf{O}\|^2 + \|\mathbf{O} - \mathbf{R}\|^2 - 2 \times \|\mathbf{M} - \mathbf{O}\| \times \|\mathbf{O} - \mathbf{R}\| \cos O \tag{2.0.5}$$

$$\implies RM = 8.38 \tag{2.0.6}$$

4) Let,

$$\mathbf{M} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \mathbf{O} = \begin{pmatrix} 6 \\ 0 \end{pmatrix}. \tag{2.0.7}$$

Now we will use vector equation of a line, to get the exact co-ordinates of R

$$\mathbf{R} = \mathbf{O} + \lambda m \tag{2.0.8}$$

$$\implies \mathbf{R} = \mathbf{O} + \lambda \times \begin{pmatrix} cos 75^\circ \\ sin 75^\circ \end{pmatrix} \tag{2.0.9}$$

$$\implies \|\mathbf{R} - \mathbf{O}\| = |\lambda| \times \|\begin{pmatrix} 0.258 \\ 0.965 \end{pmatrix}\| \tag{2.0.10}$$

$$\implies 4.5 = |\lambda| \times 1 \tag{2.0.11}$$

$$\implies \lambda = 4.5 \tag{2.0.12}$$

Lemma 2.1. *Exact co-ordinates of the given R can be expresssed as*

$$\mathbf{R} = \mathbf{O} + |\lambda| \times \begin{pmatrix} cos\theta \\ sin\theta \end{pmatrix} \tag{2.0.13}$$

5) Putting the values in the above equation we get,

$$\implies \mathbf{R} = \begin{pmatrix} 6 \\ 0 \end{pmatrix} + \begin{pmatrix} 1.161 \\ 4.342 \end{pmatrix} \tag{2.0.14}$$

$$\implies \mathbf{R} = \begin{pmatrix} 7.161 \\ 4.342 \end{pmatrix} \tag{2.0.15}$$

6) Now in $\triangle MER$,we know

$$\angle M = 28.76^\circ, \angle E = 90^\circ. \tag{2.0.16}$$

We know that sum of the angles of a triangle is 180°

$$\implies \angle M + \angle E + \angle R = 180^\circ \tag{2.0.17}$$

$$\implies 28.76^\circ + 90^\circ + \angle R = 180^\circ \tag{2.0.18}$$

$$\implies \angle R = 61.24^\circ \tag{2.0.19}$$

7) Now applying sine law of triangle, we get EM= 7.34

8) Using the vector equation of a line, we will find the exact co-ordinates of E

$$\mathbf{E} = \mathbf{M} + \lambda m \tag{2.0.20}$$

$$\implies \mathbf{E} - \mathbf{M} = \lambda \times \begin{pmatrix} cos60^\circ \\ sin60^\circ \end{pmatrix} \tag{2.0.21}$$

$$\implies \|\mathbf{E} - \mathbf{M}\| = |\lambda| \times \| \begin{pmatrix} 0.50 \\ 0.87 \end{pmatrix} \| \tag{2.0.22}$$

$$\implies 7.34 = |\lambda| \times 1 \tag{2.0.23}$$

$$\implies \lambda = 7.34 \tag{2.0.24}$$

Lemma 2.2. *Exact co-ordinates of the given E can be expresssed as*

$$\implies \mathbf{E} = \mathbf{M} + |\lambda| \times \begin{pmatrix} cos\theta \\ sin\theta \end{pmatrix} \tag{2.0.25}$$

9) Putting the values in the above equation we get,

$$\implies \mathbf{E} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} + 7.34 \times \begin{pmatrix} 0.50 \\ 0.87 \end{pmatrix} \tag{2.0.26}$$

$$\implies \mathbf{E} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} + \begin{pmatrix} 3.67 \\ 6.36 \end{pmatrix} \tag{2.0.27}$$

$$\mathbf{E} = \begin{pmatrix} 3.67 \\ 6.36 \end{pmatrix} \tag{2.0.28}$$

10) Now, we have the coordinate of vertices M,O,R,E as,

$$\mathbf{M} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \mathbf{O} = \begin{pmatrix} 6 \\ 0 \end{pmatrix}, \mathbf{R} = \begin{pmatrix} 7.16 \\ 4.35 \end{pmatrix}, \mathbf{E} = \begin{pmatrix} 3.67 \\ 6.36 \end{pmatrix}. \tag{2.0.29}$$

11) On constructing the given quadilateral on python and marking angle we get:

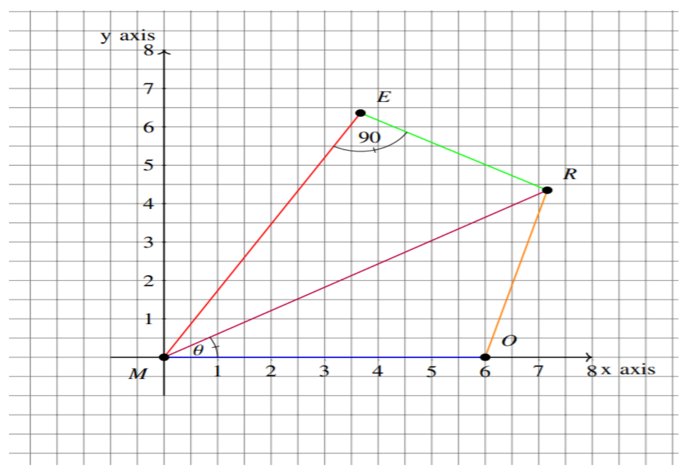

Fig. 2.1: Quadrilateral MORE