

# Math Document Template

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**Abstract**—This is a document explaining a question about the concept of cyclic quadrilateral.

Download all python codes from

```
svn co https://github.com/chakki1234/summer
-2020/trunk/Circle/codes
```

and latex-tikz codes from

```
svn co https://github.com/chakki1234/summer
-2020/trunk/Circle/figs
```

Design Parameters	
Parameters	Value
b	5
h	3
$\angle A$	70

TABLE 2.2: Trapezium  $ABCD$

## 1 PROBLEM

If the non-parallel sides of a trapezium are equal, prove that it is cyclic.

## 2 CONSTRUCTION

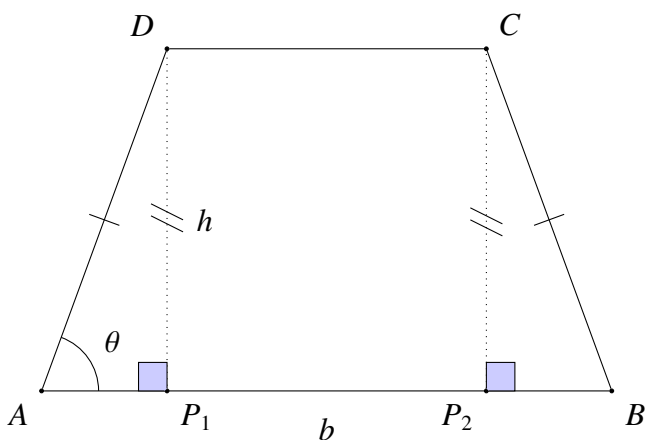


Fig. 2.0: Trapezium by Latex-Tikz

2.1. The figure obtained looks like Fig. 2.0.

$AD = BC$ ,  $AB \parallel DC$ .

2.2. The design parameters used for construction  
See Table. 2.2.

2.3. Find the coordinates of the various points in Fig

$$\mathbf{A} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \quad (2.3.1)$$

$$\mathbf{B} = \mathbf{A} + \begin{pmatrix} a \\ 0 \end{pmatrix}, \quad (2.3.2)$$

$$\mathbf{AP}_1 = -\mathbf{BP}_2 = \begin{pmatrix} h \cot \theta \\ 0 \end{pmatrix} \quad (2.3.3)$$

$$\mathbf{P}_1\mathbf{D} = \mathbf{P}_2\mathbf{C} = \begin{pmatrix} 0 \\ h \end{pmatrix} \quad (2.3.4)$$

$$\mathbf{C} = \mathbf{B} - \mathbf{BP}_2 + \mathbf{P}_2\mathbf{C} \quad (2.3.5)$$

$$\mathbf{D} = \mathbf{A} + \mathbf{AP}_1 + \mathbf{P}_1\mathbf{D} \quad (2.3.6)$$

2.4. **Solution:** From the given information, The values are listed in 2.4

Ouput values	
Parameter	Value
$\mathbf{C}$	$\begin{pmatrix} 3.9 \\ 3 \end{pmatrix}$
$\mathbf{D}$	$\begin{pmatrix} 1.09 \\ 3 \end{pmatrix}$

TABLE 2.4: Values of  $\mathbf{C}$  and  $\mathbf{D}$

2.5. Draw Fig. 2.0.

From equation 5.1:

$$\angle B + \angle D = 180^\circ \quad (5.4)$$

$$\angle A + \angle C = 180^\circ \quad (5.5)$$

$\therefore ABCD$  is a cyclic quadrilateral.

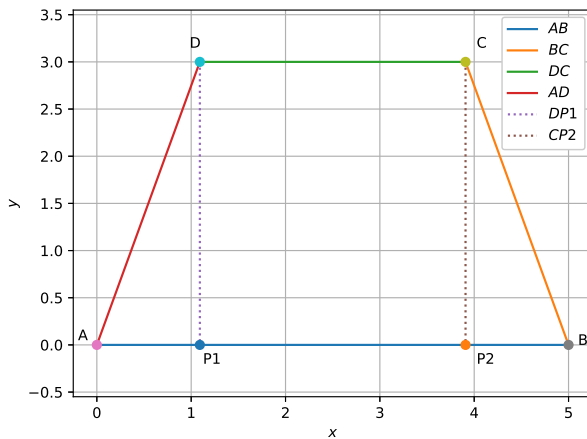


Fig. 2.5: Trapezium generated using python

**Solution:** The following Python code generates Fig. 2.5

codes/quad.py

and the equivalent latex-tikz code generating Fig. 2.5 is

figs/trapezium\_altitude\_fig.tex

The above latex code can be compiled as a standalone document as

figs/trapezium\_final\_altitude.tex

### 3 SOLUTION

**Theorem 3.1.** *In a cyclic quadrilateral, the sum of each pair of opposite angles is  $180^\circ$ .*

**Solution:** From theorem 3.1 to prove  $ABCD$  is a cyclic quadrilateral, it is sufficient to prove that sum of opposite angles is  $180^\circ$ .

In  $\triangle ADP_1$  and  $\triangle BCP_2$

$$\angle AP_1D = \angle BP_2C$$

$$P_1D = P_2C$$

$$AD = BC$$

$$\therefore \triangle ADP_1 \cong \triangle BCP_2$$

$$\implies \angle A = \angle B \quad (5.1)$$

Since  $AB \parallel DC$

$$\angle A + \angle D = 180^\circ \quad (5.2)$$

$$\angle B + \angle C = 180^\circ \quad (5.3)$$