Math Document Template

C ANISH

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

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
```

1 Problem

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

2 Construction

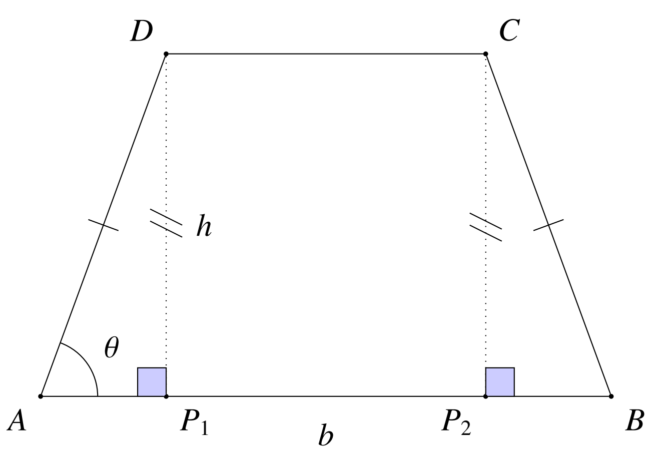

Fig. 2.0: Trapezium by Latex-Tikz

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.

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

TABLE 2.2: Trapezium $ABCD$

2.3. Find the coordinates of the various points in Fig

$$\mathbf{A} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \tag{2.3.1}$$

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

$$\mathbf{AP_1} = -\mathbf{BP_2} = \begin{pmatrix} h\cot\theta \\ 0 \end{pmatrix} \tag{2.3.3}$$

$$\mathbf{P_1D} = \mathbf{P_2C} = \begin{pmatrix} 0 \\ h \end{pmatrix} \tag{2.3.4}$$

$$\mathbf{C} = \mathbf{B} - \mathbf{BP_2} + \mathbf{P_2C} \tag{2.3.5}$$

$$\mathbf{D} = \mathbf{A} + \mathbf{AP_1} + \mathbf{P_1D} \tag{2.3.6}$$

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

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

TABLE 2.4: Values of **C** *and* **D**

2.5. Draw Fig. 2.0.

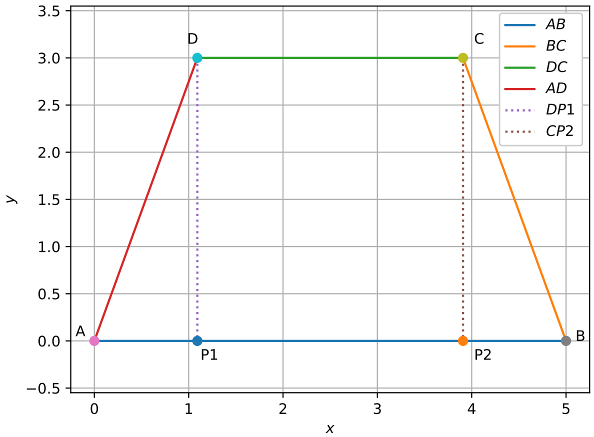

Fig. 2.5: Trapezium generated using python

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°.

Solution: From theorem 3.1 to prove $ABCD$ is a cyclic quadilateral, it is sufficient to prove that sum of opposite angles is 180°.

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

$$\angle AP_1D = \angle BP_2C$$
$$P_1D = P_2C$$
$$AD = BC$$
$$\therefore \triangle ADP_1 \cong \triangle BCP_2$$
$$\implies \angle A = \angle B \tag{5.1}$$

Since $AB \parallel DC$

$$\angle A + \angle D = 180^\circ \tag{5.2}$$
$$\angle B + \angle C = 180^\circ \tag{5.3}$$

From equation 5.1:

$$\angle B + \angle D = 180^\circ \tag{5.4}$$
$$\angle A + \angle C = 180^\circ \tag{5.5}$$

$\therefore ABCD$ is a cyclic quadilateral.