# Math Computing

Chakali Suresh

## NCERT 9.7.1.7

**This question is from class 9 ncert chapter 7.triangles**

1. **AB** is a line segment and **P** is its mid-point. **D** and **E** are points on the same side of **AB** such that $\angle BAD = \angle ABE$ and $\angle EPA = \angle DPB$. Show that
   (a) $\triangle$**DAP** $\cong \triangle$**EBP**
   (b) **AD** = **BE**

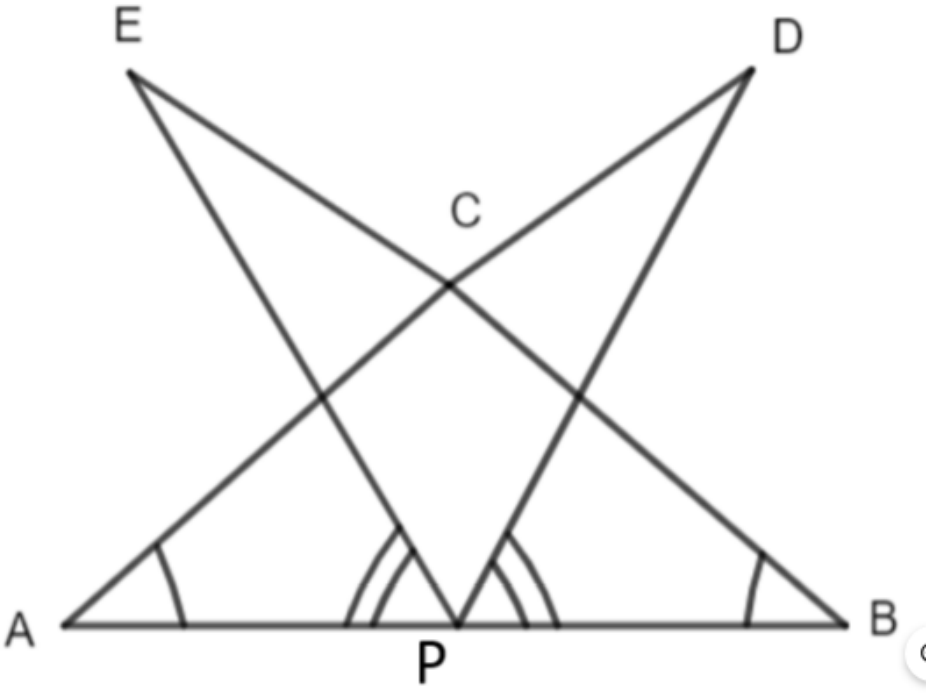


Figure 1: $\triangle$**DAP** *and* $\triangle$**EBP**

**Construction steps:**

(i) Let point **A** be the reference point whose coordinates are at origin.

$$\mathbf{A} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \tag{1}$$

(ii) Let the distance between point **A** and **B** be $x$, and also considering the point **B** on same axis .

$$\|A - B\| = x \tag{2}$$

So,the coordinates of point **B** be,

$$\mathbf{B} = \begin{pmatrix} x \\ 0 \end{pmatrix} \tag{3}$$

(iii) Given the point **P** is the mid-point of line segment **AB**,

$$\mathbf{P} = \left(\tfrac{A+B}{2}\right) \tag{4}$$

$$\mathbf{P} = \begin{pmatrix} a \\ b \end{pmatrix} \tag{5}$$

(iv) Let the coordinate points of **D** and **E** are,

$$\mathbf{D} = \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}, \tag{6}$$

$$\mathbf{E} = \begin{pmatrix} x_3 \\ x_4 \end{pmatrix} \tag{7}$$

(v) Let assume the distance between points $(\mathbf{A}, \mathbf{D})$ and $(\mathbf{B}, \mathbf{E})$ be $r$ ,the line **AB** makes an angle $\theta_1$ anticlock-wise from point **A** and makes the same angle in clock-wise from point **B** with the lines $(\mathbf{AD}, \mathbf{BE})$.

$$\|A - D\| = r = \|B - E\| \tag{8}$$

$$\angle BAD = \theta = \angle ABE \tag{9}$$

$\therefore$ Now the coordinates of point $\mathbf{D}, \mathbf{E}$ are,

$$\mathbf{D} = \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = \begin{pmatrix} r\cos\theta \\ r\sin\theta \end{pmatrix} \tag{10}$$

$$\mathbf{E} = \begin{pmatrix} x_3 \\ x_4 \end{pmatrix} = \begin{pmatrix} -r\cos\theta \\ r\sin\theta \end{pmatrix} \tag{11}$$

(vi) Similarly, the mid-point **P** also makes an angle $\theta_2$ with the points **D** and **E**

$$\angle BAD = \theta = \angle ABE \tag{12}$$

(vii) Let assume,

| **Symbol** | **Value** | **Description** |
|---|---|---|
| $\theta_1$ | $30^\circ$ | $\angle BAD = \angle ABE$ |
| $\theta_2$ | $60^\circ$ | $\angle EPA = \angle DPB$ |
| **A** | $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$ | Reference point at origin |
| **B** | $\begin{pmatrix} 5 \\ 0 \end{pmatrix}$ | point **B** on the same axis of **A** |

Table 1: Input Parameters

| **Symbol** | **Value** | **Description** |
|---|---|---|
| $r$ | $\|A - B\|$ | Length of **AB** |
| **P** | $\frac{A+B}{2}$ | Mid-point of **AB** |
| **D** | $\mathrm{A} + \begin{pmatrix} r\cos\theta_1 \\ r\sin\theta_1 \end{pmatrix}$ | From point **A** makes an angle $\theta_1$ in anticlock-wise with line **AB**, **AD** |
| **E** | $\mathrm{B} + \begin{pmatrix} -r\cos\theta_1 \\ r\sin\theta_1 \end{pmatrix}$ | From point **B** makes an angle $\theta_1$ in clock-wise with line **AB**, **BE** |
| **D** | $\mathrm{P} + \begin{pmatrix} r\cos\theta_2 \\ r\sin\theta_2 \end{pmatrix}$ | From point **P** makes an angle $\theta_2$ in anticlock-wise with line **BP**, **DP** |
| **E** | $\mathrm{P} + \begin{pmatrix} -r\cos\theta_2 \\ r\sin\theta_2 \end{pmatrix}$ | From point **P** makes an angle $\theta_2$ in anticlock-wise with line **AP**, **EP** |

Table 2: Output Parameters

Joining these points forms the required figure

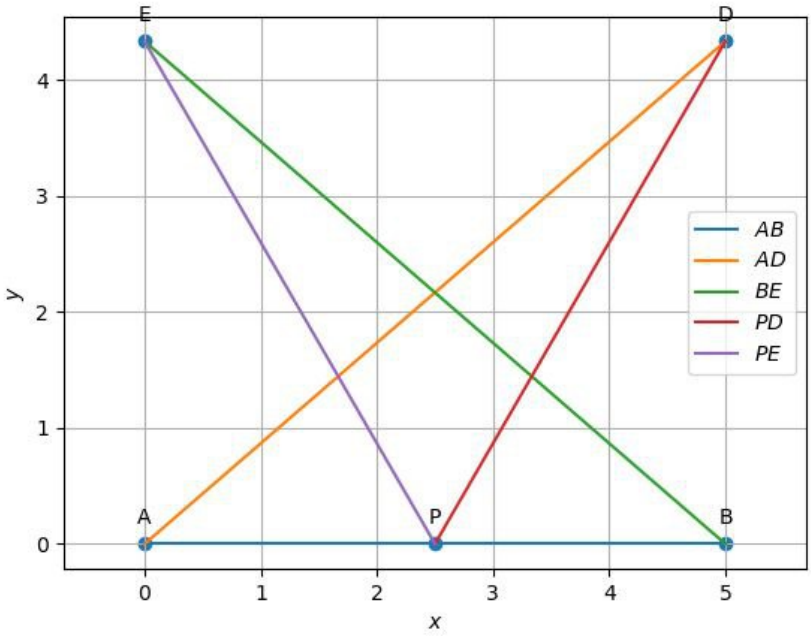


Figure 2: $\triangle$**DAP** *and* $\triangle$**EBP**