# Solution with figure

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Consider a triangle with vertices

$$\mathbf{A} = \begin{pmatrix} -5 \\ 4 \end{pmatrix} \tag{1}$$

$$\mathbf{B} = \begin{pmatrix} 4 \\ 5 \end{pmatrix} \tag{2}$$

$$\mathbf{C} = \begin{pmatrix} -1 \\ 4 \end{pmatrix} \tag{3}$$

| parameter | value | description |
|---|---|---|
| $\mathbf{m_1}$ | $\begin{pmatrix} 9 \\ 4 \end{pmatrix}$ | AB |
| $\mathbf{m_2}$ | $\begin{pmatrix} -5 \\ -1 \end{pmatrix}$ | BC |
| $\mathbf{m_3}$ | $\begin{pmatrix} -4 \\ -3 \end{pmatrix}$ | AC |
| $\|\|B-A\|\|$ | 5.83 | AB |
| $\|\|C-B\|\|$ | 6.40 | BC |
| $\|\|A-C\|\|$ | 9.21 | AC |
| rank | 3 | points are not collinear |
| $\mathbf{n_1}^\top$ | $\begin{pmatrix} 4 & -9 \end{pmatrix}$ | AB |
| $c_1$ | -3 | |
| $\mathbf{n_2}^\top$ | $\begin{pmatrix} -1 & 5 \end{pmatrix}$ | BC |
| $c_2$ | 5 | |
| $\mathbf{n_3}^\top$ | $\begin{pmatrix} -3 & 4 \end{pmatrix}$ | AC |
| $c_3$ | -39 | |
| area | 18.5 | area of triangle |
| $\angle A$ | 12.90740° | Angle |
| $\angle B$ | 12.65255° | |
| $\angle C$ | 154.44003° | |

TABLE 0
VECTORS

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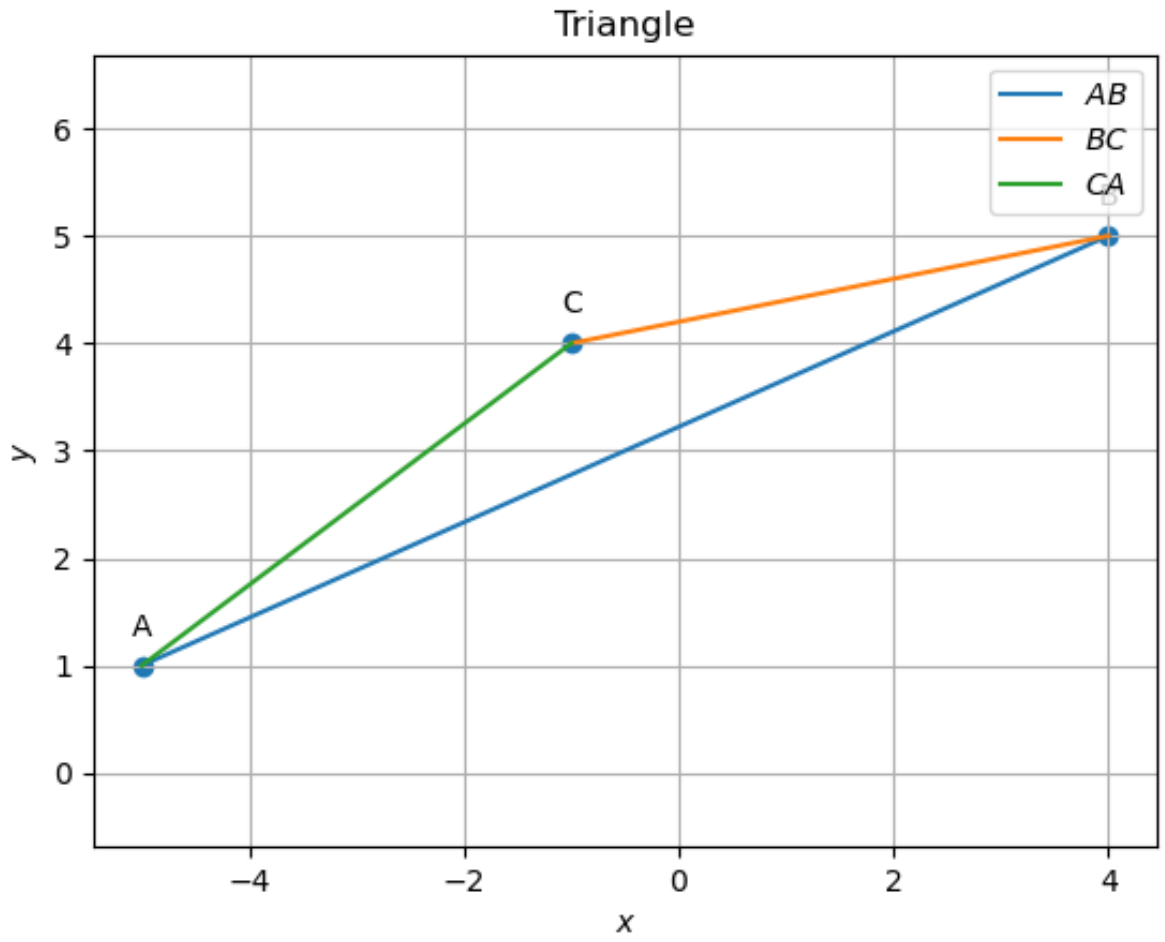


Fig. 0. Triangle

| parameter | value | description |
|---|---|---|
| **D** | $\begin{pmatrix} 1.5 \\ -4.5 \end{pmatrix}$ | midpoint of line BC |
| **E** | $\begin{pmatrix} -3 \\ -2.5 \end{pmatrix}$ | midpoint of line AC |
| **F** | $\begin{pmatrix} -0.5 \\ 3 \end{pmatrix}$ | midpoint of line AB |
| $\mathbf{n_4}^\top$ | $\begin{pmatrix} 3.5 & -6.5 \end{pmatrix}$ | AD |
| $c_4$ | 18 | |
| $\mathbf{n_5}^\top$ | $\begin{pmatrix} -2.5 & 7 \end{pmatrix}$ | BE |
| $c_5$ | 4 | |
| $\mathbf{n_6}^\top$ | $\begin{pmatrix} -1 & -0.5 \end{pmatrix}$ | CF |
| $c_6$ | -22 | |
| **G** | $\begin{pmatrix} -0.67 \\ 3.33 \end{pmatrix}$ | centroid of triangle |

TABLE 0
TRIANGLE WITH MIDPOINT

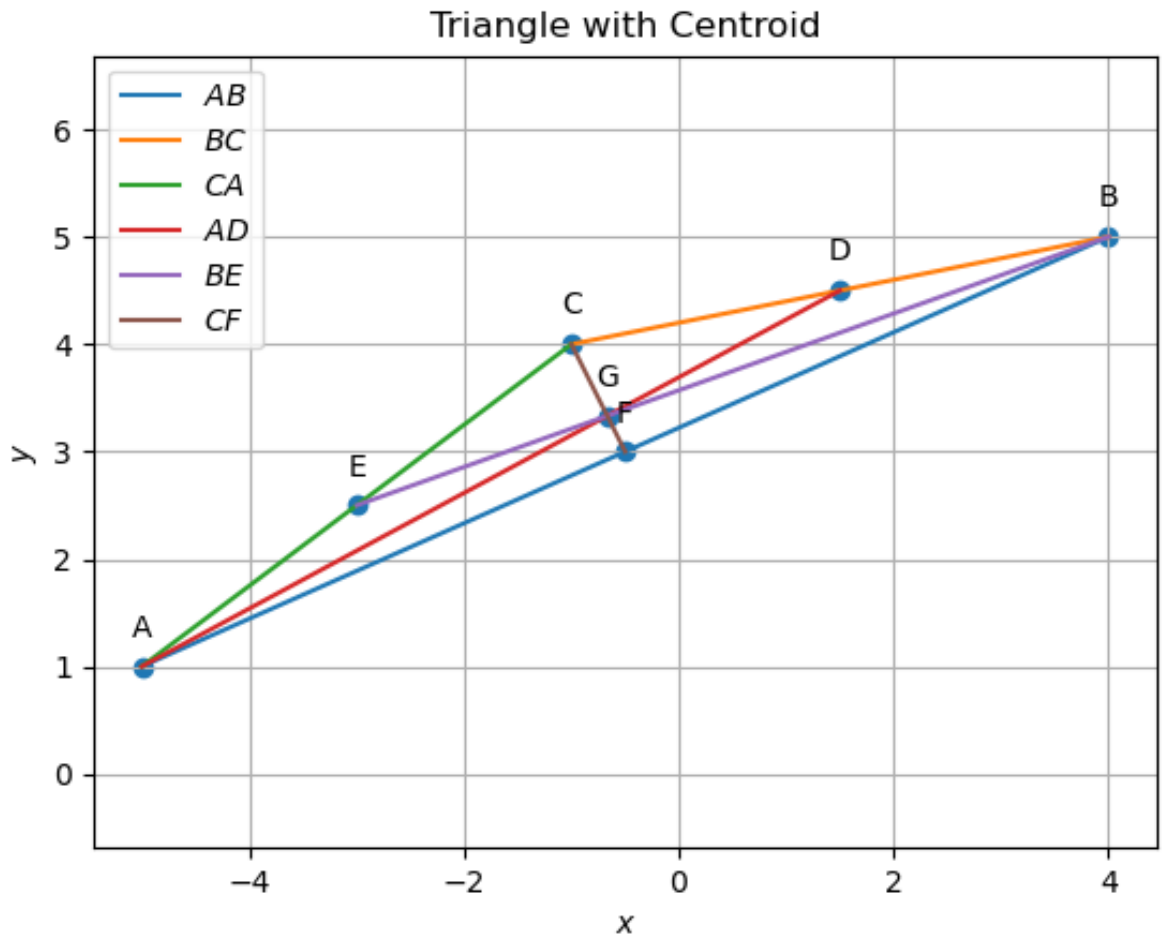


Fig. 0. Triangle

| parameter | value | description |
|---|---|---|
| $\mathbf{n}_7^\top$ | $\begin{pmatrix}-5 & -1\end{pmatrix}$ | A$D_1$ |
| $c_7$ | -9 | |
| $\mathbf{n}_8^\top$ | $\begin{pmatrix}-4 & -3\end{pmatrix}$ | B$E_1$ |
| $c_8$ | 9 | |
| $\mathbf{n}_9^\top$ | $\begin{pmatrix}9 & 4\end{pmatrix}$ | C$F_1$ |
| $c_9$ | 0 | |
| $\mathbf{H}$ | $\begin{pmatrix}-9.36\\22.81\end{pmatrix}$ | orthocentre of triangle |

TABLE 0
TRIANGLE WITH ORTHOCENTER

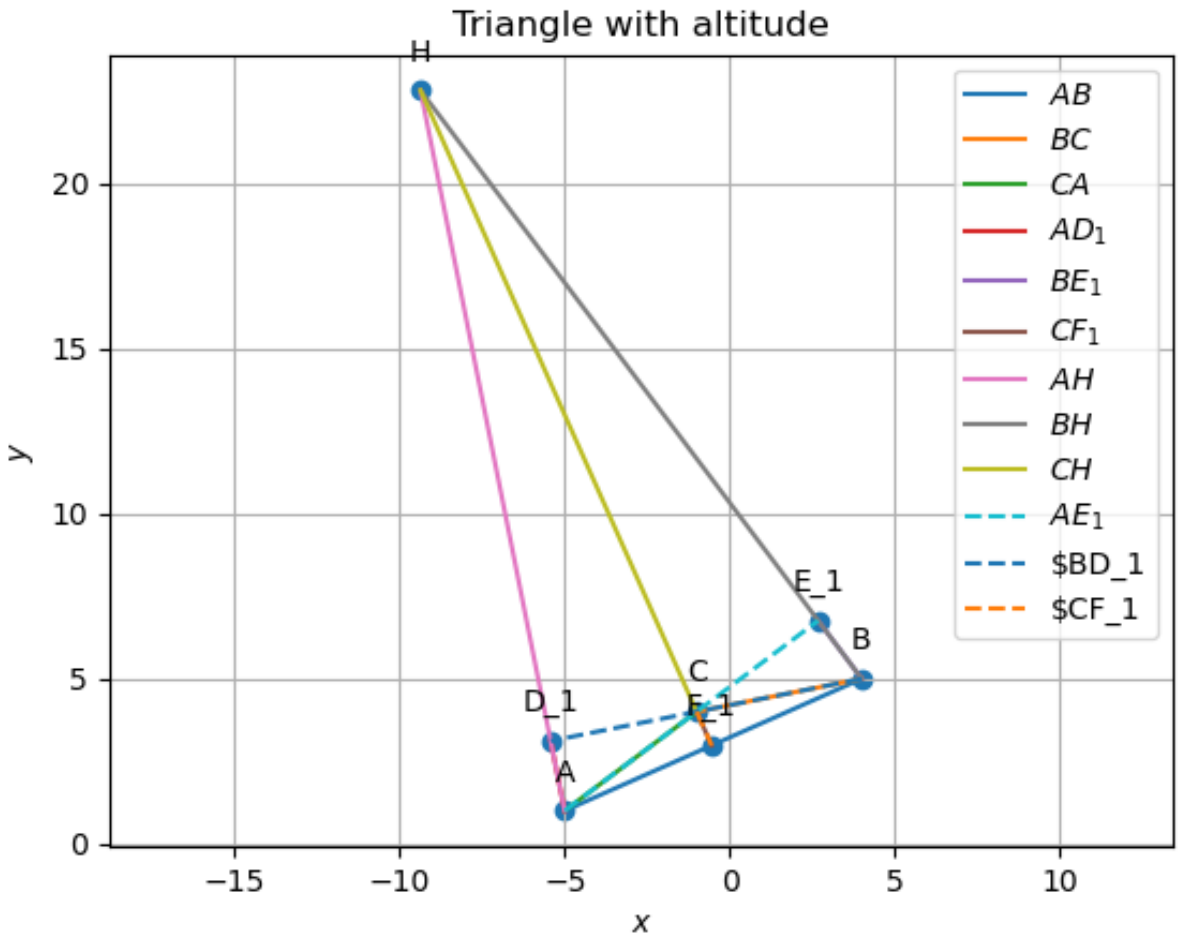


Fig. 0. Triangle

| parameter | value | description |
|---|---|---|
| $\mathbf{n}_{13}^{\top}$ | $\begin{pmatrix}1.00613847 & -1.71381155\end{pmatrix}$ | Angular bisector of A |
| $c_{13}$ | 3.71 | |
| $\mathbf{n}_{14}^{\top}$ | $\begin{pmatrix}-0.6022546 & 1.89439222\end{pmatrix}$ | Angular bisector of B |
| $c_{14}$ | 1.29 | |
| $\mathbf{n}_{15}^{\top}$ | $\begin{pmatrix}-0.40388386 & -0.18058068\end{pmatrix}$ | Angular bisector of C |
| $c_{15}$ | -10.78 | |
| **I** | $\begin{pmatrix}-0.7692024 & 3.4838017\end{pmatrix}$ | Incircle |
| radius | -1.72 | |

TABLE 0
TRIANGLE WITH INCIRCLE

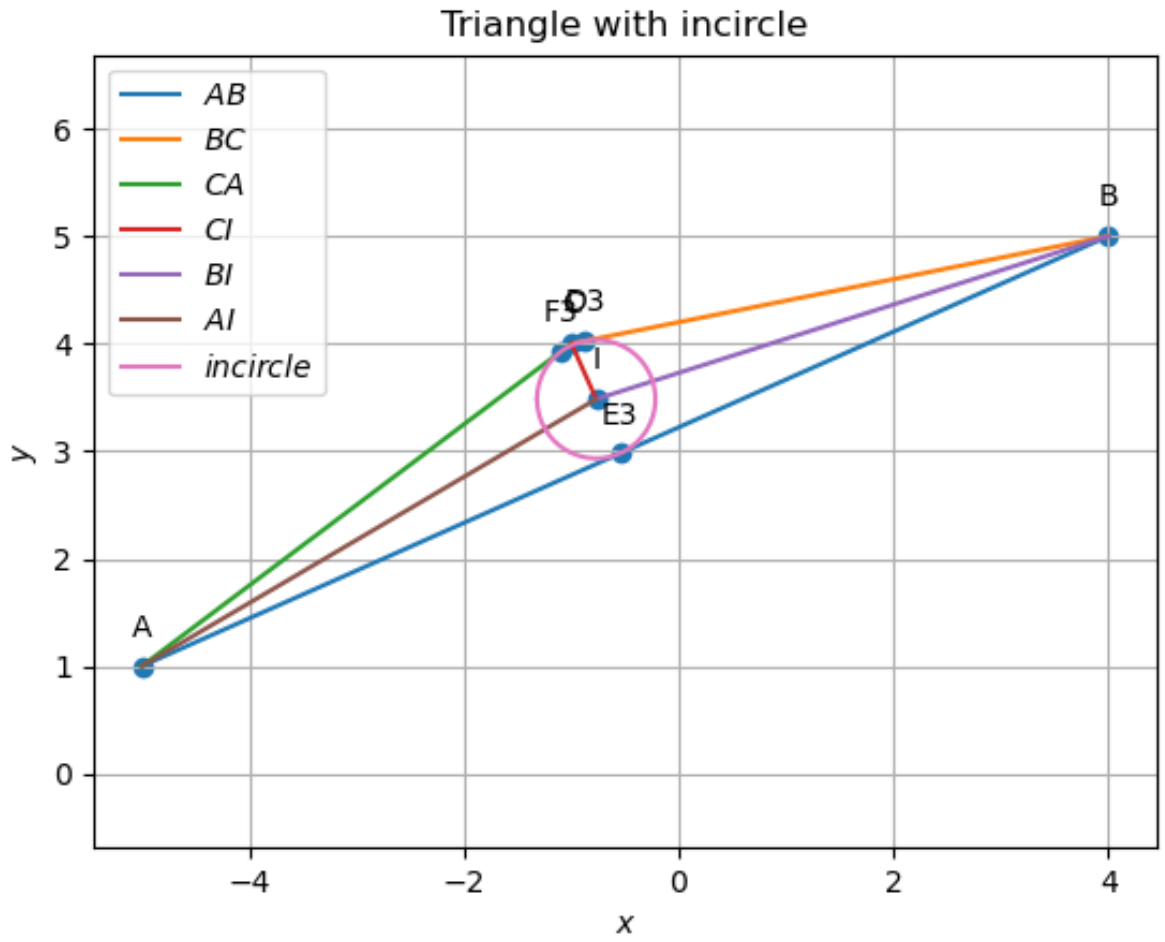


Fig. 0. Triangle

| parameter | value | description |
|---|---|---|
| $\mathbf{n_{10}^\top}$ | $\begin{pmatrix} 9 & 4 \end{pmatrix}$ | Perpendicular bisector of AB |
| $c_{10}$ | 22 | |
| $\mathbf{n_{11}^\top}$ | $\begin{pmatrix} -5 & -1 \end{pmatrix}$ | Perpendicular bisector of BC |
| $c_{11}$ | -16.5 | |
| $\mathbf{n_{12}^\top}$ | $\begin{pmatrix} -4 & -3 \end{pmatrix}$ | Perpendicular bisector of CA |
| $c_{12}$ | -5.5 | |
| $\mathbf{O}$ | $\begin{pmatrix} 3.681 \\ -6.409 \end{pmatrix}$ | Circumcircle |
| radius | 4.65 | |

TABLE 0
TRIANGLE WITH CIRCUMCIRCLE

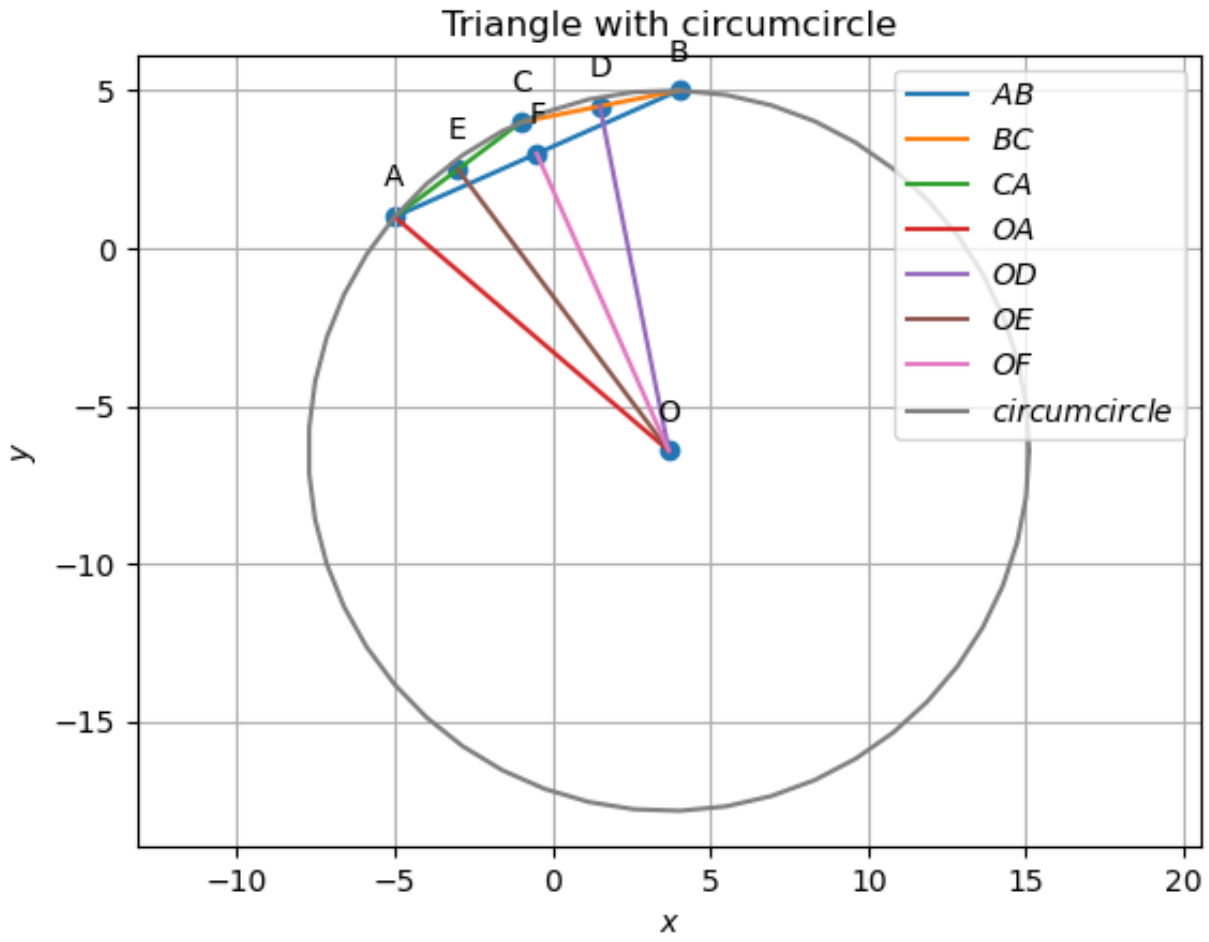


Fig. 0. Triangle