Probability and Random Processes

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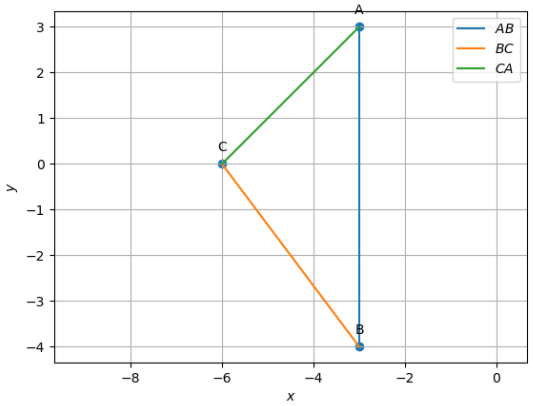
$$\mathbf{A} = \begin{pmatrix} -3 \\ 3 \end{pmatrix}; \mathbf{B} = \begin{pmatrix} -3 \\ -4 \end{pmatrix}; \mathbf{C} = \begin{pmatrix} -6 \\ 0 \end{pmatrix}$$

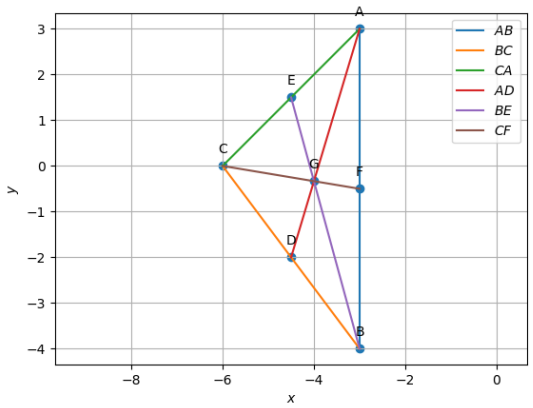


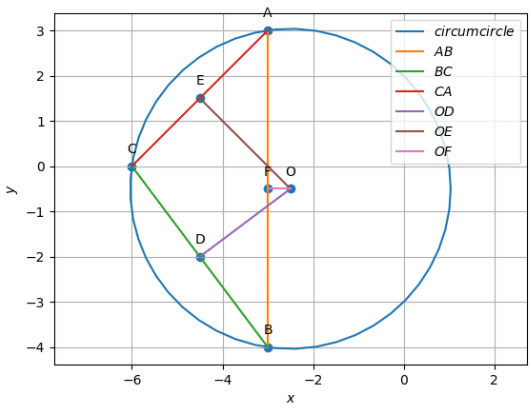
I. Vertices

Parameters	Values	Description
$\mathbf{m_1}$	$\begin{pmatrix} 0 \\ -7 \end{pmatrix}$	$\mathbf{B} - \mathbf{A}$
$\mathbf{m_2}$	$\begin{pmatrix} -3 \\ 4 \end{pmatrix}$	$\mathbf{C} - \mathbf{B}$
$\mathbf{m_3}$	$\begin{pmatrix} 3 \\ 3 \end{pmatrix}$	$\mathbf{A} - \mathbf{C}$
$\|\mathbf{B} - \mathbf{A}\|$	7	length of AB
$\|\mathbf{C} - \mathbf{B}\|$	5	length of BC
$\|\mathbf{A} - \mathbf{C}\|$	$\sqrt{18}$	length of CA
$\text{rank}\begin{pmatrix} 1 & 1 & 1 \\ \mathbf{A} & \mathbf{B} & \mathbf{C} \end{pmatrix}$	3	Non-collinear
$\mathbf{n_1}$	$\begin{pmatrix} -7 \\ 0 \end{pmatrix}$	$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}\mathbf{m_1}$
$\mathbf{n_2}$	$\begin{pmatrix} 4 \\ 3 \end{pmatrix}$	$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}\mathbf{m_2}$
$\mathbf{n_3}$	$\begin{pmatrix} 3 \\ -3 \end{pmatrix}$	$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}\mathbf{m_3}$
$\frac{1}{2}\|\mathbf{m_1} \times \mathbf{m_2}\|$	10.5	Area
$\angle A$	45°	Angle A
$\angle B$	36.870°	Angle B
$\angle C$	98.13°	Angle C

II. Centroid

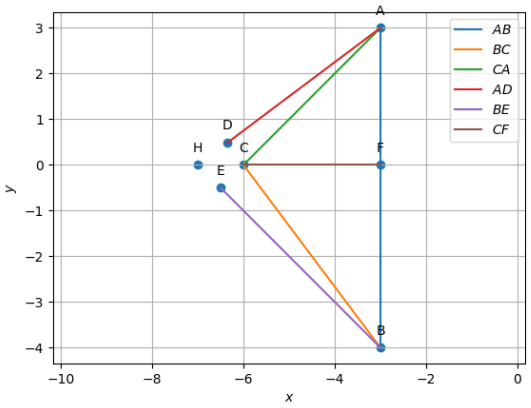
Parameters	Values	Description
$\mathbf{D}$	$\begin{pmatrix} -\frac{9}{2} \\ -2 \end{pmatrix}$	$\frac{\mathbf{A+B}}{2}$
$\mathbf{E}$	$\begin{pmatrix} -\frac{9}{2} \\ \frac{3}{2} \end{pmatrix}$	$\frac{\mathbf{C+A}}{2}$
$\mathbf{F}$	$\begin{pmatrix} -3 \\ -\frac{1}{2} \end{pmatrix}$	$\frac{\mathbf{B+C}}{2}$
$\mathbf{m_4}$	$\begin{pmatrix} -\frac{3}{2} \\ -5 \end{pmatrix}$	$\mathbf{D - A}$
$\mathbf{m_5}$	$\begin{pmatrix} -\frac{3}{2} \\ \frac{11}{2} \end{pmatrix}$	$\mathbf{E - B}$
$\mathbf{m_6}$	$\begin{pmatrix} 3 \\ -\frac{1}{2} \end{pmatrix}$	$\mathbf{F - C}$
$\mathbf{n_4}$	$\begin{pmatrix} -5 \\ \frac{3}{2} \end{pmatrix}$	$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}\mathbf{m_4}$
$\mathbf{n_5}$	$\begin{pmatrix} \frac{11}{2} \\ \frac{3}{2} \end{pmatrix}$	$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}\mathbf{m_5}$
$\mathbf{n_6}$	$\begin{pmatrix} -\frac{1}{2} \\ -3 \end{pmatrix}$	$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}\mathbf{m_6}$
$\mathbf{G}$	$\begin{pmatrix} -4 \\ -\frac{1}{3} \end{pmatrix}$	$\frac{\mathbf{A+B+C}}{3}$
$\|\mathbf{A - G}\|$	3.480	$\therefore \frac{AG}{GD} = \frac{BG}{GE} = \frac{CG}{GF} = 2$
$\|\mathbf{D - G}\|$	1.740	
$\|\mathbf{B - G}\|$	3.800	
$\|\mathbf{E - G}\|$	1.900	
$\|\mathbf{C - G}\|$	2.028	
$\|\mathbf{F - G}\|$	1.014	
$\text{rank}\begin{pmatrix} 1 & 1 & 1 \\ \mathbf{A} & \mathbf{D} & \mathbf{G} \end{pmatrix}$	2	The points are collinear
$\text{rank}\begin{pmatrix} 1 & 1 & 1 \\ \mathbf{B} & \mathbf{E} & \mathbf{G} \end{pmatrix}$		
$\text{rank}\begin{pmatrix} 1 & 1 & 1 \\ \mathbf{C} & \mathbf{F} & \mathbf{G} \end{pmatrix}$		
AF	$\begin{pmatrix} 0 \\ \frac{7}{2} \end{pmatrix}$	AFDE is a quadrilateral
ED		





III. Orthocentre

Parameters	Values	Description
$\mathbf{n_7}$	$\begin{pmatrix}-3\\4\end{pmatrix}$	alt AD_1
$\mathbf{n_8}$	$\begin{pmatrix}3\\3\end{pmatrix}$	alt BE_1
$\mathbf{n_9}$	$\begin{pmatrix}0\\-7\end{pmatrix}$	alt CF_1
$\mathbf{H}$	$\begin{pmatrix}-7\\0\end{pmatrix}$	orthocentre

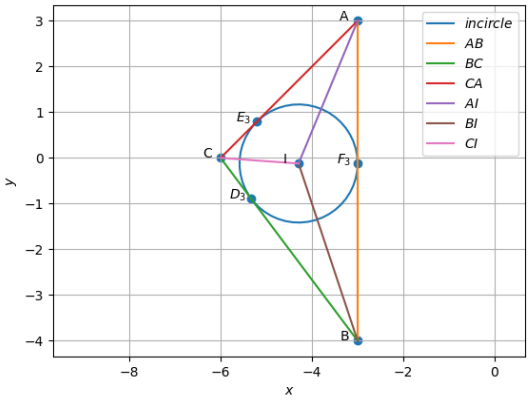


IV. Circumcentre

Parameters	Values	Description
$\mathbf{O}$	$\left(-\frac{5}{2},-\frac{1}{2}\right)$	circumcentre
$\|\mathbf{O}-\mathbf{A}\|$	3.535	circumradius
$\|\mathbf{O}-\mathbf{B}\|$		
$\|\mathbf{O}-\mathbf{C}\|$		

V. Incentre

Parameters	Values	Description
$\mathbf{I}-\mathbf{A}$	$\begin{pmatrix}0.707\\1.707\end{pmatrix}$	angle bisector of A
$\mathbf{I}-\mathbf{B}$	$\begin{pmatrix}-0.6\\1.8\end{pmatrix}$	angle bisector of B
$\mathbf{I}-\mathbf{C}$	$\begin{pmatrix}-1.307\\0.093\end{pmatrix}$	angle bisector of C
$\mathbf{I}$	$\begin{pmatrix}-4.293\\-0.121\end{pmatrix}$	incentre
r	1.293	incentre radius
$\angle BAI$	22.5°	bisector of A
$\angle CAI$		
$\angle ABI$	161.56°	bisector of B
$\angle CBI$		
$\angle BCI$	130.935°	bisector of C
$\angle ACI$		
$\mathbf{D_3}$	$\begin{pmatrix}-5.327\\-0.897\end{pmatrix}$	points of intersection
$\mathbf{E_3}$	$\begin{pmatrix}-5.207\\0.793\end{pmatrix}$	
$\mathbf{F_3}$	$\begin{pmatrix}-3\\-0.121\end{pmatrix}$	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AB
BC
CA
AI
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A
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