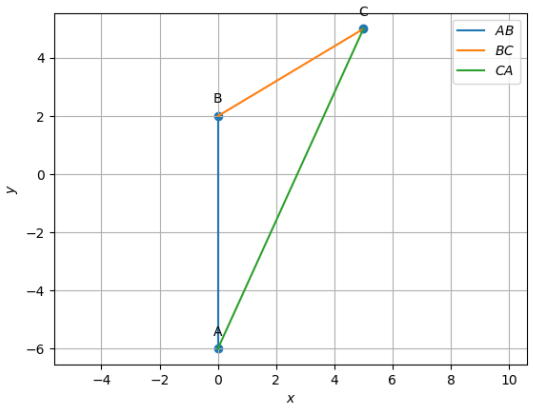
Probability and Random Processes

Nikita Balure EE22BTECH11037*

$$\mathbf{A} = \begin{pmatrix} 0 \\ -6 \end{pmatrix}; \mathbf{B} = \begin{pmatrix} 0 \\ 2 \end{pmatrix}; \mathbf{C} = \begin{pmatrix} 5 \\ 5 \end{pmatrix}$$

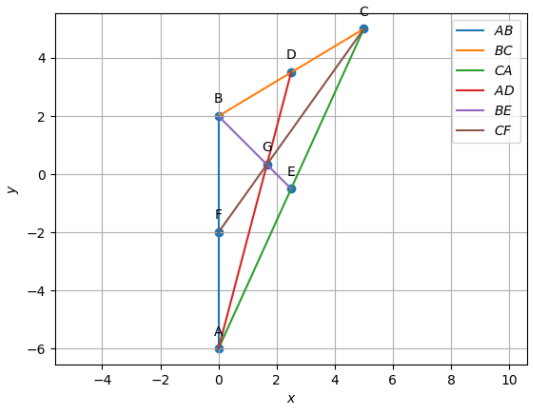


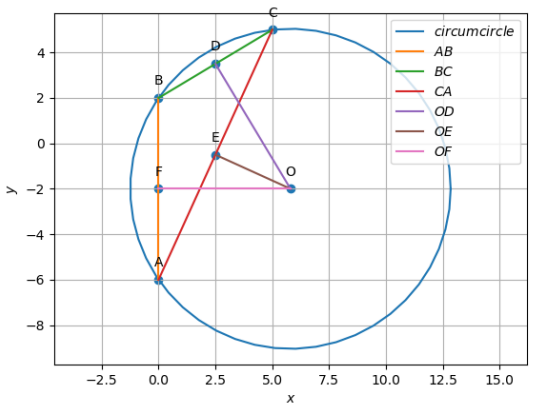
I. Vertices

Parameters	Values	Description
$\mathbf{m_1}$	$\begin{pmatrix} 0 \\ 8 \end{pmatrix}$	$\mathbf{B} - \mathbf{A}$
$\mathbf{m_2}$	$\begin{pmatrix} 5 \\ 3 \end{pmatrix}$	$\mathbf{C} - \mathbf{B}$
$\mathbf{m_3}$	$\begin{pmatrix} -5 \\ -11 \end{pmatrix}$	$\mathbf{A} - \mathbf{C}$
$\|\mathbf{B} - \mathbf{A}\|$	8	length of AB
$\|\mathbf{C} - \mathbf{B}\|$	$\sqrt{34}$	length of BC
$\|\mathbf{A} - \mathbf{C}\|$	$\sqrt{146}$	length of CA
$\text{rank}\begin{pmatrix} 1 & 1 & 1 \\ \mathbf{A} & \mathbf{B} & \mathbf{C} \end{pmatrix}$	3	Non-collinear
$\mathbf{n_1}$	$\begin{pmatrix} 8 \\ 0 \end{pmatrix}$	$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}\mathbf{m_1}$
$\mathbf{n_2}$	$\begin{pmatrix} 3 \\ -5 \end{pmatrix}$	$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}\mathbf{m_2}$
$\mathbf{n_3}$	$\begin{pmatrix} -11 \\ 5 \end{pmatrix}$	$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}\mathbf{m_3}$
$\frac{1}{2}\|\mathbf{m_1} \times \mathbf{m_2}\|$	20	Area
$\angle A$	24.444°	Angle A
$\angle B$	120.964°	Angle B
$\angle C$	34.592°	Angle C

II. Centroid

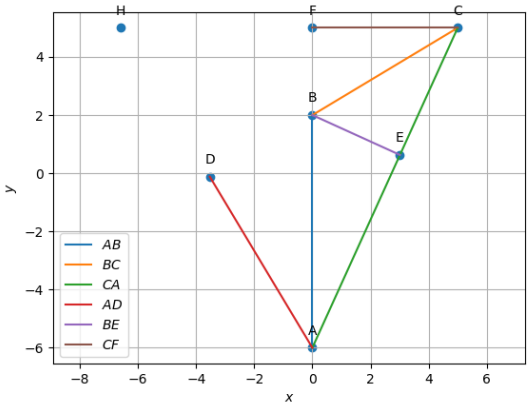
Parameters	Values	Description
$\mathbf{D}$	$\begin{pmatrix}\frac{5}{2}\\ \frac{7}{2}\end{pmatrix}$	$\frac{\mathbf{A+B}}{2}$
$\mathbf{E}$	$\begin{pmatrix}\frac{5}{2}\\ -\frac{1}{2}\end{pmatrix}$	$\frac{\mathbf{C+A}}{2}$
$\mathbf{F}$	$\begin{pmatrix}0\\ -2\end{pmatrix}$	$\frac{\mathbf{B+C}}{2}$
$\mathbf{m_4}$	$\begin{pmatrix}\frac{5}{2}\\ \frac{19}{2}\end{pmatrix}$	$\mathbf{D-A}$
$\mathbf{m_5}$	$\begin{pmatrix}\frac{5}{2}\\ -\frac{5}{2}\end{pmatrix}$	$\mathbf{E-B}$
$\mathbf{m_6}$	$\begin{pmatrix}-5\\ -7\end{pmatrix}$	$\mathbf{F-C}$
$\mathbf{n_4}$	$\begin{pmatrix}\frac{19}{2}\\ -\frac{5}{2}\end{pmatrix}$	$\begin{pmatrix}0 & 1\\ -1 & 0\end{pmatrix}\mathbf{m_4}$
$\mathbf{n_5}$	$\begin{pmatrix}-\frac{5}{2}\\ -\frac{5}{2}\end{pmatrix}$	$\begin{pmatrix}0 & 1\\ -1 & 0\end{pmatrix}\mathbf{m_5}$
$\mathbf{n_6}$	$\begin{pmatrix}-7\\ 5\end{pmatrix}$	$\begin{pmatrix}0 & 1\\ -1 & 0\end{pmatrix}\mathbf{m_6}$
$\mathbf{G}$	$\begin{pmatrix}\frac{5}{3}\\ \frac{1}{3}\end{pmatrix}$	$\frac{\mathbf{A+B+C}}{3}$
$\|\mathbf{A-G}\|$	6.549	$\therefore \frac{AG}{GD} = \frac{BG}{GE} = \frac{CG}{GF} = 2$
$\|\mathbf{D-G}\|$	3.274	
$\|\mathbf{B-G}\|$	2.357	
$\|\mathbf{E-G}\|$	1.178	
$\|\mathbf{C-G}\|$	5.735	
$\|\mathbf{F-G}\|$	2.867	
$\text{rank}\begin{pmatrix}1 & 1 & 1\\ \mathbf{A} & \mathbf{D} & \mathbf{G}\end{pmatrix}$	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	$\begin{pmatrix}0\\ -4\end{pmatrix}$	AFDE is a quadrilateral
ED		





III. Orthocentre

Parameters	Values	Description
$\mathbf{n_7}$	$\begin{pmatrix}5\\3\end{pmatrix}$	alt AD_1
$\mathbf{n_8}$	$\begin{pmatrix}-5\\-11\end{pmatrix}$	alt BE_1
$\mathbf{n_9}$	$\begin{pmatrix}0\\8\end{pmatrix}$	alt CF_1
$\mathbf{H}$	$\begin{pmatrix}-6.6\\5\end{pmatrix}$	orthocentre

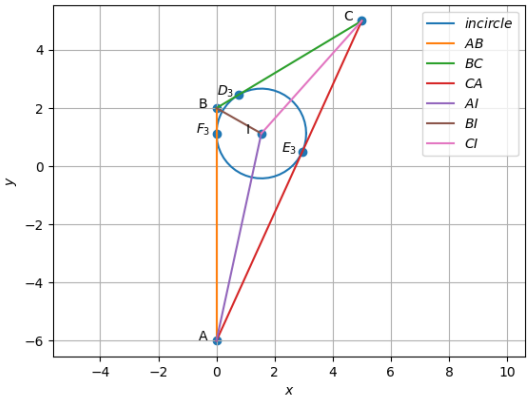


IV. Circumcentre

Parameters	Values	Description
$\mathbf{O}$	$(5.8, -2)$	circumcentre
$\|\mathbf{O}-\mathbf{A}\|$	7.046	circumradius
$\|\mathbf{O}-\mathbf{B}\|$		
$\|\mathbf{O}-\mathbf{C}\|$		

V. Incentre

Parameters	Values	Description
$\mathbf{I}-\mathbf{A}$	$\begin{pmatrix}-0.414\\-1.910\end{pmatrix}$	angle bisector of A
$\mathbf{I}-\mathbf{B}$	$\begin{pmatrix}0.857\\-0.486\end{pmatrix}$	angle bisector of B
$\mathbf{I}-\mathbf{C}$	$\begin{pmatrix}1.271\\1.425\end{pmatrix}$	angle bisector of C
$\mathbf{I}$	$\begin{pmatrix}1.544\\1.126\end{pmatrix}$	incentre
r	1.544	incentre radius
$\angle BAI$	12.222°	bisector of A
$\angle CAI$		
$\angle ABI$	60.482°	bisector of B
$\angle CBI$		
$\angle BCI$	17.296°	bisector of C
$\angle ACI$		
$\mathbf{D_3}$	$\begin{pmatrix}0.749\\2.450\end{pmatrix}$	points of intersection
$\mathbf{E_3}$	$\begin{pmatrix}2.949\\0.487\end{pmatrix}$	
$\mathbf{F_3}$	$\begin{pmatrix}0\\1.126\end{pmatrix}$	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