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$C_1 \to C_1 + C_3 - 2\cos dx\, C_2$

$R_1 \to R_1 + R_2 + R_3$

$\sum A+P = 0$

$\tan(A+P)\tan(B+Q)\tan(C+R)$

$\begin{vmatrix} 1 & \sum \tan(A+P) + \tan(B+Q) + \tan(C+R) \\ 0 & \\ 0 & \end{vmatrix}$

$(a+b+c) \begin{vmatrix} 1 & 1 & 1 \\ & & \\ & & \end{vmatrix}$

$pqr \sum a^3 \quad -\left(\sum p^3\right) abc$

$pqr\left(\sum a^3 - 3abc\right)$

$C_1 \to C_1 - bC_3, \quad C_2 \to C_2 + aC_3$

$C_2 \to C_2 - C_1$

$C_3 \to C_3 - C_1$

$(1+a^2+b^2)^2 \begin{vmatrix} 1 & 0 & -2b \\ 0 & 1 & \\ b & -a & \end{vmatrix}$

$C_3 \to C_3 + 2bC_1$

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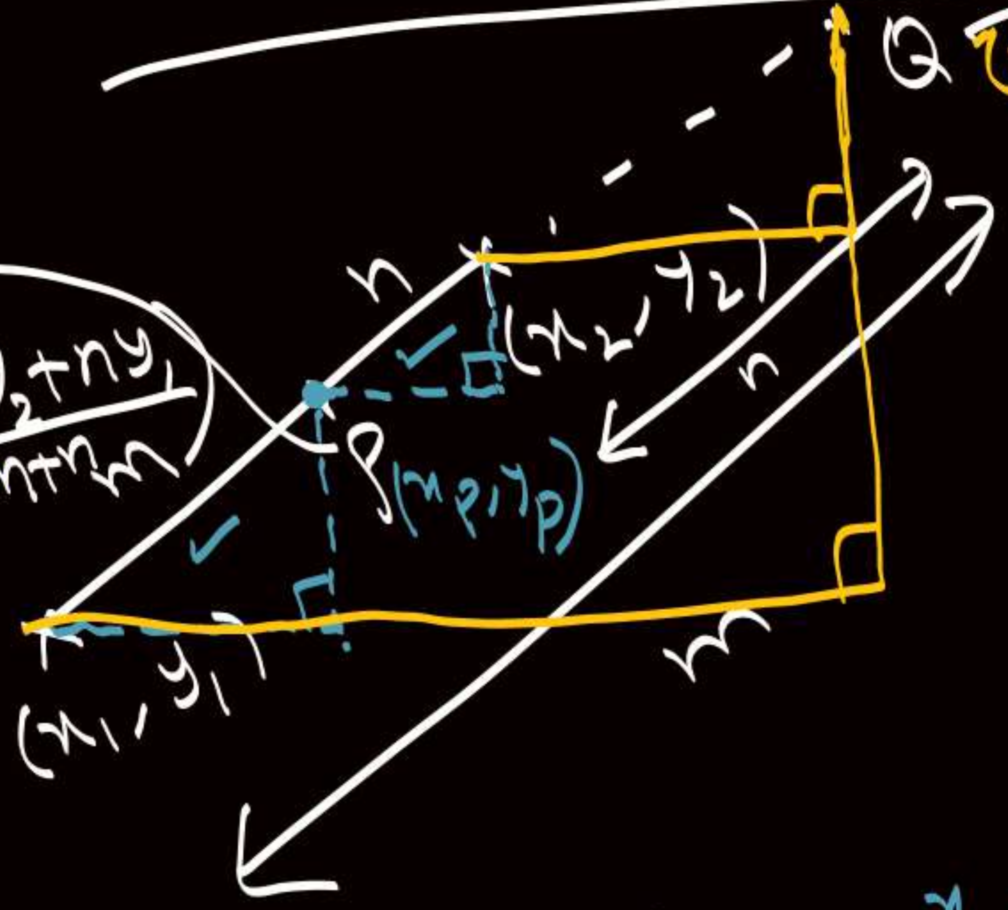
Section Formula

$$\left(\frac{mx_2+nx_1}{m+n}, \frac{my_2+ny_1}{m+n}\right)$$

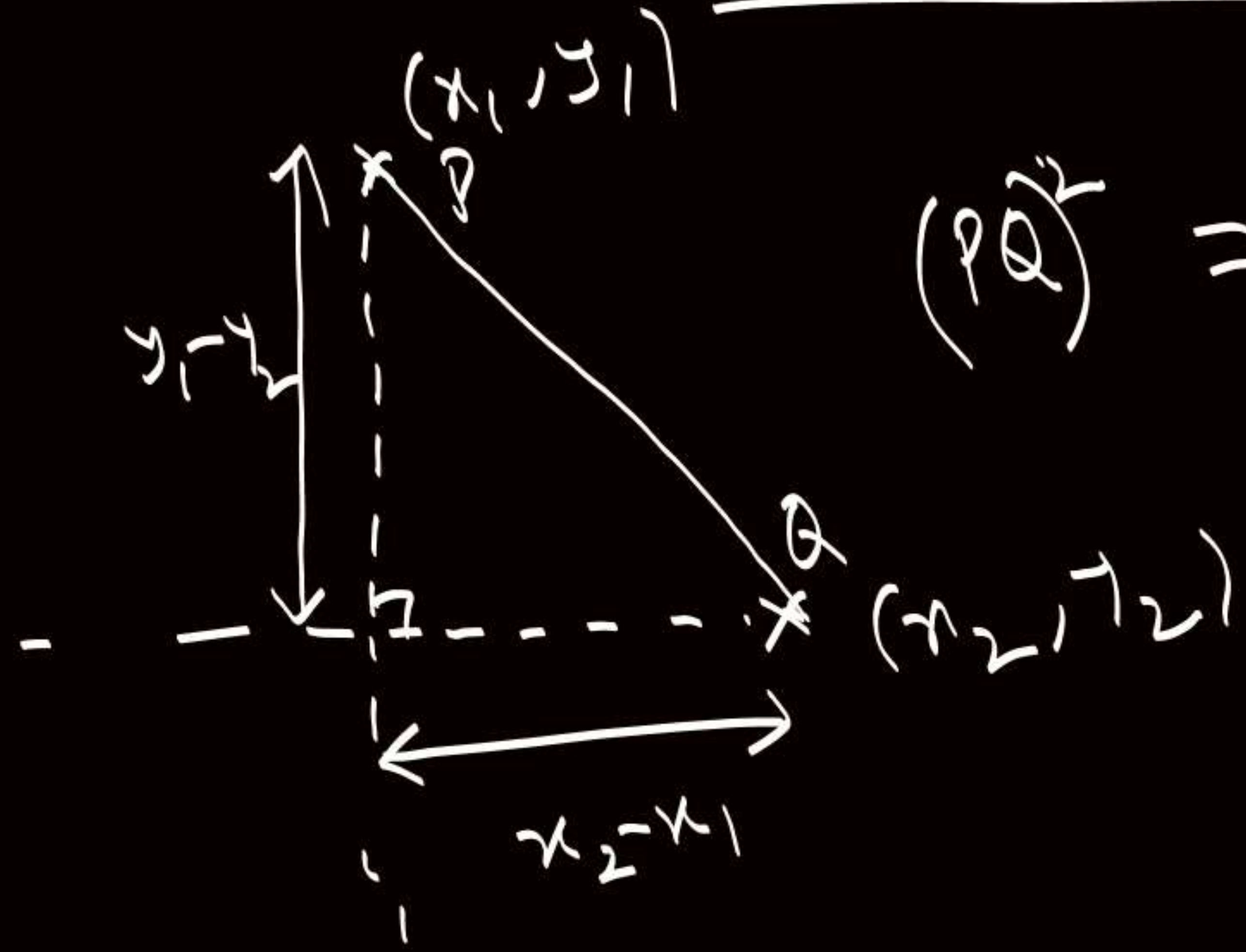


$$\left(\frac{mx_2-nx_1}{m-n}, \frac{my_2-ny_1}{m-n}\right)$$

$$\frac{y_2-y_P}{y_P-y_1} = \frac{n}{m} = \frac{x_2-x_P}{x_P-x_1}$$

$$\frac{x_Q-x_2}{x_Q-x_1} = \frac{n}{m} = \frac{y_Q-y_2}{y_Q-y_1}$$

Distance b/n 2 points



$$(PQ)^2 = (x_2 - x_1)^2 + (y_1 - y_2)^2$$

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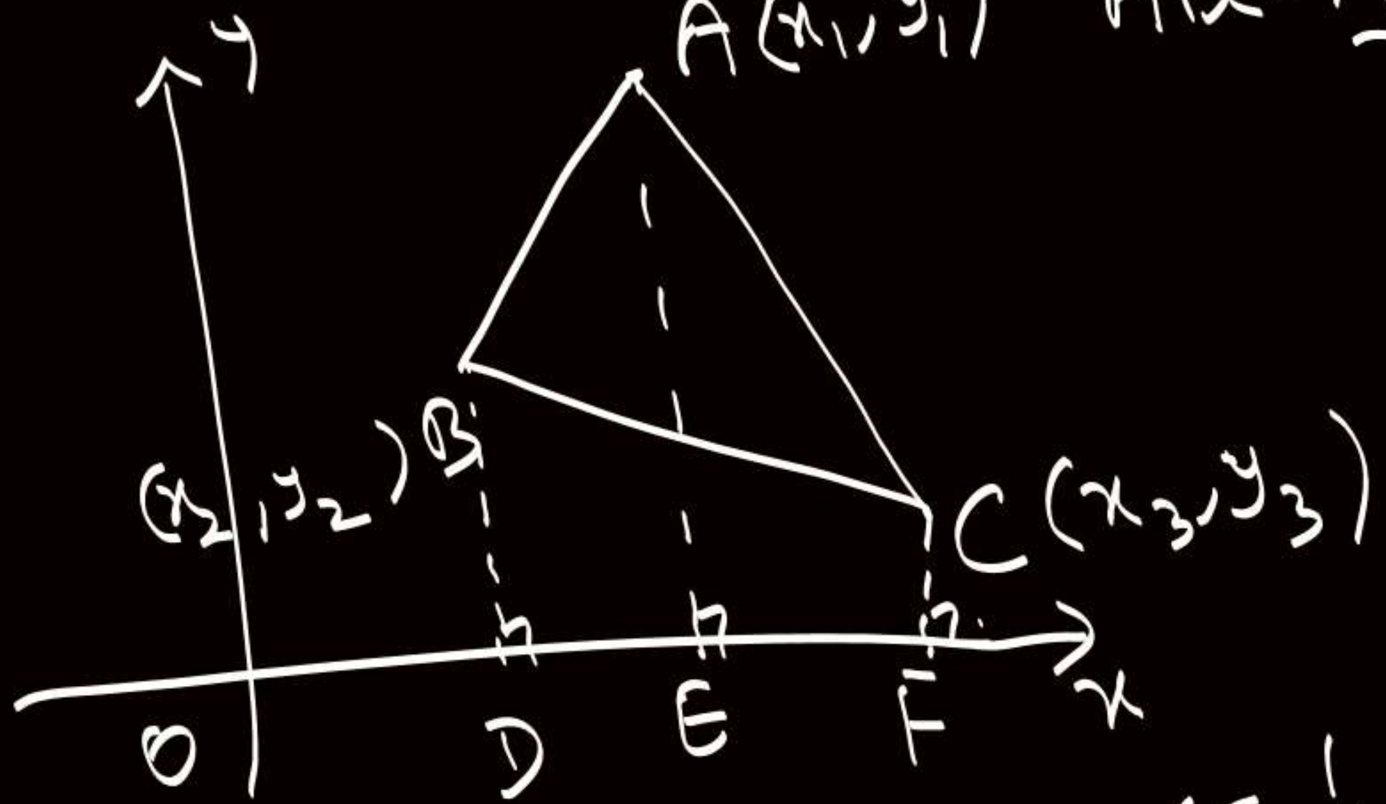
Area of triangle



ABC = ABDE + AEFC − BDFC

$$\Delta ABC = \frac{1}{2}(y_2 + y_1)(x_1 - x_2) + \frac{1}{2}(y_1 + y_3)(x_3 - x_1) - \frac{1}{2}(y_2 + y_3)(x_3 - x_2)$$

$$\frac{1}{2}\left|\vec{BA} \times \vec{BC}\right|$$

$$= \text{modulus of } \frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$$

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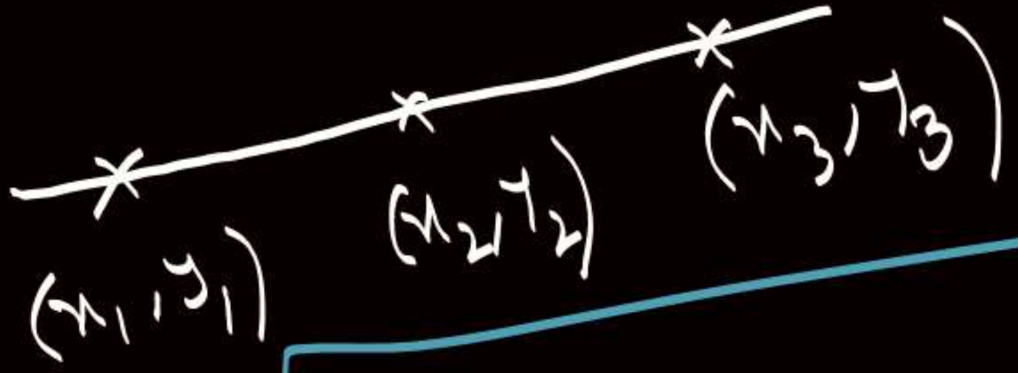
Condition for Collinear of 3 points



$$\boxed{\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} = 0}$$

Harmonic Conjugates

$$\Rightarrow \frac{AB}{AP} = \frac{(AQ-AB)+AQ}{AQ} \Rightarrow \frac{AB}{AP} = 2 - \frac{AB}{AQ} \Rightarrow \boxed{\frac{1}{AP}+\frac{1}{AQ}=\frac{2}{AB}}$$

P, Q are HC to A, B

$$1+\frac{PB}{PA} = \frac{QB}{QA}+1 \Leftarrow \frac{PA}{PB} = \frac{QA}{QB}$$

$\boxed{\text{AP, AB, AQ will be in HP}}$

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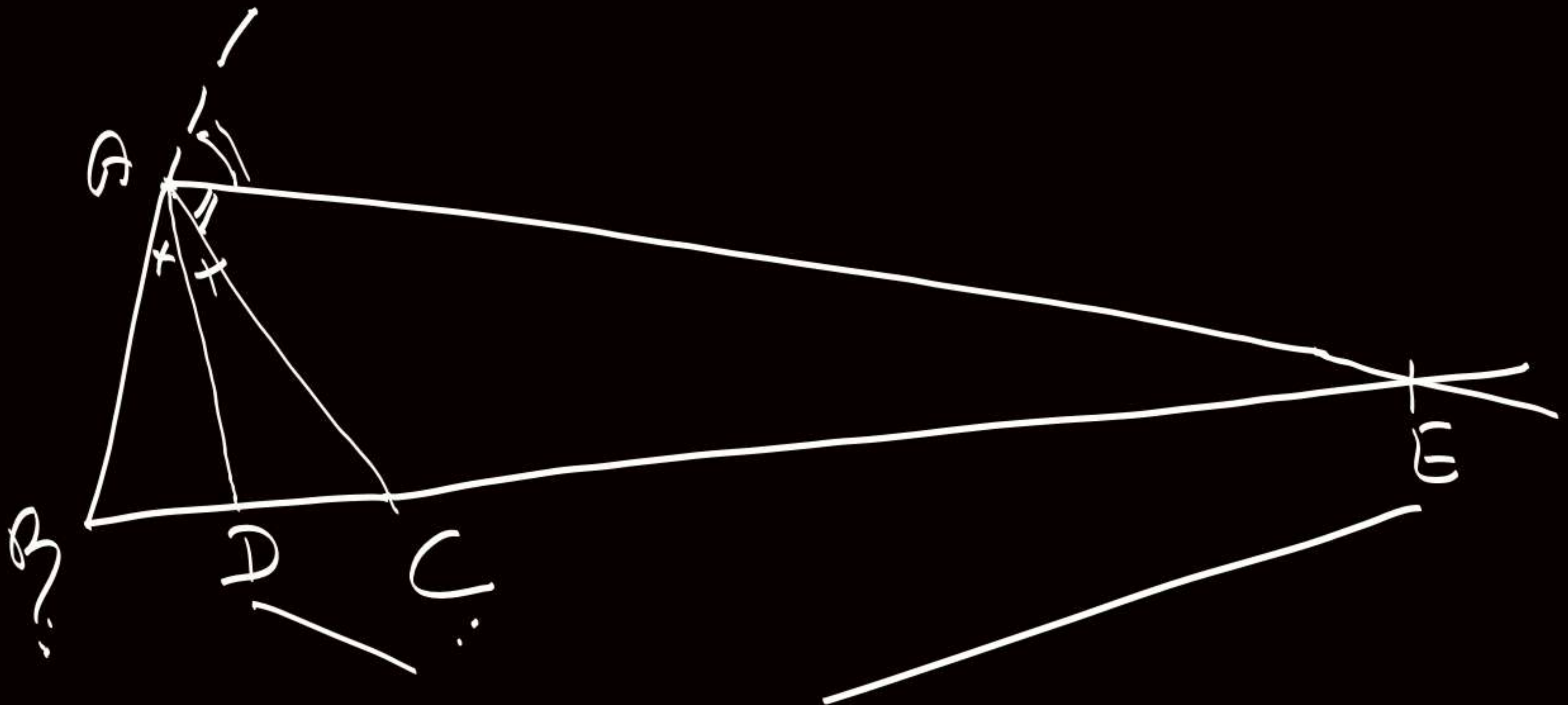

HC to B, C

BD, BC, BE will form harmonic progression

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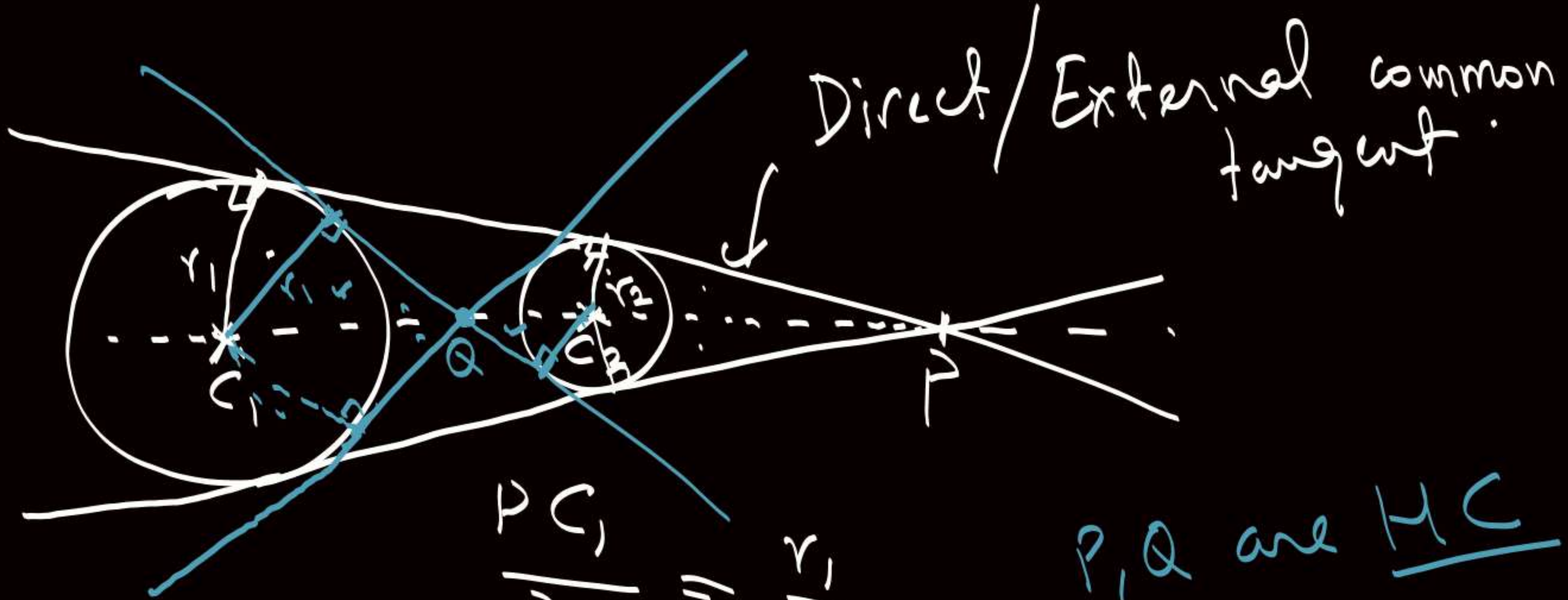

$$\frac{PC_1}{PC_2} = \frac{r_1}{r_2}$$

$$\frac{QC_1}{QC_2} = \frac{r_1}{r_2}$$

P, Q are HC to C_1, C_2.

C_1Q, C_1C_2, C_1P will form HP

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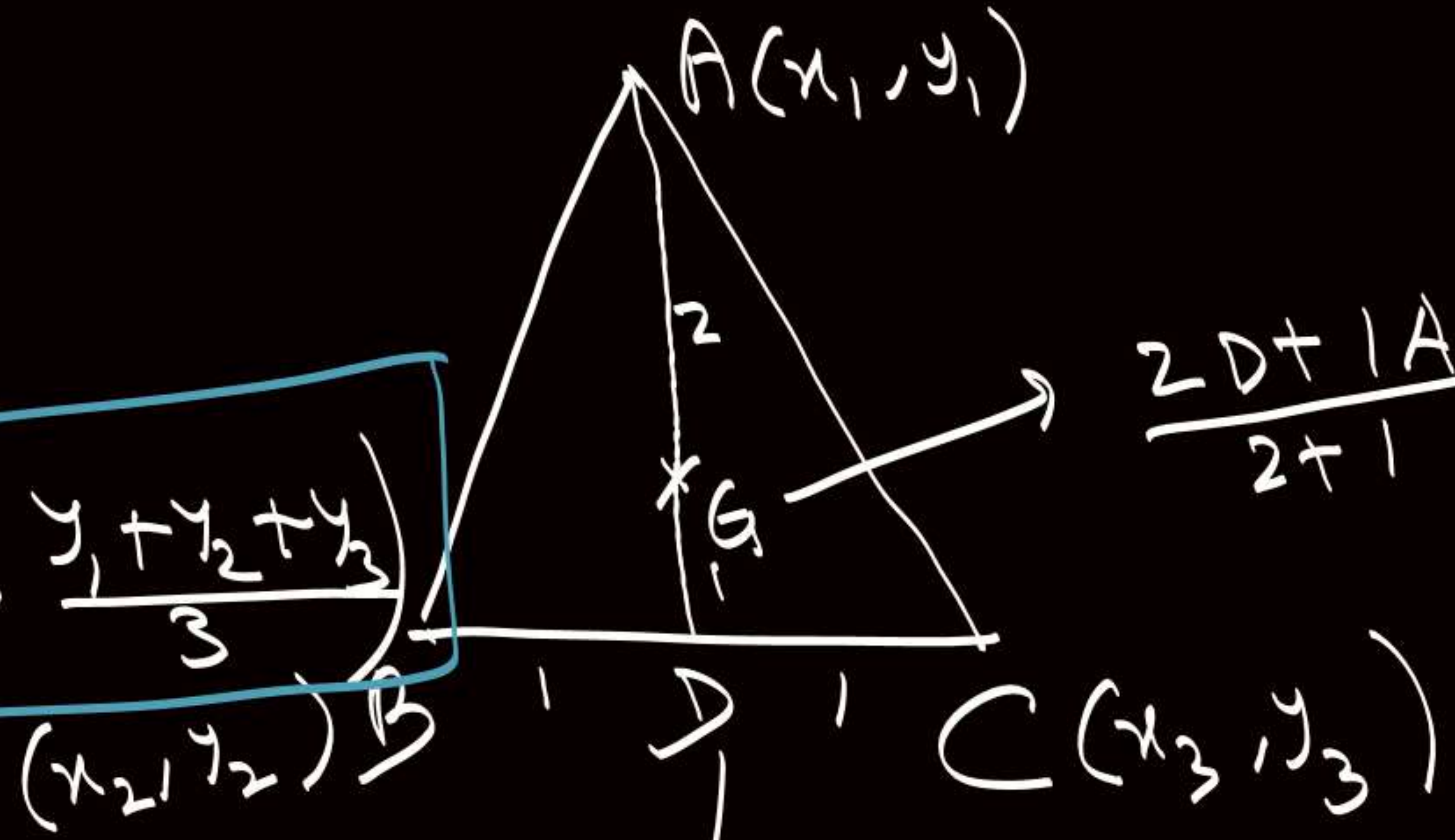
Centroid

$$G = \left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3} \right)$$



$$\frac{2D + 1A}{2 + 1}$$

$$D = \left(\frac{x_2 + x_3}{2}, \frac{y_2 + y_3}{2} \right)$$

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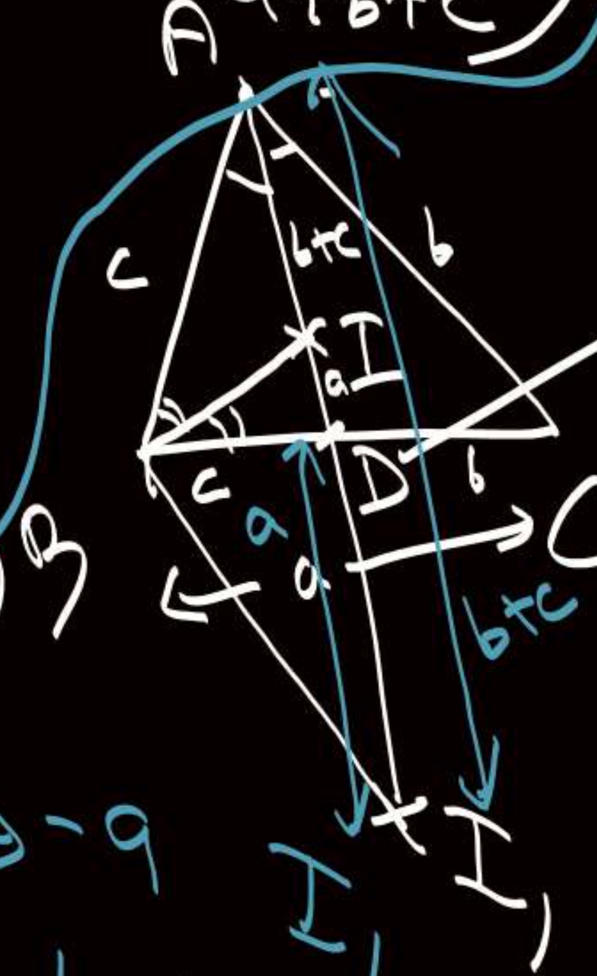
Incentre / Excentre

$$I = \left(\frac{ax_1+bx_2+cx_3}{a+b+c}, \frac{ay_1+by_2+cy_3}{a+b+c}\right)$$

$$I_1 = \left(\frac{-ax_1+bx_2+cx_3}{-a+b+c}, \frac{-ay_1+by_2+cy_3}{-a+b+c}\right)$$



ΔABD

$$\frac{AI}{ID} = \frac{AB}{BD} = \frac{c}{\frac{ca}{c+b}} = \frac{b+c}{a}$$

$$\frac{AI_1}{I_1D}$$

$$D = \left(\frac{bx_2+cx_3}{b+c}, \frac{by_2+cy_3}{b+c}\right)$$

$$\frac{AI}{ID}$$

$I \Rightarrow$ $a \to -a$ I_1

$b \to -b \Rightarrow I_2$

$c \to -c \Rightarrow I_3$

$$I = \frac{(b+c)D + aA}{(b+c)+a}$$

$$I_1 = \frac{(b+c)D - aA}{(b+c)-a}$$

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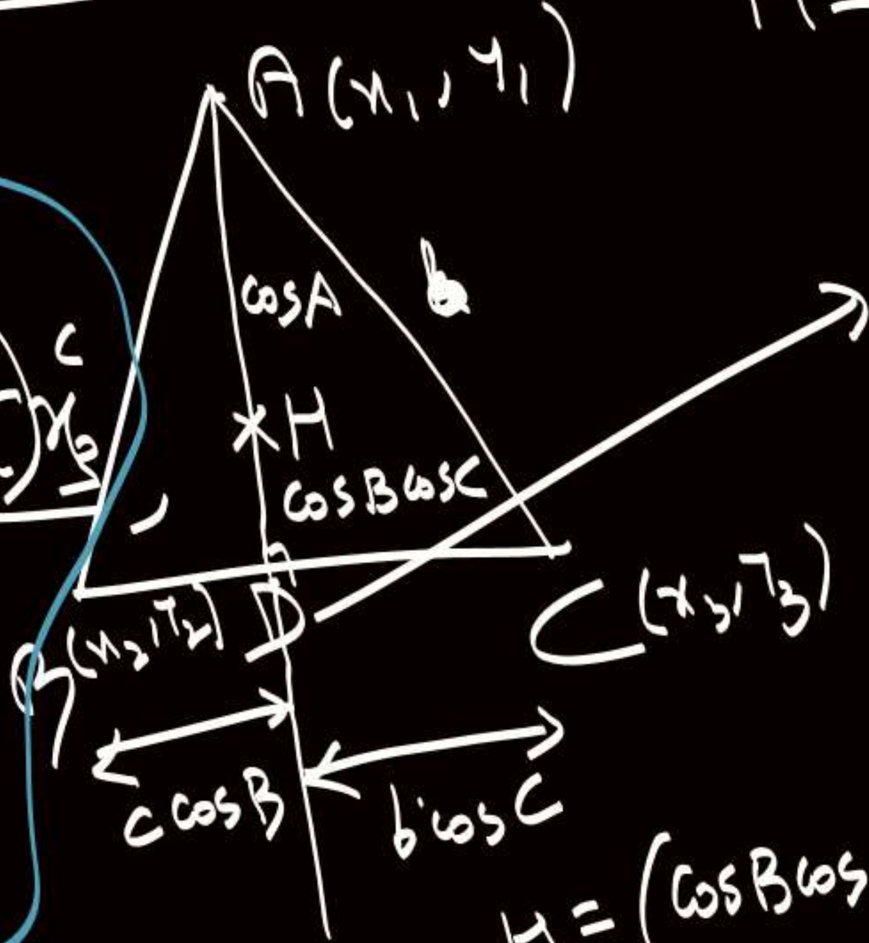
Orthocentre



$$H = \left(\frac{(\tan A)x_1 + (\tan B)x_2 + (\tan C)x_3}{\tan A + \tan B + \tan C}, \; - \right)$$

$$H = \left(\frac{\sum \tan A\, x_1}{\sum \tan A}, \frac{\sum \tan A\, y_1}{\sum \tan A} \right)$$

$$\left(\frac{c\cos B\, x_3 + b\cos C\, x_2}{a}, \; - \right)$$

$$H = \frac{(\cos B\cos C)A + (\cos A)D}{\cos B\cos C + \cos A}$$

$$\frac{\cos B\cos C\, x_1 + \dfrac{\cos A\, c\cos B\, x_3 + \cos A\, b\cos C\, x_2}{a}}{\cos B\cos C - \cos(B+C)}$$

$$= \frac{\sin A\cos B\cos C\, x_1 + \sin C\cos A\cos B\, x_3 + \sin B\cos A\cos C\, x_2}{\sin A(\sin B\sin C)}$$