

# Assignment 4

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Download all python codes from

<https://github.com/kavyakamal66/IITH-INTERNSHIP/blob/main/Assignment4/code4.py>

and latex-tikz codes from

<https://github.com/kavyakamal66/IITH-INTERNSHIP/blob/main/Assignment4/assignment4.tex>

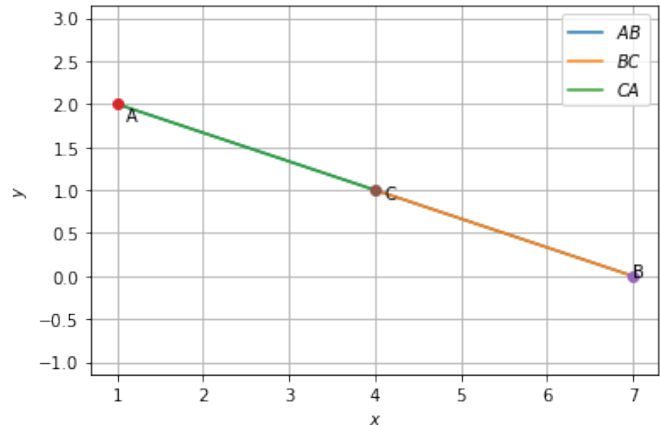


Fig. 0: Plot of given points

## 1 QUESTION NO. 2.11 - VECTORS

Find the condition on  $\mathbf{x}$  such that the points

$\mathbf{x}, \begin{pmatrix} 1 \\ 2 \end{pmatrix}, \begin{pmatrix} 7 \\ 0 \end{pmatrix}$  are collinear.

## 2 SOLUTION

Let

$$\mathbf{A} = \begin{pmatrix} 1 \\ 2 \end{pmatrix}, \mathbf{B} = \begin{pmatrix} 7 \\ 0 \end{pmatrix}, \mathbf{x} = \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} \quad (2.0.1)$$

Then

$$\mathbf{B} - \mathbf{A} = \begin{pmatrix} 6 \\ -2 \end{pmatrix}, \mathbf{x} - \mathbf{A} = \mathbf{x} - \begin{pmatrix} 1 \\ 2 \end{pmatrix} \quad (2.0.2)$$

and

$$\mathbf{M} = \begin{pmatrix} \mathbf{B} - \mathbf{A} & \mathbf{x} - \mathbf{A} \end{pmatrix}^T \quad (2.0.3)$$

For  $\mathbf{x}, \mathbf{A}$  and  $\mathbf{B}$  to be collinear

$$\implies \text{rank}(\mathbf{M}) = 1 \quad (2.0.4)$$

$$\implies R_1 = kR_2 \quad (2.0.5)$$

ie

$$k(\mathbf{x} - \mathbf{A}) = \mathbf{B} - \mathbf{A} \quad (2.0.6)$$

$$\implies \mathbf{x} - \begin{pmatrix} 1 \\ 2 \end{pmatrix} = 1/k \begin{pmatrix} 6 \\ -2 \end{pmatrix} \quad (2.0.7)$$

$$\implies \mathbf{x} = 1/k \begin{pmatrix} 6 \\ -2 \end{pmatrix} + \begin{pmatrix} 1 \\ 2 \end{pmatrix} \quad (2.0.8)$$

Now we can find  $\mathbf{x}$  by substituting values for  $k$

Let  $\mathbf{C}$  be a point collinear to  $\mathbf{A}$  and  $\mathbf{B}$

For  $k = 1/2$

$$\mathbf{C} = \begin{pmatrix} 4 \\ 1 \end{pmatrix} \quad (2.0.9)$$

Points A, B and C are plotted and is seen to be collinear.