AI1110 ASSIGNMENT 1

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Q3 (b): M and N are two points on the X axis and Y axis respectively. $\mathbf{P}(3,2)$ divides the line segment MN in the ratio 2:3.
Find:
(i)the coordinates of M and N
(ii)the slope of MN.

Solution:
Various paraetres used in this question are:

Symbol	Value	Description
$\mathbf{P}$	$\begin{pmatrix}3\\2\end{pmatrix}$	Given point
$\mathbf{e_1}$	$\begin{pmatrix}1\\0\end{pmatrix}$	Standard X-axis vector
$\mathbf{e_2}$	$\begin{pmatrix}0\\1\end{pmatrix}$	Standard Y-axis vector
$\mathbf{M}$	$a\mathbf{e_1}$	A point on X-axis and $a \in R$
$\mathbf{N}$	$b\mathbf{e_2}$	A point on Y-axis and $b \in R$
k	$\frac{2}{3}$	Ratio in which P divides MN

TABLE I
VARIABLES

According to Section formula,
If $\mathbf{P}$ divides MN in the ratio k:1,then:

$$\mathbf{P} = \frac{k(\mathbf{N}) + 1(\mathbf{M})}{k+1} \tag{0.0.1}$$

$$\mathbf{P} = \frac{bk\mathbf{e_2} + a\mathbf{e_1}}{k+1} \tag{0.0.2}$$

$$\mathbf{P} = \left(\frac{a}{k+1}\right)\mathbf{e_1} + \left(\frac{bk}{k+1}\right)\mathbf{e_2} \tag{0.0.3}$$

But we have,
$\mathbf{P} = \begin{pmatrix}3\\2\end{pmatrix}$
Therefore,

$$\left(\frac{a}{k+1}\right)\mathbf{e_1} + \left(\frac{bk}{k+1}\right)\mathbf{e_2} = \begin{pmatrix}3\\2\end{pmatrix} \tag{0.0.4}$$

$$\left(\frac{a}{k+1}\right)\mathbf{e_1} + \left(\frac{bk}{k+1}\right)\mathbf{e_2} = 3\mathbf{e_1} + 2\mathbf{e_2} \tag{0.0.5}$$

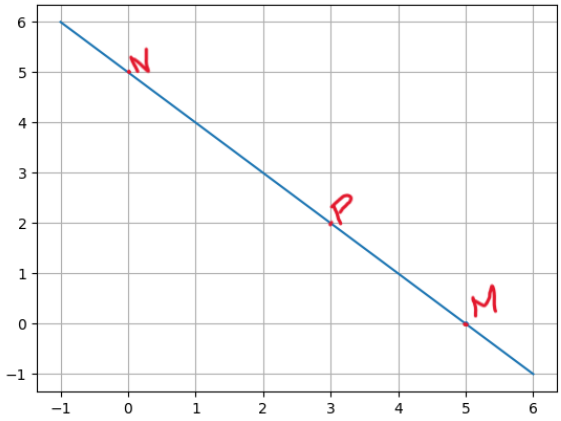

Fig. 0. graph

$$\implies \frac{a}{k+1} = 3 and \quad \frac{bk}{k+1} = 2 \tag{0.0.6}$$

$$\implies a = 3(k+1) and \quad b = \frac{2(k+1)}{k} \tag{0.0.7}$$

Substituting $k = \frac{2}{3}$, we get:
$a = 5$ and $b = 5$

1) $\mathbf{M} = 5\mathbf{e_1}$ and $\mathbf{N} = 5\mathbf{e_2}$

2)

$$Slope of MN = \frac{5-0}{0-5} \tag{0.0.8}$$

$$= -1 \tag{0.0.9}$$