“GenericError LaTeX Error: Missing
“begindocumentSee the LaTeX manual or LaTeX Companion for explanation.You’re in trouble here. Try typing ¡return¿ to proceed.Ω If that doesn’t work, type X ¡return¿ to quit.¡command¿ ¡return¿

Matgeo Presentation- problem 1.5.9

Dhanush sagar

IIT Hyderabad

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Outline

Question

We are given two points

$$A(5, -6), \quad B(-1, -4).$$

The point P divides AB in the ratio $5 : 1$. We need to find P and plot all three points with the line.

Solution

given points are A and B

$$\mathbf{A} = \begin{pmatrix} 5 \\ -6 \end{pmatrix}, \mathbf{B} = \begin{pmatrix} -1 \\ -4 \end{pmatrix}$$

Let the Y-axis divide the $\overline{\mathbf{AB}}$ at point $\mathbf{P}$ in the ratio $k : 1$. Since $\mathbf{P}$ lies on Y-axis, let intersection point P be

$$\mathbf{P} = \begin{pmatrix} 0 \\ y \end{pmatrix}$$

The point $\mathbf{A}$, $\mathbf{B}$, $\mathbf{P}$ are collinear.

$$\implies \text{rank} \begin{pmatrix} \mathbf{B} - \mathbf{A} & \mathbf{P} - \mathbf{A} \end{pmatrix} = 1 \tag{1}$$

$$\begin{pmatrix} -6 & -5 \\ 2 & y+6 \end{pmatrix} [] R_2 \to \frac{1}{3} R_1 + R_2 \begin{pmatrix} -6 & -5 \\ 0 & y + \frac{13}{3} \end{pmatrix} \tag{2}$$

Solution

The number of nonzero rows in the row reduced matrix is defined as the rank. For above matrix to be of rank 1,

$$y + \frac{13}{3} = 0 \tag{3}$$

$$y = \frac{-13}{3} \tag{4}$$

$\therefore$ The coordinates of the point of intersection are

$$\mathbf{P} = \begin{pmatrix} 0 \\ \frac{-13}{3} \end{pmatrix}$$

Substituting the values of $\mathbf{A}$, $\mathbf{B}$ and $\mathbf{P}$,

$$k = \frac{\begin{pmatrix} 5 & \frac{-5}{3} \end{pmatrix} \begin{pmatrix} 1 \\ \frac{-1}{3} \end{pmatrix}}{\left\| \begin{pmatrix} 1 \\ \frac{-1}{3} \end{pmatrix} \right\|^2} = 5 \tag{5}$$

main.c

```c
#include <stdio.h>
int main() {
    FILE *fp = fopen(points.dat, w);
    if (fp == NULL) return 1;
    fprintf(fp, 5 -6\n);
    fprintf(fp, -1 -4\n);
    fprintf(fp, 0 -4.3333\n);
    fclose(fp);
    return 0;
}
```

write_points.c

```c
#include <stdio.h>
int main() {
    FILE *fp = fopen(points.dat, w);
    if (fp == NULL) return 1;
    fprintf(fp, 5 -6\n);
    fprintf(fp, -1 -4\n);
    fprintf(fp, 0 -13/3\n);
    fclose(fp);
    return 0;
}
```

plot_points.py

```
import numpy as np
import matplotlib.pyplot as plt

# Load points from file
data = np.loadtxt('points.dat')

x, y = data[:,0], data[:,1]

plt.plot(x, y, 'bo--', label='Line through A, P, B')
plt.scatter(5,-6,color='red',label='A(5,-6)')
plt.scatter(-1,-4,color='green',label='B(-1,-4)')
plt.scatter(0,-13/3,color='purple',label='P(0,-13/3)')

plt.axvline(0, color='gray', linestyle='--')
plt.xlabel('X-axis')
plt.ylabel('Y-axis')
plt.title('Points and Line Division (Ratio 5:1)')
plt.legend()
plt.grid(True)
plt.show()
```

points.dat

```
5 -6
-1 -4
0 -4.3333
```

Points Table

Point	x	y
A	5	-6
B	-1	-4
P	0	$-\frac{13}{3}$

Graphical Output

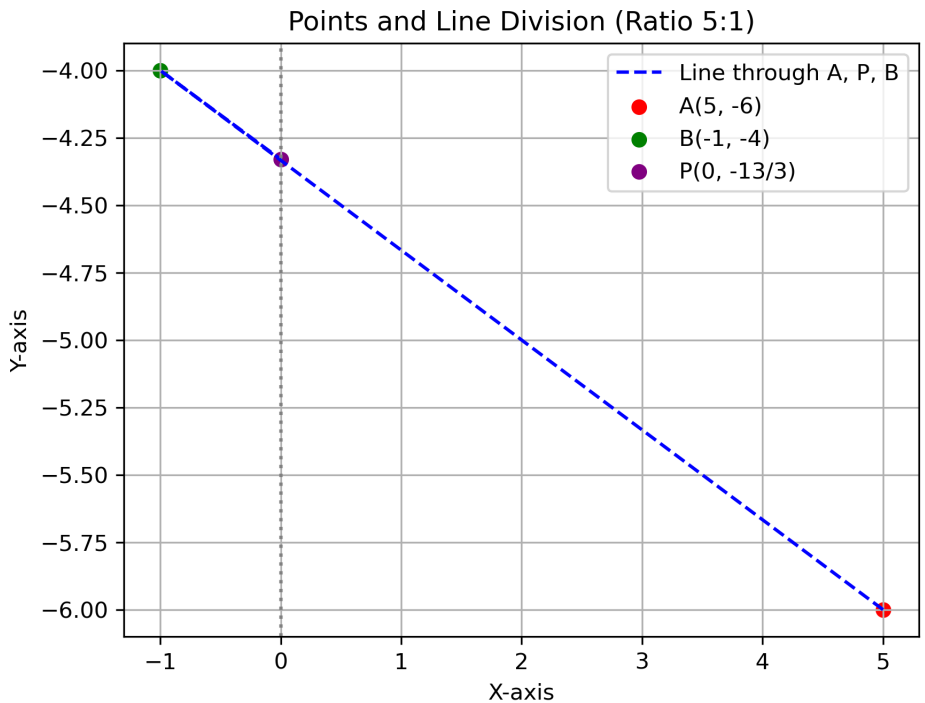

Figure:

Conclusion

The point $P(0, -\frac{13}{3})$ divides the line segment AB in the ratio $5 : 1$.