

1.5.33

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Question

Find the ratio in which the Y-axis divides the line segment joining the points $A(5, -6)$ and $B(-1, -4)$. Also find the coordinates of the point of intersection.

Let the Y-axis divide the line segment **AB** at point **P** in the ratio $k : 1$.
Since **P** lies on Y-axis, let

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

The point **A**, **B**, **P** are collinear.

$$\implies \text{rank}(\mathbf{B} - \mathbf{A}, \mathbf{P} - \mathbf{A}) = 1 \quad (1)$$

Theoretical Solution

$$\Rightarrow \begin{vmatrix} \mathbf{B} - \mathbf{A} & \mathbf{P} - \mathbf{A} \end{vmatrix} = 0 \quad (2)$$

$$\begin{vmatrix} -6 & -5 \\ 2 & y + 6 \end{vmatrix} = 0 \quad (3)$$

$$-6 \times (y + 6) - (-5) \times 2 = 0 \quad (4)$$

$$-36 - 6y + 10 = 0 \quad (5)$$

$$y = \frac{-13}{3} \quad (6)$$

∴ The coordinates of the point of intersection are

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

The section formula is

$$\mathbf{P} \equiv \begin{pmatrix} x \\ y \end{pmatrix} = \frac{k\mathbf{B} + \mathbf{A}}{k + 1} \quad (7)$$

Theoretical Solution

Here, substituting the values,

$$\begin{pmatrix} 0 \\ \frac{-13}{3} \end{pmatrix} = \frac{1}{k+1} \left(\begin{pmatrix} 5 \\ -6 \end{pmatrix} + k \begin{pmatrix} -1 \\ -4 \end{pmatrix} \right) \quad (8)$$

$$\begin{pmatrix} 0 \\ \frac{-13}{3} \end{pmatrix} = \frac{1}{k+1} \begin{pmatrix} 5-k \\ -6-4k \end{pmatrix} \quad (9)$$

$$(10)$$

$$0 = \frac{5-k}{k+1} \quad (11)$$

$$5-k=0 \quad (12)$$

$$\implies k=5 \quad (13)$$

Thus, the ratio in which the point **P** divides the line segment **AB** is **5:1**.

```
#include <stdio.h>
#include <math.h>
void function(double *P, double *B, double *A , int m, int k) {
    for ( int i = 0 ; i < m ; i++ ) {
        P[i] = (1*A[i] + k*B[i])/(k+1) ;
    }
}
```

```
import sys
import math
import numpy as np
import matplotlib.pyplot as plt
import ctypes

section_formula = ctypes.CDLL('/home/puniaditya/GitHub/ee1030
-2025/ee25btech11046/matgeo/1.5.33/codes/section_formula.so')
```

```
section_formula.argtypes = [  
    ctypes.POINTER(ctypes.c_double),  
    ctypes.POINTER(ctypes.c_double),  
    ctypes.POINTER(ctypes.c_double),  
    ctypes.c_int,  
    ctypes.c_int,  
]  
section_formula.restype = None # void function  
  
m = 2  
k = 5  
  
A = np.array([[5, -6]], dtype=np.float64)  
B = np.array([[-1, -4]], dtype=np.float64)  
P = np.zeros(m, dtype=np.float64)
```



```
section_formula.function(  
    P.ctypes.data_as(ctypes.POINTER(ctypes.c_double)),  
    B.ctypes.data_as(ctypes.POINTER(ctypes.c_double)),  
    A.ctypes.data_as(ctypes.POINTER(ctypes.c_double)),  
    m, #len(P) alternate  
    k  
)  
  
A = np.array([5, -6]).reshape(-1,1)  
B = np.array([-1, -4]).reshape(-1,1)  
P = P.reshape(-1,1)
```

```
plt.plot([A[0,0], B[0,0]], [A[1,0], B[1,0]], 'g--', label="Line  
Segment AB")  
  
plot_coords = np.block([[A, B, P]])  
plt.scatter(plot_coords[0,:], plot_coords[1,:], color='blue')  
  
vert_labels = [  
    f'A({A[0,0]}, {A[1,0]})',  
    f'B({B[0,0]}, {B[1,0]})',  
    f'P({P[0,0]}, {P[1,0]:.2f})'  
]
```

```
for i, txt in enumerate(vert_labels):
    plt.annotate(txt,
                  (plot_coords[0,i],plot_coords[1,i]),
                  textcoords="offset points",
                  xytext=(0,10),
                  ha='center')

plt.xlabel('$x$')
plt.ylabel('$y$')
plt.title("Line Segment AB Divided by Y-axis")
plt.legend(loc='best')
plt.grid()
plt.axis('equal')

plt.savefig("../figs/plot_c.jpg")
plt.show()
```

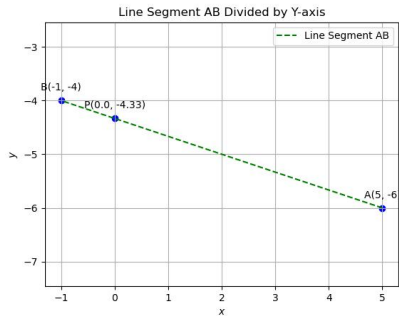


Figure: Plot of Intersection of AB by Y-axis