1.4.21

EE25BTECH11006 - ADUDOTLA SRIVIDYA

August 28,2025

Question

Find the coordinates of the point which divides the line segment joining $\mathbf{A}(2, 3)$ and $\mathbf{B}(6, -3)$ in the ratio $2 : 3$ **internally and externally**.

Formula

The section formula for a point **P** dividing **A** and **B** in the ratio $m : n$ is:

$$\mathbf{P} = \frac{m\mathbf{B} + n\mathbf{A}}{m + n} \quad \text{(Internal Division)} \tag{1}$$

$$\mathbf{P} = \frac{m\mathbf{B} - n\mathbf{A}}{m - n} \quad \text{(External Division)} \tag{2}$$

Internal Division

Here, $m = 2$, $n = 3$, $\mathbf{A} = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$, $\mathbf{B} = \begin{bmatrix} 6 \\ -3 \end{bmatrix}$.

$$\mathbf{P}_{int} = \frac{2\begin{bmatrix} 6 \\ -3 \end{bmatrix} + 3\begin{bmatrix} 2 \\ 3 \end{bmatrix}}{2+3} \tag{3}$$

$$= \frac{1}{5}\begin{bmatrix} 12+6 \\ -6+9 \end{bmatrix} = \frac{1}{5}\begin{bmatrix} 18 \\ 3 \end{bmatrix} \tag{4}$$

$$= \begin{bmatrix} \frac{18}{5} \\ \frac{3}{5} \end{bmatrix} = (3.6, 0.6) \tag{5}$$

External Division

$$\mathbf{P}_{ext} = \frac{2\begin{bmatrix}6\\-3\end{bmatrix} - 3\begin{bmatrix}2\\3\end{bmatrix}}{2-3} \tag{6}$$

$$= \frac{1}{-1}\begin{bmatrix}12-6\\-6-9\end{bmatrix} \tag{7}$$

$$= \begin{bmatrix}-6\\15\end{bmatrix} \tag{8}$$

So the external division point is $(-6, 15)$.

Final Answer

- Internal Division Point: $(3.6, 0.6)$
- External Division Point: $(-6, 15)$

Section Formula Code (C)

C Program

```c
#include <stdio.h>
void section_formula(float *P, float *A, float *B, int m, int n,
    int k){
    for (int i = 0; i < k ; i++) {
        P[i] = (m*B[i]+n*A[i])/(m+n);
    }
}
```

Python Code: Import and Setup

Part 1

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

# Load C library
c_lib = ctypes.CDLL('./formula.so')

c_lib.section_formula.argtypes = [
    ctypes.POINTER(ctypes.c_float),
    ctypes.POINTER(ctypes.c_float),
    ctypes.POINTER(ctypes.c_float),
    ctypes.c_int,
    ctypes.c_int,
    ctypes.c_int
]
c_lib.section_formula.restype = None
```

Python Code: Define Points

Part 2

```
k = 3 # 3D points

A = np.array([1, -2, 3], dtype=np.float32)
B = np.array([3, 4, -5], dtype=np.float32)

P = np.zeros(k, dtype=np.float32)
Q = np.zeros(k, dtype=np.float32)

# Internal (2:3)
m, n = 2, 3
c_lib.section_formula(
    P.ctypes.data_as(ctypes.POINTER(ctypes.c_float)),
    A.ctypes.data_as(ctypes.POINTER(ctypes.c_float)),
    B.ctypes.data_as(ctypes.POINTER(ctypes.c_float)),
    m, n, k
)
```

Python Code: External Division

Part 3

```
# External (2:3)
m, n = 2, -3 # equivalent to formula
c_lib.section_formula(
    Q.ctypes.data_as(ctypes.POINTER(ctypes.c_float)),
    A.ctypes.data_as(ctypes.POINTER(ctypes.c_float)),
    B.ctypes.data_as(ctypes.POINTER(ctypes.c_float)),
    m, n, k
)
```

Python Code: Plotting

Part 4

```
# Plot in XY-plane projection
plt.plot([A[0], B[0]], [A[1], B[1]], label='Line AB')

all_points = np.vstack([A, B, P, Q])
labels = ['A', 'B', 'P', 'Q']

plt.scatter(all_points[:, 0], all_points[:, 1], color='red')
for i, txt in enumerate(labels):
    plt.annotate(f'{txt}\n({all_points[i,0]:.1f}, {all_points[i
        ,1]:.1f})',
                 (all_points[i,0], all_points[i,1]),
                 textcoords="offset points", xytext=(0,10), ha='
                     center')
```

Python Code: Finishing Plot

Part 5

```
ax = plt.gca()
ax.spines['left'].set_position('zero')
ax.spines['bottom'].set_position('zero')
ax.spines['right'].set_color('none')
ax.spines['top'].set_color('none')
plt.xlabel('$x$')
plt.ylabel('$y$')
plt.legend(loc='upper right')
plt.grid(True)
plt.axis('equal')

plt.savefig('figs/Plot_P.png')
plt.show()
```

Plot

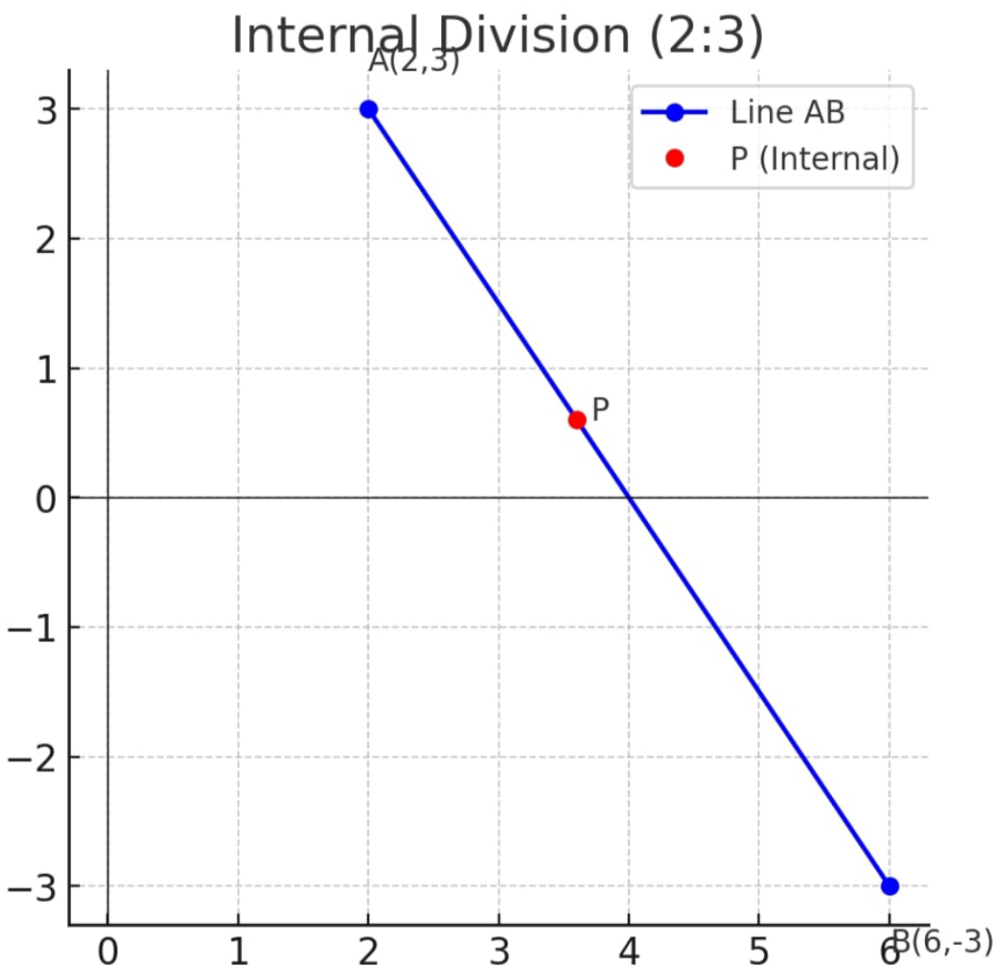

Figure: Internal division of line AB in ratio 2:3

Plot

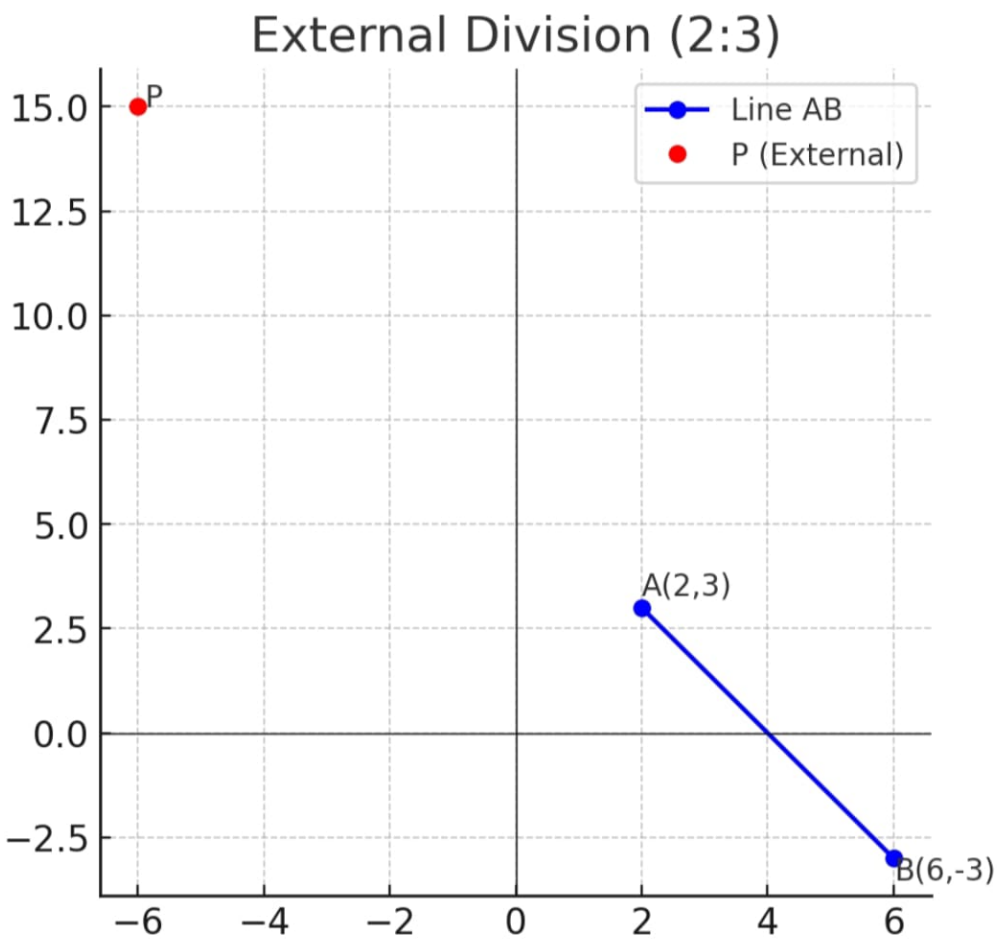

Figure: External division of line AB in ratio 2:3