

1.4.20

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Question

Find the coordinates of the point which divides the line segment joining

$$A(-2, 3, 5), \quad B(1, -4, 6)$$

in the ratio

- 1 Internally
- 2 Externally

Given Information

Given vector **A** is

$$\begin{pmatrix} -2 \\ 3 \\ 5 \end{pmatrix}$$

Given vector **B** is

$$\begin{pmatrix} 1 \\ -4 \\ 6 \end{pmatrix}$$

Required Formulae

Internal division:

$$P = \frac{mB + nA}{m + n}$$

External division:

$$Q = \frac{mB - nA}{m - n}$$

$$P = \frac{2 \begin{pmatrix} 1 \\ -4 \\ 6 \end{pmatrix} + 3 \begin{pmatrix} -2 \\ 3 \\ 5 \end{pmatrix}}{5} = \frac{\begin{pmatrix} -4 \\ 1 \\ 27 \end{pmatrix}}{5} = \begin{pmatrix} -\frac{4}{5} \\ \frac{1}{5} \\ \frac{27}{5} \end{pmatrix}$$

$$Q = \frac{2 \begin{pmatrix} 1 \\ -4 \\ 6 \end{pmatrix} - 3 \begin{pmatrix} -2 \\ 3 \\ 5 \end{pmatrix}}{-1} = \frac{\begin{pmatrix} 8 \\ -17 \\ -3 \end{pmatrix}}{-1} = \begin{pmatrix} -8 \\ 17 \\ 3 \end{pmatrix}$$

```
1 import matplotlib.pyplot as plt
2 from mpl_toolkits.mplot3d import Axes3D
3
4 A = (-2, 3, 5)
5 B = (1, -4, 6)
```

Python Code (contd.)

```
1 P = ((2*B[0] + 3*A[0]) / 5,  
2      (2*B[1] + 3*A[1]) / 5,  
3      (2*B[2] + 3*A[2]) / 5)  
4  
5 Q = ((2*B[0] - 3*A[0]) / (2-3),  
6      (2*B[1] - 3*A[1]) / (2-3),  
7      (2*B[2] - 3*A[2]) / (2-3))  
8  
9 print("Internal Division Point:", P)  
10 print("External Division Point:", Q)
```


Python Code (contd.)

```
1 fig = plt.figure(figsize=(8,8))
2 ax = fig.add_subplot(111, projection='3d')
3
4 ax.plot([A[0], B[0]],
5         [A[1], B[1]],
6         [A[2], B[2]], color='blue')
7
8 def plot_point(pt, label, color):
9     ax.scatter(*pt, color=color, s=60)
10    ax.text(pt[0], pt[1], pt[2],
11            f"{label}{pt}", fontsize=10)
```

Python Code (contd.)

```
1 plot_point(A, "A", "red")
2 plot_point(B, "B", "red")
3 plot_point(P, "P", "green")
4 plot_point(Q, "Q", "purple")
5
6 ax.set_xlabel('X-axis')
7 ax.set_ylabel('Y-axis')
8 ax.set_zlabel('Z-axis')
9 ax.set_title('3D Division of Line Segment')
10
11 ax.set_xlim(-10, 5)
12 ax.set_ylim(-10, 20)
13 ax.set_zlim(0, 10)
14
15 plt.savefig("Figs/graph.png")
16 plt.show()
```

Plot

