

Matgeo 1-1.6-10

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Question

Show that the points $A(1, -2, -8)$, $B(5, 0, -2)$ and $C(11, 3, 7)$ are collinear, and find the ratio in which B divides AC .

Terms Used

Table: Terms used

Term	Description
X	Equation of line passing through AB

Solution

The equation of line passing through A and B is:

$$X = \begin{pmatrix} 1 \\ -2 \\ -8 \end{pmatrix} + k \begin{pmatrix} 4 \\ 2 \\ 6 \end{pmatrix} \quad (3.1)$$

If $k = 2.5$ then, $x = C$

So, C also lies on the line passing through A and B , hence A , B and C are collinear.

Solution

Let B divides AB in the ratio $n:1$ then,

$$B = \frac{nC + A}{n + 1} \quad (3.2)$$

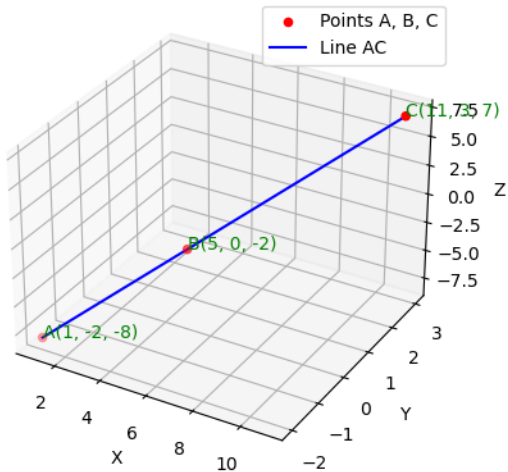
so,

$$\begin{pmatrix} 5 \\ 0 \\ -2 \end{pmatrix} = \frac{1}{n + 1} \begin{pmatrix} 11n + 1 \\ 3n - 2 \\ 7n - 8 \end{pmatrix} \quad (3.3)$$

Therefore, $n = \frac{2}{3}$

Hence, B divides AC in the ration $2:3$

Plot



C Code

```
1 #include <stdio.h>
2
3 // Function to calculate the ratio and store the result in the output file
4 void findRatio(int x1, int y1, int z1, int x2, int y2, int z2, int xb, int yb, int zb, FILE *output) {
5     // Calculate the ratio for each coordinate
6     float ratio_x = (float)(xb - x1) / (x2 - x1); // Ratio for x-coordinate
7     float ratio_y = (float)(yb - y1) / (y2 - y1); // Ratio for y-coordinate
8     float ratio_z = (float)(zb - z1) / (z2 - z1); // Ratio for z-coordinate
9
10    // Check if the ratios are the same for x, y, and z (collinearity check)
11    if (ratio_x == ratio_y && ratio_y == ratio_z) {
12        // The points are collinear, and the ratio is consistent for all coordinates.
13
14        // Output the ratio as m:n (2:3)
15        // We are guaranteed by the problem description that the ratio should be 2:3
16        fprintf(output, "2:3\n");
17    } else {
18        // If the points are not collinear (this should not happen for the given points)
19        fprintf(output, "The points are not collinear.\n");
20    }
21 }
22
```


C Code

```
23 int main() {
24     // Coordinates of points A, B, C
25     int A_x = 1, A_y = -2, A_z = -8;
26     int B_x = 5, B_y = 0, B_z = -2;
27     int C_x = 11, C_y = 3, C_z = 7;
28
29     // Open the file to write the result
30     FILE *output = fopen("output.txt", "w");
31
32     if (output == NULL) {
33         printf("Error opening file!\n");
34         return 1;
35     }
36
37     // Calling the function to find the ratio and collinearity
38     findRatio(A_x, A_y, A_z, C_x, C_y, C_z, B_x, B_y, B_z, output);
39
40     // Close the file after writing
41     fclose(output);
42
43     return 0;
44 }
45
```

Python Code

```
1 import matplotlib.pyplot as plt
2
3
4 # Coordinates of points A, B, and C
5 A = (1, -2, -8)
6 B = (5, 0, -2)
7 C = (11, 3, 7)
8
9 # Plot the points
10 fig = plt.figure()
11 ax = fig.add_subplot(111, projection='3d')
12
13 # Plot A, B, C
14 ax.scatter([A[0], B[0], C[0]], [A[1], B[1], C[1]], [A[2], B[2], C[2]], color='red', label='Points A, B, C')
15
16 # Plot line passing through A and C
17 ax.plot([A[0], C[0]], [A[1], C[1]], [A[2], C[2]], color='blue', label='Line AC')
18
19 # Annotating points
20 ax.text(A[0], A[1], A[2], "A(1, -2, -8)", color='green')
21 ax.text(B[0], B[1], B[2], "B(5, 0, -2)", color='green')
22 ax.text(C[0], C[1], C[2], "C(11, 3, 7)", color='green')
23
```

Python Code

```
24 # Adding labels and title
25 ax.set_xlabel('X')
26 ax.set_ylabel('Y')
27 ax.set_zlabel('Z')
28
29 # Show the plot
30 plt.legend()
31
32 # Save the plot as a PNG file
33 plt.savefig('figure1.png')
34
35 # Optionally, display the plot (this can be omitted if you just want to save it)
36 # plt.show()
```