1-1.5-19

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Problem Statement

Question:
Find the ratio in which the segment joining the points $(1, 3)$ and $(4, 5)$ is divided by the X axis. Also find the coordinates of this point on the X axis.

Solution

Using the section formula, the coordinates of the point dividing the line segment are given by

$$\begin{pmatrix} x \\ 0 \end{pmatrix} = \frac{\begin{pmatrix} 1 \\ 3 \end{pmatrix} + k \begin{pmatrix} 4 \\ 5 \end{pmatrix}}{1 + k} \tag{1}$$

Solution (Continued)

Solving for x, we first get

$$\frac{5k+3}{k+1} = 0 \tag{2}$$

Solution (Continued)

Solving for k, we get

$$k = \frac{-3}{5} \tag{3}$$

Solution (Continued)

Now substituting the value of k in the equation for x, we get

$$x = \frac{1}{k+1} + \frac{4k}{k+1} \tag{4}$$

Solution (Continued)

Simplifying the expression for x, we get

$$x = \frac{1 + 4\left(\frac{-3}{5}\right)}{\left(\frac{-3}{5}\right) + 1} \tag{5}$$

Solution (Final Result)

Finally, we obtain

$$x = \frac{-7}{2} \tag{6}$$

Therefore, the ratio in which the line segment joining the points $(1, 3)$ and $(4, 5)$ is divided by the X axis is $-3 : 5$. The point on the X axis which divides the line segment in the ratio is $\left(\frac{-7}{2}, 0\right)$.

Plot of Points and Line

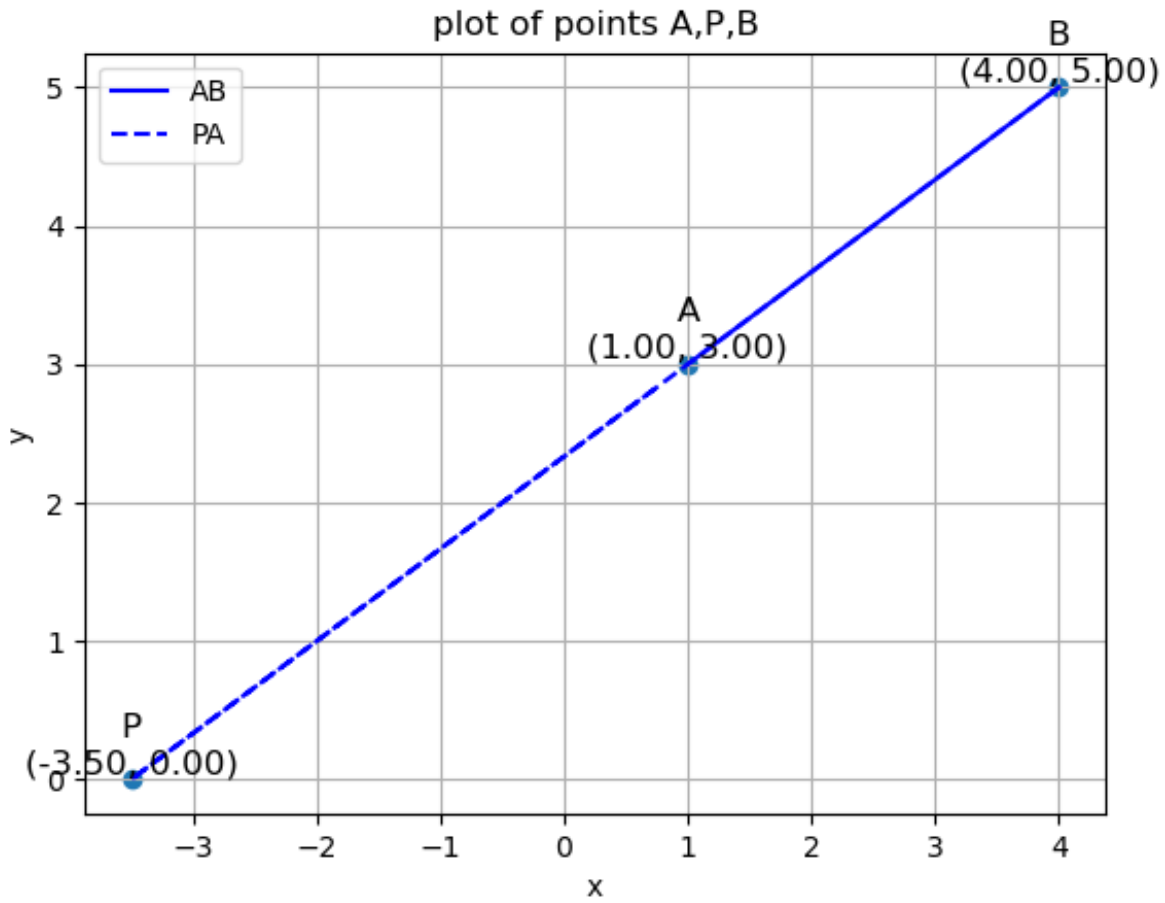

Figure: Plot of points A, B, and P, and the line joining them.

C Code (Part 1)

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <math.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <unistd.h>
#include "libs/matfun.h"
#include "libs/geofun.h"

void points(FILE *fptr, double **a, double **b, int num_points) {
    for (int i = 0; i <= num_points; i++) {
        double temp = (double)i/(double)num_points;
        double **output = Matadd(Matscale(a,2,1,1-temp),Matscale(b
            ,2,1,temp),2,1);
        printf("%lf,%lf\n",output[0][0],output[1][0]);
        fprintf(fptr, "%lf %lf\n", output[0][0], output[1][0]);
```

C Code (Part 2)

```
int main() {
    double x1,y1,x2,y2,x3,y3;
    x1 = 1;
    y1 = 3;
    x2 = 4;
    y2 = 5;
    x3 = -3.5;
    y3 = 0;
    int m = 2, n = 1;
    double **A = createMat(m,n);
    double **B = createMat(m,n);
    double **P = createMat(m,n);
    A[0][0] = x1;
    A[1][0] = y1;
    B[0][0] = x2;
    B[1][0] = y2;
    P[0][0] = x3;
```

```
    points(fptr, A,B ,20);
    points(fptr,P,A,20);
    fclose(fptr);
    return 0;
}
```

Python Code (Part 1)

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

# Load the points from the text file
points = np.loadtxt("points.txt", delimiter=',', max_rows=len(list(open(
    "./points.txt")))-1)
```

Python Code (Part 2)

```
# Extract the x and y coordinates
x1 = points[:21, 0]
y1 = points[:21, 1]
x2 = points[20:, 0]
y2 = points[20:, 1]
A = np.array([1, 3]).reshape(-1,1)
P = np.array([-3.5, 0]).reshape(-1,1)
B = np.array([4, 5]).reshape(-1,1)

plt.figure()
plt.plot(x1, y1, label='AB', linestyle='-', color='blue')
plt.plot(x2, y2, label='PA', linestyle='--',color='blue')
```

Python Code (Part 3)

```
tri_coords = np.block([A,P,B])
plt.scatter(tri_coords[0,:], tri_coords[1, :])
vert_labels = ['A','P','B'];
for i, txt in enumerate(vert_labels):
    # Annotate each point with its label and coordinates
    plt.text(tri_coords[0, i], tri_coords[1, i], f'{txt}\n({tri_coords[0,-i]:.2f},-
        {tri_coords[1,-i]:.2f})',
    fontsize=12, color = 'black', ha='center', va='bottom')
plt.xlabel("x")
plt.ylabel("y")
plt.title("plot-of-points-A,P,B")
plt.grid(True)
plt.legend()
plt.show()
```