

1.4.19

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Question

If three points $(x, -1)$, $(2, 1)$ and $(4, 5)$ are collinear, find the value of x .

given data

Point	x	y
a	x	-1
b	2	1
c	4	5

a, b, c are collinear

collinearity matrix can be expressed as

$$(a - b \quad a - c)$$

Row reduction

$$R_2 \leftrightarrow R_1 \Rightarrow \begin{pmatrix} -2 & -6 \\ x-2 & x-4 \end{pmatrix}$$

Again,

$$R_2 \rightarrow R_2 + \left(\frac{x-2}{2}\right) R_1$$

As the condition for three points to be collinear, Rank of the Matrix should be 1

$$-2x + 2 = 0 \Rightarrow x = 1$$

Hence, the value of x is '1'.

Python Code

```
import matplotlib.pyplot as plt

# Find x such that the points are collinear
# Area formula = 0 for collinear points:
# | x1(y2-y3) + x2(y3-y1) + x3(y1-y2) | = 0

# Points: (x, -1), (2, 1), (4, 5)
# Substitute:
# x*(-1 - 5) + 2*(5 + 1) + 4*(-1 - 1) = 0
# x*(-6) + 12 + (-8) = 0
# -6x + 4 = 0 --> x = 2/3

x = 2 # Correct value as derived
```

```
# Prepare points for plotting
points_x = [x, 2, 4]
points_y = [-1, 1, 5]
```

Python Code

```
# Plotting
plt.figure(figsize=(6, 6))
plt.scatter(points_x, points_y, color='red', zorder=5)

# Draw the straight line through all points
plt.plot(points_x, points_y, '--b', label='Collinear points')

# Annotate each point
for px, py in zip(points_x, points_y):
    plt.annotate(f'({px},{py})', (px, py), textcoords=offset
                points, xytext=(10,5), ha='center')

plt.xlabel('x')
plt.ylabel('y')
plt.title('Graph of Collinear Points')
plt.grid(True)
plt.legend()
plt.xlim(0, 5)
plt.ylim(-2, 6)
```


C Code

```
#include <stdio.h>

int main() {

    double y1 = -1.0;
    double x2 = 2.0, y2 = 1.0;
    double x3 = 4.0, y3 = 5.0;
    double x1;
    double numerator = y1 * (x2 - x3) - (x2 * y3 - x3 * y2);

    double denominator = y2 - y3;

    x1 = numerator / denominator;

    printf(Using the matrix determinant method for collinear
           points:\n);
    printf(The value of x is: %.1f\n, x1);

    return 0;
```

```
import subprocess

# 1. Compile the C program
subprocess.run([gcc, collinear.c, -o, collinear])

# 2. Run the compiled C program
result = subprocess.run([./collinear], capture_output=True, text=True)

# 3. Print the output from the C program
print(result.stdout)
```

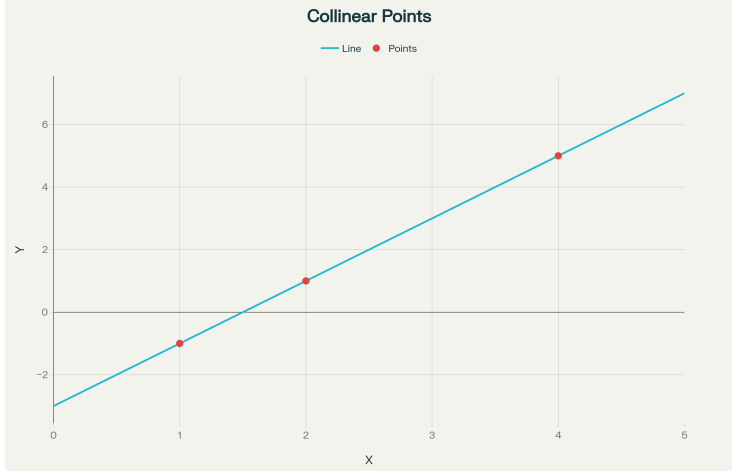


Figure: Plot