4.3.14

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Question

A line intersects the Y axis and X axis at the points **P** and **Q**, respectively. If $(2, 5)$ is the mid-point of PQ, then the coordinates of **P** and **Q** are

Equation

Let,

$$\mathbf{P} = \begin{pmatrix} 0 \\ a \end{pmatrix} \quad \textit{and} \quad \mathbf{Q} = \begin{pmatrix} b \\ 0 \end{pmatrix} \tag{1}$$

Theoretical Solution

Let

$$\mathbf{C} = \begin{pmatrix} 2 \\ 5 \end{pmatrix} \tag{2}$$

Given that $\mathbf{C}$ is the midpoint of $\mathbf{P}$ and $\mathbf{Q}$. So,

$$\mathbf{C} = \frac{\mathbf{P} + \mathbf{Q}}{2} \tag{3}$$

Now,

$$\begin{pmatrix} 2 \\ 5 \end{pmatrix} = \frac{\begin{pmatrix} 0 \\ a \end{pmatrix} + \begin{pmatrix} b \\ 0 \end{pmatrix}}{2} \tag{4}$$

Theoretical solution

$$\begin{pmatrix} 2 \\ 5 \end{pmatrix} = \begin{pmatrix} \frac{b}{2} \\ \frac{a}{2} \end{pmatrix} \tag{5}$$

$$a = 10 \quad and \quad b = 4 \tag{6}$$

Subtituting the value of a and b in Eq.1, we get:

$$\mathbf{P} = \begin{pmatrix} 0 \\ 10 \end{pmatrix} \quad and \quad \mathbf{Q} = \begin{pmatrix} 4 \\ 0 \end{pmatrix} \tag{7}$$

C Code

```c
#include <stdio.h>

// Function to fill coordinates of P and Q
void get_points(int *Px, int *Py, int *Qx, int *Qy) {
    int mx = 2, my = 5; // midpoint given

    *Px = 0;
    *Py = 2 * my; // y1 = 10
    *Qx = 2 * mx; // x1 = 4
    *Qy = 0;
}
```

Python Code

```
import ctypes
import matplotlib.pyplot as plt

# Load compiled C library
lib = ctypes.CDLL(./midpoint.so)

# Define return type and argument types
lib.get_points.argtypes = [ctypes.POINTER(ctypes.c_int), ctypes.
    POINTER(ctypes.c_int),
                           ctypes.POINTER(ctypes.c_int), ctypes.
                               POINTER(ctypes.c_int)]

# Prepare variables
Px, Py, Qx, Qy = ctypes.c_int(), ctypes.c_int(), ctypes.c_int(),
    ctypes.c_int()
```

Python Code

```
# Call C function
lib.get_points(ctypes.byref(Px), ctypes.byref(Py), ctypes.byref(
    Qx), ctypes.byref(Qy))

# Extract results
P = (Px.value, Py.value)
Q = (Qx.value, Qy.value)
M = (2, 5) # midpoint given

# --- Plotting ---
plt.plot([P[0], Q[0]], [P[1], Q[1]], 'b-', label=Line PQ)

# Plot P, Q, M
plt.scatter(*P, color=red, s=100, label=fP{P})
plt.scatter(*Q, color=green, s=100, label=fQ{Q})
plt.scatter(*M, color=purple, s=150, marker=*, label=fM{M})
```

Python Code

```
# Annotate
plt.text(P[0]+0.2, P[1], fP{P}, fontsize=10)
plt.text(Q[0]+0.2, Q[1], fQ{Q}, fontsize=10)
plt.text(M[0]+0.2, M[1], fM{M}, fontsize=10, color=purple)

# Axes
plt.axhline(0, color='black')
plt.axvline(0, color='black')

plt.title(Figure)
plt.xlabel(X-axis)
plt.ylabel(Y-axis)
plt.legend()
plt.grid(True)
plt.savefig(/media/indhiresh-s/New Volume/Matrix/ee1030-2025/
    ee25btech11027/MATGEO/4.3.14/figs/figure1.png)
plt.show()
```

Plot

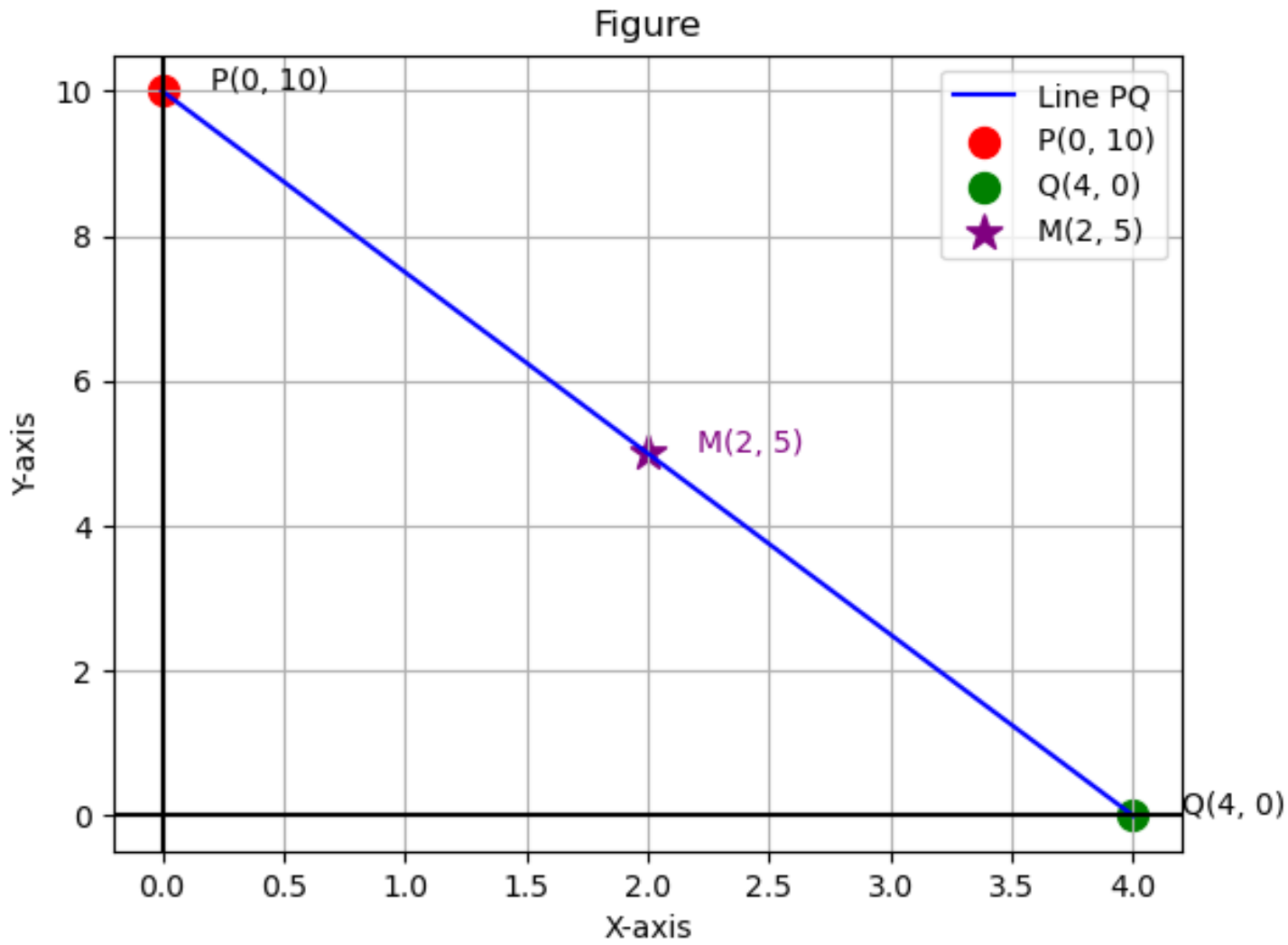
Figure
P(0, 10)
M(2, 5)
Q(4, 0)
Line PQ
P(0, 10)
Q(4, 0)
M(2, 5)
Y-axis
X-axis
10
8
6
4
2
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0