1.5.16

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Question

Find the coordinates of a point A where AB is a diameter of the circle with center $(3, -1)$ and the point B is $(2, 6)$.

given data

let C be the center of circle

Point	vector
B	$\begin{pmatrix} 2 \\ 6 \end{pmatrix}$
C	$\begin{pmatrix} 3 \\ -1 \end{pmatrix}$

Formula

Midpoint formula : If C is the Midpoint of AB . where A and B are the end points of diameter

Point	x	y
B	2	6
C	3	-1

Circle center is the **midpoint** of diameter AB. So, midpoint formula:

$$\left(\frac{x_A + x_B}{2}, \frac{y_A + y_B}{2}\right) = (3, -1)$$

Solve for x_A:

$$\frac{x_A + 2}{2} = 3 \quad \Rightarrow \quad x_A + 2 = 6 \quad \Rightarrow \quad x_A = 6 - 2 = 4$$

Solve for y_A:

$$\frac{y_A + 6}{2} = -1 \quad \Rightarrow \quad y_A + 6 = -2 \quad \Rightarrow \quad y_A = -2 - 6 = -8$$

Hence,

$$A = (4, -8)$$

Midpoint of $A(4,-8)$ and $B(2,6)$ is

$$\left(\frac{4+2}{2}, \frac{-8+6}{2}\right) = (3,-1)$$

Python Code

```
 # Plotting points A(1, -2, -8), B(5, 0, -2), and C(11, 3, 7)

import numpy as np
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D

# Define the points as numpy arrays
A = np.array([1, -2, -8])
B = np.array([5, 0, -2])
C = np.array([11, 3, 7])
```

Python Code

```
 # Create a 3D plot
fig = plt.figure(figsize=(8, 6))
ax = fig.add_subplot(111, projection='3d')

# Plot the points
ax.scatter(*A, color='red', s=100, label='A(1, -2, -8)')
ax.scatter(*B, color='green', s=100, label='B(5, 0, -2)')
ax.scatter(*C, color='blue', s=100, label='C(11, 3, 7)')
```

Python Code

```
 # Plot line AC
ax.plot([A[0], C[0]], [A[1], C[1]], [A[2], C[2]], color='purple',
     label='Line AC')

# Annotate points
ax.text(*A, ' A', color='red', fontsize=10)
ax.text(*B, ' B', color='green', fontsize=10)
ax.text(*C, ' C', color='blue', fontsize=10)
```

Python Code

```
 # Set axes labels
ax.set_xlabel('X-axis')
ax.set_ylabel('Y-axis')
ax.set_zlabel('Z-axis')
ax.set_title('3D Plot of Points A, B, C and Line AC')
ax.legend()
ax.grid(True)

# Show the plot
plt.show()
```

C Code

```c
#include <stdio.h>

int main() {
    // Given values
    int xB = 2, yB = 6;
    int xC = 3, yC = -1; // Center of the circle

    // Calculate coordinates of A using midpoint formula
    int xA = 2 * xC - xB;
    int yA = 2 * yC - yB;

    // Print result
    printf("Coordinates of point A are: (%d, %d)\n", xA, yA);

    // Verify midpoint
    float midX = (xA + xB) / 2.0;
    float midY = (yA + yB) / 2.0;
    printf("Midpoint of A and B is: (%.1f, %.1f)\n", midX, midY);
```

Python and C Code

```
 import subprocess

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

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

# Print the output from the C program (solution steps for k=2/3)
print(result.stdout)
```

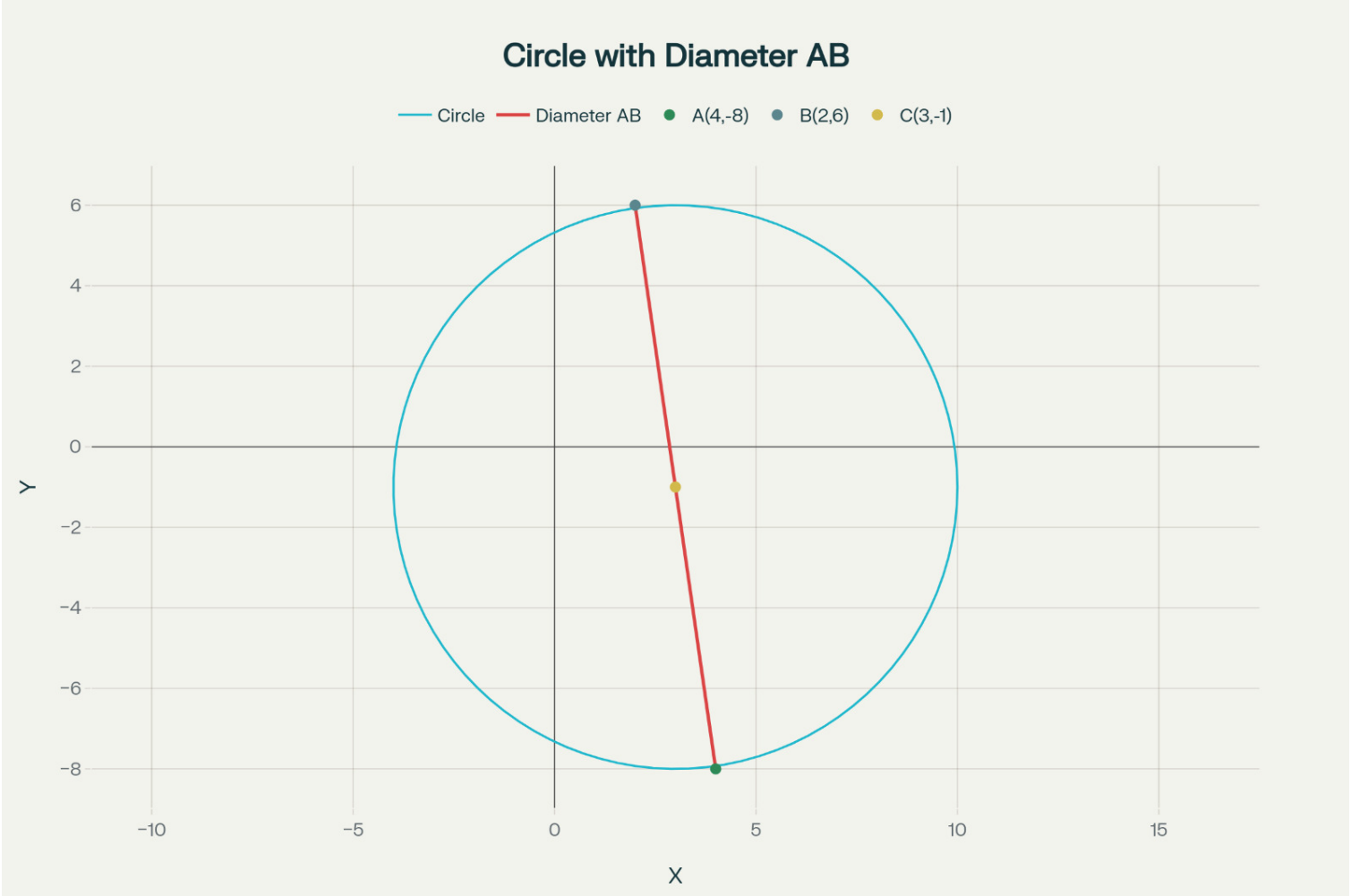
Circle with Diameter AB
Circle
Diameter AB
A(4,-8)
B(2,6)
C(3,-1)
6
4
2
0
−2
−4
−6
−8
Y
−10
−5
0
5
10
15
X

Figure: Plot