

1.9.1

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Question

The distance between the points $(m, -n)$ and $(-m, n)$ is _____

given data

let **A** and **B** be the vectors such that:

Variable	value
A	$\begin{pmatrix} m \\ -n \end{pmatrix}$
B	$\begin{pmatrix} -m \\ n \end{pmatrix}$

Table: Variables used

Norm of $\mathbf{A} - \mathbf{B}$ is given by:

$$\|\mathbf{A} - \mathbf{B}\| = \sqrt{\|\mathbf{A}\|^2 + \|\mathbf{B}\|^2 - 2\mathbf{A}^\top \mathbf{B}}$$

finding distance between **A** and **B**

$$\begin{aligned}\|\mathbf{A} - \mathbf{B}\| &= \sqrt{\|\mathbf{A}\|^2 + \|\mathbf{B}\|^2 - 2\mathbf{A}^\top \mathbf{B}} \\ &= \sqrt{(m^2 + n^2) - 2(-m^2 - n^2) + m^2 + n^2} \\ &= \sqrt{4(m^2 + n^2)} \\ &= 2\sqrt{m^2 + n^2}\end{aligned}$$

Hence Distance between **A** and **B** is $2\sqrt{m^2 + n^2}$.

Python Code

```
1 import matplotlib.pyplot as plt
2 import numpy as np
3
4 # Define m and n
5 m = 3
6 n = 4
7
8 # Define the points A and B
9 A = np.array([m, -n])
10 B = np.array([-m, n])
```

```
# Calculate the distance between A and B
distance = 2 * np.sqrt(m**2 + n**2)
print(f"Distance between A{tuple(A)} and B{tuple(B)} is: {
    distance}")

# Create the plot
fig, ax = plt.subplots(figsize=(8, 6))
```

Python Code

```
# Plot points A and B
ax.scatter(A[0], A[1], color='red', s=100, label=f'A = {tuple(A)}')
ax.scatter(B[0], B[1], color='blue', s=100, label=f'B = {tuple(B)}')

# Draw line segment between A and B
ax.plot([A[0], B[0]], [A[1], B[1]], 'k--', alpha=0.6, label='Line Segment AB')

# Plot origin for reference
ax.scatter(0, 0, color='black', s=80, label='Origin (0,0)')
```



```
# Add labels for points
ax.text(A[0] + 0.2, A[1], 'A', fontsize=14)
ax.text(B[0] + 0.2, B[1], 'B', fontsize=14)
ax.text(0.2, 0.2, 'O', fontsize=14)
```

```
# Set plot limits with some margin  
margin = max(abs(m), abs(n)) + 1  
ax.set_xlim(-margin, margin)  
ax.set_ylim(-margin, margin)
```

```
# Add grid, title, labels, legend
ax.grid(True, linestyle='--', alpha=0.5)
ax.set_title('Distance Between Points A and B', fontsize=16)
ax.set_xlabel('X-axis', fontsize=12)
ax.set_ylabel('Y-axis', fontsize=12)
ax.legend()

# Equal aspect ratio
ax.set_aspect('equal', adjustable='box')

plt.show()
```

C Code

```
#include <stdio.h>
#include <math.h>

int main() {
    double m, n, distance;

    // Input values for m and n
    printf("Enter the value of m: ");
    scanf("%lf", &m);

    printf("Enter the value of n: ");
    scanf("%lf", &n);

    // Calculate distance using the formula
    distance = 2 * sqrt(m * m + n * n);

    // Print the result
    printf("Distance between the points (%.2lf, %.2lf) and (%.2lf, %.2lf) is: %.2lf", m, n, m, n, distance);
}
```

```
import subprocess

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

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

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

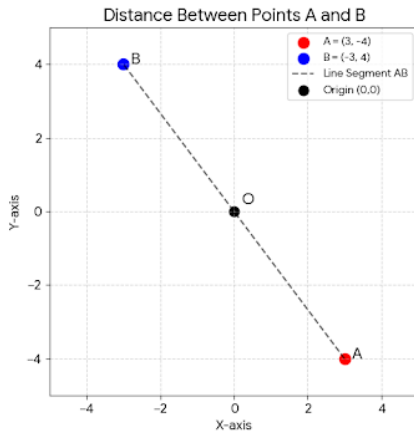


Figure: Plot