

## Problem 1.8.11

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## Question

**Question:**

AOBC is a rectangle whose three vertices are vertices  $\vec{A}(0, 3)$ ,  $\vec{O}(0, 0)$ ,  $\vec{B}(5, 0)$ . The length of diagonal is \_\_\_\_\_.

## Solution

### Solution:

From the given information,

$$\vec{A} = \begin{pmatrix} 0 \\ 3 \end{pmatrix}, \vec{O} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \vec{B} = \begin{pmatrix} 5 \\ 0 \end{pmatrix} \quad (3.1)$$

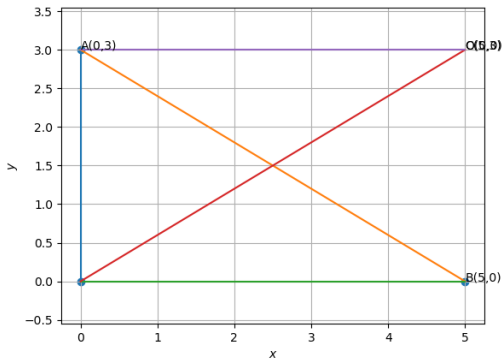
Then the direction vector of the diagonal AB is :

$$\vec{A} - \vec{B} = \begin{pmatrix} 0 \\ 3 \end{pmatrix} - \begin{pmatrix} 5 \\ 0 \end{pmatrix} = \begin{pmatrix} -5 \\ 3 \end{pmatrix}, \quad (3.2)$$

$$(3.3)$$

the length of the diagonal is :

$$(\vec{A} - \vec{B})^T (\vec{A} - \vec{B}) = 34 \Rightarrow AB = \|\vec{A} - \vec{B}\| = \sqrt{34} \quad (3.4)$$



# C Code

```
#include <stdio.h>
#include <math.h>
#include <stdlib.h>
#include "libs/matfun.h" // For createMat, freeMat

int main() {
    // Define points as column vectors
    double **A, **B;
    double dx, dy, diagonal;

    // Allocate 2x1 matrices for A and B
    A = createMat(2, 1);
    B = createMat(2, 1);

    // A = (0,3), B = (5,0)
    A[0][0] = 0; A[1][0] = 3;
    B[0][0] = 5; B[1][0] = 0;
```

## C Code

```
// Calculate diagonal length = ||A - B||
dx = A[0][0] - B[0][0];
dy = A[1][0] - B[1][0];
diagonal = sqrt(dx*dx + dy*dy);

printf("Length of diagonal AB = %.2lf\n", diagonal);

// Free matrices
freeMat(A, 2);
freeMat(B, 2);

return 0;
}
```

# Python Code for Plotting

```
import math
import sys

import numpy as np
import numpy.linalg as LA
import matplotlib.pyplot as plt
import matplotlib.image as mpimg
from line.funcs import *
#from triangle.funcs import *
#from conics.funcs import circ_gen
#if using termux
import subprocess
import shlex
#end if

A = np.array([0,3]).reshape(-1,1)
B = np.array([5,0]).reshape(-1,1)
O = np.array([0,0]).reshape(-1,1)
C = np.array([5,3]).reshape(-1,1)
```



# Python Code for Plotting

```
coords = np.block([[A,B,0]])

AO = line_gen(A,0)
AB = line_gen(A,B)
BO = line_gen(B,0)
CO = line_gen(C,0)
AC = line_gen(A,C)

plt.plot(AO[0,:],AO[1,:])
plt.plot(AB[0,:],AB[1,:])
plt.plot(BO[0,:],BO[1,:])
plt.plot(CO[0,:],CO[1,:])
plt.plot(AC[0,:],AC[1,:])
plt.scatter(coords[0,:],coords[1,:])

plt.text(A[0],A[1],"A(0,3)")
plt.text(B[0],B[1],"B(5,0)")
```

# Python Code for Plotting

```
plt.text(C[0],C[1],"C(5,3)")
plt.text(C[0],C[1],"O(0,0)")
plt.xlabel('$x$')
plt.ylabel('$y$')
plt.legend(loc='best')
plt.grid() # minor
plt.axis('equal')

plt.savefig('../figs/img.png')
```