Problem 2.10.20.

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Question

Question: Construct a right triangle in which the sides, (other than the hypotenuse) are of length 6 cm and 8 cm.

Solution

Let the two sides of the right triangle be represented as vectors:

$$\mathbf{A} = \begin{bmatrix} 6 \\ 0 \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} 0 \\ 8 \end{bmatrix}.$$

The hypotenuse vector is the sum of these two vectors:

$$\mathbf{C} = \mathbf{A} + \mathbf{B} = \begin{bmatrix} 6 \\ 0 \end{bmatrix} + \begin{bmatrix} 0 \\ 8 \end{bmatrix} = \begin{bmatrix} 6 \\ 8 \end{bmatrix}.$$

The length (magnitude) of the hypotenuse is calculated as

$$c = \|\mathbf{C}\| = \sqrt{6^2 + 8^2}$$
$$= \sqrt{36 + 64} = \sqrt{100} = 10 \text{ cm}.$$

Therefore, the sides of the right triangle are 6 cm, 8 cm, and 10 cm.
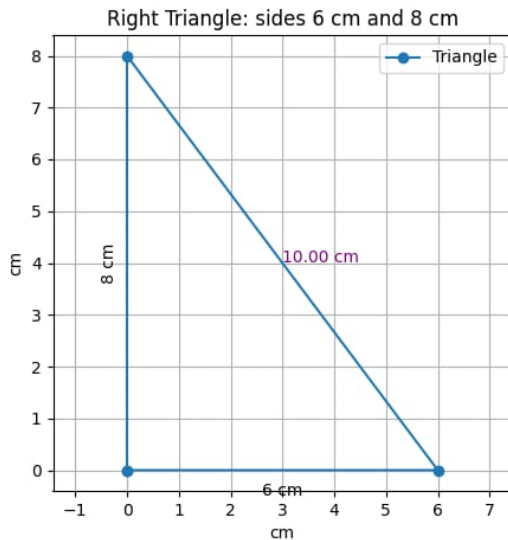
Graph

Figure: Vector Representation

C Code

```c
#include <stdio.h>
#include "trianglefun.h"

int main() {
    double side1, side2;
    printf("Enter the lengths of two sides of the right triangle: ");
    scanf("%lf %lf", &side1, &side2);

    Vector2D A = vector_create(side1, 0);
    Vector2D B = vector_create(0, side2);

    Vector2D C = vector_add(A, B);
    double hypotenuse = vector_magnitude(C);

    printf("The hypotenuse length is: %.2f\n", hypotenuse);

    return 0;
}
```

Python Code for Plotting

```python
import numpy as np
import matplotlib.pyplot as plt

a = 6
b = 8
c = (a**2 + b**2)**0.5 # Hypotenuse calculation

# Coordinates for triangle at (0,0), (a,0), (0,b)
pts = np.array([[0,0], [a,0], [0,b], [0,0]])

plt.figure(figsize=(5,5))
plt.plot(pts[:,0], pts[:,1], '-o', label='Triangle')
plt.text(a/2, -0.5, f'{a} cm', ha='center')
plt.text(-0.5, b/2, f'{b} cm', va='center', rotation=90)
plt.text(a/2, b/2, f'{c:.2f} cm', color='purple')
plt.axis('equal')
plt.grid(True)
plt.title('Right Triangle: sides 6 cm and 8 cm')
plt.xlabel('cm')
```

Python Code for Plotting

```
plt.ylabel('cm')
plt.legend()
plt.savefig('right_triangle.png')
plt.show()
```