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 perpendicular sides have lengths 6 cm and 8 cm respectively. Assume vertices:

$$\vec{A} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \quad \vec{B} = \begin{pmatrix} 6 \\ 0 \end{pmatrix}, \quad \vec{C} = \begin{pmatrix} 6\cos 90^\circ \\ 8\sin 90^\circ \end{pmatrix} = \begin{pmatrix} 0 \\ 8 \end{pmatrix}$$

This forms a right angle at vertex B.
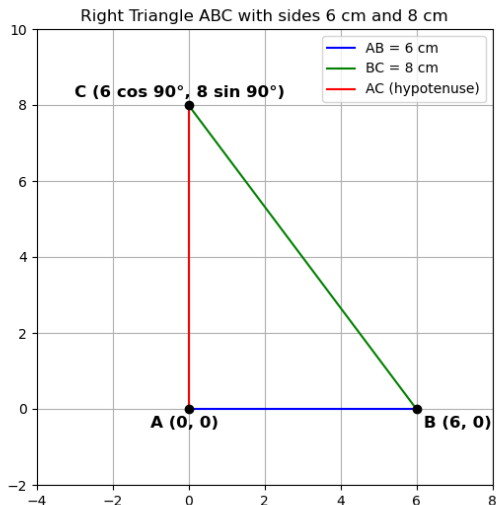
Graph

Figure: Vector Representation

C Code

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

int main() {
    Point A, B, C;

    construct_right_triangle(&A, &B, &C);

    printf("Coordinates of triangle vertices:\n");
    printf("A: (%.2f, %.2f)\n", A.x, A.y);
    printf("B: (%.2f, %.2f)\n", B.x, B.y);
    // Print symbolic expression alongside evaluated coordinate
        for C
    printf("C: (6 * cos(90) = %.2f, 8 * sin(90) = %.2f)\n", C.x,
        C.y);

    return 0;
}
```

Python Code for Plotting

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

# Define vertices A, B, C
A = np.array([0, 0])
B = np.array([6, 0])
C = np.array([6 * np.cos(np.radians(90)), 8 * np.sin(np.radians
    (90))]) # (0, 8)

# Create plot
plt.figure(figsize=(6,6))

# Draw triangle sides
plt.plot([A[0], B[0]], [A[1], B[1]], 'b-', label='AB = 6 cm')
plt.plot([B[0], C[0]], [B[1], C[1]], 'g-', label='BC = 8 cm')
plt.plot([C[0], A[0]], [C[1], A[1]], 'r-', label='AC (hypotenuse)
    ')
```

Python Code for Plotting

```python
# Mark points with labels and coordinates
plt.plot(A[0], A[1], 'ko')
plt.text(A[0]-1, A[1]-0.5, 'A (0, 0)', fontsize=12, fontweight='bold')

plt.plot(B[0], B[1], 'ko')
plt.text(B[0]+0.2, B[1]-0.5, 'B (6, 0)', fontsize=12, fontweight='bold')

plt.plot(C[0], C[1], 'ko')
plt.text(C[0]-3, C[1]+0.2, 'C (6 cos 90, 8 sin 90)', fontsize=12, fontweight='bold')

# Set axes limits and grid
plt.xlim(-4, 8)
plt.ylim(-2, 10)
plt.grid(True)
plt.gca().set_aspect('equal', adjustable='box')
```

Python Code for Plotting

```python
# Title and legend
plt.title('Right Triangle ABC with sides 6 cm and 8 cm')
plt.legend()

# Save plot as PNG file
plt.savefig('triangle_abc_with_expr_coords.png')

# Close plot
plt.close()
```