3.2.1

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Question

Draw a triangle ABC in which AB=4cm,BC=6cm and AC=9cm.

solution

According to given data lets assume,

$$\mathbf{A} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \qquad \mathbf{B} = \begin{pmatrix} 4 \\ 0 \end{pmatrix} \qquad \mathbf{C} = \begin{pmatrix} x \\ y \end{pmatrix}$$

Using cosine formulae at **B**

$$a^2 = b^2 + c^2 - 2bc\cos\mathbf{A} \tag{1}$$

(2)

solution

$$\cos \mathbf{A} = \frac{16 + 81 - 36}{72} \tag{3}$$

$$\cos \mathbf{A} = \frac{61}{72} \tag{4}$$

$$\sin \mathbf{A} = \frac{\sqrt{1463}}{72} \tag{5}$$

$$\mathbf{C} - \mathbf{A} = b \begin{pmatrix} \cos A \\ \sin A \end{pmatrix} \tag{6}$$

$$\begin{pmatrix} x \\ y \end{pmatrix} - \begin{pmatrix} 0 \\ 0 \end{pmatrix} = 9 \begin{pmatrix} \cos A \\ \sin A \end{pmatrix} \tag{7}$$

$$x = \frac{61}{8} \tag{8}$$

$$y = \frac{\sqrt{1463}}{8} \tag{9}$$

The vertices of triangle are $(0,0)$, $(4,0)$ *and* $(7.62, 4.77)$

C Code

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

int main() {
    // Given lengths
    double AB = 4.0, BC = 6.0, AC = 9.0;

    // Assign coordinates for A and B
    double Ax = 0, Ay = 0;
    double Bx = 4, By = 0;
```

C Code

```c
// Using cosine rule to find cos(A)
    double cosA = (AB*AB + AC*AC - BC*BC) / (2 * AB * AC);
     double sinA = sqrt(1 - cosA*cosA);


    // Coordinates of C
    double Cx = Ax + AC * cosA;
    double Cy = Ay + AC * sinA;

    // Print results
    printf("Coordinates of A: (%.2f, %.2f)\n", Ax, Ay);
    printf("Coordinates of B: (%.2f, %.2f)\n", Bx, By);
    printf("Coordinates of C: (%.2f, %.2f)\n", Cx, Cy);

    return 0;
}
```

Python Code

```
 import matplotlib.pyplot as plt

# Define vertices
A = (0, 0)
B = (4, 0)
C = (7.625, 4.781)

# Collect coordinates (close the triangle by repeating A at the
    end)
x_coords = [A[0], B[0], C[0], A[0]]
y_coords = [A[1], B[1], C[1], A[1]]

# Plot the triangle
plt.figure(figsize=(6,6))
plt.plot(x_coords, y_coords, 'b-', linewidth=2) # Triangle edges
plt.fill(x_coords, y_coords, 'skyblue', alpha=0.3) # Fill inside
```

Python Code

```
 # Plot vertices
plt.scatter(*A, color='red', s=60)
plt.scatter(*B, color='green', s=60)
plt.scatter(*C, color='purple', s=60)

# Label points
plt.text(A[0]-0.3, A[1]-0.3, 'A', fontsize=12, fontweight='bold')
plt.text(B[0]+0.2, B[1]-0.3, 'B', fontsize=12, fontweight='bold')
plt.text(C[0]+0.2, C[1]+0.2, 'C', fontsize=12, fontweight='bold')

# Formatting
plt.axhline(0, color='gray', linewidth=0.5)
plt.axvline(0, color='gray', linewidth=0.5)
plt.gca().set_aspect('equal', adjustable='box')
plt.title("Triangle ABC")
plt.grid(True)
plt.show()
```

C and Python Code

```
import ctypes

# Load the shared library
lib = ctypes.CDLL("./triangle.so")

# Define return/argument types
lib.compute_triangle.argtypes = [ctypes.POINTER(ctypes.c_double)]
lib.compute_triangle.restype = None
```

C and Python Code

```
# Prepare array for results (6 doubles: Ax, Ay, Bx, By, Cx, Cy)
coords = (ctypes.c_double * 6)()

# Call the C function
lib.compute_triangle(coords)

# Extract results
Ax, Ay, Bx, By, Cx, Cy = coords

print(f"Coordinates of A: ({Ax:.2f}, {Ay:.2f})")
print(f"Coordinates of B: ({Bx:.2f}, {By:.2f})")
print(f"Coordinates of C: ({Cx:.2f}, {Cy:.2f})")
```

Plot