

2.6.9

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Question

The area of a triangle with vertices $A(3,0)$, $B(7,0)$ and $C(8,4)$ is?

Theoretical Solution

Given: $A(3, 0)$, $B(7, 0)$, $C(8, 4)$.

$$\mathbf{B} - \mathbf{A} = \begin{pmatrix} 7 - 3 \\ 0 - 0 \end{pmatrix} = \begin{pmatrix} 4 \\ 0 \end{pmatrix}, \quad \mathbf{C} - \mathbf{A} = \begin{pmatrix} 8 - 3 \\ 4 - 0 \end{pmatrix} = \begin{pmatrix} 5 \\ 4 \end{pmatrix}.$$

$$\text{Area} = \frac{1}{2} ||(\mathbf{B} - \mathbf{A}) \times (\mathbf{C} - \mathbf{A})|| = \frac{1}{2} \left| \begin{pmatrix} 4 \\ 0 \end{pmatrix} \times \begin{pmatrix} 5 \\ 4 \end{pmatrix} \right| = 8$$

$\text{Area of Triangle of } ABC = 8 \text{ sq. units}$

(1)

C Code

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

double **createMat(int m, int n) {
    double **mat = (double **)malloc(m * sizeof(double *));
    if (!mat) {
        perror("Allocation failed");
        exit(EXIT_FAILURE);
    }
    for (int i = 0; i < m; i++) {
        mat[i] = (double *)malloc(n * sizeof(double));
        if (!mat[i]) {
            perror("Allocation failed");
            for (int k = 0; k < i; k++) free(mat[k]);
            free(mat);
            exit(EXIT_FAILURE);
        }
    }
}
```

C Code

```
    return mat;
}

void freeMat(double **mat, int m) {
    for (int i = 0; i < m; i++) {
        free(mat[i]);
    }
    free(mat);
}

int main() {
    int m = 3, n = 3;
    double **mat = createMat(m, n);

    mat[0][0] = 3; mat[0][1] = 0; mat[0][2] = 1;
    mat[1][0] = 7; mat[1][1] = 0; mat[1][2] = 1;
    mat[2][0] = 8; mat[2][1] = 4; mat[2][2] = 1;
```

```
double det = mat[0][0]*(mat[1][1]*mat[2][2] - mat[1][2]*mat
    [2][1])
    - mat[0][1]*(mat[1][0]*mat[2][2] - mat[1][2]*mat
    [2][0])
    + mat[0][2]*(mat[1][0]*mat[2][1] - mat[1][1]*mat
    [2][0]);

double area = 0.5 * (det >= 0 ? det : -det);

printf("Area of the triangle is: %lf\n", area);

freeMat(mat, m);
return 0;
}
```

Python Code

```
import matplotlib.pyplot as plt

A = (3, 0)
B = (7, 0)
C = (8, 4)

def triangle_area(A, B, C):
    x1, y1 = A
    x2, y2 = B
    x3, y3 = C
    return abs(x1*(y2-y3) + x2*(y3-y1) + x3*(y1-y2)) / 2.0

area = triangle_area(A, B, C)
print(f"Area of triangle ABC: {area:.2f}")
```

Python Code

```
x = [A[0], B[0], C[0], A[0]]
y = [A[1], B[1], C[1], A[1]]

plt.plot(x, y, 'r-', linewidth=2)

plt.scatter([A[0], B[0], C[0]], [A[1], B[1], C[1]], color='blue',
            zorder=5)

for point, label in zip([A, B, C], ['A', 'B', 'C']):
    plt.text(point[0], point[1], label, fontsize=12, ha='left',
             va='bottom')

plt.title(f'Triangle ABC with area = {area:.2f}')
plt.xlabel('x')
plt.ylabel('y')
plt.axis('equal')
plt.savefig('fig1.png')
plt.close()
```


Graph

