Course: ENSF 614 – Fall 2023
Lab 5:
Instructor: M. Moussavi
Student Name: Emmanuel Alafonye
Submission Date: October 23, 2023.

```
/*
* File Name: lab4Exe_A.cpp
* Assignment: ENSF 614 Lab 5, exercise A
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#include <iostream>
#include "graphicsWorld.h"
using namespace std;

void GraphicsWorld::run() {

  // Testing the Point class
   Point m(6, 8);
   Point n(6, 8);
   n.setX(9);
   cout << "\nExpected to display the distance between m and n is: 3";
   cout << "\nThe distance between m and n is: " << m.distance(n);
   cout << "\nExpected second version of the distance function also prints: 3";
   cout << "\nThe distance between m and n is again: "
       << Point::distance(m, n);

   // Testing the Square class
   cout << "\n\nTesting Functions in class Square:" <<endl;
   Square s(5, 7, 12, "SQUARE - S");
   s.display();

   // Testing the Rectangle class
   cout << "\nTesting Functions in class Rectangle:" <<endl;
   Rectangle a(5, 7, 12, 15, "RECTANGLE A");
   a.display();
   Rectangle b(16, 7, 8, 9, "RECTANGLE B");
   b.display();
   double d = a.distance(b);
   cout << "\nDistance between rectangle a and b is: " << d <<endl;
   Rectangle rec1 = a;
   rec1.display();

   // Testing assignment operator in class Rectangle
   cout << "\nTesting assignment operator in class Rectangle:" <<endl;
   Rectangle rec2(3, 4, 11, 7, "RECTANGLE rec2");
   rec2.display();
   rec2 = a;
   a.set_side_b(200);
   a.set_side_a(100);
   cout << "\nExpected to display the following values for object rec2: " <<endl;
   cout << "Rectangle Name: RECTANGLE A\n" << "X-coordinate: 5\n" << "Y-coordinate: 7\n"
          << "Side a: 12\n" << "Side b: 15\n" << "Area: 180\n" << "Perimeter: 54\n";
   cout << "\nIf it doesn't, there is a problem with your assignment operator." << std::endl;
```

```
    rec2.display();

    // Testing copy constructor in class Rectangle
    cout << "\nTesting copy constructor in class Rectangle:" << std::endl;
    Rectangle rec3(a);
    rec3.display();
    a.set_side_b(300);
    a.set_side_a(400);
    cout << "\nExpected to display the following values for object rec3: " <<endl;
    cout << "Rectangle Name: RECTANGLE A\n" << "X-coordinate: 5\n" << "Y-coordinate: 7\n"
         << "Side a: 100\n" << "Side b: 200\n" << "Area: 20000\n" << "Perimeter: 600\n";
    cout << "\nIf it doesn't, there is a problem with your copy constructor." <<endl;
    rec3.display();

    // Testing array of pointers and polymorphism
    cout << "\nTesting array of pointers and polymorphism:" <<endl;
    Shape* sh[4];
    sh[0] = &s;
    sh[1] = &b;
    sh[2] = &rec1;
    sh[3] = &rec3;

    for (int i = 0; i < 4; i++) {
        sh[i]->display();
    }
}


/*
* File Name: lab4Exe_A.cpp
* Assignment: ENSF 614 Lab 5, exercise A
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#pragma once
#include "point.h"
#include "shape.h"
#include "square.h"
#include "rectangle.h"
/**
 * @brief A class representing a graphics world, which manages shapes and their interactions.
 */
class GraphicsWorld {
public:
    void run();
};


/*
```

```
* File Name: lab4Exe_A.cpp
* Assignment: ENSF 614 Lab 5, exercise A
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#include "graphicsWorld.h" // Include the header for your GraphicsWorld class

int main() {
    GraphicsWorld program; // Create an instance of your GraphicsWorld class
    program.run(); // Call the run method to execute your program

    return 0; // Return 0 to indicate successful program execution
}

/*
* File Name: lab4Exe_A.cpp
* Assignment: ENSF 614 Lab 5, exercise A
* Created by Mahmood Moussavi
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* Submission Date: October 23, 2023.
*/

#include "point.h"
#include <iostream>
#include <cmath>

using namespace std;

int Point::pointCount = 0;

/**
 * @brief Constructor to create a Point object with specified coordinates.
 *
 * @param x The X-coordinate of the point.
 * @param y The Y-coordinate of the point.
 */

Point::Point(double x, double y) : x(x), y(y), id(1000 + pointCount) {
    pointCount++;
}

void Point::display() const {
    cout << "X-coordinate: " << x <<endl;
    cout << "Y-coordinate: " << y <<endl;
}

/**
 * @brief Calculate the Euclidean distance between this point and another point using their coordinates.
 *
 * @param other The other point.
 * @return The Euclidean distance between this point and the other point.
 */

double Point::distance(const Point& p1, const Point& p2) {
   double dx = p1.x - p2.x;
   double dy = p1.y - p2.y;
   return sqrt(dx * dx + dy * dy);
}

double Point::distance(const Point& other) const {
   return distance(*this, other);
}

double Point::getX() const {
   return x;
}

double Point::getY() const {
   return y;
}

void Point::setX(double x) {
   this->x = x;
}

void Point::setY(double y) {
   this->y = y;
}

/**
 * @brief Get the total number of Point objects created.
 *
 * @return The total number of Point objects created.
 */

int Point::counter() {
   return pointCount;
}

/*
* File Name: lab4Exe_A.cpp
* Assignment: ENSF 614 Lab 5, exercise A
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#pragma once

/**
```
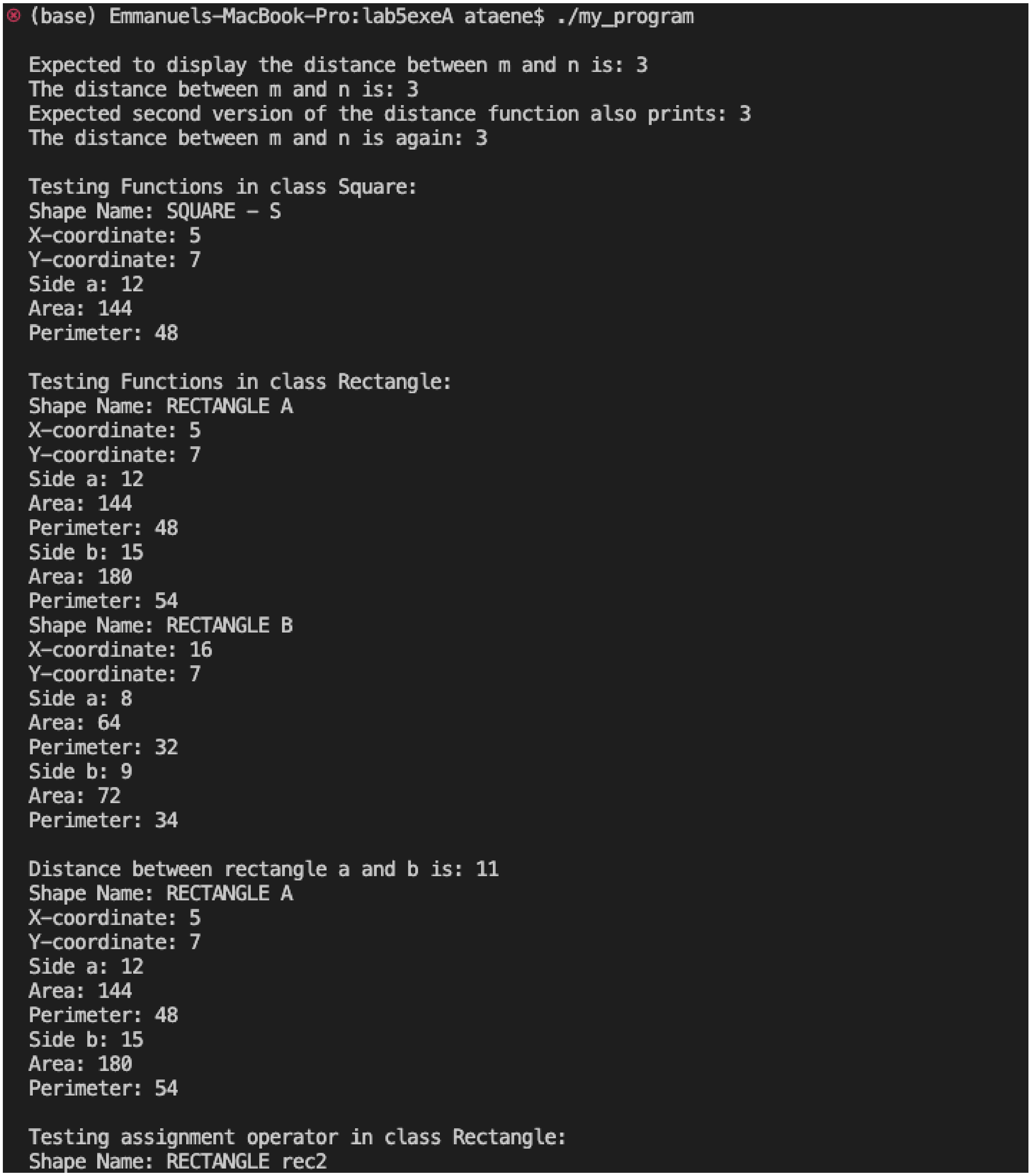
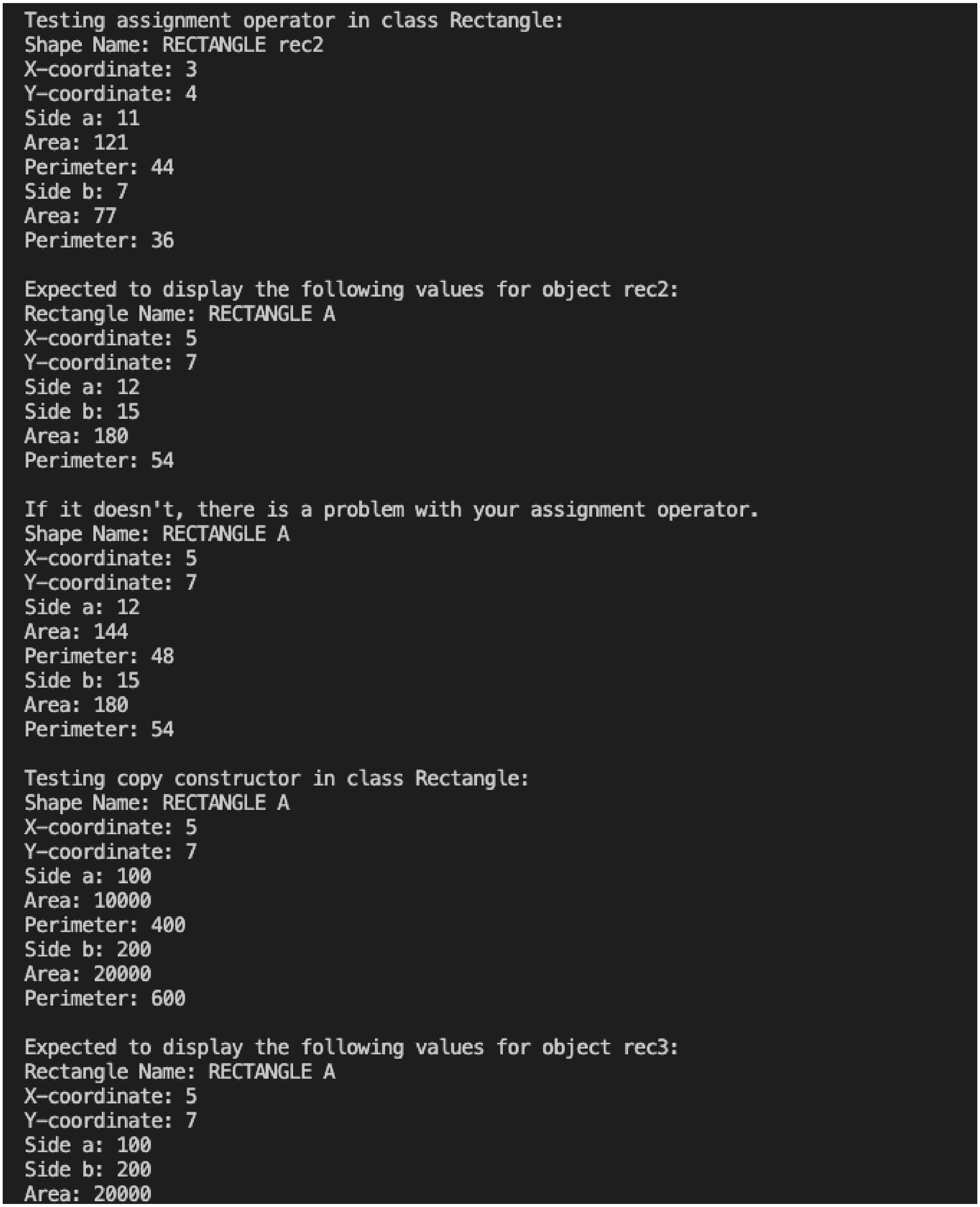

```
 * @brief A class representing a 2D point with X and Y coordinates.
 */

class Point {

private:
    double x;
    double y;
    static int pointCount;
    int id;

public:
 /**
     * @brief Constructor to create a Point object.
     *
     * @param x The X-coordinate of the point.
     * @param y The Y-coordinate of the point.
     */
    Point(double x, double y);
    void display() const;
    static double distance(const Point& p1, const Point& p2);
    double distance(const Point& other) const;
    double getX() const;
    double getY() const;
    void setX(double x); // set the X-coordinate
    void setY(double y); // set the Y-coordinate
    static int counter();
};

/*
* File Name: lab4Exe_A.cpp
* Assignment: ENSF 614 Lab 5, exercise A
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#include "rectangle.h"
#include <iostream>
using namespace std;

Rectangle::Rectangle(double x, double y, double side_a, double side_b, const char* name)
    : Square(x, y, side_a, name), side_b(side_b) {
    // Initialize a Rectangle object with provided parameters.
    }

double Rectangle::area() const {
    return getSideA() * side_b;
}

double Rectangle::perimeter() const {
   // Calculate and return the perimeter of the rectangle (2 * (length + width)).
   return 2 * (getSideA() + side_b);
}

double Rectangle::getSideB() const {
   return side_b;
}

void Rectangle::set_side_b(double side) {
   side_b = side;
}

void Rectangle::display() const {
   // Display information about the rectangle, including its name, coordinates, side lengths, area, and
perimeter.
   Square::display();
   cout << "Side b: " << side_b <<endl;
   cout << "Area: " << area() <<endl;
   cout << "Perimeter: " << perimeter() <<endl;
}

/*
* File Name: lab4Exe_A.cpp
* Assignment: ENSF 614 Lab 5, exercise A
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#pragma once
#include "square.h"

/**
 * @brief A class representing a rectangle, which is a type of quadrilateral shape.
 *
 * This class inherits from the Square class and adds a second side (side_b) to create a rectangle.
 */
class Rectangle : public Square {
private:
   double side_b;

public:
 /**
    * @brief Constructor to create a Rectangle object.
    *
    * @param x The X-coordinate of the origin.
    * @param y The Y-coordinate of the origin.
    * @param side_a The length of one side of the rectangle.
    * @param side_b The length of the second side of the rectangle.
    * @param name The name of the rectangle.
    */
   Rectangle(double x, double y, double side_a, double side_b, const char* name);
   double area() const;
   double perimeter() const;
   double getSideB() const;
   void set_side_b(double side);
   /**
    * @brief Display information about the rectangle, including its name, coordinates, and side lengths.
    */
   void display() const;
};

/*
* File Name: lab4Exe_A.cpp
* Assignment: ENSF 614 Lab 5, exercise A
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#include "shape.h"
#include <iostream>
#include <cstring>
#include <stdexcept>
using namespace std;

/**
 * @brief A class representing a shape with an origin point and a name.
 */
Shape::Shape(double x, double y, const char* name) : origin(x, y), shapeName(nullptr) {
   try {
       shapeName = new char[strlen(name) + 1];
       strcpy(shapeName, name);
   } catch (const std::bad_alloc& e) {
       // Handle memory allocation failure
       std::cerr << "Memory allocation error: " << e.what() << std::endl;
       shapeName = nullptr; // Ensure shapeName is set to nullptr
   }
}

Shape::~Shape() {
   delete[] shapeName;
}

const Point& Shape::getOrigin() const {
   return origin;
}

const char* Shape::getName() const {
   return shapeName;
}
```

```
void Shape::display() const {
    cout << "Shape Name: " << shapeName << std::endl;
    cout << "X-coordinate: " << origin.getX() << std::endl;
    cout << "Y-coordinate: " << origin.getY() << std::endl;
}

double Shape::distance(const Shape& s1, const Shape& s2) {
    return Point::distance(s1.getOrigin(), s2.getOrigin());
}

double Shape::distance(const Shape& other) const {
    return Point::distance(origin, other.getOrigin());
}

/**
     * @brief Move the shape by a specified amount in both the X and Y directions.
     *
     * @param dx The amount to move in the X direction.
     * @param dy The amount to move in the Y direction.
     */
void Shape::move(double dx, double dy) {
    origin = Point(origin.getX() + dx, origin.getY() + dy);
}

/*
* File Name: lab4Exe_A.cpp
* Assignment: ENSF 614 Lab 5, exercise A
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#pragma once
#include "point.h"

/**
 * Represents a geometric shape with an origin point and a name.
 */

class Shape {
private:
    Point origin;
    char* shapeName;

public:
    /**
     * Constructor to create a new Shape with the given coordinates and name.
     *
     * @param x The x-coordinate of the origin point.
     * @param y The y-coordinate of the origin point.
     * @param name The name of the shape.
     */
    Shape(double x, double y, const char* name);
    ~Shape();
    const Point& getOrigin() const;
    const char* getName() const;
    void display() const;
    /**
     * Calculate the distance between two Shape objects.
     *
     * @param s1 The first Shape for distance calculation.
     * @param s2 The second Shape for distance calculation.
     * @return The distance between s1 and s2 as a double.
     */
    static double distance(const Shape& s1, const Shape& s2);
    double distance(const Shape& other) const;
     /**
     * Move the shape by specified distances in the x and y directions.
     *
     * @param dx The distance to move the shape in the x-direction.
     * @param dy The distance to move the shape in the y-direction.
     */
    void move(double dx, double dy);
};

/*
* File Name: lab4Exe_A.cpp
* Assignment: ENSF 614 Lab 5, exercise A
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#include "square.h"
#include <iostream>
using namespace std;

// Constructor for the Square class, initializing the position, side length, and name.
Square::Square(double x, double y, double side_a, const char* name) : Shape(x, y, name), side_a(side_a) {}

double Square::area() const {
    return side_a * side_a;
}

double Square::perimeter() const {
    return 4 * side_a;
}

double Square::getSideA() const { // Get method to get the side_a
    return side_a;
}
```

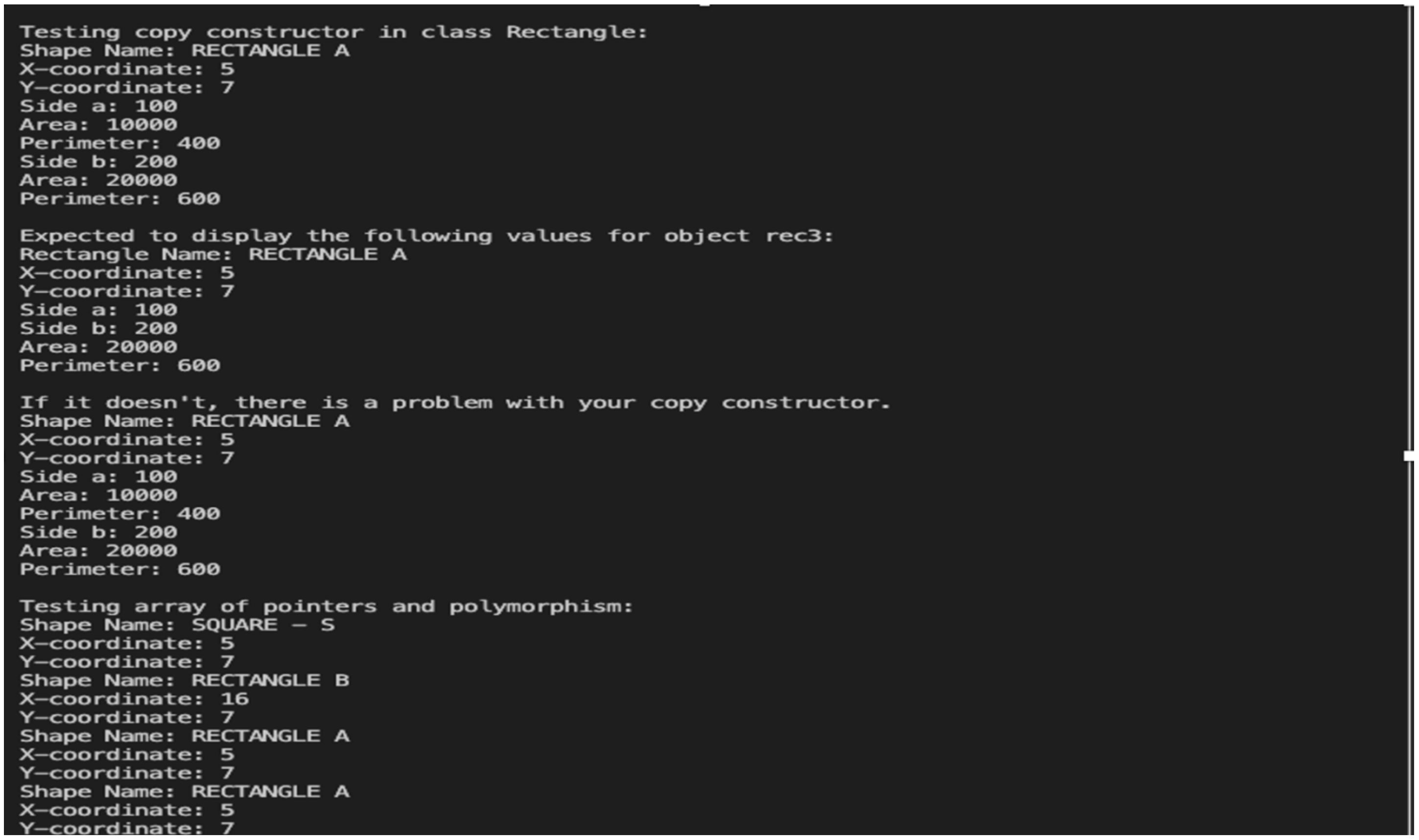
```
void Square::set_side_a(double side) {
    side_a = side;
}

void Square::display() const {
    Shape::display(); // Display method for the base class
    cout << "Side a: " << side_a <<endl;
    cout << "Area: " << area() <<endl;
    cout << "Perimeter: " << perimeter() <<endl; // Display the perimeter
}

/*
* File Name: lab4Exe_A.cpp
* Assignment: ENSF 614 Lab 5, exercise A
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#pragma once
#include "shape.h"

// Defining the Square class that inherit tfrom the shape
class Square : public Shape {
private:
    double side_a;

public:
    // The constructor to create the object
    Square(double x, double y, double side_a, const char* name);
    double area() const; // The Area method
    double perimeter() const;
    double getSideA() const;
    void set_side_a(double side); // Getter method to retrieve the value of "side_a."
    void display() const; // Used to display and print
};
```



```
⊗ (base) Emmanuels-MacBook-Pro:lab5exeA ataene$ ./my_program

  Expected to display the distance between m and n is: 3
  The distance between m and n is: 3
  Expected second version of the distance function also prints: 3
  The distance between m and n is again: 3

  Testing Functions in class Square:
  Shape Name: SQUARE - S
  X-coordinate: 5
  Y-coordinate: 7
  Side a: 12
  Area: 144
  Perimeter: 48

  Testing Functions in class Rectangle:
  Shape Name: RECTANGLE A
  X-coordinate: 5
  Y-coordinate: 7
  Side a: 12
  Area: 144
  Perimeter: 48
  Side b: 15
  Area: 180
  Perimeter: 54
  Shape Name: RECTANGLE B
  X-coordinate: 16
  Y-coordinate: 7
  Side a: 8
  Area: 64
  Perimeter: 32
  Side b: 9
  Area: 72
  Perimeter: 34

  Distance between rectangle a and b is: 11
  Shape Name: RECTANGLE A
  X-coordinate: 5
  Y-coordinate: 7
  Side a: 12
  Area: 144
  Perimeter: 48
  Side b: 15
  Area: 180
  Perimeter: 54

  Testing assignment operator in class Rectangle:
  Shape Name: RECTANGLE rec2
```



```
Testing assignment operator in class Rectangle:
Shape Name: RECTANGLE rec2
X-coordinate: 3
Y-coordinate: 4
Side a: 11
Area: 121
Perimeter: 44
Side b: 7
Area: 77
Perimeter: 36

Expected to display the following values for object rec2:
Rectangle Name: RECTANGLE A
X-coordinate: 5
Y-coordinate: 7
Side a: 12
Side b: 15
Area: 180
Perimeter: 54

If it doesn't, there is a problem with your assignment operator.
Shape Name: RECTANGLE A
X-coordinate: 5
Y-coordinate: 7
Side a: 12
Area: 144
Perimeter: 48
Side b: 15
Area: 180
Perimeter: 54

Testing copy constructor in class Rectangle:
Shape Name: RECTANGLE A
X-coordinate: 5
Y-coordinate: 7
Side a: 100
Area: 10000
Perimeter: 400
Side b: 200
Area: 20000
Perimeter: 600

Expected to display the following values for object rec3:
Rectangle Name: RECTANGLE A
X-coordinate: 5
Y-coordinate: 7
Side a: 100
Side b: 200
Area: 20000
```



```
Testing copy constructor in class Rectangle:
Shape Name: RECTANGLE A
X-coordinate: 5
Y-coordinate: 7
Side a: 100
Area: 10000
Perimeter: 400
Side b: 200
Area: 20000
Perimeter: 600

Expected to display the following values for object rec3:
Rectangle Name: RECTANGLE A
X-coordinate: 5
Y-coordinate: 7
Side a: 100
Side b: 200
Area: 20000
Perimeter: 600

If it doesn't, there is a problem with your copy constructor.
Shape Name: RECTANGLE A
X-coordinate: 5
Y-coordinate: 7
Side a: 100
Area: 10000
Perimeter: 400
Side b: 200
Area: 20000
Perimeter: 600

Testing array of pointers and polymorphism:
Shape Name: SQUARE - S
X-coordinate: 5
Y-coordinate: 7
Shape Name: RECTANGLE B
X-coordinate: 16
Y-coordinate: 7
Shape Name: RECTANGLE A
X-coordinate: 5
Y-coordinate: 7
Shape Name: RECTANGLE A
X-coordinate: 5
Y-coordinate: 7
```

Question 5B

```
/*
* File Name: lab5Exe_B.cpp
* Assignment: ENSF 614 Lab 5, exercise B
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#include "circle.h"
#include "shape.h"
#include "point.h"
#include <iostream>
#include <iomanip>
#include <cmath>
using namespace std;

Circle::Circle(double x, double y, double radius, const char *name) : Shape(x, y, name){
    setRadius(radius);
}

double Circle::area() const{
    return M_PI * pow(getRad(), 2);
}

double Circle::perimeter() const{
    return 2 * M_PI * getRad();
}

double Circle::getRad() const{
    return rad;
}

void Circle::setRadius(double radius){
    rad = radius;
}

void Circle::display() const{
    getO().display();
    cout << "Radius: " << getRad() << endl;
    cout << "Area: " << area() << endl;
    cout << "Perimeter: " << perimeter() << endl;
}

/*
* File Name: lab5Exe_B.cpp
* Assignment: ENSF 614 Lab 5, exercise B
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#include "rectangle.h"
#include "shape.h"
#pragma once

/**
 * The Circle class represents a circle with a center point, radius, and name.
 */

class Circle : virtual public Shape{
protected:
    double rad;

public:
  /**
    * Constructor to create a Circle object.
    *
    * @param x     The x-coordinate of the center.
```

```
     * @param y     The y-coordinate of the center.
     * @param radius    The radius of the circle.
     * @param name  The name of the circle.
     */
    Circle(double x, double y, double r, const char *name);
    double area() const;
    double perimeter() const;
    double getRad() const;
    void setRadius(double radius);
    void display() const;
};

/*
* File Name: lab5Exe_B.cpp
* Assignment: ENSF 614 Lab 5, exercise B
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#include "curvecut.h"
#include "circle.h"
#include "shape.h"
#include "point.h"
#include <iostream>
#include <iomanip>
#include <cmath>

using namespace std;


/**
 * Constructor to create a CurveCut object by specifying its position, width, length, cut radius, and name.
 *
 * @param x The x-coordinate of the CurveCut's position.
 * @param y The y-coordinate of the CurveCut's position.
 * @param width The width of the rectangular section.
 * @param length The length of one side of the rectangle.
 * @param cutRadius The radius of the circular cut.
 * @param name The name of the CurveCut.
 */

CurveCut::CurveCut(double x, double y, double width, double length, double cutRadius, const char *name)
    : Shape(x, y, name), Circle(x, y, cutRadius, name), Rectangle(x, y, width, length, name){
    double minLength = width < length ? width : length;

    if (cutRadius > minLength)
    {
        cerr << "\n. Error: Cut radius is too large for the given dimensions.\n";
        exit(1);
    }
```

```
}

double CurveCut::area() const{
    return (Rectangle::area() - (Circle::area() / 4));
}

double CurveCut::perimeter() const{
    return Rectangle::perimeter() - (2 * getRad()) + (Circle::perimeter() / 4);
}

/**
 * Display information about the CurveCut, including its name, position, width, length, and cut radius.
 */

void CurveCut::display() const{
    cout << "CurveCut Name: " << getName() << endl;
    getO().display();
    cout << "Width: " << getSideA() << endl;
    cout << "Length: " << getSideB() << endl;
    cout << "Radius of the cut: " << getRad() << endl;
}

/*
* File Name: lab5Exe_B.cpp
* Assignment: ENSF 614 Lab 5, exercise B
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#include "circle.h"
#include "rectangle.h"
#pragma once

/**
 * The CurveCut class represents a shape created by cutting a circular section from a rectangle.
 * It inherits properties from both the Circle and Rectangle classes.
 */

class CurveCut : public Circle, public Rectangle{
protected:
    double width;

public:
/**
     * Constructor to create a CurveCut object.
     *
     * @param x The x-coordinate of the CurveCut's position.
     * @param y The y-coordinate of the CurveCut's position.
     * @param a The length of one side of the rectangle (sideA).
     * @param width The width of the rectangular section.
     * @param radius The radius of the circular section.
     * @param name The name of the CurveCut.
     */

    CurveCut(double x, double y, double a, double width, double radius, const char *name);
    double area() const;
    double perimeter() const;

    /**
     * Display information about the CurveCut, including its name, position, side length (sideA), width, area,
and perimeter.
     */
    void display() const;
};

/*
* File Name: lab5Exe_B.cpp
* Assignment: ENSF 614 Lab 5, exercise B
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#include "graphicsWorld.h"
#include "curvecut.h"
#include "circle.h"
#include "rectangle.h"
#include "square.h"
#include "shape.h"
#include "point.h"
#include <iostream>

using namespace std;

void GraphicsWorld::run()
{
    Point m(6, 8);
    Point n(6, 8);
    n.setx(9);
    cout << "\nExpected to display the distance between m and n is: 3";
    cout << "\nThe distance between m and n is: " << m.distance(n);
    cout << "\nExpected second version of the distance function also print: 3";
    cout << "\nThe distance between m and n is again: " << Point::distance(m, n);

    cout << "\n\nTesting Functions in class Square:" << endl;
    Square s(5, 7, 12, "SQUARE - S");
    s.display();
    cout << "\nTesting Functions in class Rectangle:" << endl;
    Rectangle a(5, 7, 12, 15, "RECTANGLE A");
    a.display();
```

```
Rectangle b(16, 7, 8, 9, "RECTANGLE B");
b.display();

double d = a.distance(b);
cout << "\nDistance between square a, and b is: " << d << endl;
Rectangle rec1 = a;
rec1.display();
cout << "\nTesting assignment operator in class Rectangle:" << endl;
Rectangle rec2(3, 4, 11, 7, "RECTANGLE rec2");
rec2.display();
rec2 = a;
a.setSideB(200);
a.setSideA(100);
cout << "\nExpected to display the following values for objec rec2: " << endl;
cout << "Rectangle Name: RECTANGLE A\n"
    << "X-coordinate: 5\n"
    << "Y-coordinate: 7\n"
    << "Side a: 12\n"
    << "Side b: 15\n"
    << "Area: 180\n"
    << "Perimeter: 54\n";
cout << "\nIf it doesn't there is a problem with your assignment operator.\n"
    << endl;
rec2.display();

cout << "\nTesting copy constructor in class Rectangle:" << endl;
Rectangle rec3(a);
rec3.display();
a.setSideB(300);
a.setSideA(400);
cout << "\nExpected to display the following values for objec rec2: " << endl;
cout << "Rectangle Name: RECTANGLE A\n"
    << "X-coordinate: 5\n"
    << "Y-coordinate: 7\n"
    << "Side a: 100\n"
    << "Side b: 200\n"
    << "Area: 20000\n"
    << "Perimeter: 600\n";
cout << "\nIf it doesn't there is a problem with your assignment operator.\n"
    << endl;
rec3.display();
cout << "\nTesting array of pointers and polymorphism:" << endl;
Shape *sh[4];
sh[0] = &s;
sh[1] = &b;
sh[2] = &rec1;
sh[3] = &rec3;
sh[0]->display();
sh[1]->display();
sh[2]->display();
sh[3]->display();
```

```
    cout << "\nTesting Functions in class Circle:" << endl;
    Circle c(3, 5, 9, "CIRCLE C");
    c.display();
    cout << "the area of " << c.getName() << " is: " << c.area() << endl;
    cout << "the perimeter of " << c.getName() << " is: " << c.perimeter() << endl;
    d = a.distance(c);
    cout << "\nThe distance between rectangle a and circle c is: " << d << endl;

    CurveCut rc(6, 5, 10, 12, 9, "CurveCut rc");
    rc.display();
    cout << "the area of " << rc.getName() << " is: " << rc.area() << endl;
    cout << "the perimeter of " << rc.getName() << " is: " << rc.perimeter();
    d = rc.distance(c);
    cout << "\nThe distance between rc and c is: " << d << endl;
    sh[0] = &s;
    sh[1] = &a;
    sh[2] = &c;
    sh[3] = &rc;
    sh[0]->display();
    cout << "The area of " << sh[0]->getName() << " is: " << sh[0]->area();
    cout << "\nthe perimeter of " << sh[0]->getName() << " is: " << sh[0]->perimeter() << endl << endl;
    sh[1]->display();
    cout << "\nThe area of " << sh[1]->getName() << " is: " << sh[1]->area();
    cout << "\nthe perimeter of " << sh[0]->getName() << " is: " << sh[1]->perimeter() << endl << endl;
    sh[2]->display();
    cout << "\nThe area of " << sh[2]->getName() << " is: " << sh[2]->area();
    cout << "\nthe circumference of " << sh[2]->getName() << " is: " << sh[2]->perimeter() << endl << endl;
    sh[3]->display();
    cout << "\nThe area of " << sh[3]->getName() << " is: " << sh[3]->area();
    cout << "\nthe perimeter of " << sh[3]->getName() << " is: " << sh[3]->perimeter() << endl << endl;
    cout << "\nTesting copy constructor in class CurveCut:" << endl;
    CurveCut cc = rc;
    cc.display();
    cout << "\nTesting assignment operator in class CurveCut:" << endl;
    CurveCut cc2(2, 5, 100, 12, 9, "CurveCut cc2");
    cc2.display();
    cc2 = cc;
    cc2.display();
}

int main(){
    GraphicsWorld functionRun;
    functionRun.run();
    return 0;
}

/*
* File Name: lab5Exe_B.cpp
* Assignment: ENSF 614 Lab 5, exercise B
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/
#pragma once

class GraphicsWorld {
public:
    void run();
};

/*
* File Name: lab4Exe_B.cpp
* Assignment: ENSF 614 Lab 5, exercise B
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#include "point.h"
#include <stdio.h>
#include <iostream>
#include <math.h>
#include <iomanip>

using namespace std;

int Point::pointCount = 0;

Point::Point(double x, double y){
    x = x;
    y = y;
    id = ++pointCount + 1000;
}

Point::Point(const Point &p2){
    x = p2.getx();
    y = p2.gety();
    id = ++pointCount + 1000;
}

Point &Point::operator=(const Point &h){
    if (this != &h){
        x = h.getx();
        y = h.gety();
        id = ++pointCount + 1000;
    }

    return *this;
}

Point::~Point(){
    --pointCount;
}

void Point::display() const {
    cout <<"X-coordinate: " << getx() << endl;
    cout <<"Y-coordinate: " << gety() << endl;
}

double Point::getx() const{
    return this->x;
}

double Point::gety() const{
    return y;
}

void Point::setx(double x){
    x = x;
}

void Point::sety(double y){
    y = y;
}

int Point::counter() const{
    return pointCount;
}

double Point::distance(const Point &p1) const{
    double valueX = pow((getx() - p1.getx()), 2);
    double valueY = pow((gety() - p1.gety()), 2);

    return sqrt(valueX + valueY);
}

double Point::distance(const Point &p1, const Point &p2){
    double valueX = pow((p1.getx() - p2.getx()), 2);
    double valueY = pow((p1.gety() - p2.gety()), 2);

    return sqrt(valueX + valueY);
}

/*
* File Name: lab5Exe_B.cpp
* Assignment: ENSF 614 Lab 5, exercise B
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#pragma once
```

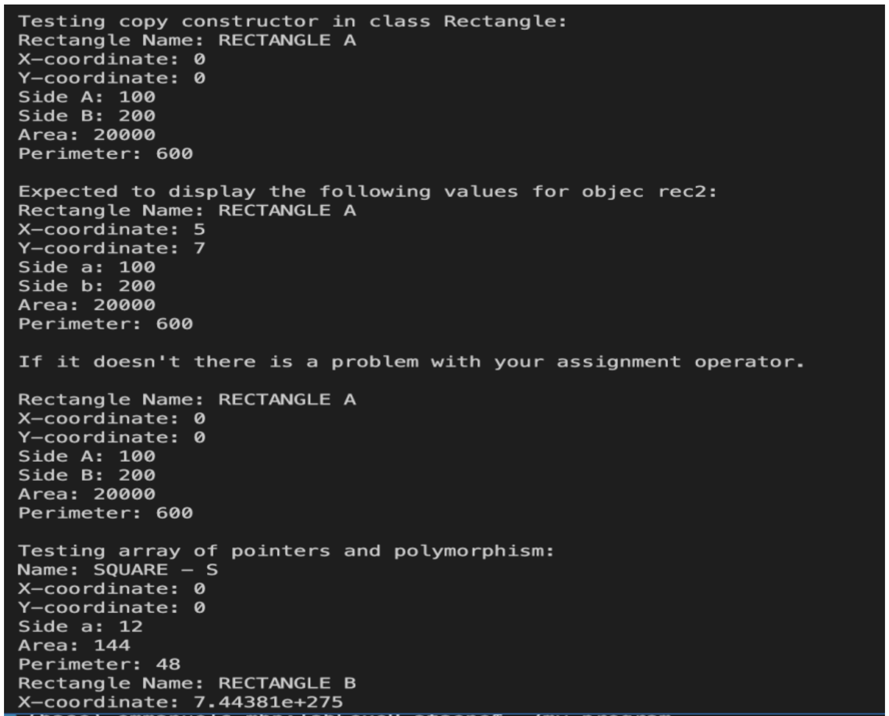
```
/**
 * The Point class represents a point in a two-dimensional space.
 */

class Point{
private:
    double x;
    double y;
    static int pointCount;
    int id;

public:
     /**
     * Constructor to create a Point object with specified coordinates.
     *
     * @param a The x-coordinate of the point.
     * @param b The y-coordinate of the point.
     */

    Point(double a, double b);
    ~Point();
    Point(const Point &other);
    Point &operator=(const Point &rhs);
    void display() const;
    double getx() const;
    double gety() const;
    void setx(double a);
    void sety(double b);
     /**
     * Calculate the distance between this point and another point.
     *
     * @param p3 The other Point object.
     * @return The distance between this point and the other point.
     */

    int counter() const;
    double distance(const Point &p3) const;
     /**
     * Calculate the distance between two points.
     *
     * @param p1 The first Point object.
     * @param p2 The second Point object.
     * @return The distance between the two points.
     */

    static double distance(const Point &p1, const Point &p2);

};

/*
* File Name: lab5Exe_B.cpp
* Assignment: ENSF 614 Lab 5, exercise B
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#include "rectangle.h"
#include "square.h"
#include "shape.h"
#include "point.h"
#include <iostream>
#include <iomanip>
using namespace std;


/**
 * The Rectangle class represents a rectangle with two different side lengths, position, and name.
 * It inherits from the Square class and adds a second side length (sideB) to create a rectangle.
 */

Rectangle::Rectangle(double x, double y, double a, double b, const char *name)
   : Shape(x, y, name), Square(x, y, a, name){
   setSideB(b);
}

double Rectangle::area() const{
   return (getSideA() * getSideB());
}
/**
 * Calculate the perimeter of the rectangle.
 *
 * @return The perimeter of the rectangle.
 */

double Rectangle::perimeter() const{
   return (2 * (getSideA() + getSideB()));
}

double Rectangle::getSideB() const{
   return sideB;
}

void Rectangle::setSideB(double side){
   sideB = side;
}
/**
 * Display information about the rectangle, including its name, position, side lengths (sideA and sideB), area,
and perimeter.
 */
void Rectangle::display() const{
   cout << "Rectangle Name: " << getName() << endl;
```

```
    getO().display();
    cout << "Side A: " << getSideA() << endl;
    cout << "Side B: " << getSideB() << endl;
    cout << "Area: " << area() << endl;
    cout << "Perimeter: " << perimeter() << endl;
}
/*
* File Name: lab5Exe_B.cpp
* Assignment: ENSF 614 Lab 5, exercise B
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#include "square.h"
#pragma once

/**
 * The Rectangle class represents a rectangle with two different side lengths, position, and name.
 * It inherits from the Square class and adds a second side length (sideB) to create a rectangle.
 */

class Rectangle : public Square{
protected:
    double sideB;

public:
 /**
     * Constructor to create a Rectangle object.
     *
     * @param x        The x-coordinate of the rectangle's position.
     * @param y        The y-coordinate of the rectangle's position.
     * @param a        The length of one side of the rectangle (sideA).
     * @param b        The length of the second side of the rectangle (sideB).
     * @param sName     The name of the rectangle.
     */
    Rectangle(double x, double y, double a, double b, const char *sName);
    double area() const;
    double perimeter() const;
    /**
     * Get the length of the second side of the rectangle.
     *
     * @return The length of the second side of the rectangle (sideB).
     */
    double getSideB() const;
    void setSideB(double side);
      /**
     * Display information about the rectangle, including its name, position, side lengths (sideA and sideB),
area, and perimeter.
     */
    void display() const;
```

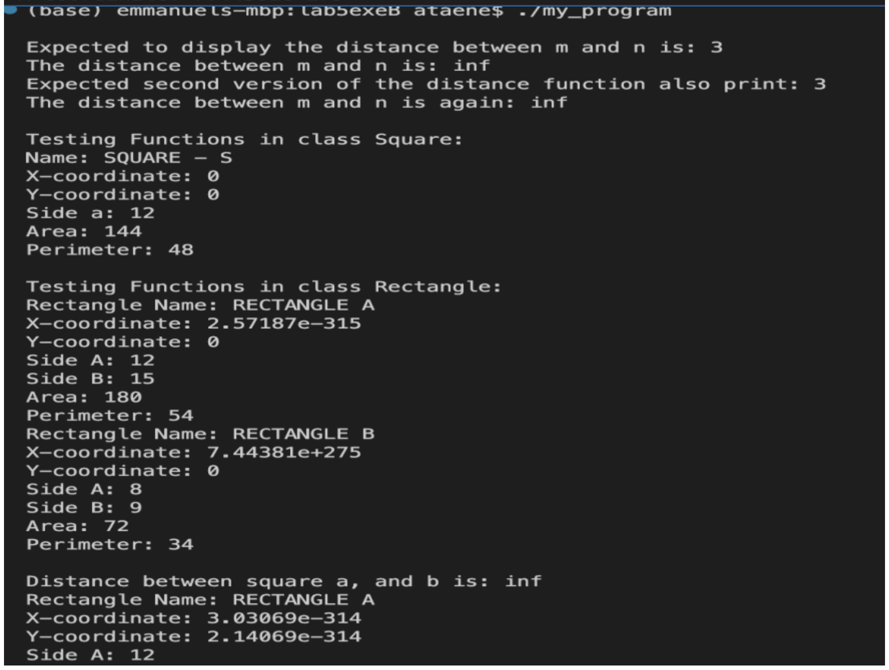
```
};

/*
* File Name: lab5Exe_B.cpp
* Assignment: ENSF 614 Lab 5, exercise B
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#include "shape.h"
#include "point.h"
#include <stdio.h>
#include <string.h>
#include <iostream>
using namespace std;

// Constructor for the Shape class.
Shape::Shape(double x, double y, const char *sName) : origin(Point(x, y)){
   name = new char[strlen(sName) + 1];
   strcpy(this->name, sName);
}

// Destructor for the Shape class.
Shape::~Shape(){
   delete[] name;
   name = nullptr;
}

Shape::Shape(const Shape &s) : origin(Point(s.getO().getx(), s.getO().gety())){
   name = new char[strlen(s.getName()) + 1];
   strcpy(name, s.getName());
}

Shape &Shape::operator=(const Shape &h){
   if (this != &h)
   {
      delete[] name;

      origin = Point(h.getO().getx(), h.getO().gety());
      name = new char[strlen(h.getName()) + 1];
      strcpy(name, h.getName());
   }

   return *this;
}

void Shape::display() const {
   cout << "Name : " << getName() << endl;
   getO().display();
}
```

```
const Point &Shape::getO() const{
    return origin;
}

// Get the name of the shape.
const char *Shape::getName() const{
    return name;
}

double Shape::distance(Shape &s1) const{
    double dist = getO().distance(s1.getO());
    return dist;
}
// Calculate the distance between two shapes using their origins.
double Shape::distance(Shape &s1, Shape &s2){
    double dist = s1.getO().distance(s1.getO(), s2.getO());
    return dist;
}

// Move the shape by a specified amount in the X and Y directions.
void Shape::move(double moveX, double moveY){
    double valueX = getO().getx();
    double valueY = getO().gety();
    origin.setx(valueX + moveX);
    origin.sety(valueY + moveY);
}

/*
* File Name: lab5Exe_B.cpp
* Assignment: ENSF 614 Lab 5, exercise B
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#include "point.h"
#pragma once

class Shape
{
protected:
    Point origin;
    char *name;

public:
    Shape(double x, double y, const char *sName);
    virtual ~Shape();

    Shape(const Shape &s);
    Shape& operator=(const Shape &h);

    const Point &getO() const;

    const char *getName() const;

    virtual void display() const;

    virtual double distance(Shape &S) const;

    static double distance(Shape &s1, Shape &s2);
    virtual double area() const = 0;
    virtual double perimeter() const = 0;
    void move (double dx, double dy);
};

/*
* File Name: lab5Exe_B.cpp
* Assignment: ENSF 614 Lab 5, exercise B
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#include "square.h"
#include "shape.h"
#include "point.h"
#include <iostream>
#include <iomanip>

using namespace std;

/**
 * The Square class represents a square with a side length, position, and name.
 */

Square::Square(double x, double y, double side, const char *name) : Shape(x, y, name){
    setSideA(side);
}

double Square::area() const{
    return getSideA() * getSideA();
}

double Square::perimeter() const{
    return getSideA() * 4;
}

double Square::getSideA() const{
    return sideA;
}
```

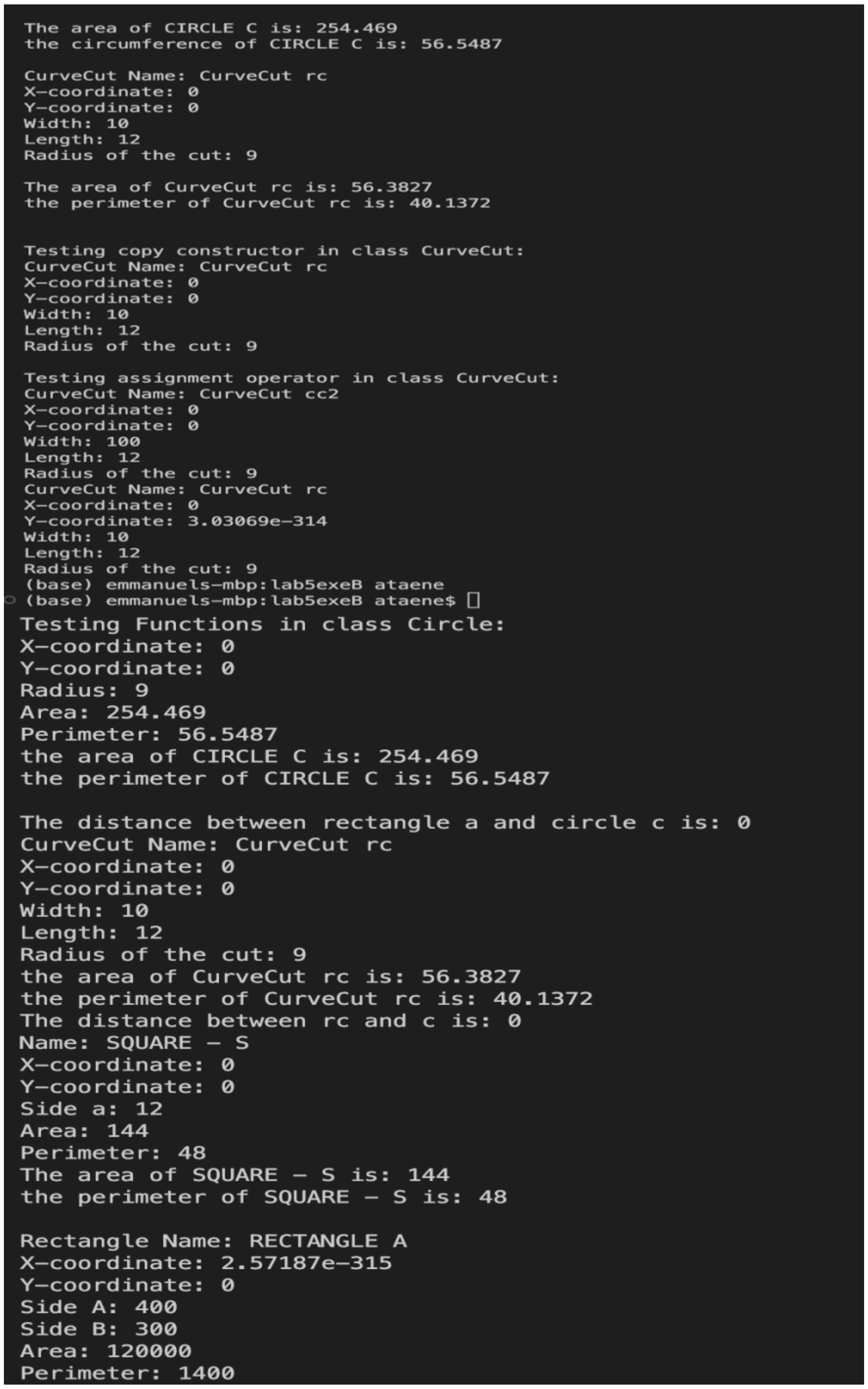
```
void Square::setSideA(double side){
   sideA = side;
}

void Square::display() const{
   cout << "Name: " << getName() << endl;
   getO().display();

   /**
    * Display information about the square, including its name, position, side length, area, and perimeter.
    */

   cout << "Side a: " << getSideA() << endl;
   cout << "Area: " << area() << endl;
   cout << "Perimeter: " << perimeter() << endl;
}

/*
* File Name: lab5Exe_B.cpp
* Assignment: ENSF 614 Lab 5, exercise B
* Created by Mahmood Moussavi
* Completed by: Emmanuel Alafonye
* Submission Date: October 23, 2023.
*/

#include "shape.h"
#include "point.h"
#pragma once

class Square : virtual public Shape{
protected:
   double sideA;

public:
   // The constructor to create the object
   Square(double x, double y, double side, const char *sName);
   double area() const;
   double perimeter() const;
   double getSideA() const;
   void setSideA(double side); // Getter method to retrieve the value of "sideA."
   void display() const; // Used to display and print
};
```



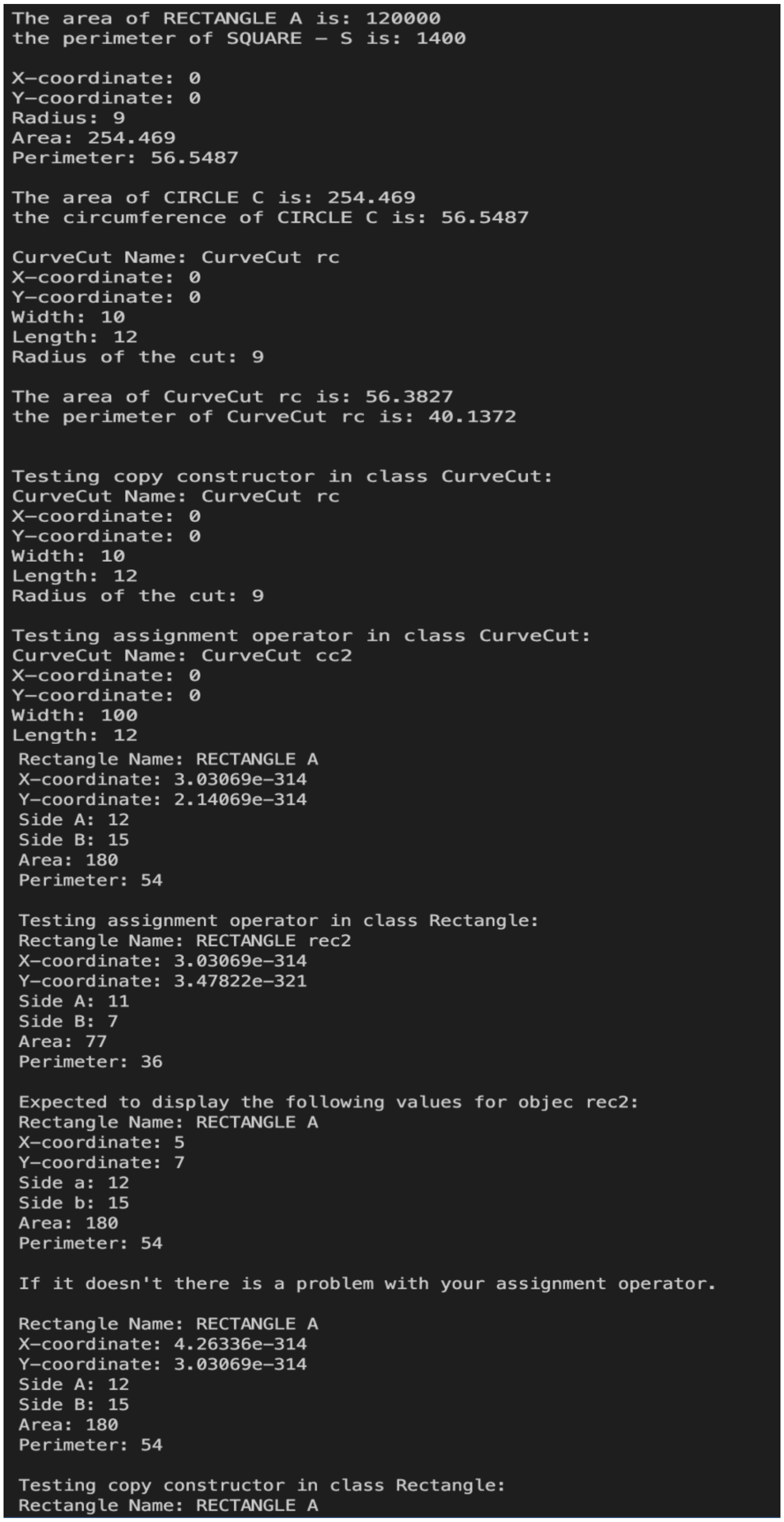
```
Testing copy constructor in class Rectangle:
Rectangle Name: RECTANGLE A
X-coordinate: 0
Y-coordinate: 0
Side A: 100
Side B: 200
Area: 20000
Perimeter: 600

Expected to display the following values for objec rec2:
Rectangle Name: RECTANGLE A
X-coordinate: 5
Y-coordinate: 7
Side a: 100
Side b: 200
Area: 20000
Perimeter: 600

If it doesn't there is a problem with your assignment operator.

Rectangle Name: RECTANGLE A
X-coordinate: 0
Y-coordinate: 0
Side A: 100
Side B: 200
Area: 20000
Perimeter: 600

Testing array of pointers and polymorphism:
Name: SQUARE - S
X-coordinate: 0
Y-coordinate: 0
Side a: 12
Area: 144
Perimeter: 48
Rectangle Name: RECTANGLE B
X-coordinate: 7.44381e+275
```



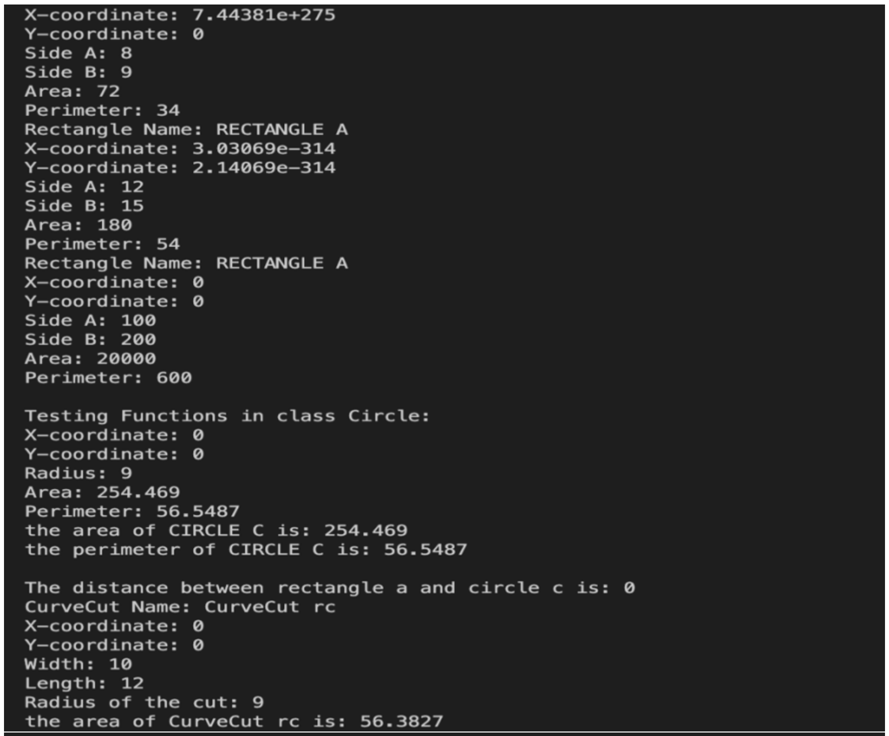
```
(base) emmanuels-mbp:lab5exeB ataene$ ./my_program

 Expected to display the distance between m and n is: 3
 The distance between m and n is: inf
 Expected second version of the distance function also print: 3
 The distance between m and n is again: inf

 Testing Functions in class Square:
 Name: SQUARE - S
 X-coordinate: 0
 Y-coordinate: 0
 Side a: 12
 Area: 144
 Perimeter: 48

 Testing Functions in class Rectangle:
 Rectangle Name: RECTANGLE A
 X-coordinate: 2.57187e-315
 Y-coordinate: 0
 Side A: 12
 Side B: 15
 Area: 180
 Perimeter: 54
 Rectangle Name: RECTANGLE B
 X-coordinate: 7.44381e+275
 Y-coordinate: 0
 Side A: 8
 Side B: 9
 Area: 72
 Perimeter: 34

 Distance between square a, and b is: inf
 Rectangle Name: RECTANGLE A
 X-coordinate: 3.03069e-314
 Y-coordinate: 2.14069e-314
 Side A: 12
```



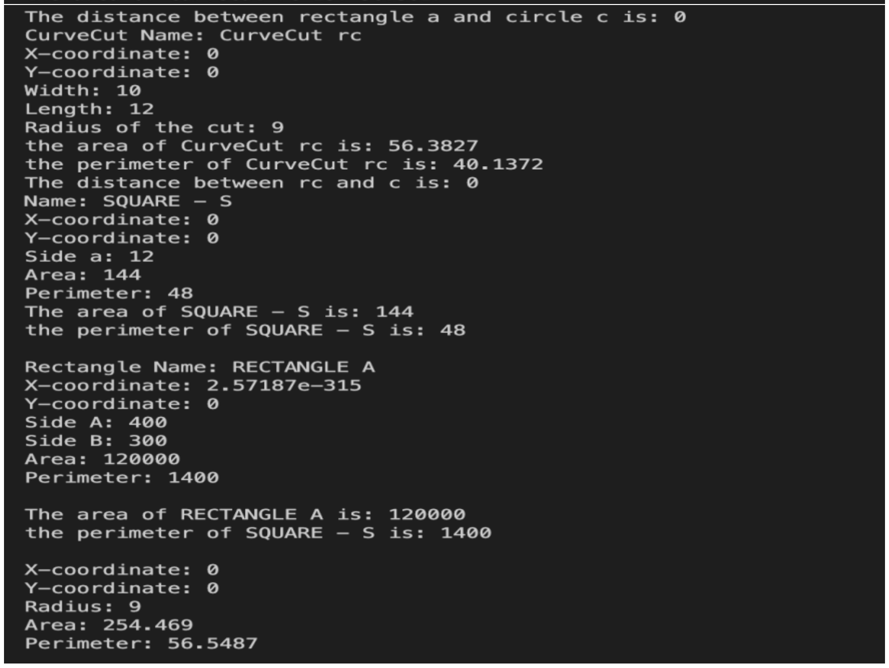
```
The area of CIRCLE C is: 254.469
the circumference of CIRCLE C is: 56.5487

CurveCut Name: CurveCut rc
X-coordinate: 0
Y-coordinate: 0
Width: 10
Length: 12
Radius of the cut: 9

The area of CurveCut rc is: 56.3827
the perimeter of CurveCut rc is: 40.1372


Testing copy constructor in class CurveCut:
CurveCut Name: CurveCut rc
X-coordinate: 0
Y-coordinate: 0
Width: 10
Length: 12
Radius of the cut: 9

Testing assignment operator in class CurveCut:
CurveCut Name: CurveCut cc2
X-coordinate: 0
Y-coordinate: 0
Width: 100
Length: 12
Radius of the cut: 9
CurveCut Name: CurveCut rc
X-coordinate: 0
Y-coordinate: 3.03069e-314
Width: 10
Length: 12
Radius of the cut: 9
(base) emmanuels-mbp:lab5exeB ataene
(base) emmanuels-mbp:lab5exeB ataene$ 
Testing Functions in class Circle:
X-coordinate: 0
Y-coordinate: 0
Radius: 9
Area: 254.469
Perimeter: 56.5487
the area of CIRCLE C is: 254.469
the perimeter of CIRCLE C is: 56.5487

The distance between rectangle a and circle c is: 0
CurveCut Name: CurveCut rc
X-coordinate: 0
Y-coordinate: 0
Width: 10
Length: 12
Radius of the cut: 9
the area of CurveCut rc is: 56.3827
the perimeter of CurveCut rc is: 40.1372
The distance between rc and c is: 0
Name: SQUARE - S
X-coordinate: 0
Y-coordinate: 0
Side a: 12
Area: 144
Perimeter: 48
The area of SQUARE - S is: 144
the perimeter of SQUARE - S is: 48

Rectangle Name: RECTANGLE A
X-coordinate: 2.57187e-315
Y-coordinate: 0
Side A: 400
Side B: 300
Area: 120000
Perimeter: 1400
```



```
The area of RECTANGLE A is: 120000
the perimeter of SQUARE - S is: 1400

X-coordinate: 0
Y-coordinate: 0
Radius: 9
Area: 254.469
Perimeter: 56.5487

The area of CIRCLE C is: 254.469
the circumference of CIRCLE C is: 56.5487

CurveCut Name: CurveCut rc
X-coordinate: 0
Y-coordinate: 0
Width: 10
Length: 12
Radius of the cut: 9

The area of CurveCut rc is: 56.3827
the perimeter of CurveCut rc is: 40.1372


Testing copy constructor in class CurveCut:
CurveCut Name: CurveCut rc
X-coordinate: 0
Y-coordinate: 0
Width: 10
Length: 12
Radius of the cut: 9

Testing assignment operator in class CurveCut:
CurveCut Name: CurveCut cc2
X-coordinate: 0
Y-coordinate: 0
Width: 100
Length: 12
 Rectangle Name: RECTANGLE A
 X-coordinate: 3.03069e-314
 Y-coordinate: 2.14069e-314
 Side A: 12
 Side B: 15
 Area: 180
 Perimeter: 54

 Testing assignment operator in class Rectangle:
 Rectangle Name: RECTANGLE rec2
 X-coordinate: 3.03069e-314
 Y-coordinate: 3.47822e-321
 Side A: 11
 Side B: 7
 Area: 77
 Perimeter: 36

 Expected to display the following values for objec rec2:
 Rectangle Name: RECTANGLE A
 X-coordinate: 5
 Y-coordinate: 7
 Side a: 12
 Side b: 15
 Area: 180
 Perimeter: 54

 If it doesn't there is a problem with your assignment operator.

 Rectangle Name: RECTANGLE A
 X-coordinate: 4.26336e-314
 Y-coordinate: 3.03069e-314
 Side A: 12
 Side B: 15
 Area: 180
 Perimeter: 54

 Testing copy constructor in class Rectangle:
 Rectangle Name: RECTANGLE A
```



```
X-coordinate: 7.44381e+275
Y-coordinate: 0
Side A: 8
Side B: 9
Area: 72
Perimeter: 34
Rectangle Name: RECTANGLE A
X-coordinate: 3.03069e-314
Y-coordinate: 2.14069e-314
Side A: 12
Side B: 15
Area: 180
Perimeter: 54
Rectangle Name: RECTANGLE A
X-coordinate: 0
Y-coordinate: 0
Side A: 100
Side B: 200
Area: 20000
Perimeter: 600

Testing Functions in class Circle:
X-coordinate: 0
Y-coordinate: 0
Radius: 9
Area: 254.469
Perimeter: 56.5487
the area of CIRCLE C is: 254.469
the perimeter of CIRCLE C is: 56.5487

The distance between rectangle a and circle c is: 0
CurveCut Name: CurveCut rc
X-coordinate: 0
Y-coordinate: 0
Width: 10
Length: 12
Radius of the cut: 9
the area of CurveCut rc is: 56.3827
```



```
The distance between rectangle a and circle c is: 0
CurveCut Name: CurveCut rc
X-coordinate: 0
Y-coordinate: 0
Width: 10
Length: 12
Radius of the cut: 9
the area of CurveCut rc is: 56.3827
the perimeter of CurveCut rc is: 40.1372
The distance between rc and c is: 0
Name: SQUARE - S
X-coordinate: 0
Y-coordinate: 0
Side a: 12
Area: 144
Perimeter: 48
The area of SQUARE - S is: 144
the perimeter of SQUARE - S is: 48

Rectangle Name: RECTANGLE A
X-coordinate: 2.57187e-315
Y-coordinate: 0
Side A: 400
Side B: 300
Area: 120000
Perimeter: 1400

The area of RECTANGLE A is: 120000
the perimeter of SQUARE - S is: 1400

X-coordinate: 0
Y-coordinate: 0
Radius: 9
Area: 254.469
Perimeter: 56.5487
```