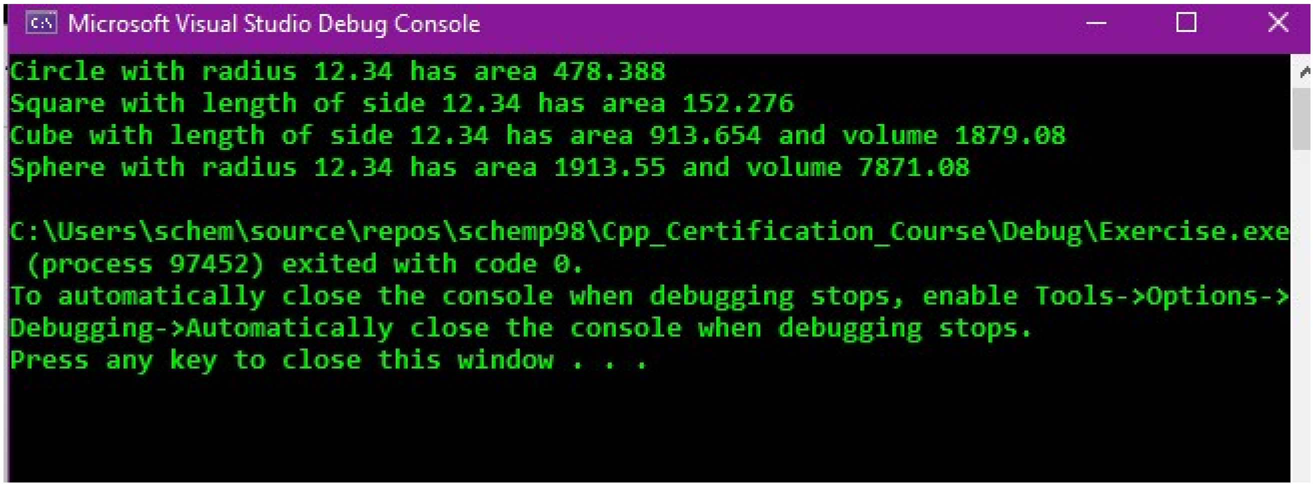
```
//
// Shaun Chemplavil U08713628
// shaun.chemplavil@gmail.com
// C/C++ Programming III : Intermediate Programming with Objects
// 151116  Raymond L. Mitchell III
// Complex.cpp
// Win10
// Visual C++ 19.0
//
// File contains the member functions for Circle, Square, Sphere and Cube class
//

#include <iostream>
#include "Shape.h"

using std::cout;

const double  PI = 3.14159265358979323846 2;

using ShaunChemplavil::Shape;
using ShaunChemplavil::TwoDimensionalShape;
using ShaunChemplavil::ThreeDimensionalShape;

using ShaunChemplavil::Circle;
using ShaunChemplavil::Square;
using ShaunChemplavil::Sphere;
using ShaunChemplavil::Cube;

   // Default Constructor
   Circle::Circle(double radius)
      : radius(radius) {}

    double Circle::getArea() const
   {
      return (radius * radius * PI);
   }

    void Circle::display() const
   {
      cout << "Circle with radius " << radius << " has area " << getArea() <<"\n";
   }

    // Default Constructor
    Square::Square(double lengthOfSide)
       : lengthOfSide(lengthOfSide) {}

    double Square::getArea() const
    {
       return (lengthOfSide * lengthOfSide);
    }

    void Square::display() const
```

```
 {
    cout << "Square with length of side " << lengthOfSide
       << " has area " << getArea() << "\n";
 }


Sphere::Sphere(double radius)
   : radius(radius) {}

double Sphere::getSurfaceArea() const
{
   return (4.0 * PI * radius * radius);
}


double Sphere::getVolume() const
{
   return (getSurfaceArea() *radius/3.0);
}

void Sphere::display() const
{
   cout << "Sphere with radius " << radius<< " has area "
      << getSurfaceArea() << " and volume " << getVolume() <<"\n";
}

// Default Constructor
Cube::Cube(double lengthOfSide)
   : lengthOfSide(lengthOfSide) {}

double Cube::getSurfaceArea() const
{
   return (lengthOfSide * lengthOfSide*6.0);
}

double Cube::getVolume() const
{
   return (lengthOfSide * lengthOfSide * lengthOfSide);
}
void Cube::display() const
{
   cout << "Cube with length of side " << lengthOfSide << " has area " << getSurfaceArea()
      << " and volume " << getVolume() << "\n";
}


```

```
//
// Shaun Chemplavil U08713628
// shaun.chemplavil@gmail.com
// C/C++ Programming III : Intermediate Programming with Objects
// 151116  Raymond L. Mitchell III
// Complex.cpp
// Win10
// Visual C++ 19.0
//
// File contains the member functions for Circle, Square, Sphere and Cube class
//

#include <iostream>
#include "Shape.h"

using std::cout;

const double  PI = 3.14159265358979323846 2;

using ShaunChemplavil::Shape;
using ShaunChemplavil::TwoDimensionalShape;
using ShaunChemplavil::ThreeDimensionalShape;

using ShaunChemplavil::Circle;
using ShaunChemplavil::Square;
using ShaunChemplavil::Sphere;
using ShaunChemplavil::Cube;

// Default Constructor
Circle::Circle(double radius)
   : radius(radius) {}

double Circle::getArea() const
{
   // area = pi*radius^2
   return (radius * radius * PI);
}

void Circle::display() const
{
   cout << "Circle with radius " << radius << " has area " << getArea() << "\n";
}

// Default Constructor
Square::Square(double lengthOfSide)
   : lengthOfSide(lengthOfSide) {}

double Square::getArea() const
{
   // area = lengthOfSide^2
   return (lengthOfSide * lengthOfSide);
}
```

```

void Square::display() const
{
   cout << "Square with length of side " << lengthOfSide
      << " has area " << getArea() << "\n";
}

Sphere::Sphere(double radius)
   : radius(radius) {}

double Sphere::getSurfaceArea() const
{
   // surface area = 4*pi*r^2
   return (4.0 * PI * radius * radius);
}

double Sphere::getVolume() const
{
   // volume = 4/3*pi*r^3
   return (getSurfaceArea() * radius / 3.0);
}

void Sphere::display() const
{
   cout << "Sphere with radius " << radius << " has area "
      << getSurfaceArea() << " and volume " << getVolume() << "\n";
}

// Default Constructor
Cube::Cube(double lengthOfSide)
   : lengthOfSide(lengthOfSide) {}

double Cube::getSurfaceArea() const
{
   // surface area = 6*lengthofSide^2
   return (lengthOfSide * lengthOfSide * 6.0);
}

double Cube::getVolume() const
{// surface area = lengthofSide^3
   return (lengthOfSide * lengthOfSide * lengthOfSide);
}
void Cube::display() const
{
   cout << "Cube with length of side " << lengthOfSide << " has area " << getSurfaceArea()
      << " and volume " << getVolume() << "\n";
}

```

```cpp
//
// Shaun Chemplavil U08713628
// shaun.chemplavil@gmail.com
// C/C++ Programming III : Intermediate Programming with Objects
// 151116  Raymond L. Mitchell III
// hw5.cpp
// Win10
// Visual C++ 19.0
//
// Test Program for the Shape class
//

#include "Shape.h"

using ShaunChemplavil::Circle;
using ShaunChemplavil::Square;
using ShaunChemplavil::Sphere;
using ShaunChemplavil::Cube;
using ShaunChemplavil::Shape;

int main()
{
   Shape * shapePtrArray[4];

   // arbitrary input
   double shapeInput = 12.34;

   // set up array of pointers to shapes to exercise virtual functions
   shapePtrArray[0] = new Circle(shapeInput);
   shapePtrArray[1] = new Square(shapeInput);
   shapePtrArray[2] = new Cube(shapeInput);
   shapePtrArray[3] = new Sphere(shapeInput);

   for (int shapeIdx = 0; shapeIdx < 4; shapeIdx++)
   {
      // call display virtual function via call by reference
      shapePtrArray[shapeIdx]->display();
      // Clean up dynamically allocated memory (utilizes virtual destructors)
      delete shapePtrArray[shapeIdx];
   }
}
```



```
Circle with radius 12.34 has area 478.388
Square with length of side 12.34 has area 152.276
Cube with length of side 12.34 has area 913.654 and volume 1879.08
Sphere with radius 12.34 has area 1913.55 and volume 7871.08

C:\Users\schem\source\repos\schemp98\Cpp_Certification_Course\Debug\Exercise.exe
 (process 97452) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->
Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .
```