

CS120 - Computer Science I

Lab #5

Fall 2014

Due: At the end of lab.

For this lab you will be rewriting Lab #2, calculating the volume and surface area of various solids, as a menu-driven program with functions (similar to the calculator program from the text). You will also be working in pairs using a software development technique called pair programming. In pair programming there are two programmers that alternate between two roles, the “driver” and the “navigator”. The “driver” controls the keyboard and types; the “navigator” watches for typos, errors, and ensures the program follows the overall design. The programmers periodically switch roles, which is what you will be doing with your teammate during this lab. The exact “schedule” for trading roles is given below.

Overall, the program your teams creates should allow the user to pick a shape to calculate the volume and surface area of (the list of shapes and the relevant formulas are given below). Then the program should ask the user for the data needed for calculations (for example, the height and radius), perform the calculations, and print the result. You should use a switch statement, as in the calculator program, and functions to perform the actual calculations.

To make sure both teammates get programming time follow this schedule:

- 1) Begin by having one team member act as the “driver” and program the basic structure of `main()`, but only for the right circular cylinder. `main()` should call functions, which are written in the next step, to get the user’s input and to calculate the surface area and volume of the cylinder.
- 2) Switch roles and have the other team member program the functions to get a value from the user, to calculate the surface area (i.e. two separate functions).
- 3) Switch roles again and have the first “driver” write the function to calculate the volume of the right circular cylinder and extend `main()` to also print the ratio of the volume to surface area.
- 4) Switch roles again and extend `main()` to include the right circular cone.
- 5) Switch roles and write the functions to calculate the surface area and volume of the right circular cone and make any changes to `main()` that are needed.
- 6) Follow the same steps to complete functions for the sphere.

- Right circular cylinder:

$$V = \pi r^2 h$$

$$S = 2\pi r(r + h)$$

- Right circular cone:

$$V = \frac{1}{3}\pi r^2 h$$

$$S = \pi r(r + \sqrt{r^2 + h^2})$$

- Sphere (does not use height)

$$V = \frac{4}{3}\pi r^3$$

$$S = 4\pi r^2$$

In addition to volume and surface area, the *ratio* of the two is often of interest, since it provides a measure of the relative “efficiency” of the solid, i.e., how much volume can be enclosed by a certain amount of surface material. For instance, in the case of a pop can (a right circular cylinder), the ratio would give some indication of the amount of liquid that can be enclosed by a certain amount of aluminum sheet - the larger the number, the more “efficient” the can will be. For this assignment, also output the ratio of volume to surface area for each solid.

For this lab, input your program using a text editor, compile it, and try it on several test cases (i.e., several sets of input values). Use the value of 3.14159 for π . Use proper style and commenting in your program. List both your names in a comment at the top of your source file and submit to only one student account. It is recommended that you place each lab and assignment in a separate subdirectory; for example, a possible directory name for this lab might be lab5. Once you are sure that the program works properly, use `cscheckin` to submit the *source code* (**not** the executable or script).

An example compilation and execution of the program might look like:

```
$ g++ lab5.cpp
$ ./a.out
Enter values for radius and height: 2.0 3.1
```

For a right circular cylinder:

```
The volume is:                38.9557
The surface area is:          64.0884
The ratio of volume to surface area is: 0.607843
```

For a right circular cone:

```
The volume is:                12.9852
The surface area is:          35.7461
The ratio of volume to surface area is: 0.363263
```

For a sphere

```
The volume is:                33.5103
The surface area is:          50.2654
The ratio of volume to surface area is: 0.666667
```

```
$
```