Computer Science 1	Lab 09B Practice/Perform Major Python Assignment
Geometry Functions	40 *through* 100 Point Versions

Assignment Purpose:

The purpose of this lab assignment is to demonstrate knowledge of modular programming and writing short user-defined mathematical functions.

For this lab assignment you are provided with a partially completed program that needs to compute the areas, perimeters, surface areas, and volumes of various 2D and 3D shapes. All of the computations need to be done with short user-defined functions. There will be a total of 24 different functions when finished. The definitions of 4 of them; **squarePerimeter**, **rectangleArea**, **cubeSurfaceArea** and **cylinderVolume**; are provided for you as examples. You will need to write the remaining 20 on your own. The "**MAIN**" section of the program has several program statements. 20 of them are "commented out". This is because these commands contain the calls to those 20 functions. Write the program one function at a time. After you write each function, remove the comment from its function call and test the program to make sure it works.

Lab 09B Student Version	Do not copy this file, which is provided.

```
 1 # Lab09Bst.pv
 2 # "Geometry Functions"
 3 # This is the student, starting version of Lab 09B.
 4
 5
 6 from math import pi
 7
 8
 9 def heading():
10     print()
11     print("**********************************")
12     print("Lab 09B, Geometry Functions")
13     print("100 Point Version")
14     print("By: JOHN SMITH") # Substitute your own name here.
15     print("**********************************")
16     print("\n")
17
18
19 # 2D Perimeters
20 def squarePerimeter (s):
21     return 4 * s
22
23
24
```

```
25
26
27 # 2D Areas
28 def rectangleArea (L,W):
29     return L * W
30
31
32
33
34
35 # 3D Surface Areas
36 def cubeSurfaceArea (s):
37     return 6 * s ** 2
38
39
40
41
42
43 # 3D Volumes
44 def cylinderVolume (r,h):
45     return pi * r ** 2 * h
46
47
48
49
50
51
52
53 ##########
54 #  MAIN  #
55 ##########
56
57 heading()
58
59 side   =  10.0
60 length =  20.0
61 width  =  30.0
62 height =  40.0
63 base1  =  60.0
64 base2  =  80.0
65 radius = 100.0
66
67 # Uncomment the print statements below as you complete each of the functions.
68 # Leave hashtags in place for any functions that you have not yet finished.
69
70 print("Perimeters of 2D Shapes")
71 print("=======================================================")
72 print("Square Perimeter:               ",squarePerimeter(side))
73 #print("Pentagon Perimeter:             ",pentagonPerimeter(side))
74 #print("Hexagon Perimeter:              ",hexagonPerimeter(side))
```

```
#print("Octagon Perimeter:              ",octagonPerimeter(side))
#print("Rectangle Perimeter:           ",rectanglePerimeter(length,width))
#print("Circle Circumference:          ",circleCircumference(radius))
print("\n")
print("Areas of 2D Shapes")
print("=================================================")
#print("Square Area:                   ",squareArea(side))
print("Rectangle Area:                ",rectangleArea(length,width))
#print("Parallelogram Area:            ",parallelogramArea(base1,height))
#print("Triangle Area:                 ",triangleArea(base1,height))
#print("Trapezoid Area:                ",trapezoidArea(base1,base2,height))
#print("Hexagon Area:                  ",hexagonArea(base1,base2,height))
#print("Circle Area:                   ",circleArea(radius))
print("\n")
print("Surface Areas of 3D Shapes")
print("=================================================")
print("Cube Surface Area:             ",cubeSurfaceArea(side))
#print("Square Prism Surface Area:     ",squarePrismSurfaceArea(side,height))
#print("Rectangular Prism Surface Area: ",rectangularPrismSurfaceArea(length,width,height))
#print("Sphere Surface Area:           ",sphereSurfaceArea(radius))
print("\n")
print("Volumes of 3D Shapes")
print("=================================================")
#print("Cube Volume:                   ",cubeVolume(side))
#print("Square Prism Volume:           ",squarePrismVolume(side,height))
#print("Rectangular Prism Volume:      ",rectangularPrismVolume(length,width,height))
#print("Pyramid Volume:                ",pyramidVolume(side,height))
print("Cylinder Volume:               ",cylinderVolume(radius,height))
#print("Cone Volume:                   ",coneVolume(radius,height))
#print("Sphere Volume:                 ",sphereVolume(radius))

```

NOTE: There is a *Formulas Chart* provided for you on the last page.

Explanation of Grading

Students earn a grade of 40 just for trying the assignment. That will be the starting point. There are 24 short functions required for this assignment. I have given you 4 of them so there are 20 left for you to do. Each function is worth 3 points. If you write all 20, then 20 * 3 = 60 and 40 + 60 = 100. Since the grading is done in this way, there is not really an “80” or “90” point version. A grade of 70 can be earned by writing 10 of the 20 functions. A grade of 85 can be earned by writing 15.

Sample Output for the Student Provided File

(This is essentially the 40 Point Version.)

```
 ----jGRASP exec: python Lab09Bst.py

**********************************
Lab 09B, Geometry Functions
100 Point Version
By: JOHN SMITH
**********************************


Perimeters of 2D Shapes
=======================================================
Square Perimeter:                   40.0


Areas of 2D Shapes
=======================================================
Rectangle Area:                     600.0


Surface Areas of 3D Shapes
=======================================================
Cube Surface Area:                  600.0


Volumes of 3D Shapes
=======================================================
Cylinder Volume:                    1256637.0614359174


 ----jGRASP: operation complete.
```

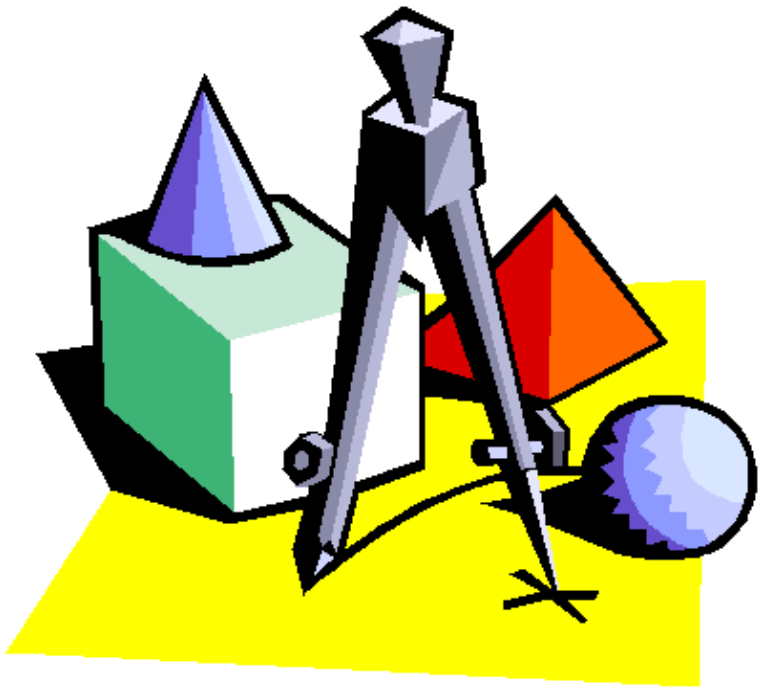
Remember… Do not hard code your program output !!!!
Also, you can write these functions in <u>any</u> order.

Sample Output for the 100 Point Version

(To earn a 100, ALL functions must be written.)

```
  ----jGRASP exec: python Lab09Bv100.py

**********************************
Lab 09B, Geometry Functions
100 Point Version
By: JOHN SMITH
**********************************


Perimeters of 2D Shapes
=======================================================
Square Perimeter:                    40.0
Pentagon Perimeter:                  50.0
Hexagon Perimeter:                   60.0
Octagon Perimeter:                   80.0
Rectangle Perimeter:                 100.0
Circle Circumference:                628.3185307179587


Areas of 2D Shapes
=======================================================
Square Area:                         100.0
Rectangle Area:                      600.0
Parallelogram Area:                  2400.0
Triangle Area:                       1200.0
Trapezoid Area:                      2800.0
Hexagon Area:                        5600.0
Circle Area:                         31415.926535897932
```

```
Surface Areas of 3D Shapes
==========================================================
Cube Surface Area:                    600.0
Square Prism Surface Area:            1800.0
Rectangular Prism Surface Area:       5200.0
Sphere Surface Area:                  125663.70614359173


Volumes of 3D Shapes
==========================================================
Cube Volume:                          1000.0
Square Prism Volume:                  4000.0
Rectangular Prism Volume:             24000.0
Pyramid Volume:                       1333.333333333333
Cylinder Volume:                      1256637.0614359174
Cone Volume:                          418879.02047863905
Sphere Volume:                        4188790.2047863905

 ----jGRASP: operation complete.
```



Formulas Chart

The bolded formulas are the ones given to you in the **Lab09Bst.py** starter file.
Use the built-in value **pi** (imported from the **math** library) for all formulas involving **π**.

Perimeter of a Square	**4 * side**
Perimeter of a Pentagon	5 * side
Perimeter of a Hexagon	6 * side
Perimeter of an Octagon	8 * side
Perimeter of a Rectangle	2 * (length + width)
Circumference of a Circle	2 * π * radius
Area of a Square	$side^2$
Area of a Rectangle	**length * width**
Area of a Parallelogram	base * height
Area of a Triangle	1/2 * base * height
Area of a Trapezoid	(base1 + base2) / 2 * height
Area of a Hexagon	(base1 + base2) * height
Area of a Circle	π * $radius^2$
Surface Area of a Cube	**6 * $side^2$**
Surface Area of a Square Prism	2 * $side^2$ + 4 * side * height
Surface Area of a Rectangle Prism	2 * length * width + 2 * length * height + 2 * width * height
Surface Area of a Sphere	4 * π * $radius^2$
Volume of a Cube	$side^3$
Volume of a Square Prism	$side^2$ * height
Volume of a Rectangular Prism	length * width * height
Volume of a Pyramid	1/3 * $side^2$ * height
Volume of a Cylinder	**π * $radius^2$ * height**
Volume of a Cone	1/3 * π * $radius^2$ * height
Volume of a Sphere	4/3 * π * $radius^3$