**Program 3**

CS 264
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Consider four three-dimensional geometric objects—a cube (1) with edge length $x$, which is circumscribed by a sphere (2), which is circumscribed by a right circular cylinder (3), which is circumscribed by another cube (4).

1. Give arithmetic expressions in terms of $x$ for the surface area and volume of each geometric object. Simplify the expressions to use a minimum number of operations.

$$\begin{aligned} \text{surface area}_1 &= \\ \text{volume}_1 &= \\ \text{surface area}_2 &= \\ \text{volume}_2 &= \\ \text{surface area}_3 &= \\ \text{volume}_3 &= \\ \text{surface area}_4 &= \\ \text{volume}_4 &= \end{aligned}$$

2. Edit a Jasmin source code file named `Program3.j` so that it reads $x$ from the standard input stream, and computes and outputs the surface area and volume of each geometric object, in the order shown above.

```
.class Program3
.super java/lang/Object

.method public static main([Ljava/lang/String;)V
        .limit locals m
        .limit stack n

        ; read x from System.in and store it in local variables 1 and 2
        new java/util/Scanner
        dup
        getstatic java/lang/System/in Ljava/io/InputStream;
        invokespecial java/util/Scanner/<init>(Ljava/io/InputStream;)V
        invokevirtual java/util/Scanner/nextDouble()D
        dstore_1

        ; store a reference to System.out in local variable 3
        getstatic java/lang/System/out Ljava/io/PrintStream;
        astore_3


        :

        return
.end method
```

a) Choose appropriate sizes `m` and `n` for the local variables and operand stack of the `main` method frame, not larger than necessary.

b) Input `x` from the standard input stream `System.in`. The instructions for reading and storing `x` of type `double` in local variables 1 and 2 are given.

c) Use only values of type `double` and arithmetic operations on values of type `double`.

d) Print each value on a separate line of the standard output stream `System.out`. The instructions for storing a reference to `System.out` in local variable 3 are given.

3 Assemble and run the program, and capture its text output on input `x = 2.0` in a file named `Program3.out`. Turn in printed copies of the Jasmin source code file `Program3.j` and the output file `Program3.out`.