1 Short Answer (5 Points Each)

1. Which of the following are valid variable names. If the variable name is invalid state why.

   (a) `soap_box`
   Solution: Valid

   (b) `else`
   Solution: Invalid: else is a reserve word.

   (c) `String`
   Solution: Valid but not recommended.

   (d) `Book#1`
   Solution: Invalid: cannot use special characters like #

   (e) `5Golden_Rings`
   Solution: Invalid: Must start with a letter.

2. What are the three types of programming errors? Briefly describe each of them.

   Solution:

   Syntax Error: An error in the program code due to misuse of the programming language.

   Run-time Error: An error that occurs during a run of the program which usually causes the program to terminate prematurely.

   Logic Error: This error occurs when the program is syntactically correct and there are no runtime errors but the program does not do what it was intended to do.

3. Answer the following questions about numeric data types in Java.

   (a) What happens when you overload an int?
   Solution: The value cycles around to the minimum value of an int.

   (b) What happens when you overload a double?
   Solution: The value turns into Infinity.

   (c) What happens when you underload an int?
   Solution: The value cycles around to the maximum value of an int.

   (d) What happens when you underload a double?
   Solution: The value turns into 0.

   (e) What happens when you input an integer when the Scanner is doing a nextDouble?
   Solution: The integer is changed to its double value equivalent. For example, 5 would become 5.0.

4. What is the difference between a compiler and an interpreter? Also, discuss Java's method. In addition, explain why this makes Java a"platform-independent language."

   Solution:

   A compiler will take a program written in a high-level language, translate it into machine language and then save the machine language program to a file that can be run on the computer. An interpreter does essentially the same thing except that it translates the high-level language to machine language one command at a time and does not save the machine language program to a file. Java uses a combination of the two. There is a compile stage that translates the Java code into byte-code that the interpreter (known as the JVM or Java Virtual Machine) runs.

   Java is compiled into byte-code, this byte code is then interpreted by the Java Virtual Machine (JVM). There is a JVM built for every common operating system, so Java byte-code can be run on any operating system.

5. What does ASCII stand for and what is it?

   Solution: American Standard Code for Information Interchange. It is a system where characters are associated with integers.

6. What are the three main career areas of computing and briefly describe each.

   Solution:

   Computer Engineering: These people design and create the physical hardware inside the machine. They design the CPU chips, memory, hard drives and solid state drives, graphics cards, networking cards, etc.

   Software Engineering: These people create the software that runs on the computer. For example, word processors, spreadsheets, presentation packages, audio and video streaming packages, drivers for the hardware, mobile applications, image processing packages, web browsers, etc.

   Information Technology: These people use the software and hardware to optimize the running of businesses and organizations. They set up hardware and software solutions for the company to be able to efficiently deliver its product or service.

7. Write a single line of code that will generate a random integer between 15 and 37 and store it in a variable named num1.

   Solution:

```
int num1 = (int)(Math.random() * 23) + 15;
```

8. Write a single line of code that will print out the ASCII value of a character variable `ch`.

   Solution:

```
System.out.println((int)ch);
```

9. Write a single line of code that will compute the volume of a sphere given the radius is stored in a variable named `r`. Recall that the volume of a sphere is calculated using the formula $V = \frac{4}{3}\pi r^3$.

   Solution:

```
double v = 4.0 / 3.0 * Math.PI * Math.pow(r, 3);
```

10. Write a couple lines of code that will take the variable `x`, a double, and extract the portion portion to the left of the decimal and the fractional part of the number. For example, if x has the value 34.529 your code will store the 34 in another variable and the 0.529 in a third.

    Solution:

```
int part = (int) x;
double frac = x - part;
```

2 Program Traces (15 Points Each)

1. For each of the given inputs, write the output of the program.

```
1  import java.util.Scanner;
2
3  public class Exam01Trace01 {
4
5      public static void main(String[] args) {
6          Scanner keyboard = new Scanner(System.in);
7
8          System.out.print("Input x: ");
9          int x = keyboard.nextInt();
10         System.out.print("Input y: ");
11         int y = keyboard.nextInt();
12         System.out.print("Input z: ");
13         double z = keyboard.nextDouble();
14
15         double w = 1;
16         long t = 2;
17         int u = 3;
18         double r = 4;
19
20         if (x <= y && y < z) {
21             System.out.println("Block 1");
22             t = y % x;
23             u = ++y + x--;
24         } else if (y > z) {
25             System.out.println("Block 2");
26             w = x / y;
27             r = Math.pow(y, 2);
28         } else {
29             System.out.println("Block 3");
30             t = ++x * y--;
31             r = x / y;
32         }
33
34         System.out.println(x + "  " + y + "  " + z);
35         System.out.println(w + "  " + t + "  " + u + "  " + r);
36     }
37 }
```

(a) Input x: 3
Input y: 7
Input z: 11.5

Solution:

```
Block 1
2  8  11.5
1.0  1  11  4.0
```

(b) Input x: 7
Input y: 3
Input z: 9

Solution:

```
Block 3
9  2  9.0
1.0  24  3  4.0
```

2. For the given input, write the output of the program. For any spaces, including leading or trailing, use an under bracket to represent the space. For example, `Hi  There` should be written as `Hi␣␣There␣`.

```
1  import java.util.Scanner;
2
3  public class Exam01Trace02 {
4
5      public static void main(String[] args) {
6          Scanner keyboard = new Scanner(System.in);
7
8          System.out.print("Input a string: ");
9          String str = keyboard.nextLine();
10
11         System.out.println(str.length());
12         System.out.println(str.charAt(10));
13         System.out.println(str.indexOf("a"));
14         System.out.println(str.indexOf("t", 17));
15         System.out.println(str.lastIndexOf("t", 17));
16
17         String str3 = str.substring(5, 13);
18         String str4 = str.substring(7);
19
20         System.out.println(str3);
21         System.out.println(str4);
22         System.out.println(str3.trim().toUpperCase());
23         System.out.println(str3);
24     }
25 }
```

`Input a string: That␣evening␣it␣was␣dark␣early.`

Solution:

`31`

`n`

`2`

`-1`

`14`

`evening␣`

`ening␣it␣was␣dark␣early.`

`EVENING`

`evening␣`

3 Coding (15 Points Each)

1. Write a program that will take as input a decimal number representing the user's yearly taxable income and return the amount of income tax they must pay the government. Income tax is calculated as a percentage of the users income according to what bracket they fall in. Here is the tax scheme. If the person makes less than $40,000 they pay 15% of their income in tax. If the person makes $40,000 or more up to but not including $65,000 they pay $6,000 plus 20% of their income that exceeds $40,000. If the person makes $65,000 or more up to but not including $100,000 they pay $11,000 plus 25% of their income that exceeds $65,000 in tax. If the person makes $100,000 or more up to but not including $200,000 they pay $19,750 plus 27.5% of their income that exceeds $100,000 in tax. If the person makes $200,000 or more they pay $47,250 plus 30% of their income that exceeds $200,000 in tax. Three separate runs are below.

```
Input your income: 25254     Input your income: 62980     Input your income: 250000
Your tax is: $3788.10        Your tax is: $10596.00       Your tax is: $62250.00
```

Solution:

```java
import java.util.Scanner;

public class Tax {

    public static void main(String[] args) {
        Scanner keyboard = new Scanner(System.in);
        System.out.print("Input your income: ");
        double income = keyboard.nextDouble();
        double tax = 0;

        if (income < 40000) {
            tax = income * 0.15;
        } else if (income < 65000) {
            tax = 6000 + (income - 40000) * 0.2;
        } else if (income < 100000) {
            tax = 11000 + (income - 65000) * 0.25;
        } else if (income < 200000) {
            tax = 19750 + (income - 100000) * 0.275;
        } else {
            tax = 47250 + (income - 200000) * 0.3;
        }

        System.out.printf("Your tax is: $%.2f \n", tax);
    }
}
```

2. Write a program that will take two strings from the user, an initial string and a removal string. Each of these might be more than one word. The program should remove just the first and last occurrence of the removal string. If there is only one occurrence of the removal string it will remove it and if the removal string is not present then the program should output the original string. Three runs are below.

```
Input a string: ace so test so string so ace so help
Input a remove string: so
ace  test so string so ace  help

Input a string: ace so test so string so ace so help
Input a remove string: test
ace so  so string so ace so help

Input a string: ace so test so string so ace so help
Input a remove string: Jack
ace so test so string so ace so help
```

```
1  import java.util.Scanner;
2
3  public class Program2b2 {
4
5      public static void main(String[] args) {
6          Scanner keyboard = new Scanner(System.in);
7
8          System.out.print("Input a string: ");
9          String str = keyboard.nextLine();
10         System.out.print("Input a remove string: ");
11         String removestr = keyboard.nextLine();
12
13         str = str.replaceFirst(removestr, "");
14         int pos = str.lastIndexOf(removestr);
15
16         if (pos != -1) {
17             String str1 = str.substring(0, pos);
18             String str2 = str.substring(pos + removestr.length());
19             str = str1 + str2;
20         }
21
22         System.out.println(str);
23     }
24 }
```

or

```
1  import java.util.Scanner;
2
3  public class Program2b {
4
5      public static void main(String[] args) {
6          Scanner keyboard = new Scanner(System.in);
7
8          System.out.print("Input a string: ");
9          String str = keyboard.nextLine();
10         System.out.print("Input a remove string: ");
11         String removestr = keyboard.nextLine();
12
13         int pos = str.lastIndexOf(removestr);
14
15         if (pos != -1) {
16             String str1 = str.substring(0, pos);
17             String str2 = str.substring(pos + removestr.length());
18             str = str1 + str2;
19         }
```

```
20
21          pos = str.indexOf(removestr);
22
23          if (pos != -1) {
24              String str1 = str.substring(0, pos);
25              String str2 = str.substring(pos + removestr.length());
26              str = str1 + str2;
27          }
28
29          System.out.println(str);
30      }
31  }
```