1 Short Answer (5 Points Each)

1. 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.

2. Write a single line of code (not an entire program) that declares an integer variable `num1` and assigns to it a random integer between 25 and 53, inclusively.

   Solution:

   ```
   int num1 = (int) (Math.random() * 29) + 25;
   ```

3. Write a single line of code (not an entire program) that declares a double variable called `pi` and stores in it the value of $\frac{3\pi}{2}$.

   Solution:

   ```
   double pi = 3 * Math.PI / 2;
   ```

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

   Solution:

   American Srtandard Code for Information Interchange. It is a system where characters are associated with numbers.

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

   (a) What is overloading and underloading an integer?

   Solution: Overloading an integer is when you try to store a value that is too large for the integer to store. Underloading is when you try to store a value that is too small for the integer to store, that is a negative number that is too large.

   (b) What happens when you overload an int?

   Solution: The value cycles around to the minimum value of an int.

   (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 input a non-numeric string when the Scanner is doing a nextInt?

   Solution: Run-time error, since it will not automatically convert a string to an int.

   (e) What happens when you input an integer when the Scanner is doing a nextDouble?

   Solution: The integer is converted to a double, so a 3 would be converted to 3.0.

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

   (a) `Help`

   Solution: Valid

   (b) `5items`

   Solution: Invalid: Variable name cannot start with a number.

   (c) `Variable 1`

   Solution: Invalid: Variable name cannot have a space.

(d) `iH4h__gT3glGygu1`
Solution: Valid

(e) `double`
Solution: Invalid: Variable name cannot be a reserved word.

7. Write a few lines of code (not an entire program) that will take an input string from the user (an entire line of text) and printout the number of spaces in the string. You may assume that a Scanner object has been created with name `kb`. Hint: if you remove all the spaces in the string then the number of spaces in the original string will be the difference in the lengths of the original string and the string with the spaces removed.

Solution:

```
String str1 = kb.nextLine();
int len1 = str1.length();
String str2 = str1.replaceAll(" ", "");
int len2 = str2.length();
System.out.println(len1 - len2);
```

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 Exam1Trace1 {
4
5      public static void main(String[] args) {
6          Scanner kb = new Scanner(System.in);
7          System.out.print("Input a number: ");
8          int a = kb.nextInt();
9          System.out.print("Input a number: ");
10         double b = kb.nextDouble();
11         System.out.print("Input a number: ");
12         int c = kb.nextInt();
13
14         if (a >= b) {
15             System.out.println("Block 1");
16             c = a / 2;
17             --a;
18             b = b + a;
19         } else if (b > c) {
20             System.out.println("Block 2");
21             c = a++ * c;
22             b = b / 2;
23         } else {
24             System.out.println("Block 3");
25             Math.pow(a, c);
26             b = --b - 1;
27             a = c;
28             c = a;
29         }
30
31         System.out.println(a + "  " + b + "  " + c);
32     }
33 }
```

(a) `Input a number: 3`
`Input a number: 5`
`Input a number: 9`

Solution:

```
Block 3
9  3.0  9
```

(b) `Input a number: 1`
`Input a number: 7`
`Input a number: 2`

Solution:

```
Block 2
2  3.5  2
```

(c) `Input a number: 15`
`Input a number: 12`
`Input a number: 4`

Solution:

```
Block 1
14  26.0  7
```

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 Exam1Trace2 {
4
5      public static void main(String[] args) {
6          Scanner kb = new Scanner(System.in);
7          System.out.print("Input a string: ");
8          String s = kb.nextLine();
9          System.out.print("Input a string: ");
10         String t = kb.nextLine();
11         System.out.print("Input a string: ");
12         String r = kb.nextLine();
13
14         int pos = s.indexOf(r);
15         System.out.println(pos);
16         if (pos >= 0) {
17             t = t.substring(pos / 2) + s.substring(pos);
18             s = s.substring(0, pos);
19             r.toUpperCase();
20         } else {
21             pos = t.length() / 2;
22             t = t.substring(pos);
23         }
24
25         System.out.println(s);
26         System.out.println(t);
27         System.out.println(r);
28
29         System.out.println(s.endsWith(r));
30         System.out.println(t.indexOf("o"));
31
32         if (s.compareToIgnoreCase(t) > 0) {
33             System.out.println(s.charAt(1));
34         }else {
35             System.out.println(t.charAt(1));
36             System.out.println(r.charAt(1));
37         }
38     }
39 }
```

(a) `Input a string: You␣are␣almost␣done␣with␣Exam␣1`
`Input a string: Must␣feel␣good`
`Input a string: most`

Solution:

```
10
You␣are␣al
feel␣goodmost␣done␣with␣Exam␣1
most
false
6
o
```

(b) `Input a string: my␣questions␣can␣be␣tricky`
`Input a string: timezone`
`Input a string: ion`

Solution:

```
8
my␣quest
zoneions␣can␣be␣tricky
ion
false
1
o
o
```

3 Coding (15 Points Each)

1. Write a program that will take as input the cost of the food bill at a restaurant. The state tax for the food is 6%, the restaurant has an additional restaurant tax that is 5% if the bill is under $200. If the bill is $200 or more then the restaurant does not include the restaurant tax. If the bill is under $50 then the tip is 15% of the food cost, if the bill is $50 up to but not including $100 then the tip is 17.5% of the food cost, and if the bill is $100 or more then the tip is 20% of the food cost. Have the program print out the food cost, the two taxes, tip, and total. The output of all the costs should have two decimal places and the decimal points should line up vertically, as in the three runs below. You may assume that the cost of any meal is less than $500.

```
Bill = 45.23
     Food Cost =  45.23
           Tax =   2.71
Restaurant Tax =   2.26
           Tip =   6.78
    Total Cost =  56.99
```

```
Bill = 154.39
     Food Cost = 154.39
           Tax =   9.26
Restaurant Tax =   7.72
           Tip =  30.88
    Total Cost = 202.25
```

```
Bill = 237.90
     Food Cost = 237.90
           Tax =  14.27
Restaurant Tax =   0.00
           Tip =  47.58
    Total Cost = 299.75
```

```
1  import java.util.Scanner;
2
3  public class Exam1p1 {
4
5      public static void main(String[] args) {
6          Scanner kb = new Scanner(System.in);
7          System.out.print("Bill = ");
8          double food = kb.nextDouble();
9          double tax = food * 0.06;
10         double resttax = 0;
11         double tip = 0;
12
13         if (food < 200)
14             resttax = food * 0.05;
15
16         if (food < 50)
17             tip = food * 0.15;
18         else if (food < 100)
19             tip = food * 0.175;
20         else
21             tip = food * 0.2;
22
23         double total = food + tax + resttax + tip;
24
25         System.out.printf("     Food Cost = %6.2f \n", food);
26         System.out.printf("           Tax = %6.2f \n", tax);
27         System.out.printf("Restaurant Tax = %6.2f \n", resttax);
28         System.out.printf("           Tip = %6.2f \n", tip);
29         System.out.printf("    Total Cost = %6.2f \n", total);
30     }
31 }
```

2. Write a program that will take in five numbers as input and print out the largest, smallest, and average of the numbers. Remember that the average is the sum of the numbers divided by the number of numbers.

```
Input five numbers: 2.7 9.8 12 1.7 4.2
Minimum = 1.7
Maximum = 12.0
Average = 6.08
```

```java
import java.util.Scanner;

public class HighLowAvg {

    public static void main(String[] args) {
        Scanner kb = new Scanner(System.in);
        System.out.print("Input five numbers: ");
        double n1 = kb.nextDouble();
        double n2 = kb.nextDouble();
        double n3 = kb.nextDouble();
        double n4 = kb.nextDouble();
        double n5 = kb.nextDouble();

        double min = n1;
        if (n2 < min)
            min = n2;
        if (n3 < min)
            min = n3;
        if (n4 < min)
            min = n4;
        if (n5 < min)
            min = n5;

        double max = n1;
        if (n2 > max)
            max = n2;
        if (n3 > max)
            max = n3;
        if (n4 > max)
            max = n4;
        if (n5 > max)
            max = n5;

        System.out.println("Minimum = " + min);
        System.out.println("Maximum = " + max);
        System.out.println("Average = " + (n1 + n2 + n3 + n4 + n5) / 5);

    }

}
```

3. Write a program that will take an input string from the user (an entire line of text) and change the input string by interchanging the first word with the last word. Finally, it should print out the altered string. You may assume that the string has no leading or trailing spaces and that words are separated by a single space. Make sure that this program will also work if there is only one word in the input string.

```
Input a string: some stupid input string
string stupid input some
```

```
1  import java.util.Scanner;
2
3  public class WordSwap {
4
5      public static void main(String[] args) {
6          Scanner kb = new Scanner(System.in);
7          System.out.print("Input a string: ");
8          String s = kb.nextLine();
9          s = s.trim();
10
11         int pos1 = s.indexOf(" ");
12         int pos2 = s.lastIndexOf(" ");
13
14         if (pos1 > -1 && pos2 > -1) {
15             String firstword = s.substring(0, pos1);
16             String lastword = s.substring(pos2 + 1);
17             String middle = s.substring(pos1, pos2 + 1);
18             s = lastword + middle + firstword;
19         }
20
21         System.out.println(s);
22     }
23 }
```