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 -17 and 19, inclusively.

   Solution:

   ```
   int num1 = (int) (Math.random() * 37) - 17;
   ```

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 $\frac{\pi}{6}$.

   Solution:

   ```
   double pi = Math.PI / 6;
   ```

4. 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 numbers.

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

   (a) What is overloading and underloading a double?

   Solution: Overloading an double is when you try to store a value that is too large for the double to store. Underloading is when you try to store a value that is too small for the double to store, that is a decimal number that is too close to 0.

   (b) What happens when you overload a double?

   Solution: The value is considered to be Infinity or -Infinity.

   (c) What happens when you underload a double?

   Solution: The value becomes 0.

   (d) What happens when you input a number when the Scanner is doing a nextLine?

   Solution: The number is converted to a string of the numeric characters.

   (e) What happens when you input a decimal number when the Scanner is doing a nextInt?

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

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

   (a) `hgY3_4qwt%p`

   Solution: Invalid: Variable names cannot have spacial characters, like `%`, in them.

   (b) `item5`

   Solution: Valid

   (c) `HelpMe`

   Solution: Valid

(d) `void`

Solution: Invalid: Variable name cannot be a reserved word.

(e) `Help Me`

Solution: Invalid: Variable name cannot have a space.

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 occurrences of the letter `a` in the string, this is to be case insensitive, so it should count the number of both `a` and `A`. You may assume that a Scanner object has been created with name `kb`. Hint: if you remove every `a` in the string then the number of letters `a` in the original string will be the difference in the lengths of the original string and the string with no letter `a`.

Solution:

```
String str1 = kb.nextLine();
int len1 = str1.length();
str1 = str1.replaceAll("a", "");
str1 = str1.replaceAll("A", "");
int len2 = str1.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: 4`
`Input a number: 3`
`Input a number: 2`

Solution:

```
Block 1
3  6.0  2
```

(b) `Input a number: 5`
`Input a number: 8`
`Input a number: 9`

Solution:

```
Block 3
9  6.0  9
```

(c) `Input a number: 7`
`Input a number: 12`
`Input a number: 5`

Solution:

```
Block 2
8  6.0  35
```

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: The␣quick␣gray␣fox␣jumped`
`Input a string: over␣the␣lazy␣dog`
`Input a string: ick`

Solution:

```
6
The␣qu
r␣the␣lazy␣dogick␣gray␣fox␣jumped
ick
false
12
h
```

(b) `Input a string: a␣very␣tricky␣question`
`Input a string: can␣have␣a␣tricky␣answer`
`Input a string: rick`

Solution:

```
8
a␣very␣t
have␣a␣tricky␣answerricky␣question
rick
false
32
a
i
```

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 product of the numbers. The product of the numbers is simply all of them multiplied together.

```
Input five numbers: 2.7 9.8 12 1.7 4.2
Minimum = 1.7
Maximum = 12.0
Product = 2267.0928
```

```java
import java.util.Scanner;

public class HighLowProd {

    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("Product = " + (n1 * n2 * n3 * n4 * n5));
    }
}
```

3. Write a program that will take an input string from the user (an entire line of text) and a single word (string with only one word). Have the program remove the last occurrence of the word from the sting and print out the new string. Make sure that this program will also work if the word is not in the string. Two runs are below.

```
Input a string: the quick brown fox jumped over the lazy dog
Input a word: the
the quick brown fox jumped over  lazy dog

Input a string: the quick brown fox jumped over the lazy dog
Input a word: pizza
the quick brown fox jumped over the lazy dog
```

```
1  import java.util.Scanner;
2
3  public class WordDelete {
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 word: ");
10         String t = kb.next();
11
12         int pos = s.lastIndexOf(t);
13
14         if (pos > -1) {
15             String firstsub = s.substring(0, pos);
16             String lastsub = s.substring(pos + t.length());
17             s = firstsub + lastsub;
18         }
19
20         System.out.println(s);
21     }
22 }
```