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 that declares an integer variable `num1` and assigns to it a random integer between 25 and 41, inclusively.

   Solution:

   ```
   int num1 = (int) (Math.random() * 17) + 25;
   ```

3. Write a few lines of code that will take a string stored in `str1`, extract the last word and then convert that word to all lowercase characters and finally print the word out to the screen.

   Solution:

   ```
   String str1 = "This is my nifty StRinG";
   str1 = str1.trim();
   int space = str1.lastIndexOf(" ");
   String word = str1.substring(space);
   word = word.toLowerCase();
   System.out.println(word);
   ```

4. 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 a double when the Scanner is doing a nextInt?
   Solution: Run-time error, since it will not automatically convert a double to an int.

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 kb = new Scanner(System.in);
7          System.out.print("Input a positive number: ");
8          int n = kb.nextInt();
9          String s = "";
10
11         while (n > 0) {
12             int r = n % 2;
13             n = n / 2;
14             s = r + s;
15         }
16         System.out.println(s);
17     }
18 }
```

   (a) `Input a positive number: 9`
   Solution:

   `1001`

   (b) `Input a positive number: 19`
   Solution:

   `10011`

   (c) `Input a positive number: 35`
   Solution:

   `100011`

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

```
1  import java.util.Scanner;
2
3  public class Exam01Trace02 {
4
5      public static void main(String[] args) {
6          Scanner kb = new Scanner(System.in);
7          System.out.print("Input n: ");
8          int n = kb.nextInt();
9          System.out.print("Input m: ");
10         int m = kb.nextInt();
11         System.out.print("Input t: ");
12         int t = kb.nextInt();
13
14         System.out.println("Start: " + n + "  " + m + "  " + t);
15
16         do {
17             if (n > t) {
18                 System.out.print("One: ");
19                 t = t + m - n;
20                 m++;
21             } else if (n < t / 2) {
22                 System.out.print("Two: ");
23                 m--;
24                 t++;
25             } else {
26                 System.out.print("Three: ");
27                 m = t++;
28             }
29
30             System.out.println(n + "  " + m + "  " + t);
31             n -= 2;
32         } while (n > 0);
33     }
34 }
```

(a) `Input n: 3`
`Input m: 5`
`Input t: 9`
Solution:

```
Start: 3  5  9
Two: 3  4  10
Two: 1  3  11
```

(b) `Input n: 4`
`Input m: 4`
`Input t: 3`
Solution:

```
Start: 4  4  3
One: 4  5  3
Three: 2  3  4
```

(c) `Input n: 12`
`Input m: 15`
`Input t: 10`
Solution:

```
Start: 12  15  10
One: 12  16  13
Three: 10  13  14
Three: 8  14  15
Two: 6  13  16
Two: 4  12  17
Two: 2  11  18
```

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

```
1  import java.util.Scanner;
2
3  public class Exam01Trace03 {
4
5      public static void main(String[] args) {
6          Scanner kb = new Scanner(System.in);
7          System.out.print("Input str1: ");
8          String str1 = kb.nextLine();
9          System.out.print("Input str2: ");
10         String str2 = kb.nextLine();
11         System.out.print("Input str3: ");
12         String str3 = kb.nextLine();
13
14         int pos = 1;
15         while (str2.length() > 0) {
16             String str4 = str2.substring(0, 1);
17
18             str1 = str1.replaceAll(str4, str3);
19             System.out.println(str1 + " : " + str2);
20
21             if (pos < str2.length())
22                 str2 = str2.substring(pos);
23             else
24                 str2 = "";
25
26             pos++;
27         }
28     }
29 }
```

(a) `Input str1: love all, trust a few, do wrong to none.`
`Input str2: william`
`Input str3: S`

Solution:

```
love all, trust a feS, do Srong to none. : william
love all, trust a feS, do Srong to none. : illiam
Sove aSS, trust a feS, do Srong to none. : liam
Sove aSS, trust a feS, do Srong to none. : m
```

(b) `Input str1: you can't blame gravity for falling in love.`
`Input str2: albert`
`Input str3: E`

Solution:

```
you cEn't blEme grEvity for fElling in love. : albert
you cEn't bEEme grEvity for fEEEing in Eove. : lbert
you cEn't bEEmE grEvity for fEEEing in EovE. : ert
```

3 Coding (15 Points Each)

1. Write a program that will simulate rolling two die and count the number rolls it takes to get two consecutive rolls of boxcars (two sixes).

```
1  public class Exam01Prog01 {
2
3      public static void main(String[] args) {
4          int count = 0;
5          int lastroll = 0;
6          int thisroll = 0;
7
8          while (lastroll < 12 || thisroll < 12) {
9              int die1 = (int) (Math.random() * 6) + 1;
10             int die2 = (int) (Math.random() * 6) + 1;
11
12             lastroll = thisroll;
13             thisroll = die1 + die2;
14
15             count++;
16         }
17         System.out.println("Number of rolls = " + count);
18     }
19 }
```

2. The double factorial of a positive integer n is defined to be $n!! = n \cdot (n-2) \cdot (n-4) \cdots 1$, also we define $0!! = 1$. Write a program that will allow the user to input an integer n and then the program should output the value $n!!$. If the user inputs a negative number the program should print out an error message saying that the input was invalid.

```
1  import java.util.Scanner;
2
3  public class Exam01Prog02 {
4
5      public static void main(String[] args) {
6          Scanner keyboard = new Scanner(System.in);
7          System.out.print("n = ");
8          int n = keyboard.nextInt();
9          long fact = 1;
10
11         if (n < 0) {
12             System.out.print("Invalid input!");
13         } else if (n == 0) {
14             System.out.print("n!! = 1");
15         } else {
16             while (n > 1) {
17                 fact *= n;
18                 n -= 2;
19             }
20             System.out.print("n!! = " + fact);
21         }
22     }
23 }
```

3. Write a program that will take an input string from the user and a character from the user and output the number of occurrences of that character in the string. The counting must be case insensitive, that is `A` and `a` are both counted when searching for an `a`. A sample run is below. Note that Java does not have a function for the scanner that reads in a single char, input a string and extract the first character.

```
String: This is a test of The character counTer.
Character: t
Count = 6
```

```
1  import java.util.Scanner;
2
3  public class Exam01Prog03 {
4
5      public static void main(String[] args) {
6          Scanner keyboard = new Scanner(System.in);
7          System.out.print("String: ");
8          String str = keyboard.nextLine().toLowerCase();
9          System.out.print("Character: ");
10         char c = keyboard.next().toLowerCase().charAt(0);
11
12         int pos = 0;
13         int count = 0;
14
15         while (pos < str.length()){
16             if (str.charAt(pos) == c)
17                 count++;
18
19             pos++;
20         }
21
22         System.out.println("Count = " + count);
23     }
24 }
```