1 Short Answer (10 Points Each)

1. Write a for loop that will calculate a factorial. Assume that the value `n` has been input by the user and have the loop create $n!$ and store it in the variable `fact`. Recall that $n! = n \cdot (n-1) \cdot (n-2) \cdots 2 \cdot 1$.

   Solution:

```
int fact = 1;
for (int i = 1; i <= n; i++)
    fact *= i;
```

2. Write a for loop that will roll a fair die 1000 times and count the number of 3's.

   Solution:

```
int count = 0;
for (int i = 0; i < 1000; i++) {
    int roll = (int) (Math.random() * 6) + 1;
    if (roll == 3)
        count++;
}
```

3. Write a method body for the following method. The method takes in the value `n`, if n is even the method should return half of n and if n is odd the method should return three times n plus 1.

   Solution:

```
public static int Nifty(int n) {
    if (n % 2 == 0)
        return n / 2;
    else
        return 3 * n + 1;
}
```

4. Write a nested for loop that outputs the following. The only thing you are allowed to print is a single asterisk and a new line. So your print statements can only be the following two commands.

```
System.out.print("*");
System.out.println();
```

Loop Output

```
*
**
***
****
*****
******
*******
********
*********
**********
```

Solution:

```
for (int i = 1; i <= 10; i++) {
    for (int j = 0; j < i; j++) {
        System.out.print("*");
    }
    System.out.println();
}
```

5. Write a method body for the following method. The method takes in the value `n`, if n is odd the method should return `true` and if n is even the method should return `false`.

   Solution:

```
public static boolean isOdd(long n) {
    if (n % 2 == 1)
        return true;
    else
        return false;
}
```

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 Exam2Trace1 {
4
5      public static int DoSomething(double a, int b) {
6          int c = (int) a;
7          int t = b - c;
8
9          if (t % 2 == 0)
10             t = t / 2;
11         else
12             t = t + 3;
13
14         return t;
15     }
16
17     public static void main(String[] args) {
18         Scanner keyboard = new Scanner(System.in);
19         System.out.print("Input x: ");
20         int x = keyboard.nextInt();
21         System.out.print("Input y: ");
22         double y = keyboard.nextDouble();
23
24         while (x > 0) {
25             x = DoSomething(y, x);
26             System.out.print(x + "  ");
27             y = y + 0.5;
28         }
29     }
30 }
```

   (a) `Input x: 25`
   `Input y: 3.7`
   Solution:

   `11  10  3  -1`

   (b) `Input x: 15`
   `Input y: 1.4`
   Solution:

   `7  3  4  1  -1`

   (c) `Input x: 15`
   `Input y: 14`
   Solution:

   `4  -5`

2. For each of the given inputs, write the output of the program. You may assume that the input strings have no leading or trailing spaces. There are also only single spaces between the words.

```
1  import java.util.Scanner;
2
3  public class Exam2Trace2 {
4
5      public static void main(String[] args) {
6          Scanner keyboard = new Scanner(System.in);
7          System.out.print("s: ");
8          String s = keyboard.nextLine();
9          System.out.print("x: ");
10         int x = keyboard.nextInt();
11         s = s.toUpperCase();
12
13         int count1 = 0;
14         int count2 = 0;
15         int count3 = 0;
16         int count4 = 0;
17
18         char ch = s.charAt(x);
19         for (int i = s.length() - 1; i >= x; i--) {
20             switch (s.charAt(i)) {
21             case 'A':
22             case 'B':
23             case 'C':
24             case 'D':
25             case 'E':
26             case 'F':
27                 count1++;
28                 break;
29             case 'G':
30             case 'H':
31             case 'I':
32             case 'J':
33                 count2++;
34                 break;
35             case 'Z':
36             case 'Y':
37             case 'X':
38             case 'W':
39                 count3++;
40             default:
41                 count4++;
42             }
43         }
44
45         System.out.println(x + "   " + ch);
46         System.out.println(count1);
47         System.out.println(count2);
48         System.out.println(count3);
49         System.out.println(count4);
50     }
51 }
```

(a) `s: Zanzibar Zebras`
`x: 2`

Solution:

```
2   N
5
1
2
7
```

(b) `s: This is a test.`
`x: 5`

Solution:

```
5   I
2
1
0
7
```

(c) `s: The brown fox jumps over the lazy dog`
`x: 10`

Solution:

```
10   F
5
3
3
19
```

3 Coding (15 Points Each)

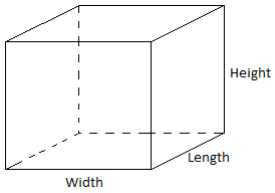
1. Write a program that will ask the user for the number of numbers that they wish to input. Then the program should ask the user for that many numbers (one at a time) and at the end of the program display the maximum number input, minimum number input, and the average of all the numbers that were input. Note that the numbers being input are to be integers but they could be large or negative, so you cannot make any assumptions on the values being input. The program must use a for loop to get the list of numbers from the user.

Program Run

```
Input number of numbers: 5
Input number: -3
Input number: 5
Input number: 0
Input number: 45
Input number: 2
Average = 9.8
Maximum = 45
Minimum = -3
```

```java
import java.util.Scanner;

public class Exam02_1 {

    public static void main(String[] args) {
        Scanner keyboard = new Scanner(System.in);
        System.out.print("Input number of numbers: ");
        int n = keyboard.nextInt();

        int sum = 0;
        int min = 0;
        int max = 0;

        for (int i = 0; i < n; i++) {
            System.out.print("Input number: ");
            int num = keyboard.nextInt();

            sum += num;

            if (i == 0) {
                min = num;
                max = num;
            } else {
                if (num < min)
                    min = num;

                if (num > max)
                    max = num;
            }
        }

        System.out.println("Average = " + (1.0 * sum / n));
        System.out.println("Maximum = " + max);
        System.out.println("Minimum = " + min);
    }
}
```

2. Write a program that will take in the length, width and height of a rectangular box (decimal numbers). The program should then print out the volume and surface area of the box. All input and output must be done in the main and the two calculations must be done in their own methods. The volume of a box is the product of the length, width and height. The surface area is the sum of the areas of each of the faces. Specifically, twice the length times the width, plus twice the length times the height, plus twice the height times the width.



```java
import java.util.Scanner;

public class Exam02_2 {

    public static double volume(double l, double w, double h) {
        return l * w * h;
    }

    public static double surfaceArea(double l, double w, double h) {
        return 2 * l * w + 2 * l * h + 2 * w * h;
    }

    public static void main(String[] args) {
        Scanner keyboard = new Scanner(System.in);
        System.out.print("Input Length: ");
        double length = keyboard.nextDouble();
        System.out.print("Input Width: ");
        double width = keyboard.nextDouble();
        System.out.print("Input Height: ");
        double height = keyboard.nextDouble();
        System.out.println("Volume = " + volume(length, width, height));
        System.out.println("Surface Area = " + surfaceArea(length, width,
            height));
    }
}
```