1 Short Answer (5 Points Each)

1. Write a declaration of an array of 300 strings.

   Solution:

```
String strArray[] = new String[300];
```

2. Write a method that takes in an integer n as a parameter and returns one half of n if n is even and $3n + 1$ if n is odd.

   Solution:

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

3. Write a method that takes in doubles x1, y1, x2, and y2 as parameters and returns the distance between the points (x_1, y_1) and (x_2, y_2).

   Solution:

```
public static double distance(double x1, double y1, double x2, double y2){
    return Math.sqrt((x2 - x1) * (x2 - x1) + (y2 - y1) * (y2 - y1));
}
```

4. Write a method that takes in an array of integers as its only parameter and doubles each entry in the array.

   Solution:

```
public static void Two(int[] A) {
    for (int i = 0; i < A.length; i++)
        A[i] = 2 * A[i];
}
```

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 DoThis(int a, int b){
6          while(b != 0){
7              int t = a;
8              a = b;
9              b = t % b;
10             System.out.print(a + "  ");
11         }
12         System.out.println();
13         return a;
14     }
15
16     public static void main(String[] args) {
17         Scanner keyboard = new Scanner(System.in);
18         System.out.print("Input x: ");
19         int x = keyboard.nextInt();
20         System.out.print("Input y: ");
21         int y = keyboard.nextInt();
22         System.out.println(DoThis(x,y));
23     }
24 }
```

(a) `Input x: 24`
`Input y: 15`
Solution:

```
15  9  6  3
3
```

(b) `Input x: 111`
`Input y: 235`
Solution:

```
235  111  13  7  6  1
1
```

2. Write the output of the program.

```
1  public class ArrayTrace {
2
3      public static int DoSomething(int[] C) {
4          for (int i = 0; i < 4; i++) {
5              C[i] = C[i] + C[i + 1];
6          }
7
8          int n = 0;
9          for (int i = 0; i < 4; i++) {
10             n += C[i];
11         }
12
13         return n;
14     }
15
16     public static void main(String[] args) {
17         int[] A = new int[5];
18
19         for (int i = 0; i < 5; i++) {
20             A[i] = 2 * i;
21         }
22
23         for (int i = 0; i < 5; i++) {
24             System.out.print(A[i] + "  ");
25         }
26         System.out.println();
27
28         int t = DoSomething(A);
29
30         for (int i = 0; i < 5; i++) {
31             System.out.print(A[i] + "  ");
32         }
33
34         System.out.println();
35         System.out.println(t);
36         System.out.println();
37
38         for (int i = 0; i < 5; i++) {
39             A[i] = 5 - i;
40         }
41
42         for (int i = 0; i < 5; i++) {
43             System.out.print(A[i] + "  ");
44         }
45         System.out.println();
46
47         t = DoSomething(A);
48
49         for (int i = 0; i < 5; i++) {
50             System.out.print(A[i] + "  ");
51         }
52         System.out.println();
53         System.out.println(t);
54     }
55 }
```

Solution:

```
0  2  4  6  8
2  6  10  14  8
32

5  4  3  2  1
9  7  5  3  1
24
```

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

```
1  public class MyObject {
2
3      private int t;
4      private int r;
5      private int s;
6
7      public MyObject(int a, int b, int c) {
8          t = a;
9          r = c;
10         s = b;
11     }
12
13     public void DoSomething() {
14         if (t > 0)
15             s = 2 * s - r;
16         else
17             r = 2 * r - s;
18
19         t = s - r;
20     }
21
22     public int DoSomethingElse(int a) {
23         int m = 3 * a;
24
25         if (m > s) {
26             m = a + r;
27             r = s + t;
28         } else {
29             m = r - m;
30             t = r + s;
31         }
32
33         return m;
34     }
35
36     public int AndMore(int a, int b) {
37         int m = 3 * a - 2 * b;
38         DoSomething();
39
40         if (s - m > 0)
41             m = a + s;
42         else
43             m = s - m;
44
45         return m;
46     }
47
48     public String toString() {
49         return t + " " + r + " " + s;
50     }
51 }
```

```
1  import java.util.Scanner;
2
3  public class ObjectTrace001 {
4
5      public static void main(String[] args) {
6          Scanner kb = new Scanner(System.in);
7          System.out.print("Input: ");
8          int h = kb.nextInt();
9          int n = kb.nextInt();
10         int m = kb.nextInt();
11
12         MyObject mo = new MyObject(n, m, h);
13         System.out.println(mo.toString());
14         mo.DoSomething();
15         System.out.println(mo.toString());
16         m = mo.DoSomethingElse(n);
17         System.out.println(mo.toString());
18         h = mo.AndMore(h, m);
19         System.out.println(mo.toString());
20         System.out.println(h);
21     }
22 }
```

(a) `Input: 9 3 7`

Solution:

```
3 9 7
-4 9 5
-4 1 5
8 -3 5
14
```

(b) `Input: -3 5 10`

Solution:

```
5 -3 10
26 -3 23
20 -3 23
52 -3 49
46
```

3 Coding (15 Points Each)

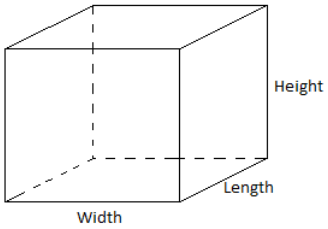
1. Write a method called IncomeTax that will take as input a decimal number representing the user's yearly taxable income and return the amount of income tax they must pay the government. Income tax is calculated as a percentage of the users income according to what bracket they fall in. Here is the tax scheme. If the person makes less than $40,000 they pay 20% of their income in tax. If the person makes $40,000 or more up to but not including $60,000 they pay $8,000 plus 25% of their income that exceeds $40,000 in tax, that is, if they make $50,000 they pay $8,000 plus 25% of $10,000. If the person makes $60,000 or more up to but not including $100,000 they pay $13,000 plus 27.5% of their income that exceeds $60,000 in tax. If the person makes $100,000 or more they pay $24,000 plus 30% of their income that exceeds $100,000 in tax.

```
1  public static double IncomeTax(double income) {
2      double tax = 0;
3
4      if (income < 40000){
5          tax = income * 0.2;
6      } else if (income < 60000){
7          tax = 8000 + 0.25*(income - 40000);
8      } else if (income < 100000){
9          tax = 13000 + 0.275*(income - 60000);
10     } else {
11         tax = 24000 + 0.3*(income - 100000);
12     }
13
14     return tax;
15 }
```

2. Write a program that takes the length of an array as input and a maximum entry size as input. The program should create an array of integers of the given size and populate it with random numbers between 1 and the maximum entry size that was input. The program should then find the maximum entry in the array and print it out, the minimum entry in the array and print it out, the average of all the entries in the array and print it out, and finally count the number of even entries in the array and print that out.

```
1  import java.util.Scanner;
2
3  public class Exam02_2 {
4
5      public static void main(String[] args) {
6          Scanner keyboard = new Scanner(System.in);
7          System.out.print("Input the array size: ");
8          int size = keyboard.nextInt();
9          System.out.print("Input max entry size: ");
10         int entrysize = keyboard.nextInt();
11
12         int A[] = new int[size];
13
14         for (int i = 0; i < A.length; i++) {
15             A[i] = (int) (Math.random() * entrysize) + 1;
16         }
17
18         int max = A[0];
19         for (int i = 0; i < A.length; i++) {
20             if (A[i] > max)
21                 max = A[i];
22         }
23
24         System.out.println(max);
25
26         int min = A[0];
27         for (int i = 0; i < A.length; i++) {
28             if (A[i] < min)
29                 min = A[i];
30         }
31
32         System.out.println(min);
33
34         double sum = 0;
35         for (int i = 0; i < A.length; i++) {
36             sum += A[i];
37         }
38
39         System.out.println(sum / A.length);
40
41         int count = 0;
42         for (int i = 0; i < A.length; i++) {
43             if (A[i] % 2 == 0)
44                 count++;
45         }
46
47         System.out.println(count);
48     }
49 }
```

3. Write a class (object) called Box that stores the length, width, and height of a rectangular box. Create methods to find the volume (the volume is the product of the length width and height), the surface area (the surface area is the sum of the areas of each of the faces), and the edge length (the edge length is the sum of the lengths of all of the edges). The constructor should take in three parameters, to initialize length, width, and height. The main should declare a box with length 5, width 7, and height 4. Then call each of the methods.



```java
public class Box {
    private double length;
    private double width;
    private double height;

    public Box(double l, double w, double h) {
        length = l;
        width = w;
        height = h;
    }

    public double volume() {
        return length * width * height;
    }

    public double surface_area() {
        return 2 * length * width + 2 * width * height + 2 * length * height;
    }

    public double edge_length() {
        return 4 * length + 4 * width + 4 * height;
    }
}
```

```java
public class Exam02_3 {

    public static void main(String[] args) {
        Box box = new Box(5, 7, 4);
        System.out.println(box.volume());
        System.out.println(box.surface_area());
        System.out.println(box.edge_length());
    }
}
```