Directions: This is a closed book, closed notes midterm. Place your answers in the space provided. The point value for each question is indicated. There are a total of 80 points on the short answer and 80 points on the programming portion for a total of 160 points that will be weighted to 100 points. You have 120 minutes for this final.

Short Answer

1. (10 pts) For each expression in the left-hand column, indicate its value in the right-hand column. Be sure to list a constant of appropriate type (e.g., 7.0 rather than 7 for a double, Strings in "quotes").

<table>
<thead>
<tr>
<th>Expression</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$8 + 5 * 3 / 2$</td>
<td></td>
</tr>
<tr>
<td>$1.5 * 4 * 7 / 8 + 3.4$</td>
<td></td>
</tr>
<tr>
<td>$73 % 10 - 6 % 10 + 28 % 3$</td>
<td></td>
</tr>
<tr>
<td>$4 + 1 + 9 + &quot;.&quot; + (-3 + 10) + 11 / 3$</td>
<td></td>
</tr>
<tr>
<td>$3 / 14 / 7 / (1.0 * 2) + 10 / 6$</td>
<td></td>
</tr>
</tbody>
</table>
public class ParameterMystery {
    public static void main(String[] args) {
        String a = "felt";
        String b = "saw";
        String c = "drew";
        String saw = "sue";
        String drew = "b";

        mystery(a, b, c);
        mystery(b, a, saw);
        mystery(drew, c, saw);
        mystery("a", saw, drew);
        mystery(a, a, "drew");
    }

    public static void mystery(String b, String a, String c) {
        System.out.println(c + " " + a + " the " + b);
    }
}
3. (10 pts) Consider the following Java method:

```java
// This method is supposed to return how many of its three arguments are odd numbers
public static int numberOfOdds(int n1, int n2, int n3) {
    int count = 0;
    if (n1 % 2 != 0) {
        count++;
    }
    if (n2 % 2 != 0) {
        count++;
    }
    if (n3 % 2 != 0) {
        count++;
    }
    return count;
}
```

If the method is correct, simply state that it is correct to answer this question. If it is incorrect, rewrite the code below.
4. (10 pts) Consider the following Java method:

```java
// This method is supposed to return true if the String str contains the
// character ch and false otherwise
public static boolean contains (String str, char ch) {
    boolean found = false;

    for (int i = 0; i < str.length(); i++) {
        if (str.charAt(i) == ch) {
            found = true;
        } else {
            found = false;
        }
    }
    return found;
}
```

If the method is correct, simply state that it is correct to answer this question. If it is incorrect, rewrite the code below.
public class Mystery {

    public static void main (String [] args) {
        int x = 1;
        int [] a = new int[2];
        mystery(a, x);
        System.out.println(x + " " + a[0] + " " + a[1]);
        x--;
        a[1] = a.length;
        mystery(a, x);
        System.out.println(x + " " + a[0] + " " + a[1]);
    }

    public static void mystery(int[] list, int x) {
        list[x]++;
        x++;
        System.out.println(x + " " + list[0] + " " + list[1]);
    }
}

5. (10 pts) What is the output of the following program?
6. (10 pts) Consider the following method:

```java
public static void mystery(int[] data, int x, int y) {
    data[data[x]] = data[y];
    data[y] = x;
}
```

What are the values of the elements in the array `numbers` after the following code executes?

```java
int[] numbers = {3, 7, 1, 0, 25, 4, 18, -1, 5};
mystery(numbers, 3, 1);
mystery(numbers, 5, 6);
mystery(numbers, 8, 4);
```
7. (10 pts) Consider the following class definition:

```java
public class Book {
    private String title;
    private String author;
    private int numberOfPages;

    public Book (String t, String a, int n) {
        String title = t;
        String author = a;
        int numberOfPages = n;
    }

    public String toString() {
        return title + " by " + author + ": " + numberOfPages + " pages";
    }
}
```

What is the output printed by the following client code segment?

```java
Book b = new Book("The Black Stallion", "Walter Farley", 245);
System.out.println(b);
```
8. (10 pts) List the three uses of a class in Java and briefly state what each use is for.
**Programming Exercises:** There are 4 exercises to complete in this part of the exam. Each is worth 20 pts.

Enter the following copy command:

```
    cp -r /home/student/Classes/201/2009  .
```

9. (20 pts) Change into directory 2009 and open Nine.java. You are not allowed to change the main() except to comment out specific lines to test certain cases.

Write a method named `before` that takes as parameters two month/day combinations and that returns whether or not the first date comes before the second date (`true` if the first month/day comes before the second month/day, `false` if it does not). The method will take four integers as parameters that represent the two month/day combinations.

The first integer in each pair represents the month and will be a value between 1 and 12 (1 for January, 2 for February, etc, up to 12 for December). The second integer in each pair represents the day of the month (a value between 1 and 31). One date is considered to come before another if it comes earlier in the year.

For example, the call:

```
    before(6, 3, 9, 20)
```

should return `true` because June 3rd (6/3) comes before September 20th (9/20). By contrast, the call:

```
    before(10, 1, 2, 25)
```

should return `false` because October 1st (10/1) comes after February 25th (2/25). If the same date is passed twice, your method should return `false`. For example:

```
    before(8, 15, 8, 15)
```

should return `false` because August 15th (8/15) does not come before August 15th (8/15).

You may assume that your method is passed values that represent legal dates. If your method is working correctly, when you run Nine.java, you should get all `true`s printed out.

When you are ready:

```
    submit 201 Nine.java
```
10. (20 pts) Open Ten.java. You are not allowed to change the main() except to comment out specific lines to test certain cases. Write a method named longestWord() that accepts a String as its parameter and returns the length of the longest word in the string. A word is a sequence of one or more non-space characters (any character other than the space character, ' ').

Here are some example calls to your method and their expected results:

<table>
<thead>
<tr>
<th>Call</th>
<th>Value returned</th>
</tr>
</thead>
<tbody>
<tr>
<td>longestWord(&quot;to be or not to be&quot;)</td>
<td>3</td>
</tr>
<tr>
<td>longestWord(&quot;oh hello, how are you?&quot;)</td>
<td>6</td>
</tr>
<tr>
<td>longestWord(&quot;I am OK&quot;)</td>
<td>2</td>
</tr>
<tr>
<td>longestWord(&quot; this example has many spaces &quot;)</td>
<td>7</td>
</tr>
<tr>
<td>longestWord(&quot;test&quot;)</td>
<td>4</td>
</tr>
<tr>
<td>longestWord(&quot;&quot;&quot;)</td>
<td>0</td>
</tr>
<tr>
<td>longestWord(&quot; &quot;)</td>
<td>0</td>
</tr>
</tbody>
</table>

Note that the string might be empty, might not contain any words, might begin with spaces, and might contain words separated by multiple spaces. You may assume that the string doesn't contain any other whitespace characters such as tabs or newlines. For full credit, you may not use a Scanner. However, use one for partial credit if you have to.

If your method is working correctly, when you run Ten.java, you should get all true printed out.

When you are ready:

    submit 201 Ten.java
11. (20 pts) Open Eleven.java. You are not allowed to change the `main()` except to comment out specific lines to test certain cases. Write a method named `minGap` that accepts an integer array as a parameter and returns the minimum 'gap' between adjacent values in the array. The gap between two adjacent values in a array is defined as the second value minus the first value. For example, suppose a variable called `array` is an array of integers that stores the following sequence of values.

```java
int[] array = {1, 3, 6, 7, 12};
```

The first gap is 2 (3 - 1), the second gap is 3 (6 - 3), the third gap is 1 (7 - 6) and the fourth gap is 5 (12 - 7).
Thus, the call of `minGap(array)` should return 1 because that is the smallest gap in the array. Notice that the minimum gap could be a negative number. For example, if `array` stores the following sequence of values:

```java
{3, 5, 11, 4, 8}
```

The gaps would be computed as 2 (5 - 3), 6 (11 - 5), -7 (4 - 11), and 4 (8 - 4). Of these values, -7 is the smallest, so it would be returned.

If you are passed an array with fewer than 2 elements, you should return 0.

If your method is working correctly, when you run Eleven.java, you should get all `true`s printed out.

When you are ready:

```
    submit 201 Eleven.java
```
12. (20 pts) Open the Twelve.java. This is client code that uses a class Rectangle that you write. You are not allowed to change the main() except to comment out specific lines to test certain cases.

   a. Each Rectangle has a length and a width which are the fields of the Rectangle.

   b. There is one constructor for a Rectangle. The constructor takes two integers, a length and a width that become the field values of this new Rectangle. For example:

       ```java
       Rectangle r1 = new Rectangle(5, 3);
       ```

       constructs a new Rectangle with a length of 5 and a width of 3.

   c. Write an area() method for Rectangles. When area() is called on a Rectangle, its area is returned as an integer. For example, for the Rectangle in b, r1.area() would be 15.

   d. Write an isSquare() method for Rectangles. When isSquare() is called on a Rectangle, it returns true if the Rectangle is also a square and false if it is not. A Rectangle is a square if its length and width are equal. For example, for the Rectangle in b, r1.isSquare() would be false.

   e. Write a method for Rectangles so that Rectangles can return a String representation of themselves for printing. The String representation should include the Rectangle’s length and width followed by the word “rectangle”. For example, for the Rectangle in b,

       ```java
       System.out.println(r1);
       ```

       should result in the output

       5 X 3 rectangle

       If your Rectangle class is working correctly, when you run Twelve.java, you should get the following output

       5 X 3 rectangle
       true
       true
       5 X 5 rectangle
       true
       true

   When you are ready:

       submit 201 Rectangle.java