1.00/1.001

Introduction to Computers and Engineering Problem Solving

Spring 2012 - Quiz 1

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Section:	

You have 80 minutes to complete this exam. For coding questions, you do not need to include comments, and you should assume that all necessary packages have already been imported. You may only add code inside the boxes. The code written outside the boxes may not be altered in any way. Good luck!

Question 1	**/ 30**
Question 2	**/ 40**
Question 3	**/ 30**
Total	**/ 100**

Question 1 - Control Structures, Operators (30 points)

1.a Will these statements compile? Write "Yes" or "No" in the "Compiles?" column. If the statements compile, write the **exact** output in the "Program Output or Explanation" column. If the statements do not compile, briefly explain the error.

Program code	Compiles? [Yes/No]	Program Output or Explanation

`public static void test(int a, double b){`
`  System.out.println("In: " + a + ", "+ b);`
`}`
`public static void main(String[] args) {`
`  test(6.55, 4.29);`
`}`		

`public static void main(String[] args) {`
`  int a = 100000000000;`
`  System.out.println(a);`
`}`		

`public static void main(String[] args) {`
`  int x = 8;`
`  x--;`
`  System.out.println("First: " + x);`
`  x /= 2;`
`  System.out.println("Second: " + x);`
`}`		

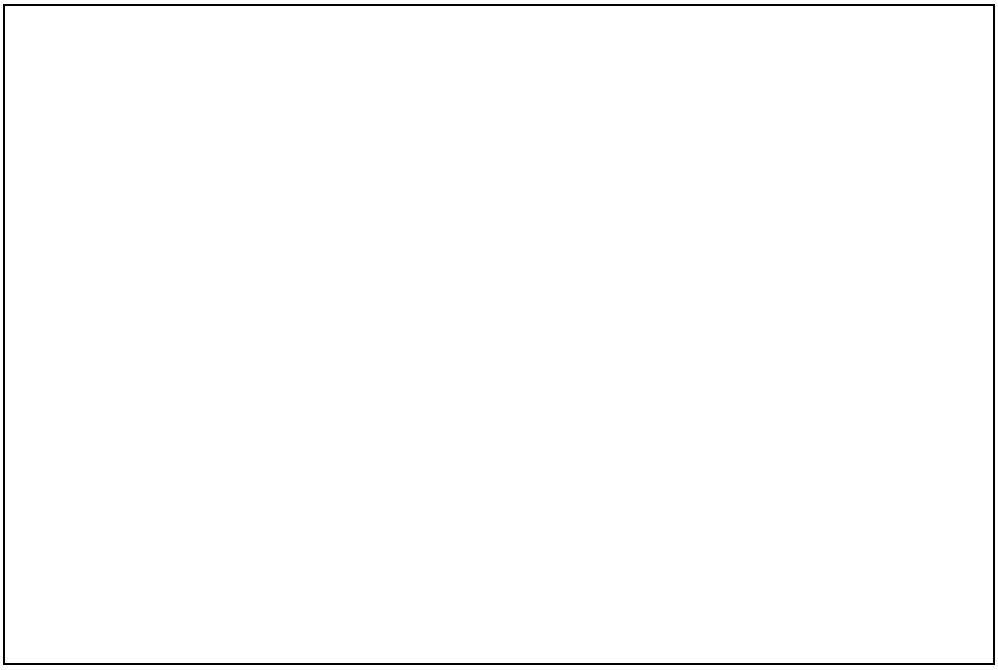
`public static void main(String[] args) {`
`  System.out.println(1 >= 2 && 3 < 7);`
`}`		

1.b Programs are often used to find numerical solutions to differential equations. You will model a simple differential equation, dx/dt=v, where x is position, t is time, and v is velocity. You can discretize the equation as: $x_1 \cong x_0 + v(t_0) * \Delta t$, $x_2 \cong x_1 + v(t_1) * \Delta t$, and so on.

Write the `getPosition()` method to find the approximate position (x) of a train at any given time t (in **minutes**). The train departs from the first station (x = 0) at time t = 0. You have a database of the train's velocity (in **kilometers/minute**), recorded every minute, and method `getVelocity()` to access this data is provided. Assume that the train's velocity over each interval is constant. Your method must return the train's position in **kilometers**. Assume `getVelocity()` returns zero for any negative input. The method `getPosition()` must return zero for any negative input.

```
public class Train{

    public static double getPosition(int t){
```



```
    }
    public static double getVelocity(int t){
        // Method body not shown

        // Method that finds the velocity at time t.
        // Returns answer in kilometers per minute.
        // Returns 0 if t < 0.

        // input: minutes
        // output: kilometers/minute
    }
```

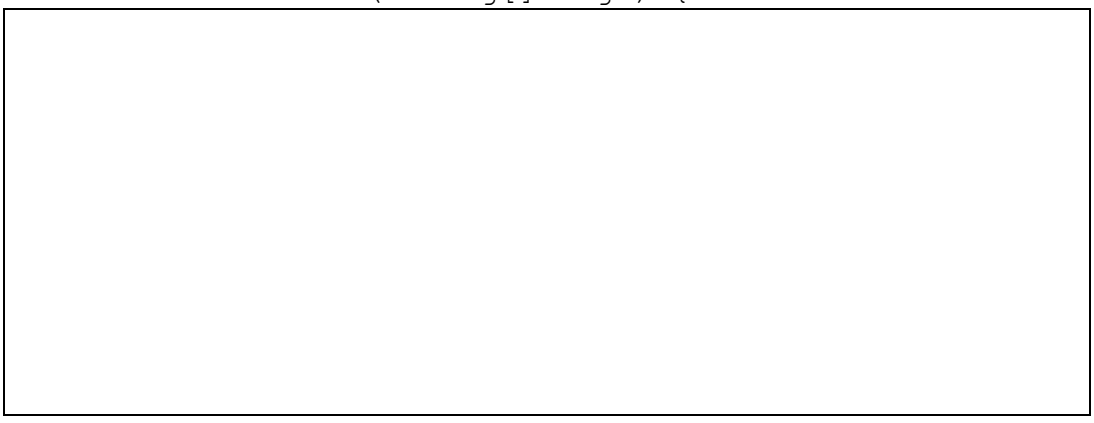
1.c You are also interested in finding the average velocity (distance traveled / time) of the train until any given time point. Complete the method `getAverageVelocity()`. Your method should return an answer in **kilometers per <u>hour</u>** (not kilometers/minute) and should return **0** for any non-positive `t`.

```
public static double getAverageVelocity(int t){
```

```
}
```

1.d Write a `main()` method to display the position (in **kilometers**) and average velocity (in **kilometers per hour**) of the train after 15 **minutes**. You may assume the previous methods are implemented properly for this section.

```
public static void main(String[] args) {
```



```
    }
}
```

Question 2 - Classes and Objects (40 points)

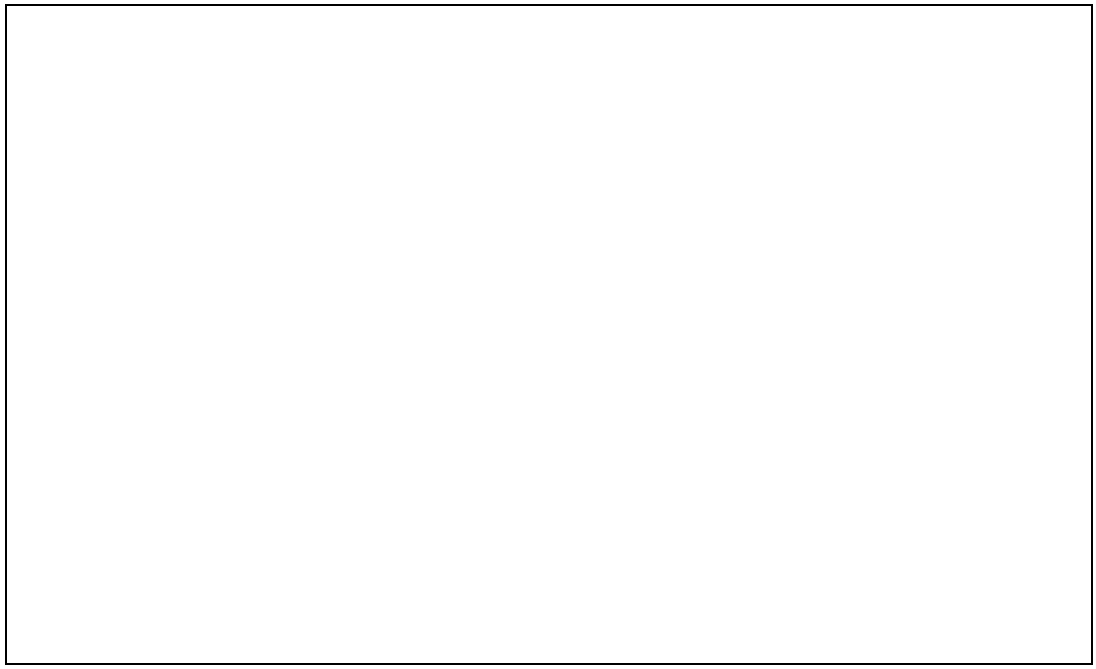
You are asked to model a polling center for the presidential election within the state of Michigan. You are given the code for the class `PoliticalParty`.

```
public class PoliticalParty {
      String partyName;
      public PoliticalParty(String nme){
            partyName = nme;
      }
}
```

2.a Write a class to represent a presidential candidate called `Candidate`. Your class should contain the following:

- A String data member called `name` that can be accessed by any class in the same package.
- A `PoliticalParty` data member called `party` that can only be accessed by the `Candidate` class.
- An `int` data member called `numberOfVotes` that can only be accessed by the `Candidate` class
- A constructor that initializes the name and the party of the `Candidate` when given a `String` and a `PoliticalParty` as input. Each `Candidate` should begin with zero `numberOfVotes`.
- A public method called `receivedAVote()` that increases the `numberOfVotes` by one.

```
public class Candidate {
```



```
}
```

2.b Write a class called `PollCenter`. Your class should contain the following:

- Two `Candidate` data members, one called `myCandidate` and one called `yourCandidate`. All data members should have `private` access.
- A constructor that takes two input arguments to initialize `myCandidate` and `yourCandidate` .
- A public method called `voteForMyCandidate()` that increases the number of votes for `myCandidate` by one.
- A public method called `voteForYourCandidate()` that increases the number of votes for `yourCandidate` by one.

```
public class PollCenter {
```

```
}
```

2.c The following method is added to the class `PollCenter`. Can you identify any problem(s) with the code?

```
public int viewPartyVotes(PoliticalParty p){
     if (myCandidate.party == p){
          return myCandidate;
     } else if (yourCandidate.party == p){
          return yourCandidate;
     } else
          return 0;
}
```

Circle all explanations that are applicable:

A. No problem; this is fine

B. The method has no return type

C. The method may not return a value of the correct type

D. The method tries to access variables that are not accessible by the class `PollCenter`

Question 3 - Arrays (30 points)

3.a Given an integer array of size N, write a static method `occurrenceK` that returns the number of occurrences of the integer at position k in that array, where $0 \leq k < N$. For example, `occurrenceK({0,1,1,1},0)` returns 1, and `occurrenceK({3,1,2,1},1)` returns 2.

```
private static int occurrenceK(int[] array, int k){
```

}

3.b Now write a second static method `maxOccurrence` that returns the integer which has the highest number of occurrences in a given integer array. Assume that the previous method has been correctly written and is in the same class as `maxOccurrence`. Also assume there is always one such unique integer.

```
public static int maxOccurrence(int[] array){
```

}

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