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!
1. 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.

<table>
<thead>
<tr>
<th>Program code</th>
<th>Compiles?</th>
<th>Program Output or Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>public static void test(int a, double b) {</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System.out.println(&quot;In: &quot; + a + &quot;, &quot; + b);</td>
<td></td>
<td></td>
</tr>
<tr>
<td>}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>public static void main(String[] args) {</td>
<td></td>
<td></td>
</tr>
<tr>
<td>test(6.55, 4.29);</td>
<td></td>
<td></td>
</tr>
<tr>
<td>}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>public static void main(String[] args) {</td>
<td></td>
<td></td>
</tr>
<tr>
<td>int a = 100000000000;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System.out.println(a);</td>
<td></td>
<td></td>
</tr>
<tr>
<td>}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>public static void main(String[] args) {</td>
<td></td>
<td></td>
</tr>
<tr>
<td>int x = 8;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>x--;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System.out.println(&quot;First: &quot; + x);</td>
<td></td>
<td></td>
</tr>
<tr>
<td>x /= 2;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System.out.println(&quot;Second: &quot; + x);</td>
<td></td>
<td></td>
</tr>
<tr>
<td>}</td>
<td></td>
<td></td>
</tr>
<tr>
<td>public static void main(String[] args) {</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System.out.println(1 &gt;= 2 &amp;&amp; 3 &lt; 7);</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1.b Programs are often used to find numerical solutions to differential equations. You will model a simple differential equation, \( \frac{dx}{dt} = v \), where \( x \) is position, \( t \) is time, and \( v \) is velocity. You can discretize the equation as: 
\[
\begin{align*}
x_1 & \approx x_0 + v(t_0) \cdot \Delta t, \\
x_2 & \approx x_1 + v(t_1) \cdot \Delta t,
\end{align*}
\]
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.

```java
public class Train {

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

    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 hour (not kilometers/minute) and should return 0 for any non-positive t.

```java
public static double getAverageVelocity(int t) {
    // Your implementation here
}
```

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.

```java
public static void main(String[] args) {
    // Your implementation here
}
```
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`.

```java
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.

```java
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.

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

```java
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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