

Beijing National Day School
Department of Mathematics & Computer Science

AP Computer Science A

Test 2: Arrays and Classes

English Name: _____

Pinyin Name: _____

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Exam Record

Part1 _____ / 25 pts

Part2 _____ / 11 pts

Part3 _____ / 16 pts

Total: _____ / 52 pts

Grade: _____

Part I: Multiple Choice (25 points)

- Determine the answer to each of the following questions, using the available space for any necessary scratchwork.
- Decide which is the best of the choices given, and select the correct answer by placing an “X” in the corresponding box.

(1^{pt}) 1. Which of the following choices correctly declares and initializes an array of integers named `nums`?

- `integer[] nums = new integer[5];`
 `new int nums[] = int[5];`
 `int[] nums = new int[5];`
 `nums = [5];`

1 pt

(1^{pt}) 2. What would be the output of the following Java code?

```
int[] nums = {2, 4, 6, 8};  
System.out.println(nums[0] + " " + nums[1]);
```

2 4
 2 6
 8
 6 8

1 pt

(1^{pt}) 3. What would be the output of the following Java code?

```
int[] nums = {2, 4, 6, 8};  
nums[0] = 23;  
nums[3] = nums[1];  
System.out.println(nums[0] + " " + nums[3]);
```

31
 23 2
 2 8
 23 4

1 pt

(1^{pt}) 4. What is the technical name for the following array declaration in Java?

```
double[] scores = {93.7, 86.2, 91.5, 98.3};
```

A customizer list.
 An initializer list.
 An elementary list.
 A verifier list.

1 pt

4 pts

- (1^{pt}) 5. What would be the output of the following Java code?

```
double[][] nums = { {1.2, 9.0, 3.2},
                    {9.2, 0.5, 1.5},
                    {7.3, 7.9, 4.8} };
```

```
System.out.println(nums[2][1]);
```

- 7.3
 7.9
 9.2
 5.1

1 pt

- (1^{pt}) 6. What would be the output of the following Java code?

```
int[] nums = {12, 34, 9, 0, -62, 88};
```

```
System.out.println(nums.length);
```

- 5
 1
 6
 12

1 pt

- (1^{pt}) 7. Consider the following Java program. We want to assign numbers into the array `nums`, such that each number is twice the value of its index. Choose one of the following statements to replace `// YOUR CODE HERE` which would generate this result.

```
int[] nums = new int[10];
for (int i = 0; i < nums.length; i++)
{
    // YOUR CODE HERE
}
```

- `i = 2*i;`
 `nums[2*i] = 2*i;`
 `nums[i] = 2*nums[i];`
 `nums[i] = 2*i;`

1 pt

- (1^{pt}) 8. What would be the output of the following Java code?

```
int[] nums = {2, 4, 6, 8, 10, 1, 3, 5, 7, 9};
```

```
for (int i = 0; i < 5; i++)
```

```
{
    System.out.print(nums[i] + " ");
}
```

- 2 4 6 8 10
 2 4 6 8
 2 4 6 8 10 1
 2 4 6 8 10 1 3 5 7 9

1 pt

4 pts

- (1^{pt}) **9.** What would be the output of the following Java code?
- ```
double[] [] nums = { {1.2, 9.0},
 {9.2, 0.5},
 {7.3, 7.9} };
System.out.println(nums.length);
```
- 2  
 4  
 3  
 9
- (1<sup>pt</sup>) **10.** Which of the following choices are considered fundamental qualities of good object-oriented design?
- catch and release  
 bait and switch  
 state and behaviour  
 hook, line, and sinker
- (1<sup>pt</sup>) **11.** Which of the following choices is the correct way to set up a constructor?
- `public String Rectangle()`  
 `public static int SportsTeam(int players)`  
 `public constructor Bicycle(int gears)`  
 `public Compass(int direction)`
- (1<sup>pt</sup>) **12.** Consider a class that has two constructors. Which of the following conditions must be true in order for the program to compile correctly?
- The constructors must be declared private and void.  
 The constructors must be placed in separate source code files.  
 The constructors must specify a return type.  
 The constructors must have unique parameter lists.
- (1<sup>pt</sup>) **13.** Which of the following choices would be considered an accessor method?
- `public Kennel(double price)`  
 `public String getName()`  
 `public Ticket()`  
 `public class Player`
- (1<sup>pt</sup>) **14.** Which of the following is a fundamental quality of mutator methods?
- Mutator methods always return an integer data type.  
 The instance variables are declared within mutator methods.  
 Mutator methods alter the instance variables.  
 Mutator methods change all the data types of the class.

- (1<sup>pt</sup>) 15. Which of the following correctly describes the purpose of the `toString()` method?
- It gives client programs the ability to easily display the instance variables of a class.
  - It constructs an object, and allocates sufficient memory for it.
  - It alters the instance variables of a class.
  - It assigns the correct data type to each of the class' variables.

1 pt

- (1<sup>pt</sup>) 16. The following is a statement in a Java program which compiles and executes correctly.  
`submarine.dive(depth);`  
Which of the following choices can be inferred from the above statement?
- `dive` must be the name of an instance variable.
  - `dive` must be a method.
  - `submarine` must be the name of a class.
  - `submarine` must be a method.

1 pt

Consider the following implementation of the `Student` class:

```
1 public class Student
2 {
3 // instance variables
4 private String name;
5 private double sum;
6 private int numGrades;
7
8 // constructors
9 public Student(String n)
10 {
11 <CODE>
12 }
13
14 // accessor methods
15 public String getName()
16 {
17 return name;
18 }
19
20 public double getAverage()
21 {
22 return sum/numGrades;
23 }
24
25 // mutator methods
26 public void setGrade(int grade)
27 {
28 sum += grade;
29 numGrades++;
30 }
31 }
```

2 pts

(1<sup>pt</sup>) 17. Which of the following should replace <CODE> such that the instance variable `name` is correctly initialized when a new object is created?

- `String name = n;`  
 `name = n;`  
 `n name;`  
 Cannot be done because `name` is `private`.

1 pt

(1<sup>pt</sup>) 18. Assuming that <CODE> is filled in correctly, how would you create a `Student` object called `pupil` and set `name` to "Sally"?

- `Student pupil = new Student();`  
 `pupil.name = "Sally";`  
 `pupil = new Student("Sally");`  
 `Student pupil = new Student("Sally");`

1 pt

(1<sup>pt</sup>) 19. Which of the following would print the name of the student represented by the object called `bart`?

- `System.out.println(bart.getName());`  
 `System.out.println(bart.name());`  
 `System.out.println(bart(name));`  
 `System.out.println(name(bart))`

1 pt

(1<sup>pt</sup>) 20. Assume a `Student` object called `lisa` has been created and grades have been assigned. How would you correctly retrieve this student's average?

- `int average = lisa.getAverage();`  
 `double average = getAverage(lisa);`  
 `double average = lisa.getAverage();`  
 `lisa.setGrade(98);`

1 pt

(1<sup>pt</sup>) 21. Given the following values of `nums` and the method `doubleLast`, what will the array `nums` contain after you execute `doubleLast()` ?

```
private int[] nums = {-10, -5, 1, 4, 8, 30};
```

```
public void doubleLast()
{
 for (int i = nums.length/2; i < nums.length; i++)
 {
 nums[i] = nums[i] * 2;
 }
}
```

- `{-20, -10, 2, 8, 16, 60}`  
 `{-20, -10, 2, 4, 8, 30}`  
 `{-10, -5, 1, 8, 16, 60}`  
 `{-10, -5, 1, 4, 8, 30}`

1 pt

5 pts

(1<sup>pt</sup>) **22.** Which of the following declarations will cause a compile time error?

- `int[] scores = null;`
- `int[] scoreArray = {50, 90, 85};`
- `String[] nameArray = new String[10];`
- `String[] nameArray = {5, 3, 2};`

1 pt

(1<sup>pt</sup>) **23.** Assume that `arr1 = {1, 5, 3, -8, 6}` and `arr2 = {-2, -1, -5, 3, -4}`. What will the contents of `arr1` be after `copyArray` finishes executing?

```
public static void copyArray(int[] arr1, int[] arr2)
{
 for (int i = arr1.length/2; i < arr1.length; i++)
 {
 arr1[i] = arr2[i];
 }
}
```

- `[-2, -1, -5, 3, -4]`
- `[-2, -1, 3, -8, 6]`
- `[1, 5, -5, 3, -4]`
- `[1, 5, 3, -8, 6]`

1 pt

(1<sup>pt</sup>) **24.** Which of the following statements assigns the letter "S" to the third row and first column of a two-dimensional array named `strGrid`(assuming row-major order)?

- `strGrid[0][2] = "S";`
- `strGrid[1][3] = "S";`
- `strGrid[3][1] = "S";`
- `strGrid[2][0] = "S";`

1 pt

(1<sup>pt</sup>) **25.** Given the following code segment, what is the value of `sum` after this code executes?

```
int[][] matrix = {{1,1,2,2}, {1,2,2,4}, {1,2,3,4}, {1,4,1,2}};
```

```
int sum = 0;
int col = matrix[0].length - 2;
for (int row = 0; row < 4; row++)
{
 sum = sum + matrix[row][col];
}
```

- 4
- 8
- 9
- 12

1 pt

4 pts

**Part II: Short Answer** (11 points)

- Solve each of the following short answer questions. Write your solution in the space provided.

(1<sup>pt</sup>) 1. Write a single line of code that will create an array of type `double` called `nums` having 800 elements.

|      |
|------|
|      |
| 1 pt |

(1<sup>pt</sup>) 2. Consider the following array: `double[] scores = new double[21]`  
What is the output of: `System.out.println(scores.length);`

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|      |
| 1 pt |

(1<sup>pt</sup>) 3. Consider the following array: `int[] temps = {34, 56, -102, 18, 5}`  
What is the output of: `System.out.println(temps[1])?`

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|      |
| 1 pt |

(1<sup>pt</sup>) 4. Consider the following array: `int[] temps = {34, 56, -102, 18, 5}`  
What is the output of: `System.out.println(temps[3] + temps[4])?`

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|      |
| 1 pt |

(1<sup>pt</sup>) 5. Consider the following array: `String[] names = {"Bob", "Jim", "Sally"}`  
Write a single line of Java code that will display the element "Sally" from this array.

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|------|
|      |
| 1 pt |

(1<sup>pt</sup>) 6. Consider the following array: `int[] nums = new int[7];`  
Write a section of Java code that would place the number 23 into every position in the array. *Hint:* Use a `for` loop.

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| 1 pt |

(1<sup>pt</sup>) 7. Consider the following two-dimensional array: `int[][] nums = new int[10][6];`  
Write a section of Java code that would place the number 58 into every position in the array. *Hint:* Use two `for` loops.

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|      |
| 1 pt |

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| 7 pts |



(4pts) 8. Consider the following incomplete implementation of the `Rectangle` class:

```
1 public class Rectangle
2 {
3 // instance variables
4 private int length;
5 private int width;
6
7 // constructors
8 public Rectangle(int len , int wid)
9 {
10 length = len;
11 width = wid;
12 }
13 }
```

4 pts

(a) (2pts) Write an accessor method called `getPerimeter()` which calculates and returns the perimeter of the rectangle.

(b) (2pts) Write an accessor method called `getArea()` which calculates and returns the area of the rectangle.

4 pts

**Part III: Java Programming** (16 points)

- Show all of your work. Remember that program segments are to be written in the Java programming language.

**APLine Question(2010 AP CompSci Free Response)**

- (7pts) 1. An **APLine** is a line defined by the equation  $ax + by + c = 0$ , where  $a$  is not equal to zero,  $b$  is not equal to zero, and  $a$ ,  $b$ , and  $c$  are all integers. The slope of an **APLine** is defined to be the **double** value  $-a/b$ .

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| 7 pts |

A point (represented by integers  $x$  and  $y$ ) is on an **APLine** if the equation of the **APLine** is satisfied when those  $x$  and  $y$  values are substituted into the equation. That is, a point represented by  $x$  and  $y$  is on the line if  $ax + by + c$  is equal to 0. Examples of two **APLine** equations are shown in the following table.

| Equation              | Slope( $-a/b$ ) | Is point (5, 2) on the line?              |
|-----------------------|-----------------|-------------------------------------------|
| $5x + 4y - 17 = 0$    | $-5/4 = -1.25$  | Yes, because $5(5) + 4(-2) + (-17) = 0$   |
| $-25x + 40y + 30 = 0$ | $25/40 = 0.625$ | No, because $-25(5) + 40(-2) + 30 \neq 0$ |

Assume that the following code segment appears in a class other than **APLine**. The code segment shows an example of using the **APLine** class to represent the two equations shown in the table.

```
APLine line1 = new APLine(5, 4, -17);
double slope1 = line1.getSlope(); // slope1 is assigned -1.25
boolean onLine1 = line1.isOnLine(5, -2); // true

APLine line2 = new APLine(-25, 40, 30);
double slope2 = line2.getSlope(); // slope2 is assigned 0.625
boolean onLine2 = line2.isOnLine(5, -2); // false
```

Write the **APLine** class. Your class must produce the indicated results when invoked by the code segment given above. You may ignore any issues related to integer overflow. Your implementation must include:

- (1 pt) The declaration of the private instance variables **a**, **b** and **c**.
- (2 pts) A constructor that has three integer parameters that represent **a**, **b**, and **c**, in that order. You may assume that the values of the parameters representing **a** and **b** are not zero.
- (2 pts) A method **getSlope()** that calculates and returns the slope of the line.
- (2 pts) A method **isOnLine(int x, int y)** that returns **true** if the point represented by its two parameters (**x** and **y**, in that order) is on the **APLine**, and returns **false** otherwise.

**Write your solution on the next page.**

|       |
|-------|
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| 7 pts |

**Complete APLine.java in the space below.**

|       |
|-------|
|       |
| 0 pts |

**The Metro Question**

(9pts)

2. After graduation, you have decided to take a summer job at the Beijing Metro to earn some money for college. Since you are an inexperienced employee, you are only allowed to operate the smallest train on the fleet, which can accommodate a maximum of 8 passengers. You have decided to put your coding skills to good use by designing a Java program to calculate the cost of each passengers' fare. You have chosen to design a `Passenger` class and a `Metro` class to accomplish this task.

9 pts

The class `Passenger` has been provided for you. It defines the instance variables `distance` and `fare`, which are associated with each passenger. It also defines the accessor and mutator methods for each of these instance variables.

**Java Source Code for `Passenger.java`**

```
1 public class Passenger
2 {
3 // instance variables
4 private double distance;
5 private double fare;
6
7 // constructors
8 public Passenger(double d, double f)
9 {
10 distance = d;
11 fare = f;
12 }
13
14 // accessor methods
15 public double getDistance()
16 {
17 return distance;
18 }
19
20 public double getFare()
21 {
22 return fare;
23 }
24
25 // mutator methods
26 public void setDistance(double d)
27 {
28 distance = d;
29 }
30
31 public void setFare(double f)
32 {
33 fare = f;
34 }
35 }
```

0 pts

Write the `Metro` class. It must include an `array` data structure that will contain each of the `Passenger` objects on your train. Also, your class must produce the indicated results when invoked by the test bench given below. *Note:* Assume that the `toString()` method has been written for you.

Your `Metro` implementation must include:

- (a) (1 pt) The declaration of the private instance variable `train`, which is an array of type `Passenger`.
- (b) (2 pts) A constructor with no parameters, which initializes the array `train` to be of size 8.
- (c) (2 pts) A mutator method called `addPassenger(int i, Passenger p)` which inserts a `Passenger` object into the `train` array at the specified index `i`. It does not return a value.
- (d) (4 pts) A mutator method called `updateFare()` which calculates each of the passengers' fares based on the distance they have travelled. It does not return a value. Each passenger must pay a boarding fee of \$2, plus an additional \$3 for every kilometer travelled. *Hint:* beware of `null` objects in the `train` array!

### Java Source Code for `MetroTest.java`, the Test Bench

```
1 public class MetroTest
2 {
3 public static void main(String[] args)
4 {
5 Passenger mac = new Passenger(10.0, 0.0);
6 Passenger frank = new Passenger(15.0, 0.0);
7
8 Metro subway = new Metro();
9 subway.addPassenger(0, mac);
10 subway.addPassenger(1, frank);
11
12 System.out.println(subway);
13 subway.updateFare();
14 System.out.println(subway);
15 }
16 }
```

### The Terminal Display Output of `MetroTest.java`

```
10.0km $0.0
15.0km $0.0

10.0km $32.0
15.0km $47.0
```

Write your solution on the next page.

**Complete Metro.java in the space below.**

|       |
|-------|
|       |
| 0 pts |