

# Introduction to **Java**

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This test will evaluate the familiarity of basic programming concepts as well as the knowledge of the Java programming language, which is used as the programming language of numerous FIRST<sup>®</sup>robotics competitions.

The following topics will be on this test:

- Primitive Types and Operations (`int`, `byte`, `boolean`, `etc.`)
- Modifiers (`final`, `public`, `static`, `etc.`)\*
- Comparison Operators (`==`, `!=`, `>=`, `etc.`)
- Assignment operators (`+=`, `*=`, `=`, `etc`)
- Flow Control (`if`, `for`, `break`, `etc`)
- Methods and Parameters\*
- Single- and Multi-Dimensional Arrays
- Object Oriented Programming\*
- Inheritance and Polymorphism\*
- Programming Habits and Conventions

\* Starred items are extremely important in programming a robot

**DO NOT BEGIN UNTIL INSTRUCTED TO DO SO**

Use this page for scratch work if desired

Scratch work will not be graded

## PART ONE: Multiple Choice

*Instructions: Choose the correct solution to the problem, there is only one correct answer for each problem.*

1. The size of a `boolean` variable is
  - (a) 1 byte
  - (b) 4 bytes
  - (c) 1 bit
  - (d) 16 bits
2. When adding an `int` to a `double`, the resulting variable will be
  - (a) an `int` with lower precision
  - (b) an `int` with the same precision
  - (c) a `double` with lower precision
  - (d) a `double` with same precision
3. When the modifier `private` is used, where could one could access the member?
  - (a) Inside the same `class`
  - (b) Inside the same `package`
  - (c) Inside the same superclass
  - (d) Only the processor could access the member
4. When should one use the modifier `static`?
  - (a) When the member should not be modified
  - (b) When the member needs to be shared across all instances of the class
  - (c) When the member should not be accessed by the end-user
  - (d) When the member changes in value frequently
5. What data type does a conditional statement return?
  - (a) `int`
  - (b) `boolean`
  - (c) `boolean*` `pointer`
  - (d) conditional statements do not return any data type

6. What is the outcome when one executes the following code?

```
public static void main(String[] args) {  
    int x = 3;  
    int []y= {3,4};  
    if((x > (int) Math.PI) && (y[2] <= 3))  
        System.out.print("True");  
    System.out.print("False");  
}
```

- (a) True
- (b) True False
- (c) False
- (d) Runtime Error: ArrayIndexOutOfBoundsException

7. What is the outcome when one executes the following code?

```
public static void main(String[] args) {  
    int x = 3;  
    int []y= {3,4};  
    if((x > Math.round(Math.PI)) & (y[2] <= 3))  
        System.out.print("True");  
    System.out.print("False");  
}
```

- (a) True
- (b) True False
- (c) False
- (d) Runtime Error: ArrayIndexOutOfBoundsException

8. Which of the following is an equivalent statement for  $(x \parallel y) \&\& !x$

- (a)  $y \&\& !x$
- (b)  $x \parallel y$
- (c)  $!y$
- (d)  $y \&\& (y \parallel x)$

9. The statement `y || (3 * x) > 24` evaluates

- (a) type `int`
- (b) type `double`
- (c) type `String`
- (d) type `boolean`

10. The output of the following annoying program is

```
public class LoopTracing {
    public static void main(String[] args) {
        int input = 10, output = 0;
        while (input > 1) {
            output += input;
            if (input % 2 == 0)
                input /= 2;
            else
                input = (input + 1) / 2;
        }

        System.out.println(output);
    }
}
```

- (a) `NullPointerException`
- (b) 0
- (c) 20
- (d) The program is an infinite loop

11. What will be printed if you run the following program?

```
public class SwitchTracing {
    public static void main(String[] args) {
        int input = 9;
        for (; input > 0; input--) {
            switch (input) {
                case 1:
                    System.out.print("One ");
                case 4:
                    System.out.print("Four ");
                case 9:
                    System.out.print("Nine ");
            }
        }
    }
}
```

- (a) Nine Four Nine One Four Nine
- (b) Nine Four One Nine Four One Nine Four One
- (c) Nine Four One
- (d) Would not compile because of incomplete for-loop

12. How is an `int` passed into a method?

- (a) By reference
- (b) By value
- (c) By object
- (d) By pointer

13. What's the output of the following program?

```
public class MethodTracing {

    public int integerValue;
    public String stringValue;

    public MethodTracing() {
        integerValue = 1;
        stringValue = "Hello World!";
    }
}
```

```

    public static void main(String[] args) {

        MethodTracing m = new MethodTracing();
        changeValues(m, m.integerValue);

        System.out.println(m.stringValue);
        System.out.println(m.integerValue);
    }

    public static void changeValues(MethodTracing m, int intValue) {
        m.stringValue="Changed!";
        intValue = 10;
    }
}

```

- (a) Hello World! 1
  - (b) Hello World! 10
  - (c) Changed! 10
  - (d) Changed! 1
14. Which keyword is used to determine a subclass relationship between two classes?
- (a) `catch`
  - (b) `continue`
  - (c) `implements`
  - (d) `extends`
15. The preferred method of documentation generation for Java is called
- (a) Javadoc
  - (b) Java Manual
  - (c) Comments
  - (d) Java Forums

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## PART TWO: Open Ended Response

*Instructions: Write the most efficient solution to the following methods. You will **not** be given any extra paper.*

1. Write a method that will return an array of  $n$  length, filled with the decimal approximations of the sequence  $\left[\frac{1}{1}, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \dots, \frac{1}{n}\right]$  where  $n$  is the integer parameter of the method.

```
public static double[] fractionGenerator(int n){
```

**DO NOT CONTINUE UNTIL INSTRUCTED TO DO SO**



2. Write a method that will recursively determine if a word *str* is a palindrome, where *str* is a string parameter of the method.

```
public static boolean palindromeChecker(String str){
```

3. Given the following super class:

```
public Counter() {  
  
    value = 10;  
    maxValue = 100;  
    minValue = 0;  
  
}  
  
public Counter(int maxValue, int minValue, int value) {  
  
    this.value = value;  
    this.maxValue = maxValue;  
    this.minValue = minValue;  
  
}  
  
public boolean countUp() {  
    value++;  
    return checkBounds();  
}  
  
public boolean countDown() {  
    value--;  
    return checkBounds();  
}  
  
public boolean checkBounds() {  
    return (value >= minValue && value <= maxValue);  
}  
}
```

Write a subclass named *IntervalCounter* that is a subclass of *Counter* and has an additional integer instance field called *interval*.

```
public class IntervalCounter extends Counter {  
    private int interval;  
    //Create a default constructor with the initial interval of 2  
  
    //Create an overloaded constructor with all of the parameters  
  
    //Override the countUp and countDown methods so that  
    //the value is changed by the interval  
  
    //Create a method named correctValues that will limit the  
    //value to the minimum or the maximum values stated
```

4. *Extra Credit:* Explain, to the best of your ability, the significance of each of the key words in the following iconic signature line and why they are necessary for the proper execution of a Java program.

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

**END OF EXAM**