INSTRUCTIONS

1. This question paper contains EIGHTEEN (18) questions and comprises ELEVEN (11) printed pages, including this page.

2. An ANSWER SHEET is provided for you to write the answers. It comprises TWO (2) printed pages.

3. Answer ALL questions within the space provided on the Answer Sheet.

4. Maximum score is 30 marks.

5. This is an OPEN BOOK test.

6. Write legibly with a pen or pencil.

7. Calculators are allowed, but not laptops, PDAs or other computing devices.

8. Submit only the Answer Sheet at the end of the test. You may keep the question paper.

9. Write your MATRICULATION NUMBER on the Answer Sheet using A PEN.

——— END OF INSTRUCTIONS ———

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SECTION A (15 Multiple Choice Questions: 15 Marks)
Each question has one correct answer. Write your answer in the space provided on the Answer Sheet. 1 mark for each correct answer and no penalty for wrong answer.

1. Given this code:

```java
class TestOverloading {
    public static void m (int i) {
        System.out.println("int i = " + i);
    }

    public static void m (short i) {
        System.out.println("short i = " + i);
    }

    public static void m (double i) {
        System.out.println("double i = " + i);
    }

    public static void main (String [] args) {
        m (4.5);
        m (4);
    }
}
```

What is the first line of output of the code?

A. int i = 4
B. short i = 4
C. int i = 4.5
D. double i = 4.5
E. The code has compilation error. Thus, no output.

2. For the same piece of code in the previous question, what is the second line of output?

A. int i = 4
B. short i = 4
C. double i = 4
D. double i = 4.0
E. The code has compilation error. Thus, no output.
3. Given this code:

```java
public class Confusing {
    private int n1, n2, n3;

    public Confusing (int n1, int n2, int n3) {
        this.n2 = n3;
        this.n3 = n2;
        this.n1 = n2 = n1;
    }

    public Confusing (int n1, int n2) {
        this (n2, n2, n1);
    }

    public String toString () {
        return n1 + " " + n2 + " " + n3;
    }

    public static void main (String[] args) {
        Confusing c1 = new Confusing (5, 6, 7);
        System.out.println("c1 = " + c1);
        Confusing c2 = new Confusing (5, 6);
        System.out.println("c2 = " + c2);
    }
}
```

What is the first line of output of the code?

A. c1 = 5 5 6
B. c1 = 5 6 7
C. c1 = 5 7 6
D. c1 = 6 5 6
E. c1 = 6 7 6

4. For the same piece of code in the previous question, what is the second line of output?

A. c2 = 5 5 6
B. c2 = 5 6 7
C. c2 = 5 7 6
D. c2 = 6 5 6
E. c2 = 6 7 6
5. Given this code:

```java
class ToDetermine {
    public static void main (String[] args) {
        String a = "1234567890";
        for (int i = 0; i < a.length(); i++)
            a = a.substring(1) + a.charAt(0);
        System.out.println ("result is " + a);
    }
}
```

What is the output of the code?

A. result is 1234567890  
B. result is 0987654321  
C. result is 0123456789  
D. result is 9876543210  
E. result is 2345678901

6. Consider the string "AABC5AABC8", and the following regular expressions:

(i) [0-9]*  
(ii) [(A|AB|ABC )+(0-9)*)+  
(iii) [[A-Z|0-9]+  
(iv) [[[A-Z]{2}]*[0-9]]+

Which of the following is true?

A. The given string does not match (i)  
B. The given string does not match (ii)  
C. The given string does not match (iii)  
D. The given string does not match (iv)  
E. The given string matches all the given regular expressions.

7. Given this code:

```java
class TestStringBuffer {
    public static void main (String[] args) {
        StringBuffer tempSB = new StringBuffer("abcdefgh");
        System.out.println ("result is "+ tempSB.setCharAt(4,'x'));
    }
}
```

Which of the following is correct?

A. The output is: result is abcdefgh  
B. The output is: result is abcxfgh  
C. The output is: result is abcdxfgh  
D. The output is: result is abcdexgh  
E. The code has compilation error.
8. What is the output of the following code?

```java
class TestException {
    public static void main (String[] args) {
        try {
            double num1 = Double.parseDouble("99999");
            System.out.println("First is okay.");
            short num2 = Short.parseShort("99999");
            System.out.println("Second is okay.");
        } catch (RuntimeException e) {
            System.out.println("Error...");
        }
        finally {
            System.out.println("Finally!" acompanamiento que acabó.
        }
    }
}
```

A. First is okay.
   Second is okay.
   Finally!

B. First is okay.
   Error...
   Finally!

C. Error...
   Finally!

D. Error...

E. First is okay.
   Error...
9. What is the output of the following code?

```java
class Test {
    public static void main (String[] args) {
        String a = "b";

        switch (a) {
            case 'a': System.out.print ("a");
                       break;
            case 'b': System.out.print ("b");
            default : System.out.print ("c");
                       break;
        }
    }
}
```

A. A compilation error occurs, hence no output.
B. b
C. bc
D. c
E. Program runs with no output produced.

10. Which of the following statements is/are true?

   (i) A final class can have instances.
   (ii) A final class can be extended.
   (iii) An abstract class can be extended.
   (iv) A final method can be overridden.
   (v) The order in which modifiers appear before a class or a method is important.

A. (i) only
B. (iii) only
C. (i) and (iii) only
D. (i), (iii) and (v) only
E. All are true
11. Which of the following code segments will correctly compute the maximum of the 3 integer variables \(a, b\) and \(c\) without changing the values of the variables in the caller?

i) 
```java
private static int getMax(int a, int b, int c) {
    int max = 0;
    if (a > max)
        max = a;
    if (b > max)
        max = b;
    if (c > max)
        max = c;
    return max;
}
```

ii) 
```java
private static int getMax(int a, int b, int c) {
    int max = a;
    if (b > max)
        max = b;
    if (c > max)
        max = c;
    return max;
}
```

iii) 
```java
private static int getMax(int a, int b, int c) {
    if (b > a)
        a = b;
    else if (c > a)
        a = c;
    return a;
}
```

iv) 
```java
private static int getMax(int a, int b, int c) {
    if (b > a)
        a = b;
    if (c > a)
        a = c;
    return a;
}
```

A. (ii) only  
B. (i) and (ii) only  
C. (i), (ii) and (iii) only  
D. (ii) and (iv) only  
E. (i), (ii) and (iv) only

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12. Consider the following method headings:

(i) \textbf{public int} myMethod(\textbf{int} a, \textbf{char} b)
(ii) \textbf{public void} myMethod()
(iii) \textbf{public int} myMethod(\textbf{int} a)
(iv) \textbf{public int} myMethod(\textbf{char} b, \textbf{int} a)
(v) \textbf{public int} myMethod(\textbf{int} b, \textbf{char} a)
(vi) \textbf{public void} myMethod(\textbf{int} a, \textbf{char} b)
(vii) \textbf{public void} myMethod(\textbf{int} a, \textbf{char} b, \textbf{float} c)

Which of the following combinations could appear together in the same class?

A. All seven can be used together.
B. All except (i) can be used together.
C. All except (v) can be used together.
D. All except (vi) can be used together.
E. All except (i) and (vi) can be used together.

13. Analyse the following code:

```java
class Test {
    public static void main(String[] args) {
        A a = new A("test");
        a.print();
    }
}

class A {
    String s;
    A(String s) {
        \textbf{this}.s = s;
    }
    \textbf{private void} print() {
        System.out.println(s);
    }
}
```

A. The program compiles fine, but has a runtime error because the \textbf{print()} method is private.
B. The program has a compilation error because there is no default constructor in class \textbf{A}.
C. The program has a compilation error because the \textbf{print()} method in class \textbf{A} is private.
D. The program runs fine and prints \textit{test}.
E. None of the above.
14. What value does the method `Distance` return if `num` has a value of 3?

```java
static int Distance(int num) {
    if (num < 1)
        return 4;
    else
        return Distance(num-1) + 3 * Distance(num-2);
}
```

A. 28  
B. 48  
C. 76  
D. 82  
E. 112

15. The following incomplete method `rotate` is supposed to shift the array elements one position to the left, while the leftmost element becomes the rightmost element, e.g. `{1, 2, 3, 4, 5}` becomes `{2, 3, 4, 5, 1}`

```java
public static void rotate (int[] a) {
    for (int i = 0; i < a.length-1; i++)
        a[i] = a[i+1];
}
```

What codes should be placed in lines 2 and 5 respectively for this to work?

A. Nothing  
B. line 2: `a[a.length - 1] = a[0];`  
       line 5: `// nothing`  
C. line 2: `// nothing`  
       line 5: `a[a.length - 1] = a[0];`  
D. line 2: `int temp = a[0];`  
       line 5: `a[i] = temp;`  
E. None of the above is correct.
SECTION B (3 Questions: 15 Marks)
Write your answer in the space provided on the Answer Sheet.

16. Draw the inheritance hierarchies for the following classes: Circle, Ellipse, Rectangle, Triangle, Polygon, Quadrilateral, and Parallelogram. (Each wrong inheritance loses half a mark.) [3 marks]

17. Your task is to write a recursive routine `sumDigitPower(int, int)` to compute the following sum for a given number \( N \) of \( i \) digits, written as \( d_i d_{i-1} \ldots d_3 d_2 d_1 \):
\[
\text{Answer} = \sum (d_i)^i
\]
For example, given \( N = 23456 \), the answer is \( 2^5 + 3^4 + 4^3 + 5^2 + 6^1 = 208 \). [3 marks]

18. This question is on the classes Polygon, Triangle, and ConvexPolygon. Your tasks here are to complete the following two methods in ConvexPolygon class:

(a) `public double area (int nSide), and` [3 marks]

(b) `public boolean collide (ConvexPolygon target).` [6 marks]

(a) requires you to compute the area of the convex polygon using recursion. A non-recursion approach is given for your reference. Note that each convex polygon of \( n \) sides can be partitioned into \( n - 2 \) triangles. (b) requires you to return `true` if the object collides with the given target object, otherwise `false`. Two convex polygons collide when one polygon has a triangle that overlaps with a triangle in the other polygon.

```java
import java.awt.*;

class Polygon {
    protected Point[] pt;
    public Polygon (Point[] pt) {
        this.pt = pt;
    }
}

import java.awt.*;

class Triangle extends Polygon {
    // constructor
    public Triangle (Point[] p) {
        super ( p );
    }

    public double area ( ) {
    }

    public boolean overlap (Triangle t) {
        // This method tests whether the given triangle t overlaps
        // with this object (which is also a triangle). The
        // computation is rather involved and is thus omitted here.
    }
}
```
import java.awt.*;

class ConvexPolygon extends Polygon {

    public ConvexPolygon (Point[] pt) {
        super ( pt );
    }

    public double area ( ) { // non-recursion approach
        Point[] p = new Point [3];
        Triangle t = new Triangle ( p );
        double result = 0.0;

        int i = 2;
        p[0] = pt[0];
        while (i < pt.length ) {
            p[1] = pt[i-1];
            p[2] = pt[i];
            result += t.area( );
            i++;
        }
        return result;
    }

    public double area (int nSide) {
        //
        //
        // for you to fill in recursive computation...
        //
    }

    public boolean collide (ConvexPolygon target) { 
        boolean result = false;
        Point [] p1 = new Point [3];
        Triangle t1 = new Triangle ( p1 );
        Point [] p2 = new Point [3];
        Triangle t2 = new Triangle ( p2 );
        int i, j;
        //
        // for you to fill in the computation...
        // -- you need to make use of overlap method in Triangle class
        //
        return result;
    }
}