

NATIONAL UNIVERSITY OF SINGAPORE

SCHOOL OF COMPUTING

TERM TEST #2
Semester 1 AY2007/2008

CS1101X/Y/Z — PROGRAMMING METHODOLOGY

10 November 2007

Time Allowed: **1 hour 30 minutes**

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** ————

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:

```
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:

```
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:

```
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-z]*`
- (ii) `[(A|AB|ABC)+(0-9)*]+`
- (iii) `[[A-Z0-9]+]+`
- (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:

```
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 abcxefgh
- 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?

```
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!");  
        }  
    }  
}
```

- 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?

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

```
iv) 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

12. Consider the following method headings:

- (i) **public int** myMethod(**int** a, **char** b)
- (ii) **public void** myMethod()
- (iii) **public int** myMethod(**int** a)
- (iv) **public int** myMethod(**char** b, **int** a)
- (v) **public int** myMethod(**int** b, **char** a)
- (vi) **public void** myMethod(**int** a, **char** b)
- (vii) **public void** myMethod(**int** a, **char** b, **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:

```

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

class A {
    String s;

    A(String s){
        this.s = s;
    }

    private void print(){
        System.out.println(s);
    }
}

```

- A. The program compiles fine, but has a runtime error because the print() method is private.
- B. The program has a compilation error because there is no default constructor in class A.
- C. The program has a compilation error because the print() method in class A is private.
- D. The program runs fine and prints test.
- E. None of the above.

14. What value does the method **Distance** return if num has a value of 3?

```
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}

```
line 1: public static void rotate (int[] a) {
line 2:
line 3:     for (int i = 0; i < a.length-1; i++)
line 4:         a[i] = a[i+1];
line 5:
line 6: }
```

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 $d_i d_{i-1} \dots d_3 d_2 d_1$:

$$\text{Answer} = \sum_i (d_i)^i$$

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.

```
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 ( ) {
        return (pt[0].x * pt[1].y - pt[1].x * pt[0].y
            - pt[0].x * pt[2].y + pt[2].x * pt[0].y
            + pt[1].x * pt[2].y - pt[2].x * pt[1].y ) / 2;
    }
    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;
    }
}

```