

University Interscholastic League

Computer Science Competition

Number 142 (State - 2013)

General Directions:

- 1) DO NOT OPEN EXAM UNTIL TOLD TO DO SO.**
- 2) NO CALCULATOR OF ANY KIND MAY BE USED.**
- 3) There are 40 questions on this contest exam. You have 45 minutes to complete this contest. If you are in the process of actually writing an answer when the signal to stop is given, you may finish writing that answer.
- 4) Papers may not be turned in until 45 minutes have elapsed. If you finish the test before the end of the allotted time, remain at your seat and retain your paper until told to do otherwise. Use this time to check your answers.
- 5) All answers must be written on the answer sheet/Scantron card provided. Indicate your answers in the appropriate blanks provided on the answer sheet or on the Scantron card. Clean erasures are necessary for accurate Scantron grading.
- 6) You may place as many notations as you desire anywhere on the test paper, but not on the answer sheet or Scantron card which are reserved for answers only.
- 7) You may use additional scratch paper provided by the contest director.
- 8) All questions have ONE and only ONE correct (BEST) answer. There is a penalty for all incorrect answers. All provided code segments are intended to be syntactically correct, unless otherwise stated. Ignore any typographical errors and assume any undefined variables are defined as used.
- 9) A reference to commonly used Java classes is provided at the end of the test, and you may use this reference sheet during the contest. You may detach the reference sheets from the test booklet, but DO NOT DO SO UNTIL THE CONTEST BEGINS.
- 10) Assume that any necessary import statements for standard Java packages and classes (e.g. `.util`, `ArrayList`, etc.) are included in any programs or code segments that refer to methods from these classes and packages.

Scoring:

- 1) All questions will receive 6 points if answered correctly; no points will be given or subtracted if unanswered; 2 points will be deducted for an incorrect answer.

QUESTION 1

What is the value of $63B9_{16} - 48A_{16}$?

- A. $583F_{16}$ B. 5929_{16} C. $5F2F_{16}$ D. $6D3E_{16}$ E. $5E3F_{16}$

QUESTION 2

What is output by the code to the right?

- A. $5x6y$ B. $x56y$ C. $xxyy$
 D. $5xyy$ E. There is no output due to a compilation error.

```
int x = 5;
int y = 6;
System.out.print(x + "x" + y + "y");
```

QUESTION 3

What is output by the call

Three4(12)

- A. 25 B. 30 C. 50
 D. 60 E. 75

```
public static void Three4(int x) {
    int c = 0;
    for(int i = 0; i < x; i++) {
        for(int j = 0; j < 5; j++)
            c++;
        i++;
    }
    System.out.print(c);
}
```

QUESTION 4

The call Three4 (K) produces the output 65 for which value of K?

- A. 13 B. 15 C. 18
 D. 25 E. 28

QUESTION 5

What is output by the code to the right?

- A. 7 B. 9 C. 10
 D. 30 E. 30.0

```
System.out.print(23%8%4+7/2*2);
```

QUESTION 6

What is output by the code to the right?

- A. 32 B. 47
 C. 48 D. 57
 E. There is no output due to an error.

```
String[] a = {"Hello", "Cat", "zebra"};
int i = 0;
while(a[i].length() < 10) {
    if(i < 2) a[i] += a[i+1];
    else a[i] += a[i]+2;
    i = (i+5)%3;
}
int total = 0;
for(int j = 0; j < a.length; j++)
    total = total + a[j].length();
System.out.print(total);
```

QUESTION 7

- What is output by the code to the right?
- A. -325
 - B. 0
 - C. 1
 - D. 325
 - E. There is no output due to a compilation error.

```
int n = -325;
int m = n >> 31;
n = n^m;
n = n-m;
System.out.print(n);
```

QUESTION 8

- What is output by the code to the right? The symbol $\backslash b$ below represents a blank space.
- A. \$ $\backslash b$ 18,
 - B. \$\$ $\backslash b$ 18,
 - C. 32 $\backslash b$,
 - D. \$18 $\backslash b$,
 - E. There is no output due to a compilation error.

```
String format = "$%3$-3d,";
System.out.printf(format, 32, 5, 18);
```

QUESTION 9

- What is output by the code to the right?
- A. x2y-3
 - B. xy
 - C. zv
 - D. 122118
 - E. There is no output.

```
char x = 'x' + 2;
char y = 'y' - 3;
System.out.print(x + " " + y);
```

QUESTION 10

- What is output by line 1 in the client code to the right?
- A. 0
 - B. 10
 - C. 14
 - D. 18
 - E. 24

```
public static int[] mu(int x, int y, int z)
{
    int[] a = new int[3];
    a[0] = y + z - x;
    a[1] = x + z;
    a[2] = y - x;
    return a;
}
```

QUESTION 11

- What is output by line 2 in the client code to the right?
- A. [1, -1, 3]
 - B. [13, 4, -2]
 - C. [3, 0, 5]
 - D. [8, 16, -3]
 - E. There is no output due to a compilation error.

```
// Client code
int[] b = mu(8, 5, 11);
int sum = b[0] + b[1] + b[2];
System.out.print(sum); // line 1
int[] z = mu(mu(3, 4, -2)[1], 4, -2);
String s = Arrays.toString(z);
System.out.print(s); // line 2
```

QUESTION 12

- How many of the possible combinations of truth values for p, q and r result in the same truth value for $q \mid\mid ! (p \ \&\& \ r)$ and $! (p \ \&\& \ !(q \mid\mid !r))$?

- A. 0
- B. 2
- C. 4
- D. 1
- E. 8

<p>QUESTION 13</p> <p>What is output by the code to the right?</p> <p>A. 5 8 B. 5 21 C. 5 20 D. 6 20 E. 6 21</p>	<pre>int x = (int) Math.ceil(Math.random() + 5); int y = (int) Math.floor(Math.exp(3)); System.out.print(x + " " + y);</pre>
<p>QUESTION 14</p> <p>What is output by the code to the right?</p> <p>A. ypots B. rypoo C. rype D. ypor E. ypos</p>	<pre>String s1 = "Ph.D."; String s2 = "HarryPotter"; String s3 = "ProfessorDumbledore"; String x = s2.toLowerCase().substring(4, 8); String y = "" + s3.substring(4, s1.length() + 3).charAt(2); System.out.print(x + y);</pre>
<p>QUESTION 15</p> <p>Which choice for <*1> produces the following output? [help, me, now]</p> <p>I. s.split(".") II. s.split("\.") III. s.split("\\\.")</p> <p>A. I only B. II only C. III only D. II and III E. I and III</p>	
<p>QUESTION 16</p> <p>Which choice for <*1> results in a syntax error in the code to the right?</p> <p>I. s.split(".") II. s.split("\.") III. s.split("\\\.")</p> <p>A. I only B. II only C. III only D. II and III E. I and III</p>	<pre>String s = "help.me.now"; System.out.print(Arrays.toString(<*1>));</pre>

QUESTION 17

The `shift()` method takes a two dimensional array `a` and a positive integer `k`, and returns an array which is `a` with the columns shifted $|k|$ columns to the right, with wraparound. If `a` is

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

Then the calls `shift(a, 2)` and `shift(a, 5)` should return

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

Which choice for <*>1 in the code to the right is correct?

- A. k
- B. $j+k$
- C. $i+k$
- D. $j \% c + k$
- E. $(j+k) \% c$

Assume that <*>1 was replaced correctly.

QUESTION 18

Which choice for <*>2 is correct?

- A. `a[j][i]`
- B. `a[i][j]`
- C. `a[i][k]`
- D. `b[i][j]`
- E. `a[i][j \% c + k]`

QUESTION 19

What is output by the code to the right?

- A. true true
- B. false false
- C. true false
- D. false true
- E. There is no output due to a compilation error.

```
// pre: a is a non-jagged array of
// at least two rows and two columns
// k is positive.
public static int[][] shift(int[][] a, int
k) {
    int r = a.length;
    int c = a[0].length;
    int[][] b = new int[r][c];

    for(int j = 0; j < c; j++) {
        int d = <*>1;
        for(int i = 0; i < r; i++) {
            b[i][d] = <*>2;
        }
    }
    return b;
}
```

```
public class Nineteen {
    public int mu(int a, int b, int c) {
        return a ^ b | c;
    }
    public static void main(String[] args) {
        int one = (new Nineteen()).mu(34, 26,
5);
        Nineteen n = new Nineteen();
        System.out.print(one == n.mu(42, 18,
13));
        System.out.print(n.mu(42, 18, 13) !=
n.mu(2, 58, 21));
    }
}
```

QUESTION 20

The file `output.txt` contains the following:

Hello World

The code to the right produces an error. What is the cause of the error?

- A. Line 1 contains a syntax error.
- B. Line 2 contains a syntax error.
- C. The wrong type of exception is thrown in line 3.
- D. Line 4 contains a syntax error.
- E. Line 5 contains a syntax error.

QUESTION 21

Assume that the error in the code to the right has been corrected. What does the file `output.txt` contain after the code is executed?

- A. Hello World54321
- B. 43210 World
- C. Hello World43210
- D. 43210
- E. 54321

```
public class Twenty {
    List<Integer> L;
    static final int SIZE = 5; // 1
    public Twenty() {
        L = new ArrayList<Integer>();
        for(int i = 1; i <= SIZE; i++)
            L.add(SIZE-i); // 2
    }
    public static void main(String[] args) throws IOException { // 3
        File f = new File("output.txt");
        if(f.exists()) {
            PrintStream p;
            p = new PrintStream(f); // 4
            Twenty t = new Twenty();
            for(int i = 0; i < SIZE; i++)
                p.print(L.get(i)); // 5
            p.close();
        }
    }
}
```

QUESTION 22

What is output by the code to the right?

- A. 1
- B. 2
- C. 12
- D. 23
- E. 123

```
ArrayList<Integer> L = new ArrayList<>();
if(L instanceof Object)
    System.out.print("1");
if(L instanceof ArrayList<?>)
    System.out.print("2");
if(L instanceof ArrayList)
    System.out.print("3");
```

QUESTION 23

What is output by the code to the right?

- A. 1
- B. 2
- C. 3
- D. 23
- E. There is no output due to a syntax error.

```
public static void main(String[] args) {
    try {
        Integer i = null;
        int x = 3/0;
        System.out.print(i);
    }
    catch(NumberFormatException | NullPointerException e) {
        System.out.print("1");
    }
    catch(ArithmaticException e) {
        System.out.print("2");
    }
    catch(Exception e)
        {System.out.print("3");}
}
```

QUESTION 24

What is output by the code to the right?

- A. bab
- B. 5
- C. babba
- D. dcbab
- E. edcbabcba

```
String[] a = {"a", "b", "c", "d", "e"};
for(int i = 2; i < a.length; i++)
    a[i] = a[i-1] + a[i-2];
System.out.print(a[a.length-1]);
```

QUESTION 25

Consider a method search that searches an $n \times n$ array a of type int for a value key. The first $n/2$ rows of a are in increasing order (from left to right), and the values in the other rows are decreasing (from left to right). What is the worst case runtime if search has optimal performance? Choose the most restrictive correct answer.

- A. $O(\log n)$
- B. $O(n)$
- C. $O(n\log n)$
- D. $O(n^2)$
- E. $O(n^{1/2})$

QUESTION 26

What is output by the code to the right when it is executed with the command

`java TwentySix four thousand twenty eight`

- A. fothtweeight
- B. etwthofour
- C. fhtweeigh
- D. fothouenteig
- E. There is no output due to a runtime error.

```
// Find value key in nxn array a. If
// key is found in a, return true.
// If key does not occur in a, return
// false.
// First n/2 rows of a: values are in
// increasing order.
// Remaining rows contain values that are
// in decreasing order.
public static boolean search(int[][] a, int
key) {
    // implementation omitted
}
```

QUESTION 27

What is the output of the following statements?

```
String x = tau("hello") +
tau("elephant");
System.out.print(x);
```

- A. ehlolleehpnat
- B. ollehtnahpele
- C. leholeephnat
- D. ellpat
- E. elephanthello

```
public class TwentySix {
    public static void main(String[] args) {
        String s = "";
        for(int i = 0; i < args.length; i++) {
            s += pi(args[i], i);
        }
        System.out.print(s);
    }
    public static String pi(String t, int n) {
        if(n < t.length())
            return t.substring(0, n+1);
        return pi(t, n/2);
    }
}
```

```
public static String tau(String s) {
    int n = s.length();
    if(n == 0) return "";
    else if(n == 1) return s;
    else if(n == 2) {
        String t = ""+s.charAt(1)+s.charAt(0);
        return t;
    }
    else {
        return tau(s.substring(0, n/2+1)) +
tau(s.substring(n/2+1));
    }
}
```

QUESTION 28

What is output by the code to the right?

- A. onetwothree
- B. fourfourtwo
- C. oneonethree
- D. fourfourthree
- E. fourtwoone

QUESTION 29

In the code to the right, replace line 1 with

Stack<String> p = new Stack<>();

and replace p.remove() in line 2, line 3, and
line 4 with

p.pop()

After these changes, what is the output of the code to the
right?

- A. onetwothree
- B. fourfourtwo
- C. oneonethree
- D. fourfourthree
- E. fourtwoone

```
PriorityQueue<String> p = new
PriorityQueue<>(); // line 1
p.add("one");
p.add("two");
p.add("three");
p.add("four");
System.out.print(p.peek());
System.out.print(p.remove()); // line 2
p.remove(); // line 3
System.out.print(p.remove()); // line 4
```

QUESTION 30

Consider inserting the integers 1, 2, 3, 4, 5 (not necessarily in this order) in a binary search tree. How many
orderings on these integers produces a binary search tree of maximum height?

- A. 2
- B. 4
- C. 8
- D. 16
- E. 32

QUESTION 31

What value is returned by the call go(30, 24) ?

- A. 16
- B. 23
- C. 30
- D. 45
- E. 60

```
public static int go(int n, int m) {
    if(n <= 3) return 2;
    if(m <= 3) return 3;
    return go(m/2, n-2) + go(n/3, m-3);
}
```

QUESTION 32

What is output by the code to the right?

- A. -3
- B. 1
- C. 2
- D. 5
- E. 15

```
public class ThirtyTwo {
    public static void main(String[] args) {
        int n = 5;
        tau(n);
        System.out.print(n);
    }
    public static int tau(int n) {
        n = ((int)Math.pow(Math.PI, 3))*2%4;
        switch(n) {
            case 0:
                n += 4;
            case 1:
                n *= 3;
            case 2:
                n /= 2;
            case 3:
                n += 6;
            case 4:
                n += 8;
        }
        return n;
    }
}
```

QUESTION 33

The file `data.txt` contains:

2 3 3 13 1 3 2 4

What is output by the code to the right?

- A. 33
- B. null4
- C. 43
- D. 35
- E. 44

```
public class ThirtyThree {
    public static void main(String[] args)
        throws IOException {
        File f = new File("data.txt");
        Scanner sc = new Scanner(f);
        TreeMap<Integer, Integer> t = new
        TreeMap<>();
        while(sc.hasNextInt()) {
            int x = sc.nextInt();
            int y = sc.nextInt();
            t.put(x, y);
        }
        System.out.print(t.get(2));
        t.put(3, 8);
        System.out.print(t.size());
    }
}
```

QUESTION 34

If `<*>` is replaced with `LinkedList`, what is the average case runtime of the call in line 1? Give the most restrictive correct answer.

- A. O(1) B. O(logn)
- C. O(n) D. O(nlogn)
- E. O(n^2)

```
// n is a previously initialized positive
// int
<*><Integer> d = new <*><>();
for(int i = 0; i < n; i++)
    d.add(i);
```

QUESTION 35

If `<*>` is replaced with `ArrayList`, what is the average case runtime of the call in line 1? Give the most restrictive correct answer.

- A. O(1) B. O(logn)
- C. O(n) D. O(nlogn)
- E. O(n^2)

```
Random ran = new Random();
int x = ran.nextInt(n);
d.set(n/2, 100); // line 1
```

QUESTION 36

What is output by the code to the right?

- A. 20 7.0
- B. 35 8.0
- C. 20 9.0
- D. 35 7.0
- E. 20 8.0

```
int x = 25;
double y = 32;
if(y%x > 10 || y/x > 1)
    x -= 5;
else if(Math.ceil(Math.sqrt(y)) < 6)
    x += 10;
y = y % x > 3 ? 7 : x > 15 ? 8 : 9;
System.out.print(x + " " + y);
```

QUESTION 37

Assume that G is an undirected graph with n vertices and m edges. Given an adjacency matrix for G, what is the runtime to determine whether there is a path between every pair of vertices? Choose the most restrictive correct answer.

- A. O(1)
- B. O(m)
- C. O(n^2)
- D. O(m+n)
- E. O(mn)

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QUESTION 38

If s is an object of type Two, how many methods (not including constructors) can be invoked on s?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5

QUESTION 39

Consider the following:

```
Two t = new Two(1, 2);
System.out.print(t.getX() + " " +
t.getY());
```

Which choice for <*1> produces the output

1 2

in the code above?

- I. x = this.x;
 y = this.y;
 - II. One(x);
 this.y = y;
 - III. super(x);
 this.y = y;
- A. I only
B. II only
C. III only
D. I and II
E. II and III

QUESTION 40

Consider the following:

```
Two r = new Two(3, 4);
System.out.print(r.toString());
```

Which choice for <*2> produces the output

3 4

in the above code? Assume that <*1> was replaced correctly in question 39.

- I. return x + " " + y;
- II. return super.getX() + " " +
y;
- III. return getX() + " " + y;

- A. I only
B. II only
C. III only
D. I and II
E. II and III

```
public abstract class Zero {
    abstract void increase(int k);
}

public class One extends Zero {
    private int x;

    public One() {
        x = 0;
    }

    public One(int i) {
        x = i;
    }

    public void increase(int inc) {
        x += inc;
    }

    public int getX() {
        return x;
    }
}

public class Two extends One {
    private int y;

    public Two(int x, int y) {
        <*1>
    }

    public int getY() {
        return y;
    }

    public String toString() {
        <*2>
    }
}
```