University Interscholastic League
Computer Science Competition

Number 143 (Invitational A - 2014)

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.

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.

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.

Note: Correct responses are based on Java, **J2sdk v 1.7.25**, from Sun Microsystems, Inc. All provided code segments are intended to be syntactically correct, unless otherwise stated (i. e. `error` is an answer choice) and any necessary Java 2 Standard Packages have been imported. Ignore any typographical errors and assume any undefined variables are defined as used. **For all output statements, assume that the System class has been statically imported…** ***import static java.lang.System.*;***

QUESTION 1

Which of these is NOT equivalent to $11110_2 + 11011_2$?

A. 57_{10} B. 71_8 C. 39_{16} D. 111101_2 E. All are equivalent

QUESTION 2

What is output by the code to the right?

A. `19 32` B. `32 13`

C. `19 13` D. `32 19`

E. There is no output due to a compile error.

```
long b = 19;
int c = 13;
b+=c;
out.println(b+" "+c);
```

QUESTION 3

What is output by the code to the right?

A. `4` B. `3` C. `4.0`

D. There is no output due to a compile error.

E. There is no output due to a runtime error.

```
Integer [] list = {1,2,3,4.0};
out.println(list[3]);
```

QUESTION 4

What is output by the code to the right?

A. `4 3 2 1` B. `4 3 2`

C. `5 4 3 2` D. `5 4 3`

E. There is no output.

```
int j = 5;
do
{
  out.print(--j + " ");
}
while (j>1);
```

QUESTION 5

What is output by the code to the right?

A. `gBad` B. `reak` C. `Brea` D. `a` E. `k`

```
String s = "BreakingBad";
out.println(s.charAt(4));
```

QUESTION 6

What is output by the code to the right?

A. `aead` B. `abcd`

C. `abeb` D. `cecd`

E. There is no output.

```
char [] list1 = {'a','b','c','d'};
char [] list2 = list1;
list2[2] = 'e';
list1[3] = list2[1];
for(char a:list1)
     out.print(a);
```

QUESTION 7

What is output by the code to the right?

A. `false false` B. `false true`

C. `true false` D. `true true`

E. There is no output due to a runtime error.

```
boolean p = true;
boolean q = true;
p = p^q;
out.println(p + " " + q);
```

QUESTION 8

What is output by the code to the right?

A. `yum` B. `yumyom`

C. `burp` D. `chomp`

E. `yumyomchompburp`

```
String s1 = "sweet";
switch(s1)
{
  case "sweet":out.print("yum");
  case "sour" :out.print("yom");
               break;
  case "spicy":out.print("chomp");
  default     :out.print("burp");
}
```

QUESTION 9

What is output by the code to the right?

A. `3.1` B. `5.2` C. `8.3`
D. `2.1` E. `2.5`

```
out.println(Math.max(5.2,3.1));
```

QUESTION 10

What is output by the code to the right?

A. `999` B. `333`
C. `342` D. `101010`
E. `231`

```
int[][]grid={{1,2,3},{4,5,6,7},
             {8,9}};
out.println(grid[0].length + "" +
            grid[1].length + "" +
            grid[2].length);
```

QUESTION 11

Which of the following correctly replaces **<statement1>** in the Guitar class definition on the right ?

A. `public void`
B. `public int`
C. `private void`
D. `private int`
E. `public static int`

QUESTION 12

Which of the following correctly replaces **<statement2>** in the Guitar class definition on the right ?

A. `( );`
B. `(int n)`
C. `( )`
D. `(String s)`
E. `(int n);`

QUESTION 13

Which of the following correctly replaces **<statement3>** in the Guitar class definition on the right ?

A. `type = s;`
B. `numStrings = n;`
C. `return type;`
D. `return numStrings;`
E. `return 6;`

```
class Guitar
{
  private String type;
  private int numStrings;
  public Guitar()
  {
     type = "acoustic";
     numStrings = 6;
  }
  public Guitar(int n)
  {
     this();
     numStrings = n;
  }
  public Guitar(int n, String s)
  {
     this(n);
     type = s;
  }
  public String toString()
  {
     return type + ": " +
        numStrings + " string";
  }
<statement1>getNumStrings<statement2>
  {
           <statement3>
  }
}

/////////////////////////////////
////client code
Guitar g = new Guitar(5,"bass");
out.println(g);
```

QUESTION 14

What is output by the code to the right?

A. `7` B. `9`
C. `15` D. `12`
E. `31`

```
int d = 25;
d = d | 15 & 7;
out.println(d);
```

QUESTION 15

What is output by the code to the right?

A. `99` B. `8` C. `7`

D. `100` E. `0`

```
int e = 0, f = 1;
while(f<100){
  e++;
  f*=2;
}
out.println(e);
```

QUESTION 16

Which term best describes the variable type for **a** in the client code shown?

A. actual parameter

B. formal parameter

C. instance field

D. class variable

E. temporary variable

QUESTION 17

What is output by the client code to the right?

A. `30 1 7`

B. `30 1 1 7`

C. `30 1 6 1 9 7`

D. `30 1 6 45 1 9 35 1 7`

E. There is no output due to a syntax error.

```
static void stuff(int x)
{
  if(x%2==0)
     out.print(x*5+" ");
  else
  if(x%3==0)
     out.print(x/5+" ");
  else
     out.print(x+" ");
}
//client code
int a = 6;
stuff(a);
a+=3;
stuff(a);
a-=2;
stuff(a);
```

QUESTION 18

Which of these statements will return the substring "`Probe`"?

I. `s.substring(7,12);`
II. `s.substring(8);`
III. `s.substring(8,13);`
IV. `s.substring(7,13);`
V. `s.substring(7);`

A. I and V only
B. II only
C. III only
D. II and III only
E. IV only

```
String s = "Cassini_Probe";
```

QUESTION 19

What is output by the code to the right?

A. `2.9` B. `4.5` C. `19.5` D. `4.9` E. `3.2`

```
long k = 12;
int m = 5;
double p = 2.5;
out.println(p+k/m);
```

QUESTION 20

What is output by the code to the right?

A. `001 010 101 111`

B. `000 010 100 111`

C. `001 010 101 110`

D. `001 011 100 110`

E. `000 010 101 111`

```
for(int p = 0; p <= 1; p++)
 for(int q = 0; q <= 1; q++)
  out.print(""+p+q+(p|q&p)+" ");
```

QUESTION 21

Based on the value of x in the code on the right, which of the following statements will output only the value 6 ?

I. `out.println(x%1000/100);`
II. `out.println(x/100%10);`
III. `out.println(x/1000%10);`

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

```
int x = 49627;
```

QUESTION 22

What is output by the code to the right?

A. `360.0` B. `180.0` C. `90.0`
D. `45.0` E. `0.0`

```
double d = Math.toDegrees(Math.PI*2);
out.printf("%.1f\n",d);
```

QUESTION 23

What is output by the code to the right?

A. `2147483647`
B. `-2147483648`
C. `111100000000000000000000000000000000`(4 1s, 32 zeroes)
D. `11111111111111111111111111111111` (32 1s)
E. `1111`

```
int x = 15 << 32;
String s = Integer.toBinaryString(x);
out.println(s);
```

QUESTION 24

What is output by the code to the right?

A. `true0.0`
B. `true2.3`
C. `true3.1`
D. `false2.3`
E. `false4.2`

```
ArrayList <Double> list;
list = new ArrayList<Double>();
out.print(list.isEmpty());
list.add(2.3);
list.set(0,4.2);
list.add(3.1);
list.remove(0);
out.print(list.get(0));
```

QUESTION 25

Find f(12,6) according to the recursive function definition shown on the right. You may use the space below to do your work.

f(12,6) =

A. `5` B. `6` C. `7`
D. `9` E. `12`

$$f(x,y)=\begin{cases} f(x-y,y-1)+2 & \text{when } x>y \\ x+y & \text{otherwise} \end{cases}$$

QUESTION 26

What is output by the code to the right?

A. `Fry` B. `FryFa`

C. `FreettyFall` D. `FreeFallinTomPetty`

E. There is no output due to a compile error

```
String s = "FreeFallinTomPetty";
String [] ar = s.split("[elt]+");
out.println(ar[0]+ar[ar.length-1]
           +ar[1]);
```

QUESTION 27

What is output by the code to the right?

A. `1` B. `33`

C. `100` D. `bad`

E. `breaking`

```
String bb = (100%3==0)?"breaking"
                      :"bad";
out.println(bb);
```

QUESTION 28

What is output by the code to the right?

A. `false` B. `-8`

C. `8` D. `-1`

E. `1`

```
String s = "KarelJRobot";
String t = "Kilamanjaro";
out.println(s.compareTo(t));
```

QUESTION 29

A. `10` B. `20`

C. `ten` D. `sepuluh`

E. `tensepuluh`

```
Map<Integer,String> m =
  new HashMap<Integer,String>();
m.put(10,"ten");
m.put(14,"fourteen");
m.put(9,"nine");
m.put(10,"sepuluh");
out.println(m.get(10));
```

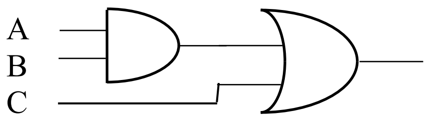
QUESTION 30

Which of the following logical statements is represented by the digital electronics diagram on the right ?

A. A && B || C B. A || B && C

C. A ^ B || C D. A || B ^ C

E. A && B ^ C



QUESTION 31

On the right is a boolean expression using generic notation. Which of the expressions below represents the simplest form of this expression ? (Note : * means AND, + means OR)

A. $\overline{A}$ B. 0 C. $\overline{A} * \overline{B}$ D. $\overline{A}(\overline{A}*\overline{B})$ E. $\overline{A}+\overline{B}$

$\overline{A}(\overline{A + B})$

(this translates to ***"not A and not (A or B)"***)

QUESTION 32

In a typical binary search process, in how many steps will the value 5 be found in the array shown on the right?

A. 3 B. 4

C. 5 D. 6

E. 7

```
0 1 2 3 4 5 6 7 8 9 10 11 12 13
```

QUESTION 33

Which statement below best describes the minimum required <implementation> of class B for the class structure shown on the right?

A. class B is only required to define method **`one()`**.
B. class B is not required to implement anything.
C. class B is required to implement method **`one()`** and override method **`two()`**.
D. class B is only required to override method **`two()`**.
E. This class structure is invalid.

QUESTION 34

Suppose all is correctly defined with this class structure so that method one()returns the value 4. What is the output for the client code shown on the right?

A. `0` B. `5`
C. `20` D. `40`
E. There is no output due to a runtime error.

QUESTION 35

Which of the following is an **INVALID** class B definition?

I.
```
class B extends A{
      int one(){
         return 4;
      }}
```
II.
```
class B extends A{
      x=1;
      int one(){
         return 4;
      }}
```
III.
```
class B extends A{
      int one(){
         return 4;
      }
      int two(){
         return 6;
      }}
```
IV.
```
class B extends A{
      int x = 4;
      int one(){
         return 4;
      }
      int two(){
         return 6;
      }}
```

A. I is invalid
B. II is invalid
C. III is invalid
D. IV is invalid
E. All of these are valid

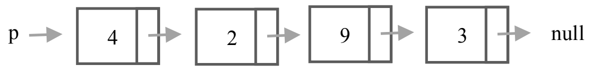
```
abstract class A
{
   int x = 2;
   abstract int one();
   int two()
   {
      return 5;
   }
}
class B extends A
{
   //<implementation>
}

//////////client code//////////////
B bop = new B();
out.println(bop.one()*bop.two()
              *bop.x);
```

QUESTION 36

Suppose a linked list has been implemented as shown in the diagram on the right, with public fields **`data`** and **`next`**. What is the output of the statement below?

```
out.print(p.next.data);
```

A. `2` B. `3` C. `4` D. `5` E. `9`



QUESTION 37

What is output by the code to the right?

A. `3null`

B. `3false`

C. `3true`

D. `4false`

E. `4true`

```
Set<Integer> sa = new
  TreeSet<Integer>();
sa.add(4);
sa.add(5);
sa.add(4);
sa.add(6);
sa.add(7);
sa.remove(6);
out.print(sa.size());
out.println(sa.contains(6));
```

QUESTION 38

What is the output of this code if the value of ***`<keyboard integer input>`*** is `3.14`?

A. `Bad data.`

B. `All is good.`

C. `Bad data. All is good.`

D. There is no output.

E. There is no output due to a runtime error.

```
int tx;
try{
  tx = <keyboard integer input>;
}
catch(Exception ee){
  out.print("Bad data. ");
}
finally{
  out.print("All is good. ");
}
```

QUESTION 39

On the right is a binary tree implementing a min heap, with the 1 in position 0, the 7 in position 1, and the 5 in position 2. The last element added was a 2. In what position does the value 2settle when the min heap is reestablished in the sifting up process?

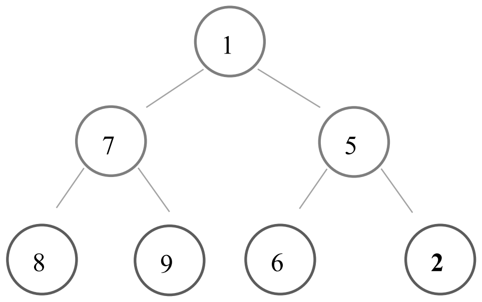
A. position 0

B. position 1

C. position 2

D. position 5

E. position 6



QUESTION 40

OPEN ENDED QUESTION – Using the ***enqueue*** and ***dequeue*** sequence given on the right, process the commands shown into a standard queue and indicate the ***last value dequeued*** and which value would be the ***next one dequeued***.

Find the ***two*** *answers and write them on your answer sheet* ***correctly labeled****. If using a ScanTron form, write them out to the side of the bubbles, also* ***correctly labeled****. If not labeled, the order you put your answers will be assumed to be* ***last value dequeued****, then* ***next value to be dequeued****.*

Last value dequeued	Next value to be dequeued

enqueue 3
enqueue 5
enqueue 4
dequeue x
enqueue 7
dequeue x
dequeue x
enqueue 9

Standard Classes and Interfaces — Supplemental Reference

class java.lang.Object

- `boolean equals(Object other)`
- `String toString()`
- `int hashCode()`

interface java.lang.Comparable<T>

- `int compareTo(T other)`
  Return value < 0 if `this` is less than `other`.
  Return value = 0 if `this` is equal to `other`.
  Return value > 0 if `this` is greater than `other`.

class java.lang.Integer implements Comparable<Integer>

- `Integer(int value)`
- `int intValue()`
- `boolean equals(Object obj)`
- `String toString()`
- `int compareTo(Integer anotherInteger)`
- `static int parseInt(String s)`
- `static int parseInt(String s, int radix)`

class java.lang.Double implements Comparable<Double>

- `Double(double value)`
- `double doubleValue()`
- `boolean equals(Object obj)`
- `String toString()`
- `int compareTo(Double anotherDouble)`
- `static double parseDouble(String s)`

class java.lang.String implements Comparable<String>

- `int compareTo(String anotherString)`
- `boolean equals(Object obj)`
- `int length()`
- `String substring(int begin, int end)`
  Returns the substring starting at index `begin` and ending at index `(end - 1)`.
- `String substring(int begin)`
  Returns `substring(from, length())`.
- `int indexOf(String str)`
  Returns the index within this string of the first occurrence of `str`. Returns `-1` if `str` is not found.
- `int indexOf(String str, int fromIndex)`
  Returns the index within this string of the first occurrence of `str`, starting the search at the specified index.. Returns `-1` if `str` is not found.
- `charAt(int index)`
- `int indexOf(int ch)`
- `int indexOf(int ch, int fromIndex)`
- `String toLowerCase()`
- `String toUpperCase()`
- `String[] split(String regex)`
- `boolean matches(String regex)`

class java.lang.Character

- `static boolean isDigit(char ch)`
- `static boolean isLetter(char ch)`
- `static boolean isLetterOrDigit(char ch)`
- `static boolean isLowerCase(char ch)`
- `static boolean isUpperCase(char ch)`
- `static char toUpperCase(char ch)`
- `static char toLowerCase(char ch)`

class java.lang.Math

- `static int abs(int a)`
- `static double abs(double a)`
- `static double pow(double base, double exponent)`
- `static double sqrt(double a)`
- `static double ceil(double a)`
- `static double floor(double a)`
- `static double min(double a, double b)`
- `static double max(double a, double b)`
- `static int min(int a, in b)`
- `static int max(int a, int b)`
- `static long round(double a)`
- `static double random()`
  Returns a `double` value with a positive sign, greater than or equal to `0.0` and less than `1.0`.

interface java.util.List<E>

- `boolean add(E e)`
- `int size()`
- `Iterator<E> iterator()`
- `ListIterator<E> listIterator()`
- `E get(int index)`
- `E set(int index, E e)`
  Replaces the element at `index` with the object `e`.
- `void add(int index, E e)`
  Inserts the object `e` at position `index`, sliding elements at position `index` and higher to the right (adds 1 to their indices) and adjusts `size`.
- `E remove(int index)`
  Removes element from position `index`, sliding elements at position `(index + 1)` and higher to the left (subtracts 1 from their indices) and adjusts `size`.

class java.util.ArrayList<E> implements List<E>

class java.util.LinkedList<E> implements List<E>, Queue<E>

Methods in addition to the `List` methods:

- `void addFirst(E e)`
- `void addLast(E e)`
- `E getFirst()`
- `E getLast()`
- `E removeFirst()`
- `E removeLast()`

`class java.util.Stack<E>`

- `boolean isEmpty()`
- `E peek()`
- `E pop()`
- `E push(E item)`

`interface java.util.Queue<E>`

- `boolean add(E e)`
- `boolean isEmpty()`
- `E peek()`
- `E remove()`

`class java.util.PriorityQueue<E>`

- `boolean add(E e)`
- `boolean isEmpty()`
- `E peek()`
- `E remove()`

`interface java.util.Set<E>`

- `boolean add(E e)`
- `boolean contains(Object obj)`
- `boolean remove(Object obj)`
- `int size()`
- `Iterator<E> iterator()`
- `boolean addAll(Collection<? extends E> c)`
- `boolean removeAll(Collection<?> c)`
- `boolean retainAll(Collection<?> c)`

`class java.util.HashSet<E> implements Set<E>`

`class java.util.TreeSet<E> implements Set<E>`

`interface java.util.Map<K,V>`

- `Object put(K key, V value)`
- `V get(Object key)`
- `boolean containsKey(Object key)`
- `int size()`
- `Set<K> keySet()`
- `Set<Map.Entry<K, V>> entrySet()`

`class java.util.HashMap<K,V> implements Map<K,V>`

`class java.util.TreeMap<K,V> implements Map<K,V>`

`interface java.util.Map.Entry<K,V>`

- `K getKey()`
- `V getValue()`
- `V setValue(V value)`

`interface java.util.Iterator<E>`

- `boolean hasNext()`
- `E next()`
- `void remove()`

`interface java.util.ListIterator<E> extends java.util.Iterator<E>`

Methods in addition to the `Iterator` methods:

- `void add(E e)`
- `void set(E e)`

`class java.lang.Exception`

- `Exception()`
- `Exception(String message)`

`class java.util.Scanner`

- `Scanner(InputStream source)`
- `boolean hasNext()`
- `boolean hasNextInt()`
- `boolean hasNextDouble()`
- `String next()`
- `int nextInt()`
- `double nextDouble()`
- `String nextLine()`
- `Scanner useDelimiter(String pattern)`