University Interscholastic League

Computer Science Competition

Number 93 (Region - 2005)

General Directions (Please read carefully!):

1) DO NOT OPEN EXAM UNTIL TOLD TO DO SO.

2) **NO CALCULATORS OF ANY KIND MAY BE USED.**

3) 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. You may 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.

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 product of 10110_2 and 11001_2?

A. 1000100110_2 B. 1000011111_2 C. 1010100001_2 D. 1001001010_2 E. None of these

QUESTION 2

What is output if the return value of the call to `nextInt()` is 374?

A. `Heads` B. `Tails`

C. `Edge!` D. Not a valid return value

E. None of these

QUESTION 3

What is output if the return value of the call to `nextInt()` is 1001?

A. `Heads` B. `Tails`

C. `Edge!` D. Not a valid return value

E. None of these

```
public static void flip() {
  Random r = new Random();
  int toss = r.nextInt(1001);
  if (toss < 500)
    System.out.print("Heads");
  else if (toss < 1000)
    System.out.print("Tails");
  else
    System.out.print("Edge!");
}
```

QUESTION 4

Which of these is a valid declaration and initialization?

A. `Cat c = new Animal();`

B. `Animal a = new Cat();`

C. `Cat c();`

D. `Animal a();`

E. More than one of these

```
public class Animal {
  public Animal() {}
  // other methods and data not shown
}

public class Cat extends Animal {
  public Cat() {}
  // other methods and data not shown
}
```

QUESTION 5

What is returned by `f(0, 12)`?

A. 12 B. 120

C. Infinite loop D. 0

E. None of these

QUESTION 6

What is returned by `f(-10,-12)`?

A. 12 B. 120

C. Infinite loop D. 0

E. None of these

```
public static int f(int x, int y) {
  if (x<0) return -f(-x,y);
  if (x==0) return 0;
  return y + f(--x,y);
}
```

QUESTION 7

Suppose `Shirt s` and `Pants p` are initialized to reference a shirt object and a pants object. What happens when the method `p.compareTo(s)` is executed?

A. `0` is returned

B. If the `Shirt` class has two integer data members then they are used in place of `inseam` and `length` for the comparisons

C. Both `p` and `s` are compared using the `Clothing` version of `compareTo()`

D. A `ClassCastException` is thrown

E. None of these

QUESTION 8

Suppose for `Pants p1` and `Pants p2` the method `p1.compareTo(p2)` returns `4`. Which of these statements is true?

A. The length of `p2` is bigger than the length of `p1` by `4`

B. Either the inseam of `p1` is bigger than the inseam of `p2` by `4` or the inseams are the same and the length of `p1` is bigger than the length of `p2` by `4`

C. The inseam of `p1` is bigger than the inseam of `p2` by `4`

D. Either the inseam of `p2` is bigger than the inseam of `p1` by `4` or the inseams are the same and the length of `p2` is bigger than the length of `p1` by `4`

E. None of these

QUESTION 9

What is output by the code below?

```
Pants p1 = new Pants(34, 32);
Pants p2 = new Pants(34, 32);
System.out.print(
  (p1 == p2) + " " +
  p1.equals(p2) + " " +
  (p1.compareTo(p2) == 0));
```

A. `false false true`

B. `false true true`

C. `true true false`

D. `true false false`

E. None of these

```
// part of an inventory program

public class Pants extends Clothing
                   implements Comparable {

  public Pants(int inseam, int length) {
    this.inseam = inseam;
    this.length = length;
  }

  public int compareTo(Object o) {
    Pants p = (Pants)o;
    if (inseam != p.inseam)
      return inseam - p.inseam;
    else
      return length - p.length;
  }

  private int inseam, length;
}

public class Shirt extends Clothing
                   implements Comparable {
// methods and data not shown
}
```

QUESTION 10

What is the value of z?

A. 3 B. 17 C. 1

D. 19 E. None of these

```
int x = 3, y = 17;

int z = x & y;
```

QUESTION 11

Which of these replaces **<*1>** to declare an integer variable named `len` whose initial value is the length of `s`?

A. `int len = new int(s.length);`

B. `int len(s.length());`

C. `int len = s.length;`

D. `int len = s.length();`

E. None of these

QUESTION 12

Assume **<*1>** is filled in correctly. What is returned by `process("regional")`?

A. `"regional"` B. `"lanoiger"`

C. `"onalonal"` D. `"igerlano"`

E. None of these

```
public static String process(String s) {
  StringBuffer sb;
  sb = new StringBuffer(s);
  <*1>
  for (int i=0; i<len/2; ++i)
    sb.setCharAt(i, s.charAt(i+len/2));
  return sb.toString();
}
```

QUESTION 13

How many `*`'s are output by the code to the right if `n` is initialized to `16`?

A. 16 B. 32

C. 64 D. 128

E. None of these

```
int n;
// code to initialize n not shown

for (int i=0; i<n; ++i)
  for (int j=1; j<n; j*=2)
    System.out.print('*');
```

QUESTION 14

What is the running time of the nested loops? Choose the smallest correct answer.

A. $O(n)$ B. $O(\log n)$

C. $O(n^2)$ D. $O(n \log n)$

E. None of these

QUESTION 15

Which of these replaces **<*1>** in the code to the right to move all of the items in `array` from position `pos` to position `i-1` one spot closer to the end of `array`?

A.
```
for (int j=pos; j<i; ++j)
    array[j+1] = array[j];
```

B.
```
for (int j=pos; j>i; --j)
    array[j+1] = array[j];
```

C.
```
for (int j=i; j<pos; ++j)
    array[j] = array[j-1];
```

D.
```
for (int j=i; j>pos; --j)
    array[j] = array[j-1];
```

E. More than one of these

For the remaining questions, assume that **<*1>** has been filled in correctly.

QUESTION 16

Which sorting algorithm is implemented by the code to the right?

A. Insertion sort
B. Selection sort
C. Merge sort
D. Quicksort
E. None of these

QUESTION 17

Suppose the array below is sorted with the `sort()` method. Which of these shows the state of the array after the body of the outer `for` loop has executed twice?

17	22	8	-3	3	7

A.

17	22	8	-3	3	7

B.

8	-3	3	7	17	22

C.

-3	3	7	8	17	22

D.

8	17	22	-3	3	7

E. None of these

```
public static int search(int[] array,
                         int front,
                         int back,
                         int item) {
  if (front == back) return front;
  int mid = (back-front)/2 + front;
  if (item < array[mid])
    return search(array,front,mid-1,item);
  return search(array,mid+1,back,item);
}


public static void sort(int[] array) {
  for (int i=1; i<array.length; ++i) {
    int pos = search(array,0,i,array[i]);
    int temp = array[i];
    <*1>
    array[pos] = temp;
  }
}
```

QUESTION 18

What does the array below look like after it is passed as a parameter to `turn()`?

'a'	'b'	'c'
'd'	'w'	'x'
'y'	'z'	'm'

A.

'z'	'y'	'x'
'w'	'd'	'c'
'b'	'a'	'n'

B.

'a'	'd'	'y'
'b'	'w'	'z'
'c'	'x'	'n'

C.

'z'	'w'	'b'
'y'	'd'	'a'
'x'	'c'	'n'

D.

'a'	'b'	'c'
'd'	'w'	'x'
'y'	'z'	'm'

E. None of these

```
public static void turn(char[][] array) {
  for (int i=0; i<array.length; ++i)
    for (int j=0; j<array[i].length; ++j)
      array[i][j] =
            (char)('z'-(array[i][j]-'a'));
}
```

QUESTION 19

Which of these declarations creates the array below?

'a'	'b'	'c'
'd'	'w'	'x'
'y'	'z'	'm'

A.
```
char [] array = {a,b,c,d,w,x,y,z,m};
```

B.
```
char [][] array = {{'a','b','c'},
                   {'d','w','x'},
                   {'y','z','m'}};
```

C.
```
char [] array = {'a','b','c','d',
                 'w','x','y','z','m'};
```

D.
```
char array = {{'a','b','c'},
              {'d','w','x'},
              {'y','z','m'}};
```

E. None of these

QUESTION 20

Which of these string literals represents the two character string containing a backslash and a lowercase "t"?

A. `"\t"` B. `"\\t"` C. `"\\t"` D. `"\\tt"` E. None of these

QUESTION 21

Which of these calls to the `substring()` method returns the string `"days are here"`?

A. `s.substring("days are here")`

B. `s.substring(7,13)`

C. `s.substring(6,19)`

D. `s.substring(7,20)`

E. None of these

```
String s = "happy days are here again";

String t = "here today, gone tomorrow";
```

QUESTION 22

Which of these expressions evaluates to the string `"happy days are gone"`?

A.
```
"happy" + "days" + "are" +
t.substring(11,5)
```

B.
```
s.substring(0,15) +
t.substring(12,16)
```

C.
```
s.substring(0,15) +
t.substring(12,4)
```

D.
```
s.substring(0,14) +
t.substring(11,5)
```

E. Both C and D

QUESTION 23

What is output by the code to the right if static method `f()` returns the string `"Try"`?

A. `Try`

B. `CatchFinally`

C. `TryCatchFinally`

D. `TryFinally`

E. None of these

```
try {
  System.out.print(f());
}
catch (Exception e) {
  System.out.print("Catch");
}
finally {
  System.out.print("Finally");
}
```

QUESTION 24

What is returned by `Double.parseDouble(".027e2")`?

A. `.0027` B. `.027` C. `.27` D. `NumberFormatException` is thrown E. None of these

QUESTION 25

What is the maximum number of levels in a binary search tree with `32` elements?

A. `32` B. `16` C. `5` D. `1` E. None of these

QUESTION 26

Which of these could replace <*1> in the code to the right so that the assignment can be done without a cast?

A. `char` B. `short` C. `byte`

D. `double` E. Both A and D

```
int x = 10;
<*1> y;
y = x;
```

QUESTION 27

What replaces <*1> in the code to the right to declare publicly accessible constants?

A. `public constant int`

B. `public final constant int`

C. `public static final int`

D. `public const static int`

E. None of these

QUESTION 28

What replaces <*2> in the code to the right to cause an exception to be thrown?

A. `return` B. `exit`

C. `stop` D. `throw`

E. None of these

QUESTION 29

Assume that <*1> and <*2> have been filled in correctly. Which of these builds a card representing the ace of spades?

A. `new Card(Card.ACE, Card.SPADES)`

B. `new Card(Card(ACE), Card(SPADES))`

C. `new Card(ACE.Card, SPADES.Card)`

D.
```
new Card(new Card(ACE),
         new Card(SPADE))
```

E. More than one of these

```
public class Card implements Comparable {
  public Card(int rank, int suit) {
    if (rank>=ACE && rank<=KING)
      this.rank = rank;
    else
      <*2> new IllegalArgumentException();
    if (suit>=CLUBS && suit<=SPADES)
      this.suit = suit;
    else
      <*2> new IllegalArgumentException();
  }

  public int compareTo(Object o) {
    Card c = (Card)o;
    if (this.rank != c.rank)
      return this.rank - c.rank;
    else
      return 100*(this.suit - c.suit);
  }

  private int rank, suit;

  <*1> CLUBS = 0;
  <*1> DIAMONDS = 1;
  <*1> HEARTS = 2;
  <*1> SPADES = 3;
  <*1> ACE = 1;
  <*1> JACK = 11;
  <*1> QUEEN = 12;
  <*1> KING = 13;
}
```

QUESTION 30

What is output by the code to the right?

A. 30 B. 31

C. 32 D. 33

E. None of these

```
int x = 12, y = 15, z = -3;

if ((x<y++) || (y<=z--))
  System.out.print(++x + y-- - z);
else
  System.out.print(x++ + --y - z);
```

QUESTION 31

Assume the `Stack` class correctly implements push and pop operations. What is output by the first output statement in the code to the right?

A. 15 B. 28
C. 23 D. 37
E. None of these

```
Stack s = new Stack();

s.push(new Integer(15));
s.push(new Integer(28));
s.push(new Integer(23));
s.push(new Integer(37));

System.out.print(s.pop());

System.out.print(s.pop());
```

QUESTION 32

Assume the `Stack` class correctly implements push and pop operations. What is output by the second output statement in the code to the right?

A. 15 B. 28
C. 23 D. 37
E. None of these

QUESTION 33

What is returned by `f(37)`?

A. 0 B. 10
C. 18 D. 19
E. None of these

```
public static int f(int x) {
  switch(x%4) {
  case 0:
    return 0;
  case 1:
  case 3:
    return x/2;
  case 2:
    return 2*x;
  default:
    return x;
  }
}
```

QUESTION 34

Suppose `x` is not negative. When does `f(f(x))` return `x`?

A. When `x` is even
B. When `x` is a multiple of 4
C. When `x` is even, but not a multiple of 4
D. When `x` is 0
E. None of these

QUESTION 35

What replaces **<*1>** in the code to the right to make a loop that prints all elements of `s`?

A. `i=s.iterator();i.hasNext();++i`
B. `i=s.iterator;i.next();`
C. `i=s.iterator;;i.hasNext()`
D. `i=s;i.hasNext();true`
E. None of these

```
public Set s = new TreeSet();
// code to add elements to s not shown

Iterator i;

for (<*1>)
  System.out.print(i.next());
```

QUESTION 36

How often is the initialization code in the static block executed when a program runs that uses `class A`?

A. Not valid syntax
B. Never
C. Once
D. Each time an object of type `A` is built
E. None of these

```
public class A {
  // methods and data now shown
  static {
    // initialization code
  }
}
```

QUESTION 37

How many `*`'s are output by the code to the right?

A. 9 B. 8
C. 7 D. 1, then an infinite loop
E. None of these

```
int x = 10;

while (x>=0) {
  if (x%3 == 0) continue;
  System.out.print('*');
  --x;
}
```

QUESTION 38

Which of these describes the rent of an apartment computed using method `computeRent()`?

A. Proportional to the number of bathrooms, with an additional charge for each bedroom
B. Proportional to the number of square feet, with an additional charge for each bathroom
C. Proportional to the number of square feet, with an additional charge for each bedroom and bathroom
D. Fixed at $1000
E. None of these

```
public class Apartment {
  // public three argument constructor to
  // initialize private data not shown

  // returns monthly rent in dollars
  public int computeRent(double x, int y) {
    return (int)(squareFeet*x +
                 numBathrooms*y);
  }

  private int numBedrooms;
  private int numBathrooms;
  private int squareFeet;
}
```

QUESTION 39

If `Apartment a` has 1000 square feet, two bedrooms, and three bathrooms, what is returned by the method call `a.computeRent(.75, 100)`?

A. 700 B. 800
C. 900 D. 1000
E. None of these

QUESTION 40

What keyword is used inside a `switch` statement to indicate that control should jump to the end of the statement?

A. `outside` B. `goto` C. `stop` D. `break` E. None of these