QUESTION 1

What does 11100101_2 minus BF_{16} equal?

A. 40_8 B. $D6_{16}$ C. 306_8 D. 46_8 E. 1001110_2

QUESTION 2

What is output by the code to the right?

A. 18-4 B. 24-4 C. 24-24

D. 14-4 E. 14-14

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

QUESTION 3

What is output by the code to the right?

A. 120 B. 124 C. 129

D. 144 E. 15

```
int total = 0;
for(int i = 0; i < 4; i++){
    total++;
    for(int j = 0; j < 5; j++){
      total++;
      for(int k = 0; k < 6; k++)
        total++;
    }
}
System.out.print( total );
```

QUESTION 4

What is output by the code to the right?

A. tboy B. ertboy C. rtboyer

D. ertboye E. Nothing is printed out.

```
String s1 = "robertboyer";
int p1 = s1.indexOf("er");
int p2 = s1.indexOf("er", p1 + 1);
s1 = s1.substring(p1, p2);
System.out.println( s1 );
```

QUESTION 5

What is output by the code to the right?

A. 2-21

B. 7-15

C. 1-5

D. 0-7

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

```
int[] list = {7, 2, 20, 14, 6, 21, 15};
int m1 = 0;
int m2 = 0;

for(int i = 1; i < list.length - 1; i++){
  if( list[i] < list[i + 1] ){
    if( list[i] < list[m1] )
      m1 = i;
    if( list[i+1] > list[m2] )
      m2 = i;
  } else {
    if( list[i + 1] < list[m1] )
      m1 = i + 1;
    if( list[i] > list[m2] )
      m2 = i;
  }
}

System.out.print( m1 + "-" + m2 );
```

QUESTION 6

What is output by the code to the right?

A. `0149` B. `481632`

C. `491625` D. `251694`

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

```
int[][] mat = new int[4][4];
for(int i = 0; i < 4; i++)
  for(int j = 0; j < 4; j++)
    mat[j][i] = (i + j) * (i + j);

for(int k = 0; k < 4; k++)
    System.out.print( mat[k][2] );
```

QUESTION 7

Which of the following replaces **<*1>** in the code to the right to set the variable `b` to `true`?

A. `r.toLowerCase().equals(s)`

B. `(r + t).equals(s)`

C. `Integer.parseInt(t) > s.length()`

D. `s.compareTo(r) == 0`

E. More than one of these.

```
boolean b;
String r = "abc";
String s = "ABC5";
String t = "5";
b = <*1>;
```

QUESTION 8

What is output by the code to the right?

A. `1` B. `2` C. `3`

D. `12` E. `13`

```
double a = 7.5;
double b = a / 2;
if( a > b * 2 )
    System.out.print(1);
if( b / a > 3 || a * b > 3 )
    System.out.print(2);
else
    System.out.print(3);
```

QUESTION 9

The code to the right results in the following output:

```
false
```

Which of these best explains why?

A. The `==` operator compares references to objects, not the objects themselves.

B. The `Strings n2` and `n4` have differences in capitalization.

C. The `==` operator compares which methods have been called on an object.

D. The `Strings n2` and `n4` are not made up of the same characters in the same order.

E. The `==` operator compares variable names.

```
String n1 = "Computer";
String n2 = n1.substring(1,4);
String n3 = "OMP";
String n4 = n3.toLowerCase();
System.out.println( n2 == n4 );
```

QUESTION 10

What is output by the code to the right?

A. `_week_n`

B. `l_week_n`

C. `l_w`

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

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

```
String q1 =
          "real_week_neon_at_the_seaside.";

String[] chop = q1.split("e[aiou].");
System.out.print( chop[1] );
```

QUESTION 11

Which of these data types replaces **<*1>** in the code to the right so the parameter `other` is of the correct type to implement the `compareTo` method from the `Comparable` interface.

A. `T`

B. `Score`

C. `Object`

D. `Comparable<T>`

E. `Comparable`

Assume **<*1>** is filled in correctly.

QUESTION 12

Which of these replaces **<*2>** in the code to the right to correctly implement the `compareTo` method from the `Comparable` interface? A `Score` object is greater than another `Score` object if the value stored in its `pts` field is greater than the value stored in the other `Score` object's `pts` field.

A. `return pts - other.pts`

B. `return getPts() - other.getPts()`

C. `return other.pts - pts`

D. `return other.getPts() - getPts()`

E. More than one of these.

Assume **<*1>** and **<*2>** are filled in correctly.

QUESTION 13

What is the output by the code to the right when method `mavs` is called?

A. `3` B. `4` C. `5`

D. `6` E. `8`

QUESTION 14

What is the output by the code to the right when method `spurs` is called?

A. `1234`

B. `4321`

C. The output cannot be predicted.

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

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

```
public class Score
             implements Comparable<Score>{

  private int pts;

  public Score(int p){
    pts = p;
  }

  public void freeThrow(){
    pts++;
  }

  public void basket(){
    pts += 2;
  }

  public void trey(){
    pts += 3;
  }

  public int getPts(){
    return pts;
  }

  public int compareTo(<*1> other){
    <*2>;
  }
}
```

```
// methods in a client of Score
public void mavs(){
  Score s1 = new Score(0);
  Score s2 = new Score(0);
  s1.basket();
  s2.trey();
  s1 = s2;
  s1.basket();
  s2.freeThrow();
  System.out.print( s1.getPts() );
}

public void spurs(){
  Set<Score> coll = new HashSet<Score>();
  for(int i = 1; i < 5; i++)
    coll.add( new Score(i) );
  for( Score s : coll )
    System.out.print( s.getPts() );
}
```

QUESTION 15

What is returned by the following method call?

`ways(new int[]{5, 3, 6, 3}, 15, 0 )`

A. 270 B. 17 C. 4

D. 10 E. 18

```
public static int ways(int[] ds,
                       int g, int c){
  int result = 0;
  if( c == ds.length ){
    if( g == 0 )
      result = 1;
  } else {
    for(int i = 1; i <= ds[c]; i++)
      result += ways(ds, g - i, c + 1);
  }
  return result;
}
```

QUESTION 16

What is the running time of method `manip`? Choose the most restrictive correct answer.

A. $O(1)$ B. $O(n)$ C. $O(n \log n)$

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

```
public int manip(int n){
  int total = 0;
  for(int i = n; i > 0; i /= 2)
    for(int j = 0; j < i; j++)
      total += (j * i) % n;
  return total;
}
```

QUESTION 17

What is output by the code to the right?

A. 7-4.4 B. 7-2.2 C. 8-2.2

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

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

```
int x3 = 3;
double a3 = 2.2;
x3 += a3 * 2;
System.out.print( x3 + "-" + a3 );
```

QUESTION 18

What is output by the code to the right?

A. %1$04d,%2$+5.3f,365,4.1356

B. 5554.136

C. 0365,4.135

D. 0365+4.1

E. 0365,+4.136

```
double planck = 4.1356;
int days = 365;
String format = "%1$04d,%2$+4.3f";
System.out.printf(format, days, planck);
```

QUESTION 19

What is output by the code to the right?

A. 253

B. -2

C. 3

D. -3

E. -125

```
byte val1 = 2;
byte val2 = (byte)~val1;
System.out.print( val2 );
```

QUESTION 20

What replaces **<*1>** in the code to the right to set `mid` to the middle element of the portion of the array `vals` from `st` to `fin`?

A. `mid = st + fin / 2`

B. `mid = st / 2 + fin`

C. `mid = 1.0 * (st + fin) / 2`

D. `mid = (st + fin) / 2`

E. More than one of these.

Assume **<*1>** is filled in correctly.

QUESTION 21

What is returned by the method call `demo1()` ?

A. `8` B. `0`

C. `9` D. `10`

E. There is no return value due to a runtime error.

QUESTION 22

What is returned by the method call `demo2()` ?

A. `0` B. `-1`

C. `4` D. `5`

E. There is no return value due to a runtime error.

QUESTION 23

If `vals` has a length of N and every element of `vals` equals the same value `x`, what is the running time of method `find(vals, x)`? Choose the most restrictive correct answer.

A. `O(x)`

B. `O(logN)`

C. `O(N)`

D. $O(N^2)$

E. `O(xN)`

```
// pre: elements in vals are sorted in
// ascending order
public static int find(int[] vals, int tgt){
  int st = 0;
  int fin = vals.length - 1;
  int mid;
  int result = -1;

  while( result == -1 && st <= fin ){
    <*1>;
    if( vals[mid] == tgt )
      result = mid;
    else if( vals[mid] < tgt )
      st = mid + 1;
    else
      fin = mid - 1;
  }

  while( result > 0
              && vals[ result - 1 ] == tgt ){
    result--;
  }

  return result;
}

public static int demo1(){
  int[] list = new int[20];
  int pos = 0;
  for(int i = -2; i <= 2; i++){
    for(int j = 0; j < 4; j++){
      list[pos] = i;
      pos++;
    }
  }

  return find( list, 0 );
}

public static int demo2(){
  int[] list = new int[10];
  for(int i = 0; i < 100; i += 10)
    list[ i / 10 ] = i;

  return find( list, 45 );
}
```

QUESTION 24

What is output by the code to the right when method `three` is called?

A. `4`

B. `0`

C. `3`

D. `7`

E. `5`

QUESTION 25

What is output by the code to the right when method `four` is called?

A. `0`

B. `1`

C. `2`

D. `null`

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

```
public class IntCell{

  public int val;
  public IntCell next;

  public IntCell(int v){
    val = v;
  }

}
-----------------------------------------

// methods in a client of IntCell
public boolean one(IntCell x, IntCell y){
  x.val++;
  y.val += 2;
  return x.val < y.val;
}

public boolean two(IntCell x, IntCell y){
  x.val++;
  y.val--;
  return y.val <= x.val;
}

public void three(){
  IntCell a = new IntCell(6);
  IntCell b = new IntCell(3);
  if( one(a,b) && two(a,b) )
    System.out.print( a.val );
  else
    System.out.print( b.val );
}

public void four(){
  IntCell a = new IntCell(1);
  IntCell b = new IntCell(2);
  a.next = b;
  b.next = a.next;
  System.out.print( a.next.next.val );
}
```

QUESTION 26

What is output by the code to the right?

A. `12_3`

B. `8_3`

C. `8_2`

D. `12_2`

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

```
int x = 3;
int y = 4;
int z = y * x--;
System.out.print( z + "_" + x );
```

QUESTION 27

What is output by the following client code?

```
Structure s1 = new Structure();
System.out.print( s1.findP(13) );
```

A. 1 B. 1000 C. 1011

D. 101 E. 1101

QUESTION 28

What is output by the following client code?

```
Structure s2 = new Structure();
int[] ents = {12, 5, 13, 17, -5};
for( int i : ents )
  s2.add( i );
System.out.print( s2.peek() );
```

A. 12 B. 5 C. 13

D. 17 E. -5

QUESTION 29

What is output by the following client code?

```
Structure s3 = new Structure();
int[] els = {12, 5, 13, 17, -5};
for(int i : els )
  s3.add( i );
s3.show();
```

A. -55121317

B. 17135-512

C. 5-5131217

D. 1713125-5

E. 513-51712

QUESTION 30

What type of data structure does the `Structure` class implement?

A. A stack.

B. A list.

C. A max heap.

D. A hash table.

E. A binary search tree.

```
public class Node{
  public Node pt, rt, lt;
  public int dt;
  public Node(Node p, int d){ pt = p; dt = d; }
}

public class Structure{
  private int size;
  private Node start;

  public void add(int d){
    String path = findP(++size).substring(1);
    if( size == 1 )
      start = new Node(null, d);
    else
      addHelp(path, d);
  }

  private void addHelp(String p, int d){
    Node tp = start;
    while( p.length() > 1 ){
      tp = p.charAt(0) == '0' ? tp.lt : tp.rt;
      p = p.substring(1);
    }
    if( p.equals("0")){
      tp.lt = new Node(tp, d); tp = tp.lt;
    } else {
      tp.rt = new Node(tp, d); tp = tp.rt;
    }
    adjust(tp);
  }

  private void adjust(Node tp){
    int temp;
    while(tp.pt != null && tp.dt > tp.pt.dt){
      temp = tp.dt;
      tp.dt = tp.pt.dt;
      tp.pt.dt = temp;
      tp = tp.pt;
    }
  }

  public String findP(int t){
    if(t == 0 || t == 1)
      return t + "";
    else
      return findP( t / 2 ) + (t % 2);
  }

  private void show(Node n){
    if(n != null){
      System.out.print(n.dt);
      show(n.lt);
      show(n.rt);
    }
  }
  public void show(){  show(start); }
  public int peek(){ return start.dt; }
}
```

QUESTION 31

Which of the following replaces **<*1>** in the code to the right to end method `sort` if the Boolean expression is `true`?

A. `break`

B. `continue`

C. `exit`

D. `end`

E. `return`

Assume **<*1>** is filled in correctly.

QUESTION 32

What is output by the code to the right when method `sample` is called?

A. `403-1786`

B. `-1034678`

C. `-1034786`

D. `467830-1`

E. `6034-187`

QUESTION 33

What sorting algorithm is implemented by method `sort`?

A. Mergesort

B. Heapsort

C. Quicksort

D. Selection sort

E. Insertion sort

QUESTION 34

Given an array of N unique integers in random order, what is the running time of method `sort`? Assume the `print` method is O(1). Choose the most restrictive correct answer.

A. O(N)

B. O(NlogN)

C. $O(N^{3/2})$

D. $O(N^2)$

E. O(N!)

```
public static void swap( int[] a,
                                int i, int j) {
  int tmp = a[i];
  a[i] = a[j];
  a[j] = tmp;
}


public static void sort( int[] list,
                         int start, int stop ){
  if(start >= stop)
    <*1>;

  int p = (start + stop) / 2;

  swap(list, p, start);
  int pVal = list[start];

  int i, j = start;

  for(i = start + 1; i <= stop; i++ ){
    if( list[i] <= pVal){
      j++;
      swap(list, i, j);
    }
  }

  if(start == 0 && stop == list.length - 1)
    for(int v : list)
      System.out.print(v);

  swap(list, start, j);
  sort( list, start, j - 1 );
  sort( list, j + 1, stop );
}


public static void sample(){
  int[] data = {6, 0, 3, 4, 7, 8, -1};
  sort(data, 0, 6);
}
```

QUESTION 35

Which of the following best describes what method `eval` returns?

A. The minimum of the three parameters.

B. The maximum of the three parameters.

C. How many of the three parameters equal each other.

D. The range of the three parameters.

E. The sum of the three parameters.

QUESTION 36

Which of the following replaces **<*1>** in the code to the right to create a two dimensional array of `int`s with one more row than the number of characters in the `String s` and one more column than then number of characters in the `String t`?

A. `int[s.length()][t.length()]`

B. `new int[t.size()+1][s.size()+1]`

C. `new int[i + 1][j + 1]`

D. `new int[n + 1][m + 1]`

E. More than one of these.

Assume **<*1>** is filled in correctly.

QUESTION 37

What is returned by the method call `comp("uilcs", "uilcs")` ?

A. 6

B. 5

C. 3

D. 2

E. 0

QUESTION 38

What is returned by the method call `comp("state", "stilte")` ?

A. 2

B. 3

C. 4

D. 5

E. 6

```
private static int eval (int a, int b, int c){
  int m;
  m = a;
  if (b < m)
    m = b;
  if (c < m)
    m = c;
  return m;
}

public static int comp (String s, String t){
  int d[][];
  int n, m, i, j;
  char s_i, t_j, cost;

  n = s.length ();
  m = t.length ();
  if (n == 0)
    return m;
  if (m == 0)
    return n;

  d = <*1>;
  for (i = 0; i <= n; i++)
    d[i][0] = i;

  for (j = 0; j <= m; j++)
    d[0][j] = j;

  for (i = 1; i <= n; i++) {
    s_i = s.charAt (i - 1);
    for (j = 1; j <= m; j++) {
      t_j = t.charAt (j - 1);

      if (s_i == t_j)
        cost = 0;
      else
        cost = 1;

      d[i][j] = eval(d[i-1][j]+1,
              d[i][j-1]+1, d[i-1][j-1] + cost);
    }
  }
  return d[n][m];
}
```

QUESTION 39

When implementing a hash table what are the two most common collision resolution schemes?

A. heapify and post order

B. open addressing and chaining

C. serialization and cloning

D. constructors and interfaces

E. keying and perfect hashing

QUESTION 40

You are working with an existing sort method that sorts data into ascending order, but you do not have the source code for the method. Here are some results of experiments with the sorting method:

Time to sort an array of 10,000 elements in random order: 0.5 seconds
Time to sort an array of 20,000 elements in random order: 2.0 seconds

Time to sort an array of 10,000 elements already in ascending order: 0.5 seconds
Time to sort an array of 20,000 elements already in ascending order: 2.0 seconds

Based on these results, which sorting algorithm is most likely being used?

A. Insertion sort

B. Selection sort

C. Mergesort

D. Quicksort

E. Radixsort