QUESTION 1

What is the sum of 745_8 and 1101101_2?

A. 900_{16} B. 11111111_2 C. 252_{16} D. 900_{10} E. $B22_{16}$

QUESTION 2

What is output by the code to the right?

A. 30 B. 15 C. 12

D. 312 E. 18

```
int s = 3;
int t = s + 2 * s;
System.out.println( s + t );
```

QUESTION 3

What is output by the code to the right?

A. 10 B. 9 C. 22

D. 18 E. 20

```
int accum = 0;
for(int i = 1; i <= 10; i++){
  accum++;
  accum++;
}
System.out.println( accum );
```

QUESTION 4

What is output by the code to the right?

A. 4 B. 10 C. 9

D. 3 E. 5

```
String first = "Doug";
String second = "Burger";
first += second;
System.out.println( first.length() );
```

QUESTION 5

What is output by the code to the right?

A. 13 B. 15 C. 17

D. 16 E. 10

```
int[] ps = {2, 3, 5, 7, 11};
ps[1] += ps[0] + 3 + ps.length;
System.out.println( ps[1] );
```

QUESTION 6

What is output by the code to the right?

A. 14 B. 6 C. 2

D. 6.0 E. 2.33333333

```
int x = 14;
int y = 2;
x /= 3 * y;
System.out.println( x );
```

QUESTION 7

How many combinations of values for the `boolean` variables `a`, `b`, and `c` will result in `d` being set to `false`?

A. 7 B. 8 C. 2

D. 4 E. 1

```
boolean a, b, c;
// code to initialize a, b, and c

boolean d = ( b || !c || !a );
```

QUESTION 8

What is output by the code to the right?

A. 12 B. 13 C. 1

D. 2 E. 3

```
String ans = "ABBAACDC";
if( ans.equals( "ABBA" ) )
  System.out.println( 1 );
if( ans.length() > 4 )
  System.out.println( 2 );
else
  System.out.println( 3 );
```

QUESTION 9

Which class is `Rectangle`'s super class?

A. `Shape`

B. `Object`

C. `Square`

D. `String`

E. `Rectangle` does not have a super class.

QUESTION 10

What is output by the client code to the right?

A. `r1`

B. `this`

C. `6`

D. `0`

E. The output cannot be determined until the program is run.

```
public class Rectangle{

  private int width;
  private int height;

  public Rectangle(int w, int h){
    width = w;
    height = h;
  }

  public int area(){
    return width * height;
  }

  public String toString(){
    return "" + this.area();
  }
}

// client code
Rectangle r1 = new Rectangle( 2, 3 );
System.out.println( r1 );
```

QUESTION 11

What is output by the code to the right?

A. 13 B. 63 C. 21

D. -31 E. 26

```
int m = 63;
int n = 42;
int o = n ^ m;
System.out.print( o );
```

QUESTION 12

What is output by the code to the right?

A. 4.0 B. 1 C. 4.4

D. 5.0 E. 5

```
double p = 1.1;
System.out.print( Math.ceil( p * 4 ) );
```

QUESTION 13

What is output by the code to the right?

A. `linelineline`

B.
```
lineline
line
```

C.
```
line
lineline
```

D. `line/nlineline`

E.
```
line
line
line
```

```
System.out.print( "line\n" );
System.out.println( "line" );
System.out.print( "line" );
```

QUESTION 14

What is output by the code to the right?

A. `(012)` B. `00010` C. `00012`

D. `(((12` E. `(00012)`

```
String format = "%0(5d";
int val = 12;
System.out.printf( format, val );
```

QUESTION 15

What is returned by the method call `change( change(8) )` ?

A. `10` B. `6` C. `13`

D. `4` E. `8`

```
public static int change(int x){
  int y = x;
  y = y - 2;
  x /= 2;
  return x + y;
}
```

QUESTION 16

What is output by the code to the right?

A. `_gr` B. `_gray` C. `m_`

D. `_gra` E. `_g`

```
String name = "jim_gray";
String st;
st = name.substring(1, 5).substring(2);
System.out.print( st );
```

QUESTION 17

What is output by the code to the right?

A. `:` B. `71` C. `7`

D. `14` E. `*&^`

```
String messy;
messy = "6...56fg@71*&^14:";
String[] res = messy.split( "\\D+" );
System.out.print( res[3] );
```

QUESTION 18

What is output by the code to the right?

A. `7`

B. `13`

C. `6`

D. `5`

E. `9`

```
String data = "MAURICEWILKES";
int count = 0;
for(int i = 0; i < data.length(); i++){
  if( data.charAt( i ) < 'J' )
    continue;
  count++;
  i++;
}
System.out.print( count );
```

QUESTION 19

What is output by method `over` if `input` initially contains the following `String`s?

`["Perl", "Cobol", "Fortran", "Ruby"]`

A. `Cobol`

B. `Fortran`

C. There is no output due to a syntax error in method `over`.

D. There is no output due to a `NoSuchElementException`.

E. There is no output due to an infinite loop caused by a logic error in method `over`.

```
public static void over
                  (ArrayList<String> input){

  Iterator<String> it = input.iterator();
  boolean found = false;
  while( it.hasNext() ){
    found = found
        || it.next().length() > 4;
  }
  System.out.println( it.next() );
}
```

QUESTION 20

What replaces **<*1>** in the code to the right to indicate `numRight` is not defined in the `TestScore` class and that subclasses are responsible for defining it?

A. `static`

B. `interface`

C. `abstract`

D. `abstract extends`

E. `extends`

```
public abstract class TestScore{

  public <*1> int numRight();

  public int numQuestions(){
    return 100;
  }

  public int score(){
    double raw = numRight();
    raw = raw / numQuestions() * 100;
    return (int)raw;
  }
}

public class ACTScore extends TestScore{
  private int correct;
  private int questions;

  public ACTScore(int c, int q){
    correct = c;
    questions = q;
  }

  public int numRight(){
    return correct;
  }

  public int numQuestions(){
    return questions;
  }

  public void adjustScore(int adj){
    correct += adj;
  }

}
```

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

QUESTION 21

What is output by the following client code?

```
ACTScore sc = new ACTScore( 50, 100 );
System.out.print( sc.score() );
```

A. `0.5` B. `100` C. `50`

D. `1.0` E. `0.0`

QUESTION 22

What is output by the following client code?

```
ACTScore as = new ACTScore( 145, 200 );
TestScore ts = as;
as.adjustScore( 5 );
System.out.print( ts.score() );
```

A. `75`

B. `150`

C. `145`

D. 72

E. There is no output due to a syntax error in the client code.

QUESTION 23

What is output by the code to the right?

```
int j = 5;
int k = (j++ > 5) ? 4 : ((j > 4) ? 3 : 2);
System.out.println( k );
```

A. `2` B. `6` C. `4`

D. `5` E. `3`

QUESTION 24

What is output by the code to the right?

```
ArrayList<String> letters = new
                        ArrayList<String>();
letters.add( "A" );
letters.add( "A" );
letters.add( 1, "B" );
letters.set( 0, "AA" );
System.out.println( letters );
```

A. `[AAA, AB]` B. `[AA, A, B, A]`

C. `[AA, A, B]` D. `[AA, B]`

E. `[AA, B, A]`

QUESTION 25

What is output by the statement marked `line 1` when method `demo` is called?

A. `0` B. `5`

C. `3` D. `1`

E. `12208`

QUESTION 26

What is output by the statement marked `line 2` when method `demo` is called?

A. `24` B. `9`

C. `5` D. `7`

E. `15`

```
public static int sum(int[][] mat,
                          int row, int col){
  if( row == -1 || col == mat[0].length )
    return 0;

  int tot1 = sum(mat, row - 1, col);
  int tot2 = sum(mat, row - 1, col + 1);
  return tot1 + tot2 + mat[row][col];
}

public static void demo(){
  int[][] t = { {1, 2, 2, 0, 8},
                {5, 1, 0, 1, 2},
                {4, 2, 3, 2, 1}};

  System.out.println( t.length ); // line 1

  int x = sum( t, 2, 1 );

  System.out.println( x ); // line 2
}
```

QUESTION 27

Which searching algorithm does method `search` implement?

A. Greedy B. Sequential C. Heap

D. Binary E. Interpolation

QUESTION 28

Which of the following best describes method `search`'s post condition ?

A. Returns the index of the first occurrence of `tgt` in `nums`.

B. Returns the index of the first occurrence of `tgt` in `nums` or `-1` if `tgt` is not present.

C. Returns the number of times `tgt` appears in `nums`.

D. Returns the number of elements in `nums` that are less than `tgt`.

E. Returns the index of the last occurrence of `tgt` in `nums` or `-1` if `tgt` is not present.

```
// pre: nums != null
// post: see question 28
public static int search(int[] nums,
                                    int tgt){
  int result = -1;
  for(int i = 0; i < nums.length; i++){
    if( nums[i] == tgt ){
      result = i;
    }
  }
  return result;
}
```

QUESTION 29

What is output by the code to the right?

A. `aan_emer` B. `lb_emer` C. `n_emer`

D. `bn_emer` E. `alan_emer`

```
/* explanation of method replaceFirst:
   String replaceFirst(String regex,
                       String replacement)
   Creates and returns a new String by
   replacing the first substring that
   matches regex with replacement.
*/

String nm = "alan_emer";
String regex = "a..";
String rs = nm.replaceFirst( regex, "b" );
System.out.print( rs );
```

QUESTION 30

Consider method `build` to the right. When the parameter `n` equals 500,000 the method takes 1.5 seconds to complete. What is the expected time for method `build` to complete when `n` equals 1,000,000?

A. 6.0 sec. B. 2.25 sec. C. 3.15 sec.

D. 1.5 sec. E. 3.0 sec.

```
public TreeSet<Integer> build(int n){
  TreeSet<Integer> tree
                  = new TreeSet<Integer>();
  for(int i = 0; i < n; i++)
    tree.add( i );
  return tree;
}
```

QUESTION 31

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

A. `6`

B. `9`

C. `3`

D. There is no output due to a syntax error in method `alter`.

E. There is not output due to an `ArrayIndexOutOfBoundsException`.

```
public static int alter(int[] data){
  int i = 0;
  try{
    while( i < data.length )
      data[i++] *= 2;
    if( i > 2 )
      return i;
    return 0;
  }
  finally{
    data[1] += 3;
  }
}

public static void initiate(){
  int[] data = {5, 3, 5, 2, 1, 7, 8};
  alter( data );
  System.out.println( data[1] );
}
```

QUESTION 32

If N equals `values.length` what is the Big O of method `fill` when `res` is an `ArrayList` and when `res` is a `LinkedList`? Pick the most restrictive correct set of answers.

	ArrayList	LinkedList
A.	O(N)	O(N)
B.	$O(N^3)$	$O(N^2)$
C.	$O(N^2)$	$O(N^2)$
D.	$O(N^2)$	O(N)
E.	O(N)	$O(N^2)$

```
// pre: res.size() == 0
public static void fill(List<Integer> res,
                                int[] values){

    for(int element : values)
      res.add( 0, element );
}
```

QUESTION 33

What is returned by the method call `beta(20)`?

A. `-4` B. `-10` C. `0`

D. `-9` E. `-7`

```
public static int alpha(int x){
  return (x < 0) ? x * 2 : beta( x + 10 );
}

public static int beta(int y){
  return alpha( y - 15 ) + 1;
}
```

QUESTION 34

What replaces **<*1>** in the code to the right so that the body of the `if` statement executes when the element at position `i` in the array `d` is less that or equal to the variable `guide` according to the natural ordering of the elements of `d`?

A. `d[i].compareTo( guide ) >= 0`

B. `guide.compareTo( d[i] ) <= 0`

C. `!guide.equals( d[i] )`

D. `d[i] <= guide`

E. `d[i].compareTo( guide ) <= 0`

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

QUESTION 35

Which sorting algorithm do methods `sort` and `swap` implement?

A. Merge sort

B. Insertion sort

C. Quicksort

D. Selection sort

E. Stack sort

```
public static void sort(Comparable[] d){
  int start, end;
  Stack<Integer> sp = new Stack<Integer>();
  sp.push( 0 );
  sp.push( d.length - 1 );
  while( !sp.isEmpty() ){
    end = sp.pop();
    start = sp.pop();
    if(start < end){
      int p = ( start + end ) / 2;
      swap( d, p, start );
      Comparable guide = d[start];
      int i, j = start;
      for(i = start + 1; i <= end; i++ ){
        if( <*1> ){
          j++;
          swap( d, i, j );
        }
      }
      swap( d, start, j );
      sp.push( start );
      sp.push( j - 1 );
      sp.push( j + 1 );
      sp.push( end );
    }
  }
}

public static void swap(Comparable[] d,
                                int i, int j){
  Comparable t = d[i];
  d[i] = d[j];
  d[j] = t;
}
```

QUESTION 36

The depth of a node in a tree is defined as the number of links from the root node of the tree to that node. The depth of the root node is 0.

The following values are inserted one at a time in the order shown, from left to right, into a binary search tree using the traditional insertion algorithm.

`25  1  13  -5  100  12  50  10  -7  200  8`

What is the depth of the node that contains `12` in the resulting tree?

A. `0` B. `11` C. `3` D. `5` E. `2`

QUESTION 37

What is output by the code to the right?

A. `-1` B. `255` C. `0`

D. `128` E. `-16777216`

```
int num = -1;
System.out.println( num >>> 24 );
```

QUESTION 38

What is output by the following client code?

```
int result = Structure.value( "cab" );
System.out.print( result );
```

A. 2

B. 3

C. 6

D. 0

E. 294

QUESTION 39

What is output by the following client code?

```
Structure ds = new Structure();
ds.add( "cab" );
ds.add( "aaa" );
ds.add( "dead_e" );
ds.add( "bac" );
ds.add( "ACM" );

ds.showAll();
```

A. aaa_cab_bac_dead_e_ACM_

B. ACM_aaa_bac_cab_dead_e_

C. ACM_aaa_bac_cab_deade_

D. ACM_aaa_cab_bac_dead_e_

E. cab_aaa_ACM_bac_dead_e_

QUESTION 40

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

A. An array based list

B. A stack

C. A set

D. A hash table

E. A min heap

```
public class Structure{

  private static final int LIM = 125;

  private Object[] con;

  public Structure(){
    con = new Object[LIM];
    for(int i = 0; i < LIM; i++)
      con[i] = new ArrayList<String>();
  }

  public void add(String str){
    int spot = value( str );
    get( spot % LIM ).add( str );
  }

  public void showAll(){
    for( Object temp : con ){
      ArrayList<String> list =
                      (ArrayList<String>)temp;
      for( String str : list )
        System.out.print( str + "_" );
    }
  }

  public boolean contains(String str){
    int spot = value( str ) % LIM;
    return get( spot ).contains( str );
  }

  public boolean remove(String str){
    int spot = value( str ) % LIM;
    return get( spot ).remove( str );
  }

  private ArrayList<String> get(int p){
    return (ArrayList<String>)con[p];
  }

  public static int value(String str){
    int t = 0;
    char c;
    for(int i = 0; i < str.length(); i++){
      c = str.charAt( i );
      if( Character.isLetter(c) )
        t += Character.toLowerCase(c) - 'a';
    }
    return t;
  }
}
```