1) I wrote my student number at the top of this page	True
2) Java is an object-oriented programming language	True False
3) Java is a strongly typed programming language	True False
4) Java is a compiler	True False
5) String is a primitive type	True False
6) `A||B` - is logically equivalent to - `!(A && B)`	True False
7) When accessing successive elements of an array, a for loop is preferred over a while loop	True False
8) "`this`" is a reference variable, referencing the object an object method is invoked on	True False
9) Strings are immutable in Java	True False
10) An objects attributes should generally be private	True False
11) A method can return an object reference	True False
12) A method can take an object reference as a parameter	True False
13) Classes include attributes, constructors and methods	True False
14) While loops can be nested	True False
15) Methods can be overloaded as long as their return types differ	True False
16) Classes defining multiple constructors use overloading	True False
17) String's `length()` and array's `length` differ only in syntax	True False
18) StringTokenizer will find two tokens in the string "jellyBelly"	True False
19) Class attributes can be static	True False
20) Class methods are the same as Object methods	True False

Trace the following code segment when answering questions on this page

```
String s1 = "abcdefghij";
String s2 = "abcdefghij";
Picture pic1, pic2, pic3;
String fileName = FileChooser.pickAFile();
pic1 = new Picture(fileName);
pic2 = pic1;
Pixel[] pixelArray = pic1.getPixels();
int k, j = pixelArray.length;
pixelArray[0].setColor(java.awt.BLACK);
```

21) The number of **reference variables** declared in this code segment is:
   a. 0
   b. 9
   c. 7
   d. 6
   e. None of the above

22) The number of **objects that are referenced with a reference variable** at any point in this code segment is:
   a. 0
   b. 1
   c. 4
   d. 5
   e. None of the above

23) Which of the following statements is/are true about the above code segment
   a. `s1` and `s2` have state equality
   b. `pic1` and `pic2` have state equality
   c. `k` and `j` have state equality
   d. Only (a.) and (c.) are true
   e. None of the above are true

24) Which of the following statements is/are true about the above code segment
   a. `pickAFile` is an example of a class method
   b. `setColor` is an example of an object method
   c. `length` is an example of an attribute
   d. Only two of the above are true
   e. All of the above are true

25) By convention in Java, when defining a variable name, one should:
   a. Choose a descriptive name
   b. Begin with a lowercase letter, then capitalize the first letters of the other words that are part of the name
   c. Never use underscore characters
   d. Never use hyphens
   e. All of the above are correct

26) By convention in Java, when defining the name of a constant, one should:
   a. Use camel casing
   b. Never use underscore characters
   c. Use all capital letters, and underscore characters to separate words that are part of the name
   d. Capitalize the first letter
   e. None of the above are correct

27) What will be printed when the following code segment is executed?

```
String s = "Have a good summer";
System.out.println(s.length());
```

   a. 15
   b. 16
   c. 18
   d. 19
   e. Nothing will print. The code contains an error

28) The method header for a method that returns an integer value must contain the following keyword:
   a. int
   b. return
   c. break
   d. public
   e. None of the above

29) When defining a method, which of the following can be omitted if not required?
   a. Return type
   b. Method name
   c. Parameters
   d. Visibility
   e. None of the above can be omitted

30) In what way(s) do Java arrays behave like objects?
   a. They have an attribute
   b. They can store only primitive types or reference variables
   c. They are accessed using reference variables
   d. They are allocated using new
   e. All of the above are correct

31) The following line of code

```
number = pic.getWhitePixels();
```

is an example of which of the following?
   a. An assignment
   b. A declaration
   c. A method call
   d. Both (a.) and (c.) are true
   e. All of the above are true

32) Which of the following statements is/are true about Machine Language?
   a. It is produced by the Java compiler
   b. It is close to English for ease of programming
   c. It will run directly on any machine
   d. It is in Binary
   e. None of the above are true

33) Reference variables:
   a. Have a type, which describes what type of objects they can reference
   b. Should be initialized to "-1" meaning "no reference"
   c. Are used when primitive types are not available
   d. Can only be used after they have a null value assigned to them
   e. Cannot be described by any of the above statements

34) Which of the following is/are true about `if` statements
   a. They evaluate a boolean expression
   b. They are used for conditional execution
   c. They can be paired with an `else`
   d. One of the above is false
   e. All of the above are true

Consider the following code segment when answering questions 35 through 37

```
int[] numbers = {2, 7, 3, 55};
numbers[3] = 5;
numbers[1] = numbers[2];
System.out.println(numbers.length);
```

35) Which of the following best describes the contents of the array numbers **after** the segment runs?

a. `{2,7,3,55}`
b. `{2,7,7,5}`
c. `{7,7,5,55}`
d. `{2,3,3,5}`
e. None of the above.

36) What will be printed by the call to println?

a. 3
b. 4
c. 55
d. This is incorrect syntax
e. None of the above

37) How many reference variables are in the above code segment?

a. 1
b. 2
c. 4
d. 0
e. None of the above are correct

38) Which of the following expression would correctly test for **state equality** between two objects referenced by `obj1` and `obj2`? (You may assume that the `equals()` method is defined as per convention)

a. `obj1 = obj2`
b. `obj1.equals(obj2)`
c. `obj1.obj2.equals()`
d. `obj1 == obj2`
e. None of the above

39) Which of the following expression would correctly test for **identity equality** between two objects referenced by `obj1` and `obj2`? (You may assume that the `equals()` method is defined as per convention)

a. `obj1 = obj2`
b. `obj1.equals(obj2)`
c. `obj1.obj2.equals()`
d. `obj1 == obj2`
e. None of the above

Assume we have a Student class, including the following code:

```
public class Student{

  private String name;
  private double[] gradeArray;

  public Student(){
    name = null;
    gradeArray = null;
  }

  public Student(String theName, double[] theGrades) {
    name = theName;
    gradeArray = theGrades;
  }

  ...

  public String toString(){
    String s = "Student " + this.name;
    if ( gradeArray != null ){
      s += " has grades ";
      for (int i = 0; i < this.gradeArray.length; i ++) {
        s = s + this.gradeArray[i] + " ";
      }
    }
    return s;
  }

  //main method within Student class for testing
  public static void main(String[] args) {
    double[] grades = {86,83,90,78};
    Student hasan = new Student("Hasan", grades);
    Student nisha = new Student("Nisha", grades);
    nisha.gradeArray[0] = 89;
    System.out.println(hasan);
  }
}
```

Use the above code on the previous page to answer the following questions:

40) **[** 4 Marks **]** What will be the output of the main method?
   a. "Student Hasan has grades 89.0 83.0 90.0 78.0"
   b. "Student Hasan"
   c. "Student Hasan has grades 89 83 90 78"
   d. "Student Hasan has grades 86.0 83.0 90.0 78.0"
   e. None of the above are correct

41) How many arrays were created in memory when running the main method?
   a. 0
   b. 1
   c. 3
   d. 4
   e. None of the above

42) What is the value of the following boolean expression?

```
hasan.toString().equals(nisha.toString())
```

   a. True
   b. False
   c. Will not compile
   d. Will crash
   e. None of the above

43) What would the following statement print, if it were added to the **end** of the main method in the Student class on the previous page?

```
System.out.println( hasan.gradeArray[2] == nisha.gradeArray[2] );
```

   a. `true`
   b. `false`
   c. Will not compile
   d. Will crash
   e. None of the above

44) The method with the header:

```
public Student(String theName, double[] theGrades)
```

Is an example of which type of method?
   a. Modifier
   b. Accessor
   c. Setter
   d. Constructor
   e. Creator

45) Why is it useful to have constant static attributes in a Class definition?
   a. Can define private constants for the objects of that class to use
   b. Can define public constants for anyone to use
   c. Can avoid objects storing constant values unnecessarily
   d. All of the above are useful
   e. None of the above are useful

46) Java is
   a. A programming language
   b. A computer
   c. A programmer
   d. A CPU
   e. None of the above

47)

PART 2 – Written Answer – 70 marks

For the following questions, please write your answers in the space provided.

47) **[4 marks]** Use the following code segment for this question:

```
int a = 0;
int b = 10;
int c = 100;
```

For the following statements, fill in the blank with a Boolean operator that will make the expression evaluate to TRUE. If it could be ANY operator, you must indicate this by writing a "*" in the blank. [2 marks each, NO PART MARKS]

a. `a < 0 || b < 0 _____ c/b > 0`

b. `!( b <= c && a == 0 ) || b%c _____ c/b`

48) **[6 marks]** Consider the following code segment for this question:

```
if (((a > 0) && (a < 10)) && ((b > 0) || (c > 0)))
   System.out.println("Output 1");

else if (((a < 0) || (b < 10))) && ((b > 0) || (c < 0)))
   System.out.println("Output 2");

else
   System.out.println("Output 3");
```

a. What values for a, b and c would cause the above code to print "Output 1". Assume the declarations will appear before the above code segment.

```
int a =          ;

int b =          ;

int c =          ;
```

b. What values for a, b and c would cause the above code to print "Output 3" Assume the declarations will appear before the above code segment.

```
int a =          ;

int b =          ;

int c =          ;
```

49) **[7 marks]** Write program that will get a string from the user using a pop up dialog, find the reverse of the string using the length() and charAt(int) functions, and display it to the user in a pop up window.

```
public static void main (String[] args){









}
```

50) **[5 Marks]** The following Java method added to the `Picture` class is supposed to count all the white pixels in a Picture.
It has 2 semantic errors (The code compiles fine, but does not behave as expected when run). In the space provided below, identify each error by its line number and rewrite the line correcting the error. Omission of essential steps is considered an error. There is 1 error at most per line.

```
1. public int countWhitePixels() {
2.   int counter = 0, red=0, green=0, blue=0;
3.   Pixel pixelObj = null;
4.   for (int x = 0; x < this.getWidth(); x++) {
5.     for (int y = 0; y < this.getHeight(); x++) {
6.
7.       pixelObj = this.getPixel(x,y);
8.       red = pixelObj.getRed();
9.       green = pixelObj.getGreen();
10.      blue = pixelObj.getBlue();
11.
12.      if (red == 255 || green == 255 || blue == 255) {
13.         counter = counter + 1;
14.      }
15.    }
16.  }
17.  return counter;
18. }
```

Error 1:

Error 2:

51) **[10 marks]** The following is the start of a class definition for describing a class, Book, representing books that might be used to build a digital library. Consider the part of the class definition presented and then answer the following questions.

```
public class EBook {

      // Instance variables; attributes
      private String title, author;
      private int bookId, sizeKb;

      // Constructors
      public EBook () {
            title = "unknown";
            author = "unknown";
            bookId = 0;
            sizeKb = 0;
      }

      public EBook (String aTitle) {
            this.title = aTitle;
      }

      // Getter methods
      public String getTitle () {   return this.title;   }

      public String getAuthor () {   return this.author;   }

      public int getId () {   return this.bookId;   }

      // Setter methods
      public void setTitle (String aTitle) {
            this.title = aTitle;
      }

      public void setAuthor (String auth) {
            this.author = auth;
      }
}
```

a. **[3 of 10 Marks]** The following is the header of another constructor for class Books. Define the constructor's method body that would correctly initialize the class instance variables similar to how they were initialized in the constructors provided.

```
// Another constructor for the class EBook
//****THE HEADER

public EBook (String aTitle, String auth, int id, int size)  {









}
```

b. **[2 of 10 Marks]** Write a setter method to set the size attribute of a Book object.

```
// A setter method for the eBook identifier for the class Book
```

c. **[5 of 10 Marks]** Two eBooks are considered equal if the title and author are the same. Assume that a method "equals" is defined that would compare two Strings. For example, given String variables str1 and str2, then str1.equals(str2) returns true if the String referenced by str1 is identical to the string str2 and false otherwise. Write a method equals to determine if two books are equal. The header for the method is given below. Note: any of the constructors listed or as you've written could have been used to initialize the eBooks being compared.

```
// An equals method for the EBook class
// ******* THE METHOD HEADER IS BELOW

 public boolean equals(EBook otherEBook)
 {









 }
```

52) **[15 Marks]** In the previous question, the basics for a class `Book` were presented. The following is the start of a class definition for describing a class, `Library`, representing a collection of eBooks - a personal library. This class assumes that the class `EBook` has been defined as per the previous question. Consider the part of the class definition presented and then answer the following questions

```
public class Library {

  // Constant attributes
  // maximum number of ebooks
  private static final int MAX_NUMBER = 100;
  // maximum size in Kb ~6Gb
  private static final int MAX_SIZE_KB = 6291456;

  // Instance variables; attributes
  private String name;          // name of the library
  private int numberOfEBooks;   // current number of eBooks
  private int sizeKb;           // current size of library in Kb
  private EBook[] library;      // the library, an array of EBooks

  // Constructors
  public Library () {
    name = "";
    numberOfEBooks = 0;
    sizeKb = 0;
    library = new EBook[MAX_NUMBER];
  }

  public Library (String str) {
    name = str;
    numberOfEBooks = 0;
    sizeKb = 0;
    library = new EBook[MAX_NUMBER];
  }

} // end of class Library
```

a. **[2 of 15 Marks]** Define a getter method to get the current number of eBooks in a library.

```
//Returns the current number of eBooks in the library
```

b. **[4 of 15 Marks]** Write a method called `isSpaceFor` for the class `Library` which returns `true` if there is "space" in a library to add the ebook given as a parameter, that is, the current number of books in the library is less than the size of the library, and the current size will be able to accommodate the size of the new addition. If not, the method should return `false`.

```
//A method that determines if there is space to add
// the eBook given as a parameter to the this Library
```

c. **[9 of 15 Marks]** Write a method for the class `Library` which adds an eBook to a given library, i.e. adds it to the array. Your method should:
- Make use of the `isSpaceFor` method from part b (above) to make sure that there is room to add the book and if not, then the method should do nothing.
- Make sure that no eBook is added that is already in the library. To do this, you should make use of the method `equals` from the `EBook` class (even if you did not complete this in the previous question, assume it exists). If the book already exists in the library then nothing is done and the method ends.

```
// A method that adds an EBook, given as a parameter, to a Library
// An Ebook will only be added if there is space for it,
// and if it is not already in the library,
// otherwise the method does nothing
```

Bonus Question: [5 marks] Create a method that will return true if "this" Picture is a cropped portion of the Picture passed in as a parameter, and false otherwise. "this" must be completely contained by the parameter Picture. Use comments to outline your algorithm.

Please only attempt this question if you are confident about the rest of your exam. It is a more difficult question, and full marks will only be awarded for elegant implementation, as well as the correctness.