Question 1

a) (10 marks)
Briefly explain the following:

(i) Java Virtual Machine

(ii) Compiler

(iii) Class

(iv) Constructor

(v) Instance variable

(vi) Pass-by-Reference parameter

(vii) Data abstraction

(viii) Overloading a method

(ix) Assertions

(x) Inheritance

b) (5 marks)
Write Java loops to output to the screen each of the following sequences, exactly as shown:

(i) 2 5 8 11 14 17 20 23 26 29 32 35

(ii) 0 1 1 2 2 2 3 3 3 3 4 4 4 4 4

(iii) 1 4 9 16 25 36 49 64 81 100

c) (5 marks)
Suppose that the cost of living in a country increases at a rate of 3 percent every year. Write a Java program that reads, from the keyboard, a person's current cost of living (a floating point number) and an integer number *n* indicating the number of years. The program then computes and displays the person's cost of living after *n* years.

Question 2

a) (5 marks)
Describe the top-down testing and bottom-up testing approaches to the testing of a program, clearly explaining the differences between the two.

b) (5 marks)
Consider a Java program in which the variables `s1` and `s2` can refer to strings of characters. Write Java statements to do the following:

(i) output to the screen the string which is larger in length;

(ii) output to the screen the last two characters in string `s1`;

(iii) output to the screen the two strings `s1` and `s2` in alphabetical order;

(iv) output to the screen whether one string is a substring of the other string;

(v) output to the screen whether the string s2 contains a digit.

c) (5 marks)
Write a Java method which takes a string parameter and checks whether or not the string contains two or more occurrences of any character. The method will return true if there is at least one character which appears more than once in the string, otherwise it returns false.

Write a Java statement to show how you would call this method.

d) (5 marks)
Write a Java method to read in three integer numbers from the user in random order, arrange the numbers in ascending order and then write them out on the screen. For example, if the input is

45 17 29

then the output should be

17 29 45

Do not use arrays.

Question 3

a) (6 marks)
Suppose that a Country class has the following already available:

1. a name String and population (a long integer),
2. a default constructor,
3. a constructor which is given the country's name as a String and its population as a **long** (integer),
4. a method set(...) for setting the name and population of a country,
5. accessor methods for accessing the name and population of a country,
6. an isMorePopulousThan(...) method which compares the argument Country to the calling Country and returns true if the calling Country has a bigger population than the argument Country, otherwise it returns false.

Give Java code for a client program that does the following. It will create a Country object using the default constructor. It will then get the name and population of a country from the user and set the Country object to the input values. The program will then get the name and population of another country from the user, and create a second Country object using the non-default constructor. Finally it should display whether or not the first country has a bigger population than the second one (by using the isMorePopulousThan() method to compare them).

b) (6 marks)
Give Java code for the Country class described above in Question 3 a).

c) (4 marks)
Give Java code for readCountryDetails() and writeCountryDetails() methods for the Country class. The readCountryDetails() method is to allow input of all the information about a country from the keyboard. The writeCountryDetails() method is to allow output of the information to the screen.

d) (4 marks)
Give Java code (which is meant to be part of a client program) which uses your Country class to do the following. Get an integer *n* from the user. Loop around getting details of *n* countries from the user. At the end the program should output the country (of those *n*) with the highest population.

Question 4

a) (5 marks)
Give Java code for a method called displayElectionResults which takes two arrays as arguments. The first array argument contains the names (Strings) of candidates in an election. The corresponding elements in the second array argument contain the votes (integers) received by each candidate. The method is to output (to the screen) each candidate's name, the votes received by that candidate, and the percentage of the total votes received by that candidate. The method should also output the winner of the election, assuming that the candidate with the highest votes wins the election and that only one candidate gets the highest votes.

b) (5 marks)
Give Java statements to get a positive integer n (<= 10) from the user and declare variables candidates and votes that can be used (in an election) to store candidates' names (as Strings) and votes (as integers) in separate arrays. Write Java statements to loop around getting the details (i.e., names and votes received) of n candidates from the user and storing them in the two arrays. Ask the user for a candidate's name and then the votes received by that candidate.

Finally, write Java statement(s) to invoke the method displayElectionResults described above in Question 4 a) to output the results of an election.

c) (10 marks)
Explain the following Java or computing terms:

(i) GUI

(ii) Event

(iii) AWT and Swing

(iv) Exception

(v) try

(vi) catch

(vii) throw

(viii) Stream

(ix) Text file

(x) Binary file

Question 5

a) (5 marks)
A binary file containing test scores is available. Each score is an integer value between 0 and 100. Give Java code for a main method to do the following. Get the name of the binary file from the user. Open this binary file for input, loop around reading scores out of it, determine the largest score and the average of all scores in the file, and output to the screen all the scores, one per line, followed by the largest score and the average value. Assume that there is at least one number in the file.

b) (5 marks)
List the public methods which you would expect to find in a Stack class. Give return types and types of arguments and a brief description of each.

c) (5 marks)
Assume that a Stack class as you have described above in Question 5 b) is available. Give Java code to loop around getting Strings from the user and using a Stack, collect them and output them in the opposite order (ie last String entered gets displayed first). The user should use an empty string to indicate the end of input.

d) (5 marks)
The raising of x to a non-negative integer power can be expressed as

$x^0 = 1$

$x^n = x * x^{n-1}$

Write Java code for a **recursive** static method, power, which takes as its parameters two integers x and n, and returns x raised to the power n.

Show how you would call this method in program code.

END OF PAPER