SUMMARY ANSWERS

There are in total seven questions in this paper.
Answer all seven questions using the spaces provided.
Each question carries 10 marks in total.
Calculators and other electronic devices are not permitted.
The examination is closed book.
No supplementary material is provided.
This paper is not prior disclosed.
The quote marks for strings are in the following style: "string".
1. Consider the following Java program.

```java
public class HelloPrinter
{
    public static void main(String[] args)
    {
        System.out.println("Hello World");
    }
}
```

a) The above program is compiled and run in the BlueJ Java Development Environment. Describe what is observed when the program is run. (2 marks)

   Answer: A window appears and displays the text "Hello World". Two marks. One mark for the window and 1 mark for the text.

b) Why is it necessary for a Java program to include a method called main? (2 marks)

   Answer: the first method to run must be main. If there is no method main then the program does not run. Two marks.

c) List four of the reserved words used in the above program. (4 marks)

   Answer: public, class, static, void. Four marks in total. One mark each.

d) State the name of the class in the program. (2 marks)

   Answer: HelloPrinter. Two marks.

2. a) Find the values of the following arithmetical expressions when they are evaluated in a correct Java program.

   i) 3.5/2
   ii) 35/2
   iii) 9+(7*4)
   iv) 19 - (19%3)  

   (4 marks)

   Answer: i) 1.75; ii) 17; iii) 37; iv) 18. Four marks. One mark each.

b) A variable of type int can take integer values in the range $-2^{31}$ to $2^{31} - 1$. Explain what is meant by the statement that a variable of type int has overflowed. (2 marks)

   Answer: the statement means that there has been an attempt to give the variable an integer value outside the permitted range. Two marks. One additional mark, but only within the total of 2 marks, if it is stated that the value of v after overflow is arbitrary or of no use.
c) Consider the following Java instructions.

```java
int total = 0;
int a = total+1;
int b = a+1;
int c = 2*total;
total += 4;
```

What is the value of `total` and what are the values of `a`, `b` and `c` when the above instructions are executed in a correct Java program? (4 marks)

Answer: `total = 4`, `a = 1`, `b = 2`, `c = 0`. Four marks. One mark each.

3. a) Find the values of the following expressions when they are evaluated in a correct Java program. In all four cases state the type of the result.

   i) "Harry".charAt(0)
   ii) "AA"+1
   iii) "AA"+"1"
   iv) "John Smith".substring(0, 4) (4 marks)

   Answer: i) 'H', char; ii) "AA1", String; iii) "AA1", String; iv) "John", String. Four marks, one mark each.

b) Find the values of the following expressions when they are evaluated in a correct Java program. The variable `x` is of type `int` and has the value 5.

   i) 5 < 0
   ii) x > 0
   iii) x > 6 && x < 10
   iv) 0 < 10 || 10 < 20 (4 marks)

   Answer: i) false; ii) true; iii) false; iv) true. Four marks. One mark each.

c) The following instructions are executed in a correct Java program. What are the values of `b1` and `b2`?

   ```java
   String str = "test";
   boolean b1 = str.equals("test");
   boolean b2 = str.equals(str);
   ```

   (2 marks)

   Answer: `b1 is true and b2 is true`. Two marks. One mark for each correct answer.
4. a) State what is meant by a compile time error and what is meant by a run time error.

Answer: a compile time error is an error found by the compiler. A run time error is an error which occurs when a program that has successfully compiled is run. Four marks. Two marks for each statement.

b) Identify four compile time errors in the following Java program.

```java
import java.util.Scanner;
public class HasErrors {
    public static vacant main(String[] args) {
        System.out.println("Please type in a number: ");
        Scanner in = new Scanner(System.in);
        int x = in.nextInt();
        System.out.println("Please type in another number: ");
        int x = in.nextInt();
        System.out.println("sum: "+x+y);
    }
}
```

Answer: i) vacant in place of void; ii) Missing quote marks in the argument for the second call of System.out.println(); iii) second declaration and initialization of x; iv) use of the variable y which has not been declared or initialized. Four marks. One mark each.

c) A Java program to sort an array of numbers in increasing order has been written. The program compiles without any errors. Suggest one way of testing the program for run time errors.

Answer: run the program with test data for which the correct result is known. Two marks.

5. a) Consider the following format specifier for floating point numbers: "%10.2f". Explain the role of the symbol % and the number 10 in the format specifier.

Answer: the symbol % indicates the beginning of the format specifier. The number 10 specifies the width in characters of the field in which the number is to be printed. Four marks. Two marks for each explanation.

b) It is required to print the numbers 0.361, 1.25, 31.75, 4.9752 on separate lines, placed such that the decimal points are aligned. For each number, the three digits to the
right of the decimal point are printed. State with reasons a single appropriate format specifier. Add the notation for a new line to the format specifier. (4 marks)

Answer: "%.6.3f\n". Other format specifiers accepted, eg "%.10.3f\n". The f is required because the numbers are floating point. The field must include the three digits to the right of the decimal point, the decimal point itself and at most two digits to the left of the decimal point. It follows that the minimum width of the field is 6. The 3 specifies the number of digits to the right of the decimal point. Four marks. One mark each for the reasons for f, 6, 3. One mark for a correctly placed new line.

c) Find the error in the format specifier "%.5.2d". (2 marks)

Answer: The symbol d indicates that an integer is to be printed, but the inclusion of 5.2 in the format specifier indicates that a floating point number is to be printed. Two marks.

6. a) Show clearly which of the following can be chosen as names of variables in a correct Java program and show clearly which cannot be chosen as names of variables.

i) v
ii) double
iii) 6double
iv) con8stant (4 marks)

Answer: i) yes; ii) no; ii) no; iv) yes. Four marks. One mark each.

b) The following instruction is a correct declaration and initialization of a variable in a Java program.

```java
int double_ = -4;
```

Explain why the above instruction is an example of poor programming style. (2 marks)

Answer: the variable `double_` has a name which indicates that it is of type double, when in fact the variable is of type int. Also the variable name is very similar to a reserved word. Two marks for either answer.

c) The following Java instructions contain a compile time error. Describe the error.

```java
int bottles;
bottles = bottles+4;
```

(2 marks)

Answer: the variable `bottles` is used before it is assigned a value. Two marks.

d) The following Java instructions contain a run time error. Describe the error.

```java
int x = 4, y = 2;
System.out.println("The sum of x and y is"+(x*y));
```
7. Consider the following Java method.

```java
public static double pm(double[] a)
{
    double m = 0;
    for(int i = 0; i < a.length; i++)
    {
        m = m+a[i];
    }
    m = m/a.length;
    return m;
}
```

a) Suppose that the method `pm` is called with the argument `a = {1.0, 4, 7}`. How many times is the for loop traversed? what value is returned by `pm`? (2 marks)

Answer: The for loop is traversed three times. The value returned by `pm` is 4.0. Two marks. One mark each.

b) Modify the method `pm` to produce a new method `pm1` which does not return a value but instead uses the instruction `System.out.println()` to output the string "The average value is: ", followed by the value of `m`. Note that it is necessary to supply `System.out.println()` with an appropriate argument. Write out the entire method `pm1`. (4 marks)

Answer:

```java
public static void pm1(double[] a)
{
    double m = 0;
    for(int i = 0; i < a.length; i++)
    {
        m = m+a[i];
    }
    m = m/a.length;
    System.out.println("The average value is: "+m);
```

(2 marks)

Answer: the text output states that the calculation is an addition, when it fact it is a multiplication. Two marks.
c) Modify the method \texttt{pm} to produce a new method \texttt{pm2} that returns the same value as \texttt{pm}, but which calculates this value using a while loop in place of the for loop. Write out the \textit{entire} method \texttt{pm2}. (4 marks)

\textit{Answer:}

\begin{verbatim}
public static double pm2(double[] a)
{
    double m = 0;
    int i = 0;
    while(i < a.length)
    {
        m = m+a[i];
        i = i+1;
    }
    m = m/a.length;
    return m;
}
\end{verbatim}

Four marks. Deduct one mark for each error. Any reasonable answer accepted.