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)

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

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

d) State the name of the class in the program. (2 marks)
2. a) Find the values of the following arithmetical expressions when they are evaluated in a correct Java program. (4 marks)

i) \(3.5/2\)

ii) \(35/2\)

iii) \(9+(7*4)\)

iv) \(19 - (19\%3)\)

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)

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)
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)

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

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

String str = "test";
boolean b1 = str.equals("test");
boolean b2 = str.equals(str);
4. a) State what is meant by a *compile time error* and what is meant by a *run time error*.

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

```java
import java.util.Scanner;
public class HasErrors
{
  public static void 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);
  }
}
```

(4 marks)
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. \( \text{\(\text{(2 marks)}\)} \)

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. \( \text{\(\text{(4 marks)}\)} \)

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. \( \text{\(\text{(4 marks)}\)} \)

c) Find the error in the format specifier "\%5.2d". \( \text{\(\text{(2 marks)}\)} \)
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. (4 marks)

i) v

ii) double

iii) 6double

iv) con87stant

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)

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

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

   (2 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));
   ```

   (2 marks)
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)

b) Modify the method pm to produce a new method pm1 which does not return a value but instead uses the instruction

```java
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)
c) Modify the method pm to produce a new method pm2 that returns the same value as pm, but which calculates this value using a while loop in place of the for loop. Write out the entire method pm2. (4 marks)