UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

B. Sc. Examination 2004

COMPUTER SCIENCE

IS51008A(CIS109) Introduction to Java and Object–Oriented Programming

Duration: 3 **hours**

Date and time:

There are six questions on the paper. Please answer four questions. You may answer more questions, but only the best four count towards your final mark.

Calculators are not allowed.

THIS EXAMINATION PAPER MUST NOT BE REMOVED FROM THE EXAMINATION ROOM

QUESTION 1

(a) (i) Declare three variables whose names are `n`, `m` and `x` and whose types are all `int`.

(ii) Write a Java fragment which assigns to the variable `x` the largest value of `n` and `m`.

(iii) Write a Java fragment which prints out the largest value of `n` and `m`.

(iv) Write a Java fragment which swaps the contents of `n` and `m`.

(For full marks your program fragments must be syntactically correct)

[9 Marks]

(b) (i) Briefly describe the main differences and similarities between arrays and vectors.

(ii) Define a static method called `sumArray` which takes an `int` array parameter and returns the sum of all the elements of the array.

(iii) Define a static method called `aveArray` which takes a non-empty `int` array parameter and returns the average of all the elements of the array. The method, `aveArray` should call the method, `sumArray` above.

[8 Marks]

(c) Write a method which sorts a Vector of `Integer`s into descending order and discuss the time complexity of your method.

[8 Marks]

QUESTION 2

(a) (i) Declare an array of `int` whose name is `arr`.

(ii) Allocate space for `arr` to hold 50 `int`s.

(iii) Assign the value 17 to the last element of `arr`.

(iv) What causes an "array out of bounds" exception? Give an example.

[9 Marks]

(b) (i) What is an *Exception*?

(ii) Using `try` and `catch` and the method `Integer.parseInt`, write a static method, `isInt` that takes a String as a parameter and returns `true` if the String contains only digits and `false` otherwise.

[8 Marks]

(c) Consider the interface

```
interface ordering
{
    public boolean g(Object o1, Object o2);
}
```

(i) Write a static method `genMin` which takes an array of objects and an ordering and returns the minimal element of the array with respect to the ordering.

(ii) Define an implementation, `alpha` of `ordering` representing alphabetical order of Strings.

(iii) Using `genMin` and `alpha`, write a method, `alphaMin` which takes an array of Strings and returns the element of the array which come earliest in dictionary order.

[8 Marks]

QUESTION 3

(a) (i) Define a class `date` with three instance variables all of type int representing a day, a month and a year. Your class should also contain a constructor with three parameters.

(ii) Declare a variable `d`, of type `date` and assign it a value corresponding to the 7th of March 2004.

[9 Marks]

(b) (i) Briefly define *method overriding*?

(ii) Define a `toString()` method for the class `date` which would cause dates to printed in the form of integers seperated by forward slashes. So, for example, `1/2/2004` is how the object representing the first of February 2004 would be printed.

(iii) Use inheritance to define a class `newDate` which is similar to a date, but also has an instance variable representing the day of the week. (0=Sunday, 1=Monday etc.) As well as defining a constructor for this class with four parameters all of type `int`, define a `toString()` which overrides the corresponding method in the `date` class. This, new `toString()` method should cause `newDates` to be printed as described by the following examples:

Sunday, the first of February 2004 is printed `0:1/2/2004`.
Wednesday, the fourth of September 2004 is printed `3:4/9/2004`.

[8 Marks]

(c) Consider the following algorithm for reversing a `String`, s:
If s is empty then return s.
Otherwise, let t be the `String` s with its first element removed and h be the `String` consisting of the first element of s. Return the `String` obtained by concatenating h onto the right hand end of the result of reversing t.

Implement this as a recursive method whose heading is `String reverse(String s)`.

[8 Marks]

QUESTION 4

(a) (i) Give a boolean expression which evaluates to `true` if the variable `x` has the value 1 and which evaluates to `false` otherwise.

(ii) Give a boolean expression which evaluates to `true` if the variable `x` has the value 1 or the value 2 and which evaluates to `false` otherwise.

(iii) Give a boolean expression which evaluates to `true` if the variable `x` has the value 1 and the variable `y` has the value 2 and which evaluates to `false` otherwise.

(iv) Give a boolean expression which evaluates to `true` if the variables `x`, `y` and `z` all have the same value and which evaluates to `false` otherwise.

[9 Marks]

(b) (i) Briefly describe what a file is and why files are needed.

(ii) Write a program that prints out the hundredth character of the file `ggg.dat`.

[8 Marks]

(c) (i) Consider the following code fragment and explain fully the compiler error messsage that it will produce.

```
class C
{
        int x=1;
        public static void main (String[ ] args)
        {
           System.out.print(x);
        }
}
```

(ii) How can this error be corrected without changing `main`?

(iii) What is an *abstract class*?

(iv) Extend the following class `list` to a class that is not abstract. Any answer that compiles correctly is acceptable.

```
abstract class list
{
        abstract Object head();
        abstract list tail();
}
```

[8 Marks]

QUESTION 5

(a) (i) Write a Java program fragment that prints out all the whole numbers between 1 and 100000 in ascending order.

(ii) Write a Java program fragment that prints out all the whole numbers between 1 and 100000 in descending order.

(iii) Write a Java program fragment that prints out the first 100000 positive even whole numbers in ascending order.

(iv) Write a Java program fragment that prints out all the even whole numbers between 1 and 100000 in ascending order.

[9 Marks]

(b) (i) Briefly explain the need for the Java 'wrapper' class `Integer`.

(ii) Assuming `v` is a variable of type Vector, explain the error in the expression:

```
v.elementAt(0)==1
```

(iii) Assuming that the zeroth and first elements of the Vector v are Objects of type Integer, write a statement whose effect is to add a new element to v. The value of this new element is the sum of the first two elements of v.

[8 Marks]

(c) A lottery requires the generation of six random integers between 10 and 99 inclusive. All the six integers must be different form each other. Write a complete Java program that can be used by the lottery company to generate the six distinct random numbers.

[8 Marks]

QUESTION 6

(a) (i) Consider the following program:-

```
public class A
{
   public static void main(String[] args)
   {
    System.out.println(y+3);
   }
}
```

Which one of the following is true:

(a) This program will compile correctly
(b) This program has a compilation error: Variable `y` is not declared
(c) This program has a compilation error: Method `main` undefined.
(d) None of the above.

(ii) Consider the following program:-

```
public class A
{
   public static void main(String[] args)
   {
    System.out.println(8+5*2);
   }
}
```

Which one of the following is true:

(a) This program prints 26
(b) This program prints 18
(c) None of the above.

(iii) Consider the following program:-

```
public class A
{
   public static void main(String[] args)
   {
    int a=3;
    int b=4;
    a=b;
    b=a;
    System.out.println(b);
   }
}
```

Which one of the following is true:

(a) This program prints `3`

(b) This program prints `4`

(c) None of the above.

[9 Marks]

(b) (i) Briefly explain the purpose of *packages* in Java.

(ii) Briefly explain the purpose of the `CLASSPATH` environment variable in Java.

(iii) Suppose that `dir1` is a directory in the `CLASSPATH`. Also suppose that `dir2` is a subdirectory of `dir1`. Suppose the following class resides in the directory `dir2`:

```
package P;
public class A
{
        public static void method1()
        {
          System.out.print(" hello");
        }
}
```

(A) What does `P` have to replaced by so that `method1` of class `A` can be called from anywhere?

(B) Having correctly replaced the `P` above, what would you write in order to call `method1` of class `A` from a class in a different directory?

[8 Marks]

(c) One word is an anagram of another if the letters of one can be re-arranged to form the other. For example, `learn` and `renal` are anagrams, as are `moat` and `atom`. Note: a word is not an anagram of itself.

Write a method that takes two strings and returns true if one string is an anagram of another and false otherwise. You may need to write more than one method in order to achieve your solution.

Describe the algorithm you have used and the assumptions you have made (if any).

[8 Marks]