



EXAMINATIONS — 2004

MID-YEAR

COMP 102
INTRODUCTION TO
COMPUTER PROGRAM DESIGN

Time Allowed: 3 Hours

Instructions: Attempt ALL Questions.

Answer in the appropriate boxes if possible — if you write your answer elsewhere, make it clear where your answer can be found.

The exam will be marked out of 180 marks.

Non-programmable calculators without a full alphabetic key pad are permitted.

Non-electronic foreign language dictionaries are permitted.

Questions

	Marks
1. Understanding Java programs	[50]
2. Writing simple Java Programs	[18]
3. Arrays and loops	[22]
4. Files and collections	[25]
5. Recursion	[15]
6. Composition	[15]
7. Inheritance	[20]
8. GUI	[15]

Question 1. Understanding Java programs

[50 marks]

In the following sub-questions, you should assume that the given method is declared in a suitable class and called on an object of that class. The name and other details of this class are unimportant as the methods do not refer to fields or other methods of the class.

(a) [3 marks] What will be printed when the following method is called?

```
public void q1a() {
    int x = 5;
    int y = 10;
    int z = x+y;
    y = z-y;
    x = z-x;
    z = y-x;
    System.out.println(x);
    System.out.println(y);
    System.out.println(z);
}
```

(b) [7 marks] What will be printed when the following method is called?

```
public void q1b() {
    String s = "Computers are funny; 10/2/04";
    int p = s.indexOf('/');
    System.out.println( "p = " + p );
    int q = s.indexOf(' ');
    System.out.println( "q = " + q );
    int r = s.indexOf(' ', q+1);
    System.out.println( "r = " + r );
    System.out.print( s.substring(0, 4) );
    System.out.print( s.substring(p-2, p) );
    System.out.print( s.substring(p+1, p+2) + " i");
    System.out.println( "s " + s.substring(r+1, r+4) );
}
```

(c) [6 marks] Consider the following method definition:

```
public void q1c(int a, int b) {  
    int c, d;  
    c = a;  
    if ( a > b)  
        c = b;  
    if ( a == c )  
        d = b;  
    else  
        d = a;  
    System.out.println(c + " " + d);  
}
```

(i) [2 marks] What will be printed when this method is called with **1** and **5** as its arguments?

(ii) [2 marks] What will be printed when this method is called with **5** and **1** as its arguments?

(iii) [2 marks] What will be printed when this method is called with **3** and **3** as its arguments?

(d) [6 marks] What will be printed when the following method is called?

```
public void q1d() {  
    int s = 0;  
    int k = 0;  
    while ( s < 20 ) {  
        System.out.print( k + " " + s);  
        s = s + 2*k + 1;  
        k = k + 1;  
    }  
    System.out.println(s-k);  
}
```

(e) [6 marks] What will be printed when the following method is called?

```
public void q1e() {  
    int[] a = {5, 2, 10, 7, 3};  
    int s = 0;  
    for (int i = 0; i < a.length; i++) {  
        System.out.println(i + " " + a[i]);  
        s = s + a[i];  
    }  
    System.out.println(s);  
}
```

(f) [6 marks] What will be printed when the following method is called?

```
public void qlf() {
    int[] a = {8, 17, 0, 3, -4, 9};
    int[] b = {6, 1, -9, 3, 24, 39};
    for (int k = 0; k < a.length; k++) {
        if ( a[k] > b[k] )
            System.out.println(a[k]);
        else if (a[k] == b[k] )
            System.out.println( -b[k] );
        else
            System.out.println( 0 );
    }
}
```

(g) [8 marks] What will be printed when the following method is called?

```
public void qlg() {
    int m = 4;
    int[][] a = new int[m][m];
    for (int i = 0; i < m; i++) {
        for (int j = 0; j < m; j++) {
            a[i][j] = j*(i+1);
            System.out.print(a[i][j] + " ");
        }
        System.out.println();
    }
    for (int i = 0; i < m; i++) {
        System.out.println(a[i][i] + " " + a[i][m-i-1]);
    }
}
```

(h) [8 marks] What will the following program print out?

```
public class ScoreKeeper {
    public static void main(String[] args) {
        Player p = new Player("Jack");
        Player q = new Player("Jill");
        Player r = null;
        p.addScore(10);
        System.out.println(p.toString() + ", " + q.toString());
        q.addScore(5);
        System.out.println(p.toString() + ", " + q.toString());
        q.addScore(15);
        System.out.println(p.toString() + ", " + q.toString());
        p.addScore(20);
        System.out.println(p.toString() + ", " + q.toString());
        if ( p.getScore() > q.getScore() )
            r = p;
        else if ( p.getScore() < q.getScore() )
            r = q;
        if ( r == null )
            System.out.println("Game is drawn");
        else
            System.out.println(r.getName() + " wins by " +
                Math.Abs(p.getScore()-q.getScore()) + " points");
    }
}

class Player {
    private String name;
    private int score = 0;
    public Player(String n) {
        name = n;
    }
    public void addScore(int s) {
        score = score + s;
    }
    public int getScore() {
        return score;
    }
    public String getName() {
        return name;
    }
    public String toString() {
        return name + " " + score;
    }
}
```

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Cross out rough working that you do not want marked.
Specify the question number for work that you do want marked.

Question 2. Writing simple Java programs

[18 marks]

(a) [6 marks] Strings

Complete the following program, so that it will read a string and print a message which shows the length of the string and whether or not the string contains a comma. For example, if the input was `abc+9`, the output would be “Length 5, no comma”, and if the input was `ab,(.;),z`, the output would be “Length 9, has a comma”.

The input should be read using `JOptionPane.showInputDialog`, and the output should be displayed using `JOptionPane.showMessageDialog`.

```
import javax.swing.*;

public class StringTester {

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

```
        // Read and test a string
```

```
    }
}
```

(b) [12 marks] Conditionals

Below is the outline of a program for checking whether kiwifruit are acceptable for export. The given program reads the length (in centimetres) and weight (in grammes) of each kiwifruit, and prints a message showing its length and weight.

Complete the program, so that the message printed for each kiwifruit also indicates whether the kiwifruit is acceptable for export, according to the following criteria: If the length is between 15 and 25 centimetres and the weight is between 10 and 15 grammes, the program should print `OK for export`; if the length is less than 15 centimetres or the weight is less than 10 grammes, the program should print `Too small`; and if the length is greater than 25 centimetres or the weight is greater than 15 grammes, the program should print `Too big`. You should assume that input data is entered correctly.

```
import javax.swing.*;
public class KiwiFruitChecker {
    public static void main(String args[]) {
        int count = 0;
        String res = "";
        while (true) {
            String input =
                JOptionPane.showInputDialog("Enter length and weight");
            if ( input == null ) break;
            count = count+1;
            int p = input.indexOf(' ');
            double length = Integer.parseInt(input.substring(0, p));
            double weight = Integer.parseInt(input.substring(p+1));
            String msg = "Item " + count + " Length = " + length +
                " Weight = " + weight;
```

```
// Set res to indicate the outcome for this kiwifruit
```

```
JOptionPane.showMessageDialog(null, msg + "\n" + res);
    }
}
```

Question 3. Arrays and loops

[22 marks]

(a) [8 marks]

Complete the following method so that it takes an integer array `A` as its argument, and returns `true` if the elements of `A` are in strictly ascending order, and `false` otherwise.

```
public boolean testArray(int[] A) {
```

```
}
```


Question 4. Files and collections

[25 marks]

Suppose we have a file containing student data, saved in the following format:

ID
name

Assume the file `in.txt` contains the following data for three students.

```
3001
Alan
3005
Helen
2345
Daniel
```

Note:

Answer the following subquestions (a)-(c) using the example file given above.

The input and output files in these subquestions do not raise I/O exceptions.

The output of the programs in these subquestions may contain error messages.

(a) [4 marks] What will the following program print out to the screen?

```
import java.io.*;

public class Files1 {
    public static void main(String[] args) {
        try {
            FileReader inStream = new FileReader("in.txt");
            BufferedReader ins = new BufferedReader(inStream);

            String s = " ";
            int n = 0;
            for (int i = 0; i < 6; i++) {
                s = ins.readLine();
                n = Integer.parseInt(s);
                System.out.println(n);
            }
            ins.close();
        }
        catch (NumberFormatException ex) {
            System.out.println("Wrong Number format!");
        }
        catch (IOException ex) {
            System.out.println("File I/O Error");
        }
    }
}
```

(b) [12 marks] Consider the following class:

```
class Student {
    private int ID;
    private String name;

    public Student(String si, String n) {
        ID = Integer.parseInt(si);
        name = n;
    }

    public Student() {
    }

    public void print() {
        System.out.println("ID: " + ID);
        System.out.println("Name: " + name);
    }

    public void load(BufferedReader f)
        throws NumberFormatException, IOException {
        String sID = f.readLine().trim();
        ID = Integer.parseInt(sID);
        name = f.readLine();
    }

    public void save(PrintWriter f) {
        // to be completed
    }
}
```

(i) Complete the save method in the Student class so that the ID and name are saved to a file referenced by f, in the same format as the data in in.txt.

```
public void save(PrintWriter f) {

}
}
```

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Cross out rough working that you do not want marked.
Specify the question number for work that you do want marked.

(ii) What will the following program print out? Complete the answers in the answer box.

```
import java.io.*;

public class File2 {
    public static void main(String[] args) {
        try {
            FileReader inStream = new FileReader("in.txt");
            BufferedReader ins = new BufferedReader(inStream);

            Student a;
            System.out.println("1:");
            a = new Student();
            a.load(ins);
            a.print();

            System.out.println("2:");
            a = new Student("1234", "Jack");
            a.print();

            System.out.println("3:");
            String d1 = ins.readLine();
            String d2 = ins.readLine();
            a = new Student(d1,d2);
            a.print();

            ins.close();
        }
        catch (NumberFormatException ex) {
            System.out.println("Wrong Number format!");
        }
        catch (IOException ex) {
            System.out.println("File I/O Error");
        }
    }
}
```

1:

2:

3:

(c) [9 marks] Consider the following Set class:

```
class Set {
    private Object elements[];
    private int MAX = 5;

    public Set() {
        elements = new Object[MAX];
    }

    public boolean addElement(Object x) {
        if (containsElement(x))
            return false;
        int i = 0;
        while (i < MAX) {
            if (elements[i] == null) {
                elements[i] = x;
                return true;
            }
            i++;
        }
        return false;
    }

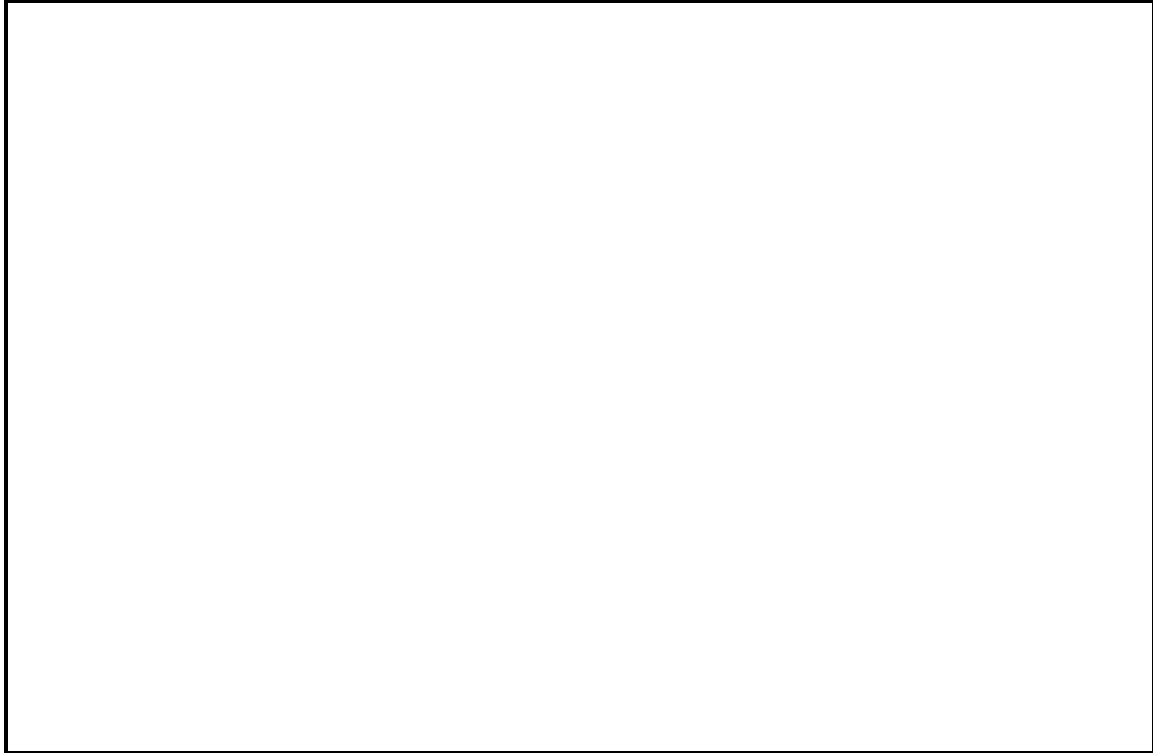
    public boolean containsElement(Object x) {
        int i = 0;
        while (i < MAX) {
            if (elements[i] != null
                && elements[i].equals(x)) {
                return true;
            }
            i++;
        }
        return false;
    }
}
```

Complete the following program `Load3Students` so that it reads the data for the three students from `in.txt` and stores the data in a `Set` collection. You must implement this program by calling methods in the `Set` class and methods in the `Student` class.

```
import java.io.*;

public class Load3Students {
    public static void main(String[] args) {
        try {
            FileReader inStream = new FileReader("in.txt");
            BufferedReader ins = new BufferedReader(inStream);

            Set s = new Set();
```



```
        ins.close();
    }
    catch (NumberFormatException ex) {
        System.out.println("Wrong Number format!");
    }
    catch (IOException ex) {
        System.out.println("File I/O Error");
    }
}
}
```

Question 5. Recursion

[15 marks]

Consider the following method:

```
public int power(int x, int n) {
    System.out.println(n);
    if (n == 0) {
        System.out.println("Stop case: return 1");
        return 1;
    }
    else {
        int ff = power(x, n - 1);
        int f = x * ff;
        System.out.println(f);
        return f;
    }
}
```

(a) [7 marks] What will this method print out if it is called with two arguments 10 and 3 as follows:

```
int i = power(10,3);
```

(We assume that this method is called in the same class.)

Question 6. Composition

[15 marks]

Consider the following classes:

```
class AA {
    private int ai;

    public AA(int i) {
        ai = i;
    }

    public void print() {
        System.out.println(ai);
        ai++;
    }
}

class BB {
    private int bi;
    private AA ba;

    public BB(int i, AA a) {
        bi = i;
        ba = a;
    }

    public void print() {
        System.out.println(bi);
        ba.print();
        bi++;
    }
}

class CC {
    private int ci;
    private BB cb;
    private AA ca;

    public CC() {
        ci = 10;
        ca = new AA(20);
        cb = new BB(100, ca);
    }

    public CC(int i, AA a) {
        ci = i;
        ca = a;
        cb = new BB(200, new AA(30));
    }

    public void print () {
        System.out.println(ci);
        cb.print();
        ca.print();
        ci++;
    }
}
```

(a) [5 marks] What will the following program print out?

```
class ABC1 {
    public static void main(String[] args) {
        AA ax = new AA(40);
        AA ay = new AA(50);
        ax.print();
        ay.print();
        ax.print();
    }
}
```

(b) [5 marks] What will the following program print out?

```
class ABC2 {
    public static void main(String[] args) {
        CC c = new CC();
        c.print();
    }
}
```

(c) [5 marks] What will the following program print out?

```
class ABC3 {
    public static void main(String[] args) {
        AA a = new AA(80);
        CC c = new CC(90, a);
        c.print();
    }
}
```

Question 7. Inheritance

[20 marks]

Consider the following code:

```
interface AB {
    public void print();
}

class AAA implements AB {
    private int i=11;

    public void print() {
        i++;
        System.out.println(i);
    }

    public int getI(){
        return i;
    }

    public void setI(int ii) {
        i = ii;
    }
}

class BBB implements AB {
    private int i=22;

    public void print() {
        i = i+2;
        System.out.println(i);
    }
}

class CCC extends AAA {
    private int ci=33;

    public void print () {
        ci = ci+3;
        System.out.println(ci);
        super.print();
    }
}
```

(a) [6 marks] What will the following program print out?

```
class TEST1 {  
    public static void main(String[] args) {  
        AB a = new AAA();  
        AB b = new BBB();  
        a.print();  
        b.print();  
        a.print();  
    }  
}
```

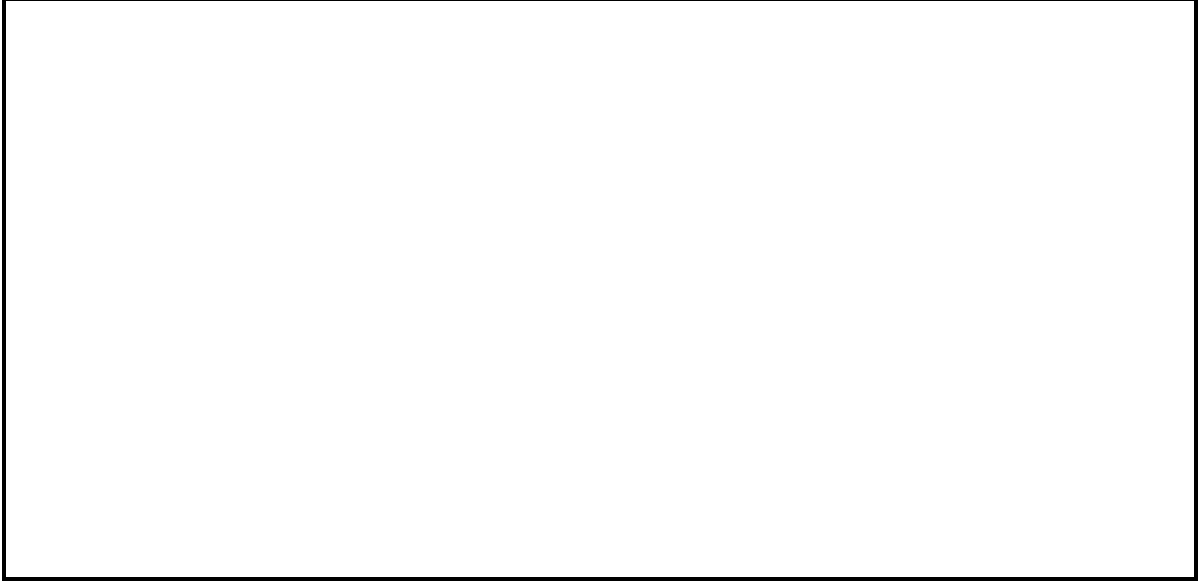
(b) [6 marks] What will the following program print out?

```
class TEST2 {  
    public static void main(String[] args) {  
        AAA a = new AAA();  
        CCC c = new CCC();  
        a.print();  
        c.print();  
        a.print();  
    }  
}
```

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Cross out rough working that you do not want marked.
Specify the question number for work that you do want marked.

(c) [8 marks] Write a class `DDD` to extend class `AAA`. The only difference between class `DDD` and class `AAA` is that the `print()` method in class `DDD` increases the data field `i` by 4 instead of 1. For example, suppose `i` is 11 at the beginning, after the `print()` method is executed, `i` becomes 15. You should not change class `AAA`.



Question 8. GUI

[15 marks]

Consider the following code:

```
import javax.swing.*;
import java.awt.event.*;

public class GUI {
    public static void main (String[] args) {
        SimpleGUI n = new SimpleGUI();
    }
}

class SimpleGUI implements ActionListener {
    private JFrame frame;
    private JPanel panel;
    private JButton newAccount;
    private JButton deposit;

    private JTextArea text;

    public SimpleGUI() {
        frame = new JFrame("GUI");
        panel = new JPanel();
        newAccount = new JButton("New Account");
        deposit = new JButton("Deposit");
        text = new JTextArea(5,30);

        panel.add(newAccount);
        panel.add(deposit);
        panel.add(text);

        frame.getContentPane().add(panel);

        newAccount.addActionListener(this);
        deposit.addActionListener(this);

        frame.setSize(300, 200);
        frame.setVisible(true);
    }

    public void actionPerformed(ActionEvent a) {
        //To be completed
    }
}
```

(a) [7 marks] Complete the `actionPerformed` method so that the name of the button is displayed in the text area when a button is pressed.

```
public void actionPerformed(ActionEvent a) {
```

```
}
```

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Cross out rough working that you do not want marked.
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(b) [8 marks] Add a Check Box labelled Joint Account to the GUI and make sure that the text area will display the message "this is a joint account" when this Check Box is turned on, and the text area is cleared when the Check Box is turned off. Show your answers by modifying the code given below.

```
class SimpleGUI implements ActionListener {
    private JFrame frame;
    private JPanel panel;
    private JButton newAccount;
    private JButton deposit;

    private JTextArea text;

    public SimpleGUI() {
        frame = new JFrame("GUI");
        panel = new JPanel();
        newAccount = new JButton("New Account");
        deposit = new JButton("Deposit");
        text = new JTextArea(5,30);

        panel.add(newAccount);
        panel.add(deposit);
        panel.add(text);

        frame.getContentPane().add(panel);

        newAccount.addActionListener(this);
        deposit.addActionListener(this);

        frame.setSize(300, 200);
        frame.setVisible(true);
    }
    public void actionPerformed(ActionEvent a) {
        //Assume this is completed
    }
}
```

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