

THE UNIVERSITY OF AUCKLAND

SUMMER SEMESTER, 2007
Campus: City

COMPUTER SCIENCE

Principles of Programming

(Time allowed: TWO hours)

NOTE: Attempt **ALL** questions
Write your answers in the space provided
There is space at the back for answers that overflow the allotted space
No calculators are permitted

Surname:	
Forenames:	
Student ID number:	
Login name:	

Q1 (/20)	Q4 (/6)	Q7 (/13)	Q10 (/6)
Q2 (/8)	Q5 (/8)	Q8 (/10)	TOTAL (/100)
Q3 (/5)	Q6 (/11)	Q9 (/13)	

Question/Answer Sheet

ID:

Question 1 (20 marks)

- a) Assume that the current directory contains a Java source file named `MyProgram.java`. The following DOS command is used to compile the source file:

```
javac MyProgram.java
```

If the file compiles successfully, what is the name of the new file that will be created?

(2 marks)

- b) One of the lines of code in the following program is surrounded by a comment. What is the output of the program?

```
public class MyProgram{  
    public void start(){  
        int x = 100;  
        if (x > 50) {  
            System.out.println("A");  
            /* } else { */  
            System.out.println("B");  
        }  
    }  
}
```

(2 marks)

Question/Answer Sheet

ID:

c) The `positive()` method is *called* in the following way:

```
int[] x = {1,2,3,4,5};  
int[] nums = positive(x, true);
```

Complete the method header for the `positive()` method (i.e. complete the first line of the method definition).

```
private _____ {  
    for (int i = 0; i < nums.length; i++) {  
        if ((nums[i] < 0) && (b)) {  
            nums[i] = -nums[i];  
        }  
    }  
    return nums;  
}
```

(2 marks)

d) What is the output of the following code?

```
String a = new String("hello");  
String b = new String("hello");  
String c;  
  
c = a;  
  
System.out.println(a.equals(b));  
System.out.println(a == b);  
  
System.out.println(a.equals(c));  
System.out.println(a == c);  
  
System.out.println(b.equals(c));  
System.out.println(b == c);
```

(2 marks)

Question/Answer Sheet

ID:

e) What is the output of the following code?

```
int[] nums = {1, -2, 3, -4, 5};  
  
for (int i = 0; i < nums.length; i++) {  
    if (nums[i] < 0) {  
        nums[i] = -1 * nums[i];  
    }  
}  
  
for (int i = 0; i < nums.length; i++) {  
    System.out.print(nums[i] + " ");  
}
```

(2 marks)

f) What is the output of the following code?

```
String a = "123";  
  
System.out.println(a + 1);  
System.out.println(Integer.parseInt(a) + 1);
```

(2 marks)

g) What is the output produced by the following code?

```
int a = 1 + 2 * 3 - 4 * 5 / 6 + 7 % 8 + 9;  
System.out.println(a);
```

(2 marks)

Question/Answer Sheet

ID:

- h) Write a Java statement which declares and constructs an array of 30 String objects. The array should be called names.

(2 marks)

- i) What is printed by the following code segment?

```
String[] s = { "how", "when", "why" };  
System.out.println(s[1].length());
```

(2 marks)

- j) What is printed by the following code segment?

```
String[] s = { "zero", "one", "two" };  
  
s[1] = s[2];  
s[0] = s[1];  
  
for(int i = 0; i < s.length; i++) {  
    System.out.print(s[i] + " ");  
}
```

(2 marks)

Question/Answer Sheet

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Question 3 (5 marks)

Consider the following method called `process()` which is passed an array of `ints` as a parameter:

```
private int process(int[] values) {
    int result = values[0];
    for (int i = 1; i < values.length; i++) {
        if (values[i] < result) {
            result = values[i];
        }
    }
    return result;
}
```

Describe in words what *value* the method `process()` returns for any given array.

(3 marks)

Now, assume that the `process()` method is called from the following `start()` method, which passes it an array of 1,000,000 integers with random values between 0 and 999 (inclusive):

```
public void start() {
    int[] numbers = new int[1000000];
    for (int i = 0; i < numbers.length; i++) {
        numbers[i] = (int)(Math.random()*1000);
    }
    int result = process(numbers);
    System.out.println(result);
}
```

What is the *most likely* value to be printed by the `start()` method?

(2 marks)

Question/Answer Sheet

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Question/Answer Sheet

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Question 4 (6 marks)

Complete the output when the following code is executed.

```
Point pt1, pt2, pt3;

pt1 = new Point(20, 30);
pt2 = new Point(20, 30);
pt3 = pt2;
System.out.println("1. " + (pt1 == pt2));

pt1.move(5, 20);
System.out.println("2. " + pt1.x + "," + pt1.y);

pt2.translate(5, 20);
System.out.println("3. " + pt2.x + "," + pt2.y);

pt3.x = pt1.y;
pt3.y = pt1.x;
System.out.println("4. " + pt3.x + "," + pt3.y);
System.out.println("5. " + pt1.x + "," + pt1.y);

System.out.println("6. " + (pt1.equals(pt2)));
```

1.
2.
3.
4.
5.
6.

(6 marks)

Question/Answer Sheet

ID:

Question 5 (8 marks)

Draw the output produced by the following code in the grid given at the bottom of the page.

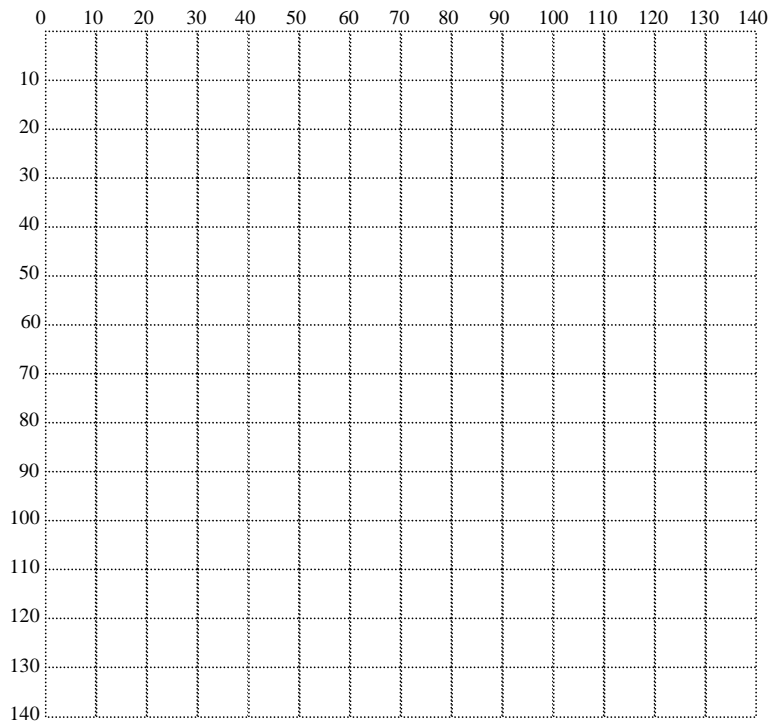
The grid lines are not part of the output but are there to help you place the drawing in the correct position. The size of each square in the grid is 10 pixels by 10 pixels.

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

public class A1JPanel extends JPanel {

    public void paintComponent(Graphics g) {
        super.paintComponent(g);
        draw(g, 10, 20, 10, "WOW");
        draw(g, 50, 40, 20, "WEE");
    }

    private void draw(Graphics g, int x, int y, int size,
                      String message) {
        g.drawLine(x, y, x + size*4, y);
        g.drawLine(x, y, x + size*3, y+size*4);
        g.drawRect(x + size*3, y, size, size);
        g.drawOval(x + size*2, y+size*3, size*2, size*2);
        g.drawString(message, x + size, y);
    }
}
```



(8 marks)

Question/Answer Sheet

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Question 6 (11 marks)

The JPanel defined on the next page contains two JLabel components, three JTextField components and one JButton component:

- centsPerKL – a JLabel displaying “Cents per kilometre”
- centsPerKT – a JTextField which contains a whole number representing the cost per kilometre
- numberKL – a JLabel displaying “Kilometres”
- numberKT – a JTextField which contains a whole number representing the number of kilometres
- priceB – a JButton displaying the String, “PRICE”.
- priceT – a JTextField which displays, in dollars and cents, the cost of travelling the stated number of kilometres

Below is a screenshot of the JPanel when it is first displayed. The centsPerKT JTextField displays “12”, the numberKT JTextField displays “100” and the priceT JTextField displays “\$12.0”.



In the centsPerKT JTextField, the user enters a whole number, representing the cost in cents of travelling one kilometre. In the numberKT JTextField, the user enters a whole number, representing the number of kilometres. When the user presses the PRICE JButton, the cost of travelling the stated number of kilometres at the stated cost in cents per kilometre is displayed, in dollars and cents, in the priceT JTextField.

You are required to complete the JPanel definition on the next page so that the JPanel behaves as described above. You must use the variables given in the code.

The screenshots below show the JPanel after the user has pressed the PRICE JButton.



Question/Answer Sheet

ID:

```
import java.awt.*;
```

```
import javax.swing.*;
```

```
public class AJPANEL extends JPanel _____ {
```

```
    private JTextField numberKT, centsPerKT, priceT;
    private JButton priceB;
```

```
    public AJPANEL() {
        JLabel numberKL = new JLabel("Kilometres");
        JLabel centsPerKL = new JLabel("Cents per kilometre");
        numberKT = new JTextField(4);
        centsPerKT = new JTextField(4);
        priceT = new JTextField(12);
        priceB = new JButton("PRICE");
```

```
        centsPerKT.setText("12");
        numberKT.setText("100");
        priceT.setText("$12.0");

        add(centsPerKL);
        add(centsPerKT);
        add(numberKL);
        add(numberKT);
        add(priceB);
        add(priceT);
```

```
    }
```

```
    public void _____ ( _____ e) {
```

```
    }
```

```
}
```

(11 marks)

CONTINUED

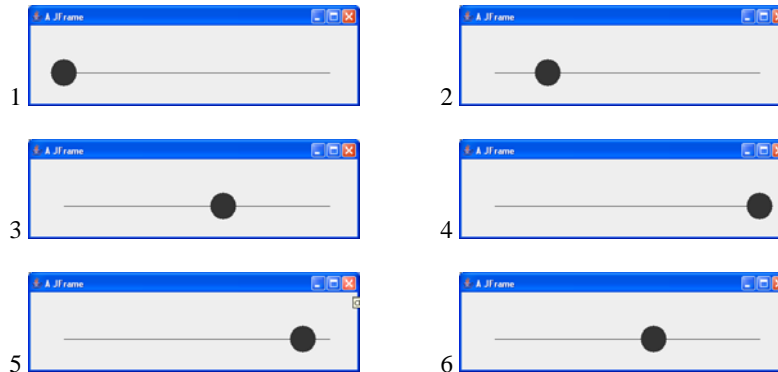
Question/Answer Sheet

ID:

Question 7 (13 marks)

The following JPanel uses a Timer object. The JPanel displays a circle which moves continuously along a horizontal line from left to right and back again. Once the JPanel is in focus, the user controls when the ball starts and stops moving by pressing the UP and DOWN arrow keys. When the user presses the UP arrow key the Timer should start and the ball begins to move from its current position in whichever direction it is currently moving. When the user presses the DOWN arrow key the Timer should stop and the ball stops in its current position.

Below are some screenshots of the JPanel in action. Screenshot 1 shows the JPanel when it is first displayed. The ball is not moving. Screenshots 2, 3 and 4 show the JPanel after the user has pressed the UP arrow key and the ball is moving to the right. Screenshot 5 shows the ball after it has reached the end of the line and has started moving to the left. The last screenshot shows the JPanel when the user has pressed the DOWN arrow key and the ball has stopped moving.



The following numbered statements are part of the code. Place the *correct number* in the *correct place* in the A JPanel definition on the next page so that the A JPanel executes as described above.

```

1.  addKeyListener(this);
2.  int code = e.getKeyCode();
3.  moveAmount = SIZE;
4.  requestFocusInWindow();
5.  g.fillOval(ball.x, ball.y, ball.width, ball.height);
6.  repaint();
7.  ball = new Rectangle(LINE_START_X-SIZE/2,
                        LINE_Y - SIZE/2, SIZE, SIZE);
8.  addMouseListener(this);
9.  ball.x = ball.x + moveAmount;
10. moveAmount = -SIZE;
11. if (code == KeyEvent.VK_UP) {
    t.start();
  } else if (code == KeyEvent.VK_DOWN) {
    t.stop();
  }
12. t = new Timer(200, this);
13. g.drawLine (LINE_START_X, LINE_Y, LINE_END_X, LINE_Y);

```

Question/Answer Sheet

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

public class AJPanel extends JPanel implements ActionListener,
    MouseListener, KeyListener {

    private static final int SIZE = 40;
    private static final int LINE_Y = 70;
    private static final int LINE_START_X = 50;
    private static final int LINE_END_X = LINE_START_X + 10*SIZE;

    private Timer t;
    private Rectangle ball;
    private int moveAmount;

    public AJPanel() {
        moveAmount = SIZE;
    }

    public void keyPressed(KeyEvent e) {

    }

    public void actionPerformed(ActionEvent e) {

        if(ball.x+SIZE >= LINE_END_X) {

        } else if(ball.x <= LINE_START_X) {

        }

    }

    public void paintComponent(Graphics g) {
        super.paintComponent(g);
    }

    public void mousePressed(MouseEvent e) {

    }

}
```

Question/Answer Sheet

ID:

```
}  
    public void keyReleased(KeyEvent e) {}  
    public void keyTyped(KeyEvent e) {}  
    public void mouseClicked(MouseEvent e) {}  
    public void mouseEntered(MouseEvent e) {}  
    public void mouseExited(MouseEvent e) {}  
    public void mouseReleased(MouseEvent e) {}  
}
```

(13 marks)

Question/Answer Sheet

ID:

Question 8 (10 marks)

For this question you need to write the sameWordLengths () method. This method is passed two parameters, both arrays of Strings. The method returns true if both arrays have corresponding String elements of the same length (i.e. the Strings in position 0 of both arrays have the same length, the Strings in position 1 of both arrays have the same length, etc.) In all other cases the method should return false.

Consider the code segment below:

```
String [] words1 = { "hip", "hoop", "he" };
String [] words2 = { "hip", "list", "am" };
String [] words3 = { "sip", "hop", "snip" };
String [] words4 = { "lop", "mope", "in" };

System.out.println("1. " + sameWordLengths (words1, words2));
System.out.println("2. " + sameWordLengths (words1, words3));
System.out.println("3. " + sameWordLengths (words1, words4));
System.out.println("4. " + sameWordLengths (words2, words3));
```

If you have defined the sameWordLengths () method correctly, the output from the above code segment should be:

- 1. true
- 2. false
- 3. true
- 4. false

You can assume that both arrays passed to the sameWordLengths () method have the same number of elements and no element in the arrays is null.

Define the sameWordLengths () method in the space provided below:

```
private _____ sameWordLengths ( _____
                                     _____ ) {
}

```

(10 marks)

Question 9 (13 marks)

CONTINUED

Question/Answer Sheet

ID:

Below is the Coins class which you need to complete. A program which uses the Coins class is shown on the next page. The Coins class represents a number of ten cent, twenty cent and fifty cent coins.

```
public class Coins {
    private String name;
    private int coins10, coins20, coins50;

    public Coins(String name, int tens, int twenties, int fifties){
        coins10 = tens;
        coins20 = twenties;
        coins50 = fifties;
        this.name = name;
    }

    public String toString() {
        int numCoins = coins10 + coins20 + coins50;
        String coinStr = "";
        coinStr = coinStr + name + ": " + numCoins + " coins";
        coinStr = coinStr + " (ten cents: " + coins10 + ",
                                twenty cents: " + coins20;
        coinStr = coinStr + ", fifty cents: " + coins50 + ")";
        return coinStr;
    }

    public int getNumCoins() {
        
    }

    public String getName() {
        
    }

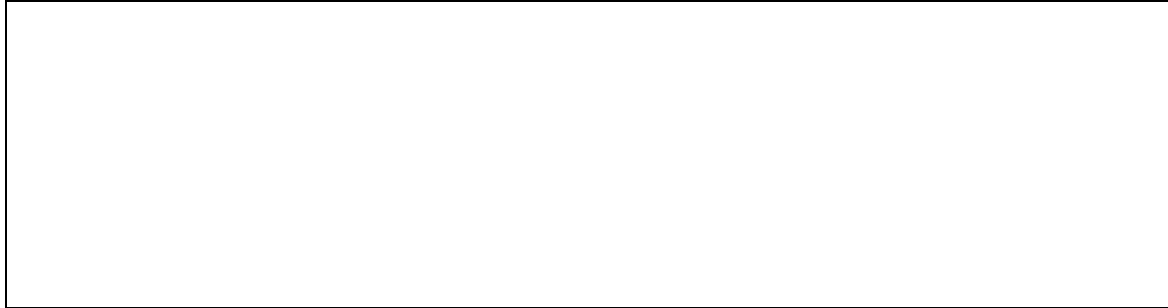
    public void addToCoins(int tens, int twenties, int fifties) {
        
    }

    public double getTotalValue() {
        
    }

    public boolean hasMoreCoins(Coins other) {
```

Question/Answer Sheet

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}
}

The code shown below uses the Coins class.

```

Coins amyCoins = new Coins("Amy", 4, 3, 5);
Coins tomCoins = new Coins("Tom", 0, 1, 8);

System.out.println("1. " + amyCoins.toString());
System.out.println("2. " + tomCoins.toString());

if (amyCoins.hasMoreCoins(tomCoins)) {
    System.out.println("3. " + amyCoins.getName()
        + " has more coins");
} else {
    System.out.println("3. " + tomCoins.getName()
        + " has more coins");
}

amyCoins.addToCoins(0, 0, 3);
tomCoins.addToCoins(2, 0, 0);
System.out.println("4. " + amyCoins.toString());
System.out.println("5. " + tomCoins.toString());

System.out.println("6. Amy now has $"
    + amyCoins.getTotalValue());
System.out.println("7. Tom now has $"
    + tomCoins.getTotalValue());
System.out.println("8. Amy now has "
    + amyCoins.getNumCoins() + " coins");
System.out.println("9. Tom now has "
    + tomCoins.getNumCoins() + " coins");

```

Complete the Coins class definition above so that the code above compiles and gives the output shown below:

1. Amy: 12 coins: (ten cents: 4, twenty cents: 3, fifty cents: 5)
2. Tom: 9 coins: (ten cents: 0, twenty cents: 1, fifty cents: 8)
3. Amy has more coins
4. Amy: 15 coins: (ten cents: 4, twenty cents: 3, fifty cents: 8)
5. Tom: 11 coins: (ten cents: 2, twenty cents: 1, fifty cents: 8)
6. Amy now has \$5.0
7. Tom now has \$4.4
8. Amy now has 15 coins
9. Tom now has 11 coins

(13 marks)

Question/Answer Sheet

ID:

Question 10 (6 marks)

The following method, `isPrime()`, tests whether or not the value of the parameter is a prime number (a prime number is an integer greater than 1 whose only divisors are 1 and itself).

In the code below, the relational operators are missing. Fill in the blanks in the code with the correct relational operators.

```
private boolean isPrime(int value) {  
    int i;  
    i = 2;  
    while ( (i  value) && (value % i  0) ) {  
        i++;  
    }  
    if (i  value) {  
        return true;  
    } else {  
        return false;  
    }  
}
```

(6 marks)

If you complete the code above correctly, the following statements:

```
System.out.println(isPrime(7));  
System.out.println(isPrime(15));  
System.out.println(isPrime(29));
```

should produce the output:

```
true  
false  
true
```

Question/Answer Sheet

ID:

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(If you have used this page, please indicate clearly under the relevant question that you have overflowed to this page)

Question/Answer Sheet

ID:

OVERFLOW PAGE

(If you have used this page, please indicate clearly under the relevant question that you have overflowed to this page)

Question/Answer Sheet

ID:

ROUGH WORKING (WILL NOT BE MARKED)

(You may use this page for rough working)

Question/Answer Sheet

ID:

ROUGH WORKING (WILL NOT BE MARKED)
(You may use this page for rough working)

