BOARD OF STUDIES
NEW SOUTH WALES

2010

HIGHER SCHOOL CERTIFICATE
EXAMINATION

Software Design and Development

Total marks – 100

(**Section I**) Pages 2–8

20 marks
- Attempt Questions 1–20
- Allow about 35 minutes for this section

(**Section II**) Pages 9–30

60 marks
- Attempt Questions 21–23
- Allow about 1 hour and 50 minutes for this section

(**Section III**) Pages 31–42

20 marks
- Attempt either Question 24 or Question 25
- Allow about 35 minutes for this section

General Instructions
- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Write your Centre Number and Student Number at the top of pages 9, 13, 15, 19, 23, 27, and either pages 31 and 33, or pages 37 and 39

4000

Section I

20 marks
Attempt Questions 1–20
Allow about 35 minutes for this section

Use the multiple-choice answer sheet for Questions 1–20.

1   Which tool is used by project managers to track the actual progress of a project against its planned progress?

    (A)   Gantt chart

    (B)   Gateway report

    (C)   Feasibility study

    (D)   Structure diagram

2   A large bank is introducing a new computer-based system. Parts of the old system will be replaced one by one until the new system is in place.

    Which implementation method is being used by the bank?

    (A)   Phased

    (B)   Parallel

    (C)   Prototyping

    (D)   Direct cut over

3   Consider the following algorithm.

```
a = 2
b = 4
a = a + b
b = a + b
PRINT a , b
```

    What is the output from this algorithm?

    (A)   6 , 10

    (B)   6 , 6

    (C)   2 , 6

    (D)   2 , 4

4   Part of the syntax of a programming language is represented in the documentation shown.

update-stmt:
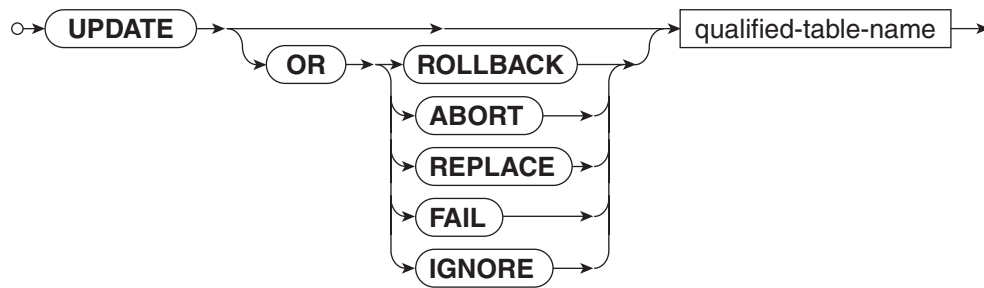
What type of representation is this?

(A)   BNF diagram

(B)   Database schema

(C)   IPO chart

(D)   Railroad diagram

5   Which of the following statements about open-source code is correct?

(A)   It is hardware dependent.

(B)   It is code that cannot legally be recompiled.

(C)   It can be incorporated into commercial software with licensing.

(D)   It can be run directly without the need for translation into object code.

6   In developing a software solution, test data should be created for the first time when

(A)   coding a solution.

(B)   designing a solution.

(C)   implementing a solution.

(D)   determining the feasibility of a solution.

Use the diagram to answer Questions 7 and 8.

The diagram shows an e-business being developed and monitored by a software developer.
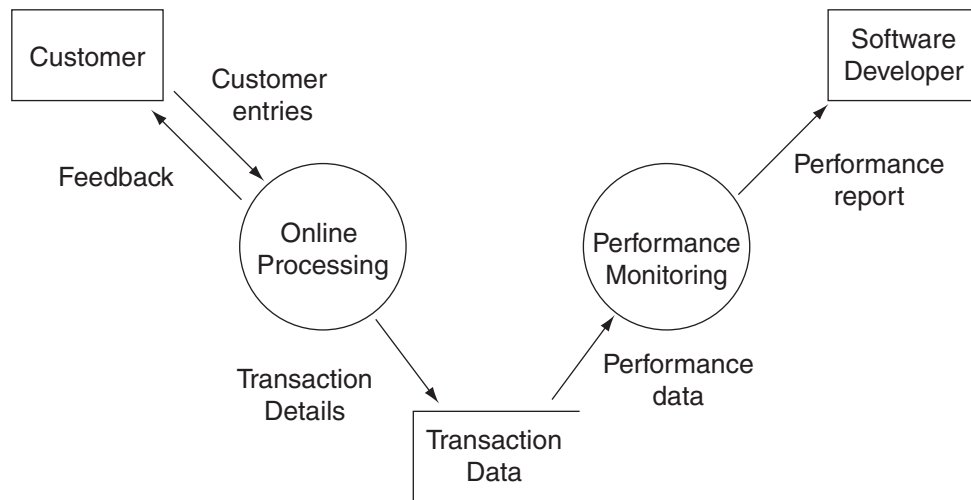
7 Which modelling tool is being used to represent this system?

(A) Context diagram

(B) Data flow diagram

(C) Logic flowchart

(D) System flowchart

8 What will happen during the Performance Monitoring process?

(A) Logic testing

(B) Peer checking

(C) Syntax checking

(D) System testing

9 The formula shown is used to calculate the tax paid by employees in a small business.

$$tax\_paid \ = \ F28 * G17 \ / \ H3$$

What type of documentation has been used in naming the variable tax_paid?

(A) External

(B) Extrinsic

(C) Internal

(D) Intrinsic

10 The leaflet shown is sent by a web design company to potential customers.

BE THE LEADER IN E-COMMERCE THROUGH
INNOVATIVE SOLUTIONS
Phish-IT websites

- We work with you to create your website design.
- We produce a partially working website with sample content so that you can see it, navigate it, and review it.
- We continue to work with you to improve your website until YOU are happy.

Which software development approach is being described in this leaflet?

(A) End user

(B) Pilot

(C) Prototyping

(D) Structured

11 A computer engineer can increase the number of unique RAM locations that can be accessed by the CPU by increasing the

(A) clock speed.

(B) number of registers.

(C) size of the data bus.

(D) size of the address bus.

12 What occurs when a program encounters a breakpoint?

(A) Program execution is terminated.

(B) Program execution is paused, awaiting an action from the programmer.

(C) The program prints an error message and immediately continues execution.

(D) The program prints the value of a variable and immediately continues execution.

13 Kim wants to write a program to list her friends' details in birthday order. She stores her friends' details in a sequential file. Each line of the file contains the name, phone number and birthday for a friend.

Which is the most appropriate data structure for handling her friends' data in the program?

(A) A record

(B) An array of records

(C) A multi-dimensional array

(D) A multi-dimensional record of arrays

Use the algorithm to answer Questions 14 and 15.

```
BEGIN
    EndUnsorted = ArraySize
    WHILE EndUnsorted > 1
        CurrentIndex = 1
        WHILE CurrentIndex < EndUnsorted
            IF Array(CurrentIndex) > Array(CurrentIndex + 1) THEN
                SWAP(CurrentIndex, CurrentIndex + 1)
            ENDIF
            CurrentIndex = CurrentIndex + 1
        ENDWHILE
        EndUnsorted = EndUnsorted – 1
    ENDWHILE
END
```

NOTE: The SWAP subprogram swaps two elements of an array.

14   What is the most appropriate data type for the variable EndUnsorted?

(A)   Array

(B)   Boolean

(C)   Floating point

(D)   Integer

15   The algorithm is applied to the following array of data. The smallest index is 1.

F	I	S	H

What will this array look like after the algorithm is applied?

(A)
F	H	I	S

(B)
H	S	I	F

(C)
I	F	S	H

(D)
S	I	H	F

16 The newly developed portal of a national company was successfully tested by its developer. During the first two weeks of implementation, staff complained about not knowing how to use some of the new features of the software.

Which area of feasibility should have been considered more carefully during the development process?

(A) Budgetary

(B) Operational

(C) Scheduling

(D) Technical

17 What happens when a syntax error occurs during compilation?

(A) Object code will be created without the section containing the erroneous code.

(B) The compiler will pass over the error as syntax errors are ignored during compilation.

(C) The error will be included in an error listing which will be produced at the end of compilation.

(D) The syntax error will be automatically corrected by the compiler and updated source code will be generated.

18 A program based on the following algorithm generates an error whenever it is executed.

```
BEGIN
    arrayLength = length of the array
    index = 1
    REPEAT
        index = index + 1
        PRINT array[index]
    UNTIL index > arrayLength
END
```

What is the most likely cause of this error?

(A) Division by zero

(B) Arithmetic overflow

(C) Incorrect program syntax

(D) Accessing an inappropriate memory location

19   The following processes take place during program translation.

   Process X: validating the relationships between elements

   Process Y: testing with a type checker

   Process Z: labelling reserved words and identifiers

What is the correct sequence of these processes?

(A)   Z, Y, X

(B)   Y, Z, X

(C)   Z, X, Y

(D)   Y, X, Z

20   Consider the following algorithm.

```
BEGIN MAINPROGRAM
    numA = 2
    numB = 3
    calc(numA, numB)
    PRINT numA, numB
END MAINPROGRAM

BEGIN SUBPROGRAM calc(numC, numD)
    temp = numC
    WHILE numD > 1
        numC = numC * temp
        numD = numD – 1
    ENDWHILE
    PRINT numC, numD
END SUBPROGRAM
```

What would be the output from this algorithm?

(A)   2, 3, 3, 2

(B)   2, 3, 1, 8

(C)   8, 1, 2, 3

(D)   8, 1, 1, 8

2010 HIGHER SCHOOL CERTIFICATE EXAMINATION

Software Design and Development

Centre Number

Student Number

Section II

60 marks
Attempt Questions 21–23
Allow about 1 hour and 50 minutes for this section

Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.

If you include diagrams in your answer, ensure that they are clearly labelled.

Question 21 (20 marks)

(a)   Describe ways in which an end user can contribute to the overall development of a software solution.   **3**

....

....

....

....

....

....

....

....

....

Question 21 (continued)

(b) A team of developers decides to apply a modular approach when developing a complex software solution.

     3

Justify the use of this approach.

....

....

....

....

....

....

....

....

....

....

....

Question 21 continues on page 11

Question 21 (continued)

(c)   Library routines are often used in softw are solutions.

(i)   What are the benefits of using library routines?   **2**

....

....

....

....

....

....

....

....

(ii)   Describe the requirements of library routines that need to be considered   **3**
during their development.

....

....

....

....

....

....

....

....

....

....

....

....

BLANK PAGE

2010 HIGHER SCHOOL CERTIFICATE EXAMINATION

Software Design and Development

Section II (continued)

Centre Number

Student Number

Question 21 (continued)

(d)   A keen gamer wants to make a computer game that she and her friends can play.
       She has no e xperience making computer games, although she has had some
       experience writing computer code. She has no intention of selling the game.

       She decides to use a combination of the Rapid Applications De   velopment
       (RAD) approach and the prototyping approach to mak e her computer game.

(i)   Discuss the suitability of using this combination of software development   **3**
       approaches.

       ....

       ....

       ....

       ....

       ....

       ....

       ....

       ....

       ....

       ....

       ....

       ....

Question 21 (d) (continued)

(ii) Outline and justify forms of documentation that she could produce during the development of this computer game.

3

....

....

....

....

....

....

....

....

....

....

....

....

(iii) Contrast the use of sequential and e   vent-driven approaches in the development of this game.

3

....

....

....

....

....

....

....

....

....

....

....

End of Question 21

2010 HIGHER SCHOOL CERTIFICATE EXAMINATION

Software Design and
Development

Centre Number

Student Number

Section II (continued)

Question 22 (20 marks)

(a)   What needs to be considered when designing a set of test data to desk check an   **2**
        algorithm?

        ....

        ....

        ....

        ....

        ....

        ....

Question 22 (continued)

(b)   A subprogram called stringMatch takes two character strings, searchString and dataString, as input parameters. The subprogram assumes that   searchString and dataString are arrays of characters of the same length.

The subprogram compares the strings with each other and prints a message indicating whether they are the same or different. The subprogram allows for the use of a 'match' character . The match character (the   ? symbol) matches any single character when comparing strings.

The table shows the test data that will be used to test the subprogram.

searchString	dataString	Expected output
Fish	Fish	Same
Fist	Fish	Different
Fis?	Fish	Same
???t	Fish	Different

  (i)   Write an algorithm for the stringMatch subprogram.   **5**

Question 22 (continued)

(ii) A student implements a solution to the stringMatch problem. When they test their solution with a searchString and dataString of different lengths the following output is produced:

3

searchString	dataString	Actual output
Fish	Fishcake	Same
Fishcake	Fish	Run time error – program terminates unexpectedly

Explain why the program produces this output.

....

....

....

....

....

....

....

....

....

....

....

....

Question 22 continues on page 19

BLANK PAGE

Software Design and
Development

Centre Number

Section II (continued)

Student Number

Question 22 (continued)

(c)   The following <u>swap</u> subprogram has been written to be used in an insertion sort
       algorithm to swap two elements of an array.

```
BEGIN SUBPROGRAM swap (array, indexA, indexB)
        array[indexA] = array[indexB]
        array[indexB] = array[indexA]
END SUBPROGRAM swap
```

   (i)   Explain why the <u>swap</u> subprogram does not function correctly.   **3**

         In your answer, suggest a possible solution.

         ....

         ....

         ....

         ....

         ....

         ....

         ....

         ....

         ....

         ....

         ....

         ....

Question 22 (continued)

(ii)   Describe how an insertion sort algorithm works.   **3**

....

....

....

....

....

....

....

....

....

....

....

Question 22 continues on page 21

Question 22 (continued)

(d)   Software requires revision and modification over time. For this reason,   **4**
      programmers develop software in a way that allows for subsequent maintenance.

      Discuss techniques that can be used in development that make software easier
      to maintain.

      ....

      ....

      ....

      ....

      ....

      ....

      ....

      ....

      ....

      ....

      ....

      ....

      ....

      ....

      ....

End of Question 22

BLANK PAGE

2010 HIGHER SCHOOL CERTIFICATE EXAMINATION

Software Design and
Development

Centre Number

Section II (continued)

Student Number

Question 23 (20 marks)

(a)   Describe project management tools that could be used to help team members   **3**
       communicate and work together effectively.

       ....

       ....

       ....

       ....

       ....

       ....

       ....

       ....

       ....

       ....

       ....

       ....

Question 23 (continued)

(b)   Based on your studies or e   xperience in project w ork, e xplain why softw are   **4**
      solutions are tested at the follo wing levels:

- module

- program

- system.

....

....

....

....

....

....

....

....

....

....

....

Question 23 (continued)

(c)   Consider the following fragment of code.

        LOAD   R1, A
        LOAD   R2, B
        ADD   R3, R1, R2
        STORE   C, R3

Note:

- A, B and C are locations in RAM
- R1, R2 and R3 are registers inside the CPU
- LOAD R, W takes the contents of W and copies it to register R
- ADD Z, X, Y adds the contents of X and Y and places the result in Z
- STORE W, R takes the contents of register R and copies it to W

(i)   Making reference to the fetch-execute cycle, describe the operation of   **2**
        the CPU in processing the first line of the code.

        ....

        ....

        ....

        ....

        ....

        ....

        ....

        ....

(ii)   Which line of the code would execute the fastest and why?   **2**

        ....

        ....

        ....

        ....

        ....

        ....

        ....

        ....

BLANK PAGE

Software Design and
Development

Section II (continued)

Centre Number

Student Number

Question 23 (continued)

Please turn over

Question 23 (continued)

(d)   Jane subscribes to a phone shopping service which sends her personalised shopping messages based on her location.

The system keeps Jane's shopping preferences in its preferences database. The system matches these preferences and Jane's location with its retailers' database of shops, products and sale items. It then sends Jane a personalised SMS message with shops, products and sale items that match these criteria.

Jane is trialling a mobile phone application which allo ws her to vie w and edit her shopping preferences.

The diagram below shows two of the screens used for this purpose. Screen 1 is the main menu for preference selection. Screen 2 allo ws the user to vie w and edit preference details for the 'SHOES' cate gory.

Screen 1   **Screen 2**
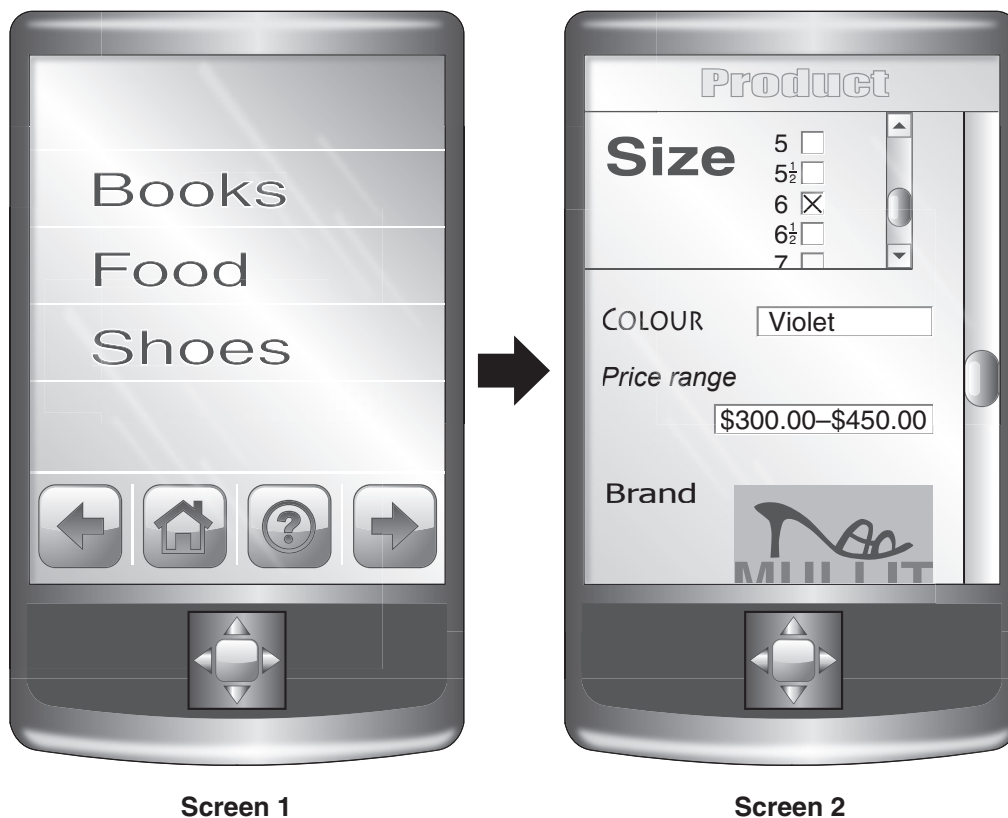
Question 23 (continued)

(i) Currently, price range data is stored as a single string. **2**

Propose a better way to store price range data.

....

....

....

....

....

....

....

....

(ii) What changes w ould you mak e to the interf ace design to mak e the **3**
application more user-friendly? Justify your answer.

....

....

....

....

....

....

....

....

....

....

....

....

(iii) In order to compile the personalised SMS messages that will be sent to Jane, the following processes occur: **4**

- The system determines Jane's location and retrieves her shopping preferences.

- For each shop in the retailers' database that is close to Jane's location, the system adds products and sale items matching her preferences to a list.

- The final list is sent to Jane's mobile phone.

Draw a structure diagram to model this system.

End of Question 23

2010 HIGHER SCHOOL CERTIFICATE EXAMINATION

Software Design and Development

Section III

Centre Number

Student Number

20 marks
Attempt either Question 24 or Question 25
Allow about 35 minutes for this section

Answer the question in the spaces provided. These spaces provide guidance for the expected length of response.

If you include diagrams in your answer, ensure that they are clearly labelled.

Question 24 — Evolution of Programming Languages (20 marks)

(a)   The following fragment of code, written using the logic paradigm, represents the organisation of part of our solar system.

```
orbits (mercury,sun) .
orbits (venus,sun) .
orbits (earth,sun) .
orbits (mars,sun) .

orbits (moon,earth) .

orbits (phobos,mars) .
orbits (deimos,mars) .

planet (P)<=orbits (P, sun) .
satellite (S)<=orbits (S, P) and planet (P)
```

© Monash University
http://www.csse.monash.edu.au/~lloyd/tildeLogic/Prolog.toy/Examples/solar/ .

(i)   Identify the basic building blocks illustrated in this code. Give examples   **2**
       from this fragment of code.

       ....

       ....

       ....

       ....

       ....

Question 24 continues on page 32

Question 24 (continued)

(ii) What would be returned for **X** if the following query were executed? **2**

? orbits (X, sun) .

....

....

....

(iii) Describe how backward chaining is used by the inference engine to evaluate the query: **3**

? satellite (phobos) .

....

....

....

....

....

....

....

....

....

(iv) Describe an advantage of using the logic paradigm instead of an imperative approach in representing the organisation of our solar system. **2**

....

....

....

....

....

....

....

Question 24 continues on page 33

– 32 –

2010 HIGHER SCHOOL CERTIFICATE EXAMINATION

Software Design and
Development

Section III (continued)

Centre Number

Student Number

Question 24 (continued)

(b)   You ha ve been emplo yed to write softw   are, using the object oriented
      programming paradigm, to classify dif ferent types of writing implements.

      All writing implements can be described by their colour   , brand, price and
      medium (medium can be ink, lead or paint).

      All writing implements ha ve tw o common beha viours which describe their
      operation:

      • Write – describes the process of lea ving a mark on a surf ace

      • Erase – describes the process of remo ving a mark from a surf ace.

      (i)   Describe the structure of the   *class* WritingImplement. In your answer ,   **3**
            identify all *methods* and *attributes*.

            ....

            ....

            ....

            ....

            ....

            ....

            ....

            ....

            ....

            ....

            ....

            ....

Question 24 continues on page 34

– 33 –

A pen is a specific type of writing implement that can be additionally described in terms of its:

- Style: for example: fountain, felt tip, ballpoint

- Thickness: for example: superfine, fine, medium.

(ii) Describe the structure of the *subclass* Pen.   2

....

....

....

....

....

....

(iii) Pencil is another *subclass* of WritingImplement and has its own unique Erase   3
behaviour.

Describe the features of the object oriented programming paradigm
which allow this subclass to be defined and used.

....

....

....

....

....

....

....

....

....

....

....

Question 24 (continued)

(iv) A technological improvement has been made to the Write behaviour of Pen. Encapsulation makes it possible to easily incorporate this improvement in a software solution. **3**

Explain how encapsulation allows software systems to be more easily adapted as technologies change.

....

....

....

....

....

....

....

....

....

End of Question 24

BLANK PAGE

2010 HIGHER SCHOOL CERTIFICATE EXAMINATION

Software Design and
Development

Centre Number

Student Number

Section III (continued)

Do NOT attempt Question 25 if you have already attempted Question 24.

Question 25 — The Software Developer's View of the Hardware (20 marks)

(a)   A binary point can be used to extend the binary representation of integers to the binary representation of mixed numerals (whole numbers and fractions).

Binary digits to the left of the binary point represent whole numbers.

Binary digits to the right of the binary point represent fractional values.

(i)   Show how the mixed numeral $2\frac{3}{4}$ can be represented in binary notation as: **2**

10.11

....

....

....

....

....

....

(ii)   Perform the following binary addition: **2**

10.11 + 10.1

....

....

....

....

....

....

Question 25 continues on page 38

Question 25 (continued)

(iii) Describe how half adders and full adders w ould be used in the addition of the binary numbers in part (ii).

3

....

....

....

....

....

....

....

....

....

(iv) Not all fractions can be represented easily as binary numbers using a binary point.

2

For example $\frac{1}{10} = 0.00010100001 \ldots$

Describe an advantage of the use of the floating point method instead of the binary point method to represent fractions.

....

....

....

....

....

....

Software Design and
Development

Centre Number

**Section III (continued)**

Student Number

Question 25 (continued)

(b)   An art gallery is displaying a v   aluable painting. T o protect the painting, the
       gallery installs a security system with tw o switches and an infrared sensor   that
       can detect movement within the painting's display area.

       The alarm will be triggered if:

       • ONLY ONE switch is on, or

       • BOTH switches are on AND the sensor detects mo vement.
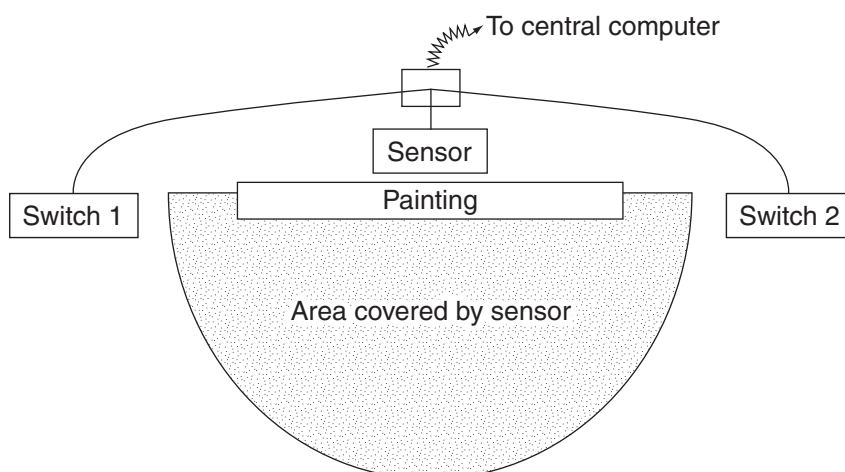
(i)   Complete the truth table to sho   w the relationship between the input   **2**
       devices and the state of the security system.

Input			Output
Switch 1 (1 = on)	*Switch 2* (1 = on)	*Sensor* (1 = movement)	*Alarm state* (1 = triggered)
0	0	0	0

– 39 –

Question 25 (continued)

  (ii) Design a circuit to solve the problem represented by the truth table. **3**

Question 25 (continued)

(iii) For security monitoring, the states of the two switches, the sensor and the   **3**
       alarm are assembled into a packet and sent at regular intervals to the art
       gallery's central computer.

The following sequence of packets is received:

	Switch 1	Switch 2	Sensor	Alarm
Packet 1	0	0	0	0
Packet 2	0	0	1	0
Packet 3	0	1	1	1

What has happened in the security system to produce this sequence of
packets?

....

....

....

....

....

....

....

....

....

Question 25 continues on page 42

Question 25 (continued)

(iv) The states of the two switches, the sensor and the alarm need to be stored **3** between each packet being sent.

Explain how flip-flops may be used to store this data.

....

....

....

....

....

....

....

....

....

End of paper