2008

HIGHER SCHOOL CERTIFICATE
EXAMINATION

Software Design and Development

General Instructions
- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
- Draw diagrams using pencil

Total marks – 100

(**Section I**) Pages 2–7

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

(**Section II**) Pages 8–14

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

(**Section III**) Pages 15–19

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

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.

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1 What document describes the responsibilities of a software developer when using software within an organisation?

 (A) Code of conduct

 (B) Code of response

 (C) Interface agreement

 (D) Reliability agreement

2 Which of the following must be indicated on an initial Gantt chart?

 (A) Time and hardware

 (B) Time and project components

 (C) Responsible personnel and hardware

 (D) Responsible personnel and project components

3 What tool would be used by a software developer to represent a system?

 (A) Font specifications

 (B) Ergonomic diagrams

 (C) Hardware specifications

 (D) Input Process Output diagrams

4 Which system flowchart symbol is used to indicate data that is to be entered using a computer keyboard?

 (A)

 (B)

 (C)

 (D)

5 What is the purpose of drawing a storyboard when analysing a computer systems problem?

(A) To document variable attributes

(B) To show possible navigation paths

(C) To conform to industry standards in screen design

(D) To ensure that a hierarchical structure has been used

6 A retail company installs and tests a new system at one store prior to releasing the system to other stores.

What is the name of this method of implementation?

(A) Direct

(B) Parallel

(C) Pilot

(D) Prototype

7 Which process would you undertake during the 'understanding' phase of the development of a software solution to a complex problem?

(A) Design of algorithms

(B) Selection of software environment

(C) Testing of program using sample data

(D) Representing the system using diagrams

8 Consider the following code.

```
LOAD A, 32
ADD A, B
STORE B
```

What type of code is this?

(A) Assembly

(B) HTML

(C) Machine

(D) Visual Basic

9   While developing a software solution the developer inserts a number of output statements to display changes in variable values as the code is executed.

What software error detection technique is this?

(A)   Flags

(B)   Breakpoints

(C)   Program traces

(D)   Single line stepping

10   A software developer wants to create documentation to show the manner in which sub-programs are called and parameters are passed between these sub-programs.

What is the most appropriate type of documentation to use?

(A)   IPO diagram

(B)   Network diagram

(C)   Structure chart

(D)   System flowchart

11   An error occurs when compiling a program.

What type of error is this?

(A)   Logical

(B)   Overflow

(C)   Run-time

(D)   Syntax

12   What allows the CPU and memory of a computer to communicate with each other?

(A)   Modem

(B)   Keyboard

(C)   System bus

(D)   Device driver

13 When documenting a software solution in the 'testing and evaluation' phase, which of the following would be of use?

(A) CASE tools to generate test data

(B) Desk checking to test algorithms

(C) Libraries of solution-specific algorithms

(D) CASE tools to generate survey responses

14 A software solution requires the following information to be processed.

- Customer Name
- Transaction Number
- Transaction Date
- Transaction Type
- Current Customer Balance

Which data structure would best represent this information?

(A) Index

(B) Variable

(C) Array of records

(D) Multi-dimensional array

15 What does a program counter do?

(A) Counts the number of lines in a program

(B) Stores the number of CPU cycles to run the program

(C) Counts the number of times an instruction goes through a program

(D) Holds the address of the instruction being executed or to be executed

Use the following information to answer Questions 16–18.

A company, *J–Phone*, wants to develop software to allow users to access the internet using personal mobile devices, such as mobile phones and personal organisers.

The software solution, composed of multiple modules, will be developed by the company's programming team.

16   What software development approach would *J–Phone* use in this scenario?

(A)   Phased development

(B)   Structured approach

(C)   End user development

(D)   Run time development approach

17   A competitor illegally uses *J–Phone's* software solution in its product.

Which term best describes this action?

(A)   Hacking

(B)   Plagiarism

(C)   Network use

(D)   Decompilation

18   *J–Phone's* software runs on a public domain operating system which has been developed freely by the computing community.

Which term best describes this operating system?

(A)   Open source

(B)   Pirated source

(C)   Forward engineered

(D)   Reverse engineered

Use the following algorithm to answer Questions 19 and 20.

```
BEGIN MAINPROGRAM
    result = 0
    FOR count = 1 to 3
        INPUT data
        IF data > result THEN
            result = data
        ENDIF
    NEXT count
    PRINT result
END MAINPROGRAM
```

19 The data set 2, 25, 10, 51 was entered into the algorithm.

What would be the output?

(A) 2

(B) 10

(C) 25

(D) 51

20 What operators are used in the algorithm?

(A) Logical

(B) Relational

(C) Repetition

(D) String

Section II

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

Answer each question in a SEPARATE writing booklet. Extra writing booklets are available.

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

Marks

Question 21 (20 marks) Use a SEPARATE writing booklet.

(a)   (i)   Identify ONE feature of reverse/backwards engineering.   **1**

        (ii)   Explain how reverse/backwards engineering affects the intellectual property rights of software developers.   **2**

(b)   The following diagram shows the structure of the Acme Golf Club's website.
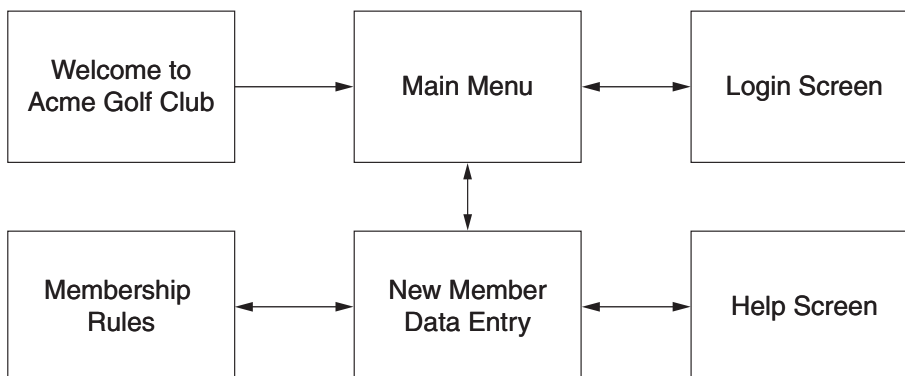
        (i)   The 'New Member Data Entry' screen is used to collect general personal details including: ID Number (nine digits), Given Names, Surname, Gender (M or F), Date of Birth, Address Line 1, Address Line 2, City, State and Postcode.   **4**

               Sketch a design for this screen and label the key screen/interface design considerations.

        (ii)   Create a data dictionary for the data to be entered on the 'New Member Data Entry' screen.   **3**

Question 21 (continued)

(c) A student designed the following algorithm to find the largest and smallest marks in a class test.

```
100     BEGIN
110         fishfingers = 0
120         PRINT "Enter a mark or –1"
130         READ number
140         small = number
150         large = number
160         REPEAT
170             PRINT "Enter a mark or –1"
180             READ number
190             IF number < small THEN
200                 small = number
210             ENDIF
220             IF number > large THEN
230                 large = number
240             ENDIF
250             fishfingers = fishfingers + 1
260         UNTIL number = –1
270         IF fishfingers <> –1 THEN
280             PRINT large, small, fishfingers
290         ENDIF
300     END
```

(i) What is the purpose of the variable 'fishfingers'? **1**

(ii) Identify the sentinel value in the algorithm. **1**

(iii) Describe aspects to be considered when designing test data for the algorithm. **2**

(iv)

fishfingers	number	large	small	OUTPUT

3

Draw the table in your answer booklet.

Complete a desk check for the algorithm using the data set:
7, 5, 5, –1, 3, 2, 999

(v) There are errors in this algorithm. **3**

Identify the errors and correct each error using pseudocode. (You do NOT need to rewrite the entire algorithm.)

End of Question 21

Question 22 (20 marks) Use a SEPARATE writing booklet.

(a) Consider the following algorithm.

```
110   BEGIN FindAccountData(accountNumber, accountName, accountAddress)
120       OPEN accountFile
130       READ accountFile
140       found = False
150       WHILE NOT found
160           IF accountFile.accountNumber = accountNumber
170               THEN found = True
180                       accountName = accountFile.accountName
190                       accountAddress = accountFile.accountAddress
200               ELSE
210                       READ accountFile
220           ENDIF
230       END WHILE
240       CLOSE accountFile
250   END FindAccountData
```

(i) Explain how the variable accountNumber has been used. **2**

(ii) There is an error in the algorithm. Describe the error. **2**

(iii) Alter the algorithm FindAccountData using pseudocode to take the data found in the algorithm and print it on the screen. The format of the data on the screen is not important. **2**

(b) (i) Define the term *design specifications* in relation to software development. **2**

(ii) Describe how software design specifications are used for quality assurance. **2**

(iii) Why would a software developer communicate with future users when developing the design specifications for a software solution? **2**

(iv) Software developers can use CASE tools to produce detailed specifications for a project. **2**

Describe benefits of producing specifications in this manner.

Question 22 (continued)

(c) A Government Tax Office is developing a new software package. The software will be distributed electronically, via download from the Tax Office website. Citizens are required to complete and submit their annual tax return electronically.

All supporting documentation will be included within the program or in a hyperlinked document file.

The user will be prompted to answer key questions and then directed accordingly to various data entry screens. The software must be easily used by, and accessible to, all citizens.

The Tax Office imposes strict penalties for any errors or misrepresentations made in a tax return.

   (i) Identify a social or ethical issue arising from this scenario and discuss its implications for the software design. **3**

   (ii) Discuss the responsibilities of the software developer in developing the tax return software for the Tax Office. **3**

End of Question 22

Question 23 (20 marks) Use a SEPARATE writing booklet.

(a) The following algorithm calculates and displays the perimeter and area of a rectangle, or the circumference and area of a circle.

```
FUNCTION Main
      PROMPT FOR rectangle OR circle
      IF rectangle THEN CALL Calc_Rectangle (message)
      ELSE CALL Calc_Circ (message)
      DISPLAY message
END


FUNCTION Subprogram Calc_Rectangle (message)
      INPUT length, width
      perimeter = 2 * length + 2 * width
      area = length * width
      message = 'perimeter = ' ; perimeter ; 'area = ' ; area
      RETURN message
END


FUNCTION Subprogram Calc_Circ (message)
      message = 'Circle'
      RETURN message
END
```

  (i)   Construct an IPO chart or IPO diagram for the algorithm.   **3**

  (ii) Identify the module that operates as a stub.   **1**

  (iii) Using pseudocode, modify the function Calc_Circ so that the circumference and area of a circle can be calculated and displayed.   **3**

   For a circle, use $c = 2\pi r$ and $a = \pi r^2$, where $r =$ radius, $c =$ circumference, $a =$ area and π has the value of 3.14.

Question 23 (continued)

(b)   The following algorithm prompts the user to enter a target rainfall. It then searches the array 'dailyRainfall' to find the days of the month with the target rainfall. The array 'dailyRainfall' contains 31 elements, one element for each day of the month.

```
100     BEGIN
110         INPUT targetRainfall
120         dayOfMonth = 1
130         WHILE dayOfMonth < = 31
140             IF dailyRainfall (dayOfMonth) = targetRainfall THEN
150                 PRINT 'Target rainfall recorded on day'
160                 PRINT dayOfMonth
170             ENDIF
180             dayOfMonth = dayOfMonth + 1
190         ENDWHILE
200     END
```

   (i)   Locate and name ONE type of control structure used within the algorithm.   **1**

   (ii)   Name the searching technique used in the algorithm.   **1**

   (iii) Modify the algorithm so that, if no target rainfall is found in the array, an appropriate message is printed.   **2**

   (iv)   Explain why software developers use standard modules.   **3**

          In your answer give an example of a standard algorithm, other than those used for searching and sorting.

Question 23 (continued)

(c)   The syntax and structure of a simplified programming language are described below.

Syntax
Letter = (A…Z)|(a…z)
Digit = (0…9)
Condition = (= | < >)
Variable = <Letter>{<Letter>}
Constant = <Digit>{<Digit>}
Condition Exp = <Variable><Condition>(<Variable>|<Constant>)
Variable List = <Variable>{,<Variable>}

Structure
Assignment Statement = <Variable> : = <Constant>
User Input Statement = GET <Variable List>
Conditional Statement = IFF <Conditional Exp> THEN
        (<Assignment Statement>|<User Input Statement>) ENDIFF

(i)   Why is the following statement legal?   **1**

GET name,number,age

(ii)   Discuss the legality of the structure and syntax of the following   **2**
statement.

IF number : = 7 THEN name : = Tom   ENDIF

(iii) Use a railroad diagram to define a post-test repetition structure for this **3**
language.

End of Question 23

Section III

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

Answer the question in a SEPARATE writing booklet. Extra writing booklets are available.

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

Marks

Question 24 — Evolution of Programming Languages (20 marks)

(a) (i) Define the term *programming paradigm*. **1**

(ii) Name ONE object oriented language. **1**

(iii) Compare and contrast the types of software solutions that can be produced using an imperative programming language and a functional programming language. **3**

(b) (i) State the purpose of an *inference engine* in the logic paradigm. **1**

(ii) Consider the following fragment of code. **3**

```
110    student ('Natasha')
120    student ('Robert')
130    teacher ('Peter')
140    attends_class ('SDD', 'Natasha')
150    attends_class ('SDD', 'Robert')
160    attends_class ('SDD', 'Peter')
170    student_in_class (X,Y) :- attends_class (X,Y), student (Y)
180    teaches_class (X,Y) :- attends_class (X,Y), teacher (Y)
190    teaches_student (X,Y) :- teaches_class (Z,Y), student_in_class (Z,X)
```

List all the possible pieces of information that could be determined from the code fragment.

Question 24 continues on page 16

Question 24 (continued)

(c)   A functional language supports the following data structures:

[Nick , Ally]
[1 , 2 , 37]
[7 , 9 , XY , talk]

The language includes three built-in functions:

CBN, LFIND and RFIND

Examples of manipulations using these functions are shown below:

CBN ([6 , 8] , [7 , BJ , PING]) = [6 , 8 , 7 , BJ , PING]
LFIND (3 , [4 , 5 , 11 , 27 , 67 , 17]) = 11
RFIND (2 , [4 , 5 , 11 , 27 , FISH , 17]) = FISH

(i)   Evaluate, showing all working: **2**

RFIND (4 , CBN ([3 , 9 , 2 , AARON] , [AS]))

(ii)   Evaluate, showing all working: **2**

RFIND (LFIND (3 , [45 , 6 , 2 , TOM]) , [PINK , BLUE , RED , GREEN])

Question 24 continues on page 17

Question 24 (continued)

(d)   Consider the following pseudocode.

```
Class ;        User
Attributes ;   ................. login_alias, password, valid, user_level .................
Methods ;      ................. get_login_alias(), get_password(), process_login(),
               retrieve_DBpasswd(), set_user_level() .................
process_login (login_alias, valid)
    IF get_password(login_alias) = retrieve_DBpasswd(login_alias) THEN
        valid = true
    ELSE
        valid = false
    ENDIF
END
```

  (i)   Outline examples of different instances of the class User within the system.   **2**

 (ii)   Describe the sequence of processes that is occurring in the instance of the class User at the time of process_login. In particular indicate messages that occur between internal and external components of the instance.   **3**

(iii)   A teacher is a specialised human being. A human being is a generalised Teacher.   **2**

      Explain the link between specialisation and generalisation when considering inheritance in object oriented programming. You may use a diagram in your answer.

End of Question 24

OR

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

(a) (i) Evaluate the following 8-bit expression, showing all working in binary. **2**

10101011 ÷ 00001001

  (ii) Describe methods that are used in the binary system to represent fractions. **3**

  (iii) The number of bits in a memory location is referred to as *wordlength*. **2**

The table below shows how the word FISH would be stored with a 32-bit *wordlength*.

Address	Data
2E	11000110 11001001 11100010 11001000
	F I S H

Redraw the table showing how the word FISH would be stored with an 8-bit *wordlength*.
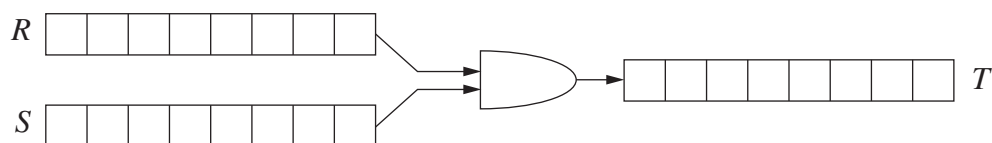
(b) (i) State the purpose of a truth table. **1**

  (ii) Draw a truth table for the following circuit diagram. **3**
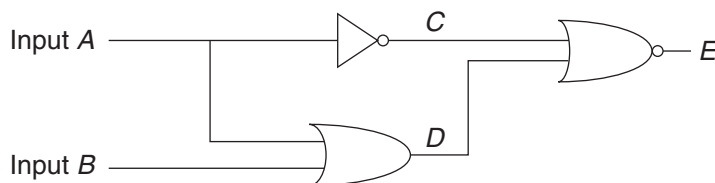
Question 25 continues on page 19

Question 25 (continued)

(c)   The diagram below shows how three registers *R*, *S* and *T* are connected.

The contents of registers *R* and *S* are passed, bit by bit, through a logic gate and the result is stored in register *T*.

(i)   If *R* contains 01001011 and *S* contains 00100101, what are the contents of *T*?   **2**

(ii) If *R* contains 10111101 and the contents of *T* are 10111101, list all of the possible 8-bit strings that could have been contained in *S*.   **2**

(d)   Packets are composed of header information, data characters and trailer information.

(i)   Identify information that may be included in a header.   **2**

(ii) Compare and contrast the packets sent from a USB mouse to a computer system and from a scanner to a computer system.   **3**

End of paper

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