BOSTES BOARD OF STUDIES TEACHING & EDUCATIONAL STANDARDS NSW

2016 HIGHER SCHOOL CERTIFICATE EXAMINATION

Software Design and Development

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black pen
- Draw diagrams using pencil
- Write your Centre Number and Student Number at the top of either pages 29 and 33 or pages 37 and 41

Total marks – 100

Section I Pages 2–11

20 marks

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

Section II Pages 13–28

60 marks

- Attempt Questions 21–33
- Allow about 1 hour and 50 minutes for this section

Section III Pages 29–43

20 marks

- Attempt either Question 34 or Question 35
- 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.

---

1 Some software is sold with keys that need to be entered to unlock the software or make it fully functional.

What is the most likely reason for this?

(A) To minimise software piracy

(B) To protect the user's private data

(C) To minimise the risk of data loss

(D) To prevent decompilation of the software

2 Which of the following best describes *reverse engineering*?

(A) Reducing compatibility issues when producing updates

(B) Using code from other sources during software development

(C) Ensuring the executable code matches the original source code

(D) Analysing a system to see how it works, in order to reproduce its functionality

3 A company needs to replace its existing software but it does not have any software development capabilities.

Which of the following best solves this problem?

(A) Develop the software inhouse

(B) Outsource the development of the software

(C) Simplify the specifications for the new software

(D) Buy off-the-shelf software that meets some requirements

4 A company spent a month training its staff before replacing its main software. After training was completed, the company switched to the new software.

Which installation method was used?

(A) Pilot

(B) Phased

(C) Parallel

(D) Direct cut over

5 Which of the following is a possible reason for developers to use CASE tools?

(A) To automate data entry processes

(B) To install packages on remote systems

(C) To link external modules with internal modules

(D) To automate some of the tasks when creating software

6 Which of the following sets of software features would be most relevant to the end user?

(A) Data types and data structures

(B) Screen settings and algorithms

(C) Accessibility and interface design

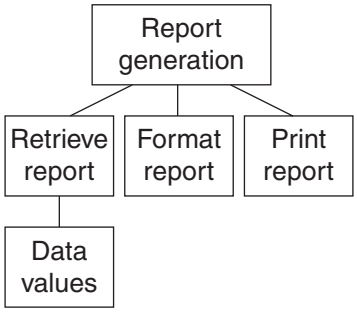
(D) Operating system and programming language

7 Which diagram best models the processes and physical components within a reporting system?

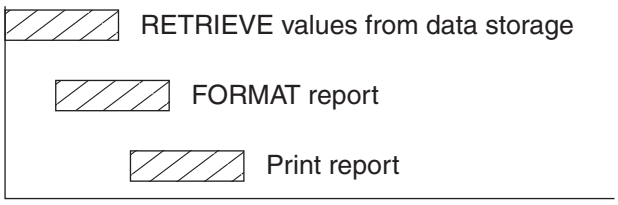
(A)

INPUT	PROCESSING	OUTPUT
Values (retrieved from datastore)	Format report	Printed report

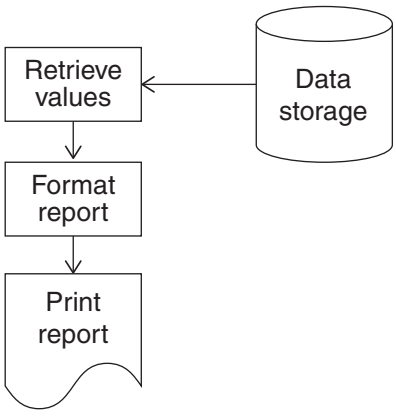
(B)



(C)



(D)



8 Why is it necessary to develop a set of criteria to evaluate a software project?

(A) To allow selection of an appropriate development process

(B) To ensure that the end users know what the software can do

(C) To check that the software is suitable for the intended purpose

(D) To enable the project managers to develop a time management schedule

9 Compiled software often needs to access DLLs.

What is the main reason for using DLLs?

(A) To allow the reuse of existing code

(B) To provide common document libraries

(C) To standardise the structure of compiled code

(D) To simplify the installation process for the user

10 An algorithm is being designed to count the number of days between two dates in the calendar.

What would be the best data type to store this count?

(A) Date

(B) Integer

(C) Real

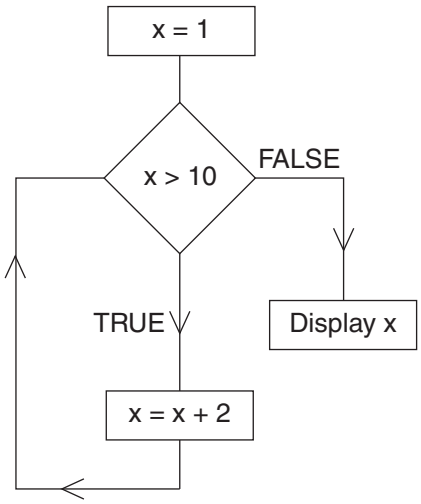
(D) String

11 Consider the following fragment of pseudocode.

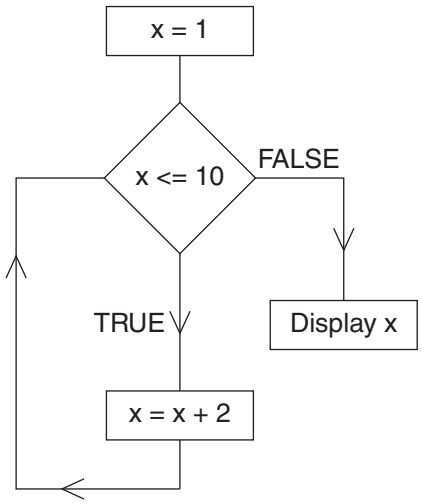
```
x = 1
REPEAT
    x = x + 2
UNTIL x > 10
Display x
```

Which of the following flowcharts best matches the fragment of pseudocode?

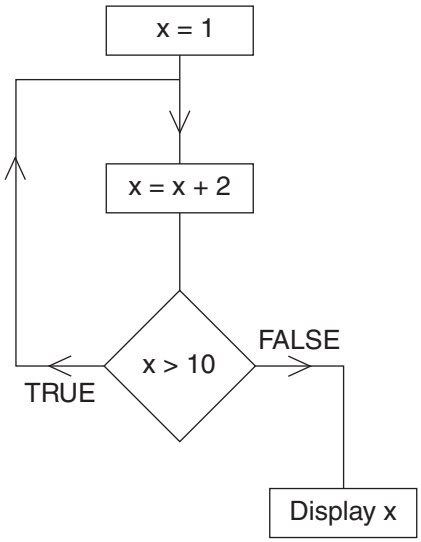
(A)



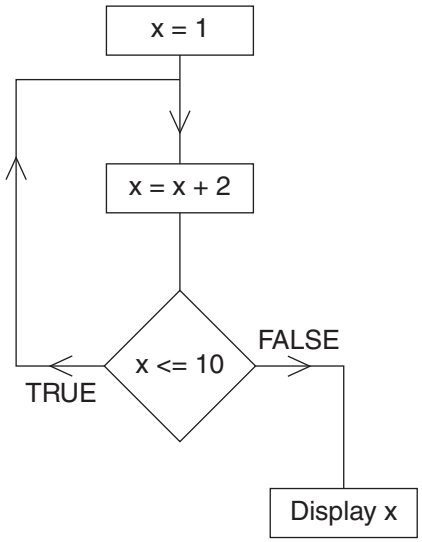
(B)



(C)



(D)



12 Consider the following algorithm which was designed to assign membership categories based on years of membership.

```
BEGIN
    get years
    CASEWHERE years is
        less than 5                  : category = "copper"
        less than or equal to 24     : category = "silver"
        greater than or equal to 30  : category = "platinum"
        otherwise                    : category = "gold"
    ENDCASE
    display category
END
```

The logic of the algorithm was tested with the following test data:

3, 24, 30, 40

If two more items are to be added to the test data, which of the following pairs would be most beneficial to the overall testing?

(A) 5, 20

(B) 5, 27

(C) 20, 35

(D) 27, 35

13 An array originally contains the following six numbers to be sorted in ascending order.

4	0	3	8	7	2

Which row of the table shows the contents of the array after one pass of the specified sort method?

	Sort method	*Array after one pass*					
(A)	Bubble	0	4	3	8	2	7
(B)	Bubble	0	3	4	2	7	8
(C)	Selection	4	0	3	2	7	8
(D)	Selection	4	0	3	7	2	8

14 Which row of the table correctly identifies a feature of a compiler and that of an interpreter?

	Compiler	*Interpreter*
(A)	Produces object code	Instructions are executed as soon as they are translated
(B)	Translates each line of source code into one machine code instruction	Interpreters produce code that executes faster than compiled code
(C)	Translates each line of source code into one machine code instruction	Instructions are executed as soon as they are translated
(D)	Produces object code	Interpreters produce code that executes faster than compiled code

Use the following information to answer Questions 15 and 16.

Consider the following code which operates on an array of integers called List, indexed from 1.

```
1   BEGIN Program
2       W = List(1)
3       X = 1
4       Y = List(1)
5       Z = 1
6       i = 2
7       REPEAT
8           IF List(i) > W THEN
9               W = List(i)
10              X = i
11          END IF
12          IF List(i) < Y THEN
13              Y = List(i)
14              Z = i
15          END IF
16          i = i + 1
17      UNTIL i > Number of elements in List
18      SwapElements (X, Z)        REM this swaps the values of the elements at X and Z
19  END Program
```

15 The array List originally contained

4	1	6	5	2	3

.

Which row of the table correctly shows the values of X and Z after the code has been executed?

	X	Z
(A)	1	6
(B)	2	3
(C)	3	2
(D)	6	1

16 Which of the following is the correct pseudocode for the SwapElements subprogram?

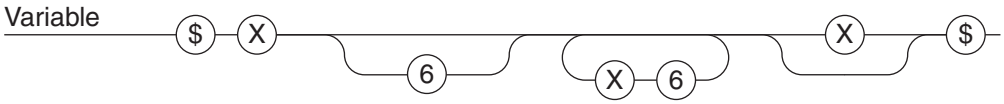
(A)
```
BEGIN SwapElements(a,b)
        temp = a
        a = b
        b = temp
END SwapElements
```

(B)
```
BEGIN SwapElements(a,b)
    temp = List(a)
    List(a) = List(b)
    List(b) = temp
END SwapElements
```

(C)
```
BEGIN SwapElements(a,b)
    a = b
    b = a
END SwapElements
```

(D)
```
BEGIN SwapElements(a,b)
    List(a) = List(b)
    List(b) = List(a)
END SwapElements
```

17 The following railroad diagram defines the syntax for a variable in a particular programming language.



Which of the following has the correct syntax?

(A) XXX

(B) $X6X6$

(C) $X666X$

(D) $X6X6X$

18 Some of the elements in the array Num need to be shifted to a different position so that 36 can be inserted in the position shown.

Num

Index	1	2	3	4	5	6
Value	12	23	54	65	88	

↑
36

Which of the following code fragments should be used to shift the elements?

(A)
```
FOR x = 6 TO 4 STEP –1
    Num(x) = Num(x–1)
NEXT
```

(B)
```
FOR x = 5 TO 3 STEP –1
    Num(x) = Num(x–1)
NEXT
```

(C)
```
FOR x = 4 TO 6
    Num(x) = Num(x+1)
NEXT
```

(D)
```
FOR x = 3 TO 5
    Num(x) = Num(x+1)
NEXT
```

Use the following information to answer Questions 19 and 20.

A CPU with a single accumulator is able to carry out these instructions.

Instruction	*Meaning*
LDA R	Load the contents of register R into the accumulator
LDR R, X	Load the contents of memory location X into register R
STA R	Store the contents of the accumulator into register R
STR R, X	Store the contents of register R into memory location X
ADD R	Add the contents of register R to the contents of the accumulator

Consider the following fragment of code.

```
LDR R, F
LDA R
LDR R, G
ADD R
STA R
STR R, H
```

19 Prior to executing the fragment of code, the contents of the memory locations are as follows.

Memory location	*Contents*
F	10
G	15
H	20

What are the contents of the memory locations after execution?

(A)

Memory location	*Contents*
F	10
G	15
H	45

(B)

Memory location	*Contents*
F	10
G	15
H	25

(C)

Memory location	*Contents*
F	0
G	0
H	25

(D)

Memory location	*Contents*
F	0
G	0
H	45

20 What is the role of the register in the execution of this code?

(A) To add numbers together and store the result in the accumulator

(B) To add numbers together and store the results in memory locations

(C) To store numbers, before and after being processed in the accumulator

(D) To store numbers, before and after being processed in memory locations

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Software Design and Development

Centre Number

Student Number

Section II

60 marks
Attempt Questions 21–33
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.

Extra writing space is provided on page 28. If you use this space, clearly indicate which question you are answering.

Write your Centre Number and Student Number at the top of this page.

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Question 21 (2 marks)

Identify ONE advantage and ONE disadvantage of developing software on a networked computer. **2**

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Question 22 (3 marks)

Explain TWO factors that can influence response time in a computer system. **3**

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Question 23 (4 marks)

A school wants to use an online survey to find out the best ways to use a multi-purpose play area. The following information needs to be captured from each student completing the survey: **4**

- the gender of the student
- year group
- three preferred uses out of the five possible uses already identified
- general comments.

Design an effective user interface for the online survey, justifying your choice of the screen elements used.

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Question 24 (5 marks)

(a) The following algorithm fragment is designed to ensure that three DIFFERENT values are input. **3**

```
1   input A
2   REPEAT
3       input B
4   UNTIL A = B
5   REPEAT
6       input C
7   UNTIL A = C OR A = B
```

There are errors in the algorithm. Identify these errors and show how they can be corrected.

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(b) For any three numbers, the following algorithm fragment has been designed to display the second largest number. For example: **2**

Input	*Output*
31, 3, 51	31
6, 101, 13	13

Complete lines 3, 6 and 8 to display the appropriate values when A > B.

```
1   IF A > B THEN
2       IF B > C THEN
3           display .....
4       ELSE
5           IF C > A THEN
6               display .....
7           ELSE
8               display .....
9           ENDIF
10      ENDIF
11  ENDIF
```

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Question 25 (7 marks)

(a) Outline how log books can be useful in project management. **2**

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(b) Outline ONE project management technique other than the use of log books. **2**

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(c) Explain why it is important for a project manager to have good communication skills. **3**

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Question 26 (6 marks)

The following algorithm calculates the total cost (TC) of a number of theatre tickets (N), allowing for discounts (D) for certain types of customers (C).

```
1   BEGIN program
2   input N
3   input C
4   if C = "Member" then
5   D=0.25
6   TC = N * 30 *(1-D)
7   display TC
8   else
9   if C = "Student" then
10  D=0.10
11  TC = N * 30 *(1-D)
12  display TC
13  else
14  TC = N * 30
15  display TC
16  end if
17  end if
18  END program
```

(a) Identify the variables used in the algorithm and suggest a suitable data type for each of the variables. **3**

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Question 26 continues on page 19

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Question 26 (continued)

(b) How can the algorithm be improved so that it is easier to maintain? **3**

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End of Question 26

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Question 27 (4 marks)

While a program is running, it does not respond to input, and does not produce any output. **4**

Describe how debugging techniques can be used to find the cause of this problem.

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Question 28 (3 marks)

Data about students in a class have been stored in a number of arrays, as shown. **3**

Name array

Index	1	2	3	4	5
Value	Min	Ling	Fatma	John	Bill

Height array

Index	1	2	3	4	5
Value	1.5	1.6	1.76	1.98	1.57

Gender array

Index	1	2	3	4	5
Value	M	F	F	M	M

Birth year array

Index	1	2	3	4	5
Value	1998	1998	1999	1998	1997

Show how these data can be stored in ONE data structure and how that data structure can be used to store all data related to John.

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Question 29 (10 marks)

A system is to be developed to record different types of Australian crops, eg wheat and rice. It will consist of a website with an online database. The data will be entered by industry experts. The website must also allow the general public to search and view the data.

(a) The project team is unsure about the 'look and feel' of the website and wants to have regular meetings with the developers to refine the concept throughout the development. **3**

Recommend a suitable development approach for the system and justify your choice.

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Question 29 continues on page 23

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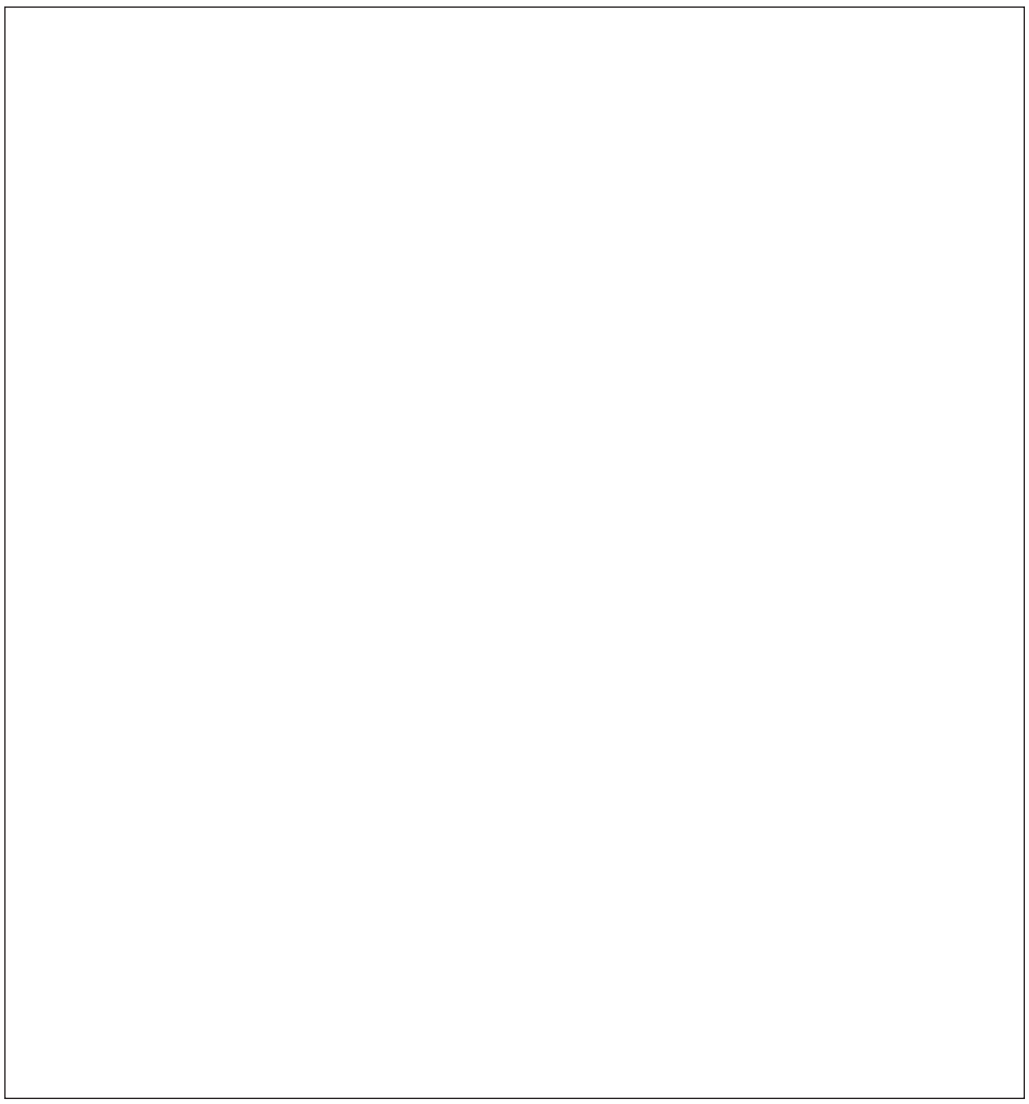
Question 29 (continued)

(b) Draw a data flow diagram to represent this system. **4**



(c) Explain social issues that should be considered when designing the website for the wide range of users. **3**

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End of Question 29

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Question 30 (3 marks)

As part of a software package, there needs to be a facility for searching for specific data in an array. The data in that array may get updated. **3**

You have to make two decisions:

- should the array be sorted?
- which search method should be used?

What factors would you need to consider when making these decisions? Justify your answer.

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Question 31 (4 marks)

A program for a puzzle is to be developed. The puzzle uses a 4-by-4 grid. A two-dimensional array, cell(row, column), is used to store the number in each square of the grid. For example, cell(2,4) = 3 in the grid provided. **4**

1	2	4	2
4	2	1	3
2	4	4	1
1	1	2	4

For the puzzle to be completed correctly, the numbers in each row must add up to 10.

The following code calculates the total of the numbers in the first row.

```
rowtotal = 0
FOR column = 1 TO 4
    rowtotal = rowtotal + cell(1,column)
NEXT column
```

Write an algorithm that checks whether a puzzle has been completed correctly and then displays an appropriate message.

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Question 32 (4 marks)

The following examples are all syntactically correct binary selections in a particular programming language. **4**

```
IF condition THEN
ENDIF

IF condition AND condition THEN
    statement
    statement
ELSE
    statement
ENDIF

IF condition AND condition OR condition AND condition THEN
ELSE
    statement
    statement
    statement
ENDIF

IF condition OR condition THEN
    statement
ELSE
ENDIF
```

The symbols used by the EBNF metalanguage include:

Symbol	*Meaning*
< >	To be defined
{ }	Zero or more repetitions
[ ]	Optional
|	Separates alternatives
( )	Groups elements together
=	Is defined as

Produce an EBNF definition for the binary selection in this language. (There is no need for you to define condition or statement.)

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Question 33 (5 marks)

A sequential file called FoodData stores the names of students and their favourite food. **5**

The following shows some of the contents of the file.

Ahmad, salmon
Betty, tuna
Charlie, whiting

Write an algorithm to display the favourite food of each student in the format shown below.

Ahmad likes salmon
Betty likes tuna
Charlie likes whiting

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Section II extra writing space

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Software Design and Development

Centre Number

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Section III

20 marks
Attempt either Question 34 or Question 35
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 34 — Programming Paradigms (20 marks)

(a) What is an expert system? **2**

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Question 34 continues on page 30

Question 34 (continued)

(b) A pharmaceutical company is planning to develop a piece of software that can: **4**

- provide medical professionals with recommendations about its products, based on data entered by the medical professionals about their patients
- manage the inventory of its products including available stock and current orders.

Explain why a combination of object oriented and logic paradigms would be suitable for this development.

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Question 34 continues on page 31

Question 34 (continued)

(c) Alice, a student, is developing a program to keep track of her subjects and classes.

The following is a fragment of her code, written using the logic paradigm, as well as an explanation of some of the syntax.

```
subject(Music)
subject(Drama)
teacher(Mr Seale, Drama)
teacher(Mr Seale, Dance)
teacher(Ms Hassib, Art)
in_class(Eunji, Drama)
in_class(Sharon, Dance)
taught(X, Y):- teacher(X, Z), in_class(Y, Z)
```

subject(Music) and subject(Drama) mean that Alice studies Music as one of her subjects

teacher(Mr Seale, Drama) means that Mr Seale is Alice's teacher for Drama

in_class(Eunji, Drama) means that Eunji is in Alice's Drama class

(i) Extend the fragment above to include code for the following logic: **3**

- Maha is in Mrs Baker's Music class with Alice.
- classmate(X, Y) determines whether X and Y are both in the same class with Alice.

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(ii) Using the facts and rules supplied, describe how taught(Mr Seale, Sharon) would be evaluated. In your answer, specify whether backward or forward chaining is used. **3**

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Question 34 continues on page 33

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2016 HIGHER SCHOOL CERTIFICATE EXAMINATION

Software Design and Development

Centre Number

Student Number

Section III (continued)

Question 34 (continued)

Please turn over

Question 34 (continued)

(d) The following fragment of code was developed using the object oriented paradigm (OOP).

```
class Plant {
        private –
                id: integer
        public –
                Plant( )
                Name: string
                Description: string
                getID()
                        RETURN id
                END getID
}

class Fruit {
        is a Plant

        public –
                Fruit( )
                Colour: string
                NumberOfSeeds: integer
                IsSweet: boolean
}

class Vegetable {
        is a Plant

        public –
                Vegetable( )
                Colour: string
                GrowsAboveGround: boolean
}
```

Question 34 continues on page 35

Question 34 (continued)

(i) How could the classes be changed to eliminate duplication of attributes? **2**

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(ii) Write an example of instantiation of the **Vegetable** class and assign appropriate values to all its attributes. **4**

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(iii) Write a method that takes a parameter and assigns its value to the id attribute during instantiation. **2**

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End of Question 34

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2016 HIGHER SCHOOL CERTIFICATE EXAMINATION

Software Design and Development

Centre Number

Section III (continued)

Student Number

Do NOT attempt Question 35 if you have already attempted Question 34.

Question 35 — The Interrelationship between Software and Hardware
(20 marks)

(a) ASCII and Unicode are both binary representations of characters. **2**

In what ways are ASCII and Unicode different?

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(b) Perform the binary division 1011101 ÷ 110, showing relevant working. **3**

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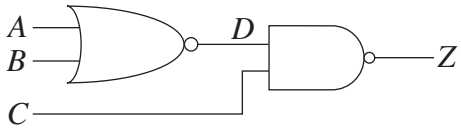
Question 35 continues on page 38

Question 35 (continued)

(c) (i) For the following circuit, show that the output Z is always 1 whenever input A is 1, regardless of the other inputs. **3**



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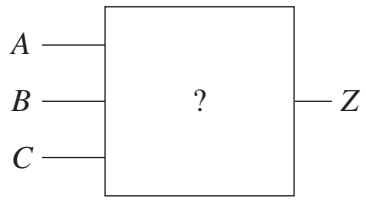
Question 35 continues on page 39

Question 35 (continued)

(ii) Consider the following logic circuit. **3**



The relationships between the outputs and inputs of the circuit are shown in the table below.

Input conditions	*Output*
A is 1	*Z* is 1
A is 0 and *C* is 1	*Z* is 1
A is 1 and *B* is 0	*Z* is 1
A and *C* are both 1	*Z* is 1
Otherwise	*Z* is 0

Design a circuit that satisfies these conditions, using no more than two logic gates.

Question 35 continues on page 41

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2016 HIGHER SCHOOL CERTIFICATE EXAMINATION

Software Design and Development

Centre Number

Student Number

Section III (continued)

Question 35 (continued)

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Question 35 (continued)

(d) Data are sent to one of several visual display units using the following data stream structure.

- Header
- The data block, consisting of ASCII codes indicating characters to be displayed and control characters that control the typeface, style and flash rate
- Trailer

1B is the hexadecimal representation of a control character. It is used to indicate the start of an 'escape' sequence that controls the appearance of the text.

1B 54 *nn* = Escape T *nn*
This changes the typeface to *nn*, which may be

nn	Typeface
01	Helvetica
02	Courier
03	Times

1B 53 *nn* = Escape S *nn*
This changes the style to nn, which may be

nn	Style
00	normal
01	underlined
02	*italic*
04	**boldface**
08	Outlined

Combinations of these styles are made by addition, for example 03 is underlined and italic.

1B 46 *vv nn* = Escape F *vv nn*
This changes the flash rate.
vv is the number of milliseconds the text is visible and
nn is the number of milliseconds the text is not visible during each flash cycle.

Question 35 continues on page 43

Question 35 (continued)

Part of the ASCII code table is shown below:

ASCII (in Hex)	41	42	43	44	45	46	47	48
Character	A	B	C	D	E	F	G	H
ASCII (in Hex)	49	4A	4B	4C	4D	4E	4F	50
Character	I	J	K	L	M	N	O	P
ASCII (in Hex)	51	52	53	54	55	56	57	58
Character	Q	R	S	T	U	V	W	X

(i) Describe the contents of the header and the trailer for a data stream for one of the visual display units. **3**

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(ii) Describe the text displayed as a result of the following data block: **3**

1B 54 02 1B 53 06 43 1B 46 50 50 41 1B 46 60 00 54

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(iii) Explain the effect of omitting the '1B' from the escape sequence 1B 46 50 50 in the data block in part (ii). **3**

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