HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY
HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION

Candidate Number ☐ ☐ ☐ ☐ ☐ ☐ ☐

INFORMATION AND COMMUNICATION TECHNOLOGY
PAPER 2D
Software Development
(Sample Paper)

Question-Answer Book

	Marker's Use Only	**Examiner's Use Only**
	Marker No.	Examiner No.
Question No.	Marks	Marks
1		
2		
3		
4		
Total		

Time allowed: 1 hour 30 minutes
This paper must be answered in English.

INSTRUCTIONS

(1) Write your Candidate Number in the space provided on Page 1.

(2) Stick barcode labels in the spaces provided on Pages 1, 3 and 5.

(3) Answer **ALL** questions.

(4) Write your answers to Section B in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.

(5) Supplementary answer sheets will be provided on request. Write your candidate number, fill in the question number and stick a barcode label on each sheet. Tie them loosely but securely with a string INSIDE this Question-Answer Book.

Answer all questions.   Write your answers in this question-answer book.

(Modified from 2005 CECIT 2A Q.1)
1.   Consider the following procedure `func1`:

```
Line        Statement
1           for counter i from 1 to 5
2           {
3             if (A[i] > A[0]) then
4             {
5                Fvalue ← A[0]
6                A[0] ← A[i]
7                A[i] ← Fvalue
8             }
9           }
```

After a program initialises the contents of array `A` below, it then executes `func1`.

A[0]	A[1]	A[2]	A[3]	A[4]	A[5]
4	2	12	7	19	2

(a) (i) Fill in the contents of the array `A` after completing the `if` statement on lines 3 to 8 when `i=1`.

A[0]	A[1]	A[2]	A[3]	A[4]	A[5]

(ii) Fill in the contents of the array `A` after completing the `if` statement on lines 3 to 8 when `i=2`.

A[0]	A[1]	A[2]	A[3]	A[4]	A[5]

(iii) Fill in the contents of the array `A` when `func1` completes.

A[0]	A[1]	A[2]	A[3]	A[4]	A[5]

(6 marks)

Provided by dse.life

(b) What is the purpose of the three assignment statements on lines 5, 6 and 7?

_____

_____

(2 marks)

(c) How many times has line 5 been executed?

_____

_____

(2 marks)

(d) (i) What is the purpose of `func1`?

_____

_____

(ii) Give an application of `func1`.

_____

_____

(3 marks)

(e) If line 1 is replaced by "`for counter i from 5 down to 1`", can `func1` achieve its purpose in (d)(i)? Explain briefly.

_____

_____

_____

_____

(2 marks)

2.   The library card number of a school consists of a leading capital letter, followed by 5 digits and a check character. In validation, the capital letters, A, B, ..., Z, represent the values, 1, 2, ..., 26, respectively. The value for the letter and each digit are multiplied by their corresponding position numbers as follows:

Card number (example):	Y	9	1	7	1	8	1
Position number:	6	5	4	3	2	1	
Multiplication values:	25×6	9×5	1×4	7×3	1×2	8×1	

check character

WS is defined as the sum of the multiplication values while RE is defined as the remainder of (WS ÷ 11). The check character is defined as:

$$\begin{cases} 0 & \text{if RE = 0} \\ A & \text{if RE = 1} \\ \text{the digit of (11-RE)} & \text{if RE} \geq 2 \end{cases}$$

In the example above,
    WS = 25×6 + 9×5 + 1×4 + 7×3 + 1×2 + 8×1 = 230
    RE = the remainder of (WS ÷ 11) = 10
Hence, the check character is 1.

(a) Find WS, RE, and the check character for the library card number, B88145.

WS = _____   RE = _____   check character = _____

(3 marks)

The computation of the check character of the library card number is done by a computer program.

(b) Given that the capital letter is stored in a character variable, ch, write a program statement to calculate the multiplication value for ch and store it in an integer variable, N.
     (For example, if ch is 'Y', N should be 25×6 = 150.)

(2 marks)

(c) Suppose that WS has been calculated and stored in an integer variable, sum. Write a program segment to find the check character and store it in a character variable, mycheck. You are not allowed to use variables other than the following.

Variables	Description
sum	an integer variable that has stored WS
r	an integer variable
mycheck	a character variable to store the check character

(4 marks)

The library card numbers are stored in a linked list in ascending order. The following example shows four card numbers in the linked list.

head ⟶ A78228 ⟶ B99145 ⟶ G84176 ⟶ W91718 ⟶ (a null pointer)

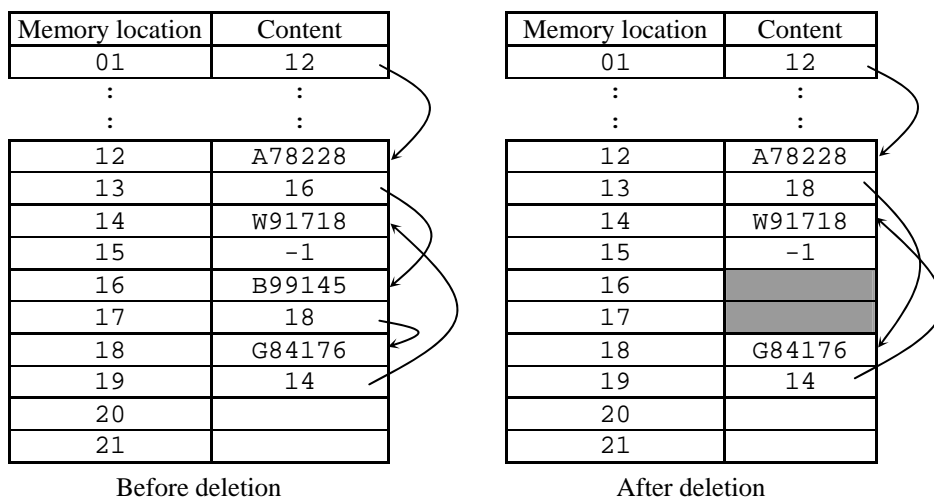(d) (i) What kind of search method should be used to search for a library card number in the linked list?

(ii) Other than the search method in (d)(i), are there other common search methods applicable to this linked list? Explain briefly.

(iii) When elements are deleted, how should the memory locations of the deleted elements be handled properly?

(4 marks)

Suppose that each element of the linked list is physically stored in a pair of memory locations. The content of head pointer is the address of the first element stored in memory location 01. The content of the pointer of the last element is −1, indicating a null pointer. When the element with B99145 is deleted, the relevant pointers are updated as shown below.

Memory location	Content
01	12
:	:
:	:
12	A78228
13	16
14	W91718
15	−1
16	B99145
17	18
18	G84176
19	14
20	
21	

Before deletion

Memory location	Content
01	12
:	:
:	:
12	A78228
13	18
14	W91718
15	−1
16	
17	
18	G84176
19	14
20	
21	

After deletion

(e)   After the deletion, two library card numbers, X12011 and C34567, are inserted in the linked list and stored in memory locations 20, 21 and 22, 23 respectively. After each insertion, the elements of the list should be in ascending order. Write down the contents of the memory locations after each insertion.

Memory location	Content
01	12
:	:
:	:
12	A78228
13	
14	W91718
15	
16	
17	
18	G84176
19	
20	X12011
21	
22	
23	

After inserting X12011

Memory location	Content
01	12
:	:
:	:
12	A78228
13	
14	W91718
15	
16	
17	
18	G84176
19	
20	X12011
21	
22	C34567
23	

After inserting X12011 and C34567

(5 marks)

Provided by dse.life

(Modified from 2007 ALCS2 Q.3)

3. mySwap(x, y) is used to swap two elements of an accessible array, A , with indices x and y.

    (a)   Complete mySwap below.

[Pascal version]
```
procedure mySwap( x, y : integer);
var
  temp : integer;
begin
  ┌─────────────────────────┐ ;
  └─────────────────────────┘
  ┌─────────────────────────┐ ;
  └─────────────────────────┘
  A[x]:= temp
end;
```

[C version]
```
void mySwap(int x, int y) {
  int temp;
  ┌─────────────────────────┐ ;
  └─────────────────────────┘
  ┌─────────────────────────┐ ;
  └─────────────────────────┘
  A[x] = temp;
}
```

[Visual Basic version]
```
Sub mySwap(ByVal x, ByVal y as Integer)
  Dim temp as Integer
  ┌─────────────────────────┐
  └─────────────────────────┘
  ┌─────────────────────────┐
  └─────────────────────────┘
  A(x) = temp
End Sub
```

[Java version]
```
static void mySwap(int x, int y) {
  int temp;
  ┌─────────────────────────┐ ;
  └─────────────────────────┘
  ┌─────────────────────────┐ ;
  └─────────────────────────┘
  A[x] = temp;
}
```

(2 marks)

myRev(x, y) is used to reverse the order of the elements of A with indices from x to y without using additional arrays. The following example shows the effect of myRev (3,6) on A.

Before

Indices:	2	3	4	5	6	7
Content of A:	6	7	9	5	11	65

After

Indices:	2	3	4	5	6	7
Content of A:	6	11	5	9	7	65

Provided by dse.life

(b)   Given `x <= y`, complete `myRev` below.

[Pascal version]
```
procedure myRev (x, y : integer);
begin
  while ( ⬚                      ) do
  begin
    mySwap( x, y);
    ⬚                      ;
    ⬚
  end
end;
```

[C version]
```
void myRev(int x, int y) {
  while ( ⬚                    ) {
    mySwap(x, y);
    ⬚                    ;
    ⬚                    ;
  }
}
```

[Visual Basic version]
```
Sub myRev(ByVal x, ByVal y As Integer)
  Do While ( ⬚                    )
    Call mySwap(x, y)
    ⬚
    ⬚
  Loop
End Sub
```

[Java version]
```
static void myRev(int x, int y) {
  while ( ⬚                    ) {
    mySwap(x, y);
    ⬚                    ;
    ⬚                    ;
  }
}
```

(3 marks)

SegSwap(x, y, z) is used to 'swap' two segments of A. It moves the elements with indices from x to y after the elements with indices from (y+1) to z. The following example shows the effect of SegSwap(3,7,9) on A.

Before

Indices:	2	3	4	5	6	7	8	9	10
Content of A:	6	7	9	5	11	65	15	19	27

After

Indices:	2	3	4	5	6	7	8	9	10
Content of A:	6	15	19	7	9	5	11	65	27

(c)   Given x <= y <= z, complete SegSwap below.

[Pascal version]
```
procedure SegSwap(x, y, z : integer);
begin
  myRev(x, y);
  [                    ] ;
  [                    ]
end;
```

[C version]
```
void SegSwap(int x, int y, int z) {
  myRev(x, y);
  [                    ] ;
  [                    ] ;
}
```

[Visual Basic version]
```
Sub SegSwap(ByVal x, ByVal y, ByVal z As Integer)
  Call myRev(x, y)
  [                    ]
  [                    ]
End Sub
```

[Java version]
```
static void SegSwap(int x, int y, int z) {
   myRev(x, y);
   [                    ] ;
   [                    ] ;
}
```

(2 marks)

(d) An experimental language supports only assignment statement (=), subprogram, output statement (print), and simple arithmetic expression. Consider the following subprograms, foo and main, with integer variables m, n, x and y:

```
m, n : integer;

subprogram foo(x : integer, y : integer)
{
   x = x + 1;
   y = m + 2 + y;
}

subprogram main
{
   m = 3;
   n = 4;
   foo(m, n);
   print(m);
   print(n);
}
```

(i) What is the output of main if the *call by value* parameters passing method is used in foo?

(ii) What is the output of main if the *call by reference* parameters passing method is used in foo?

(4 marks)

(Modified from 2007 ALCS2 Q.1, 2006 ALCS2 Q.3, 2006 ALCS2 Q.10, 2007 ALCS2 Q.8)

4.   A company applies a traditional software development model with five processes:

• Implementation
• Documentation
• Design
• Maintenance
• Analysis

One of them is an on-going process which is integrated into various phases of this model.

(a) (i) Which one is the on-going process?

(ii) Fill in the other four processes in the appropriate boxes of the following diagram to show the progress of the software development.
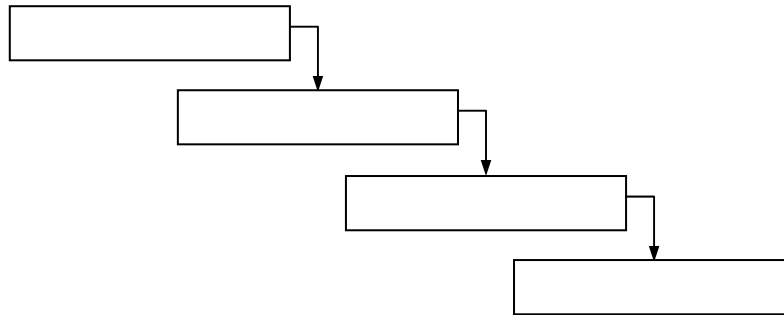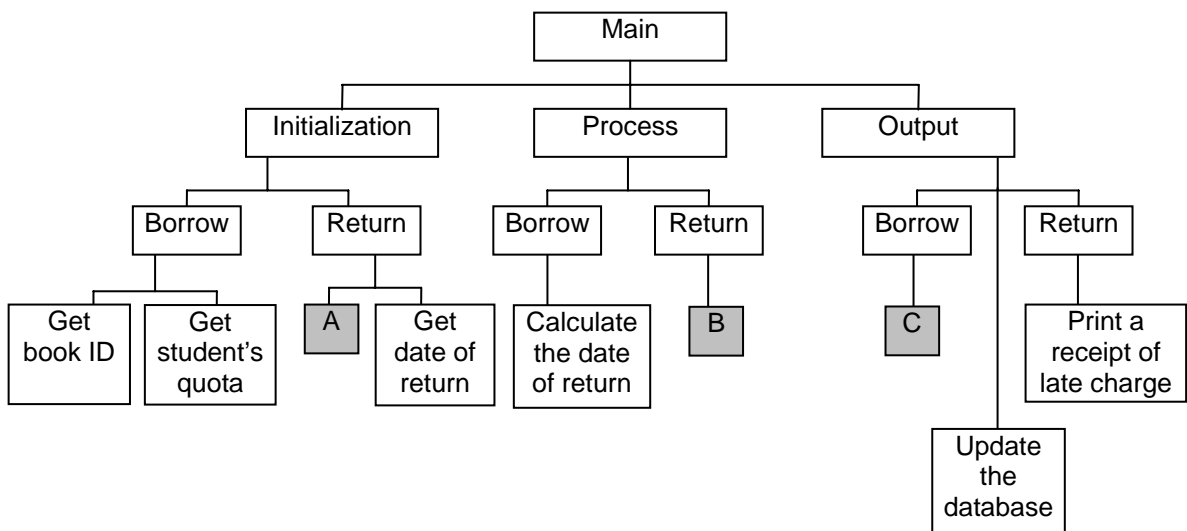

(3 marks)

(b) Give a drawback of the model and suggest a modification to it. (Candidates may modify the diagram for illustration.)

_____

_____

_____

(2 marks)

The company is going to develop a system for borrowing and returning books in a library. The draft of the structure chart of the system is given below.

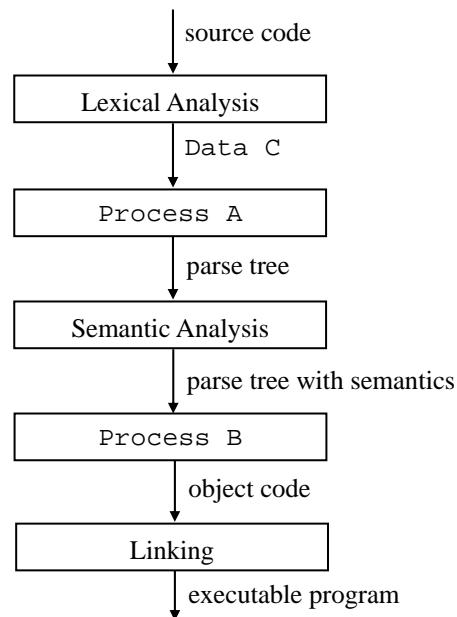(c) What should be the contents of Boxes A, B and C?

A: _____

B: _____

C: _____

(3 marks)

(d) The salaries of IT professionals in India are much lower than in Hong Kong. The company decides to move the development work to India and downsize its organization in Hong Kong. Give **two** kinds of jobs relating to systems development which should remain in Hong Kong. Justify your answer.

_____

_____

_____

(3 marks)

In system development, after selecting a programming language, coding starts. During the implementation phase, some programs are compiled and the following diagram shows the compilation processes.

source code
↓

```
Lexical Analysis
```

Data C
↓

```
Process A
```

parse tree
↓

```
Semantic Analysis
```

parse tree with semantics
↓

```
Process B
```

object code
↓

```
Linking
```

executable program
↓

(e) What are `Process A`, `Process B` and `Data C`?

A: _____

B: _____

C: _____

(3 marks)

(f) The development is completed.

(i) State a service that the company should provide for librarians.

_____

(ii) State a service that the company or the library should provide in order to maintain the system afterwards.

_____

(2 marks)

END OF PAPER