PP-DSE
ICT
PAPER 2D

Candidate Number							

Programming Language Used (Please tick one)	Pascal	☐
	C	☐
	Visual Basic	☐
	Java	☐

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION

PRACTICE PAPER
INFORMATION AND COMMUNICATION TECHNOLOGY
PAPER 2 D
Software Development
Question-Answer Book

(1 hour 30 minutes)
This paper must be answered in English

INSTRUCTIONS

(1)   After the announcement of the start of the examination, you should first write your Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided on Pages 1, 3, 5 and 7.

(2)   Tick the appropriate box for the programming language used. **No marks will be awarded if you tick either more than one box or no boxes.**

(3)   **ANSWER ALL QUESTIONS.**   Write your answers in the spaces provided in this Question-Answer book. Do not write in the margins.   Answers written in the margins will not be marked.

(4)   Supplementary answer sheets will be supplied on request.   Write your candidate number, mark the question number box and stick a barcode label on each sheet, and fasten them with string **INSIDE** this book.

(5)   No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.

Answer all questions.

1.   The following algorithm processes an integer array, M, with indices from 1 to n.

          Step 1: Initialise each element of M with a value equal to its index.
          Step 2: p ← 2
          Step 3: While $p^2 \leq n$ do Steps 4 to 7
          Step 4:   q ← integer part of (n/p)
          Step 5:   For i from 2 to q do Step 6
          Step 6:   M[i * p] ← 0
          Step 7:   p ← p + 1

Suppose n = 16. The content of M after the initialisation in Step 1 is shown below.

M[1]	M[2]	M[3]	M[4]	M[5]	M[6]	M[7]	M[8]
1	2	3	4	5	6	7	8
M[9]	M[10]	M[11]	M[12]	M[13]	M[14]	M[15]	M[16]
9	10	11	12	13	14	15	16

(a) (i) By using a loop, write the pseudo-code for Step 1.

(ii) Fill in the content of M after each of the first two passes of the loop in Step 3.

First pass

M[1]	M[2]	M[3]	M[4]	M[5]	M[6]	M[7]	M[8]
M[9]	M[10]	M[11]	M[12]	M[13]	M[14]	M[15]	M[16]

Second pass

M[1]	M[2]	M[3]	M[4]	M[5]	M[6]	M[7]	M[8]
M[9]	M[10]	M[11]	M[12]	M[13]	M[14]	M[15]	M[16]

(iii) How many times will the loop in Step 3 be executed? _____

(iv) List all the values of q in sequence when the loop in Step 3 is executed.

(v) Study the pattern of values of M in (a)(ii). What is the purpose of the algorithm?

(10 marks)

Provided by dse.life

(b) Suppose Step 5 is changed to:

For i from p to q do Step 6

What is the influence of this change on the algorithm? Explain your answer briefly.

_____

_____

_____

(2 marks)

(c) The algorithm is implemented and compiled into a subroutine in a library. A main program is written using the subroutine.

(i) What kind of program, code generator, debugger, linker or loader, puts the executable file of the main program into the main memory for execution?

_____

(ii) This subroutine will be linked to the executable file of the main program when the main program is running. Name this kind of linking method and give one advantage of it.

_____

_____

_____

(3 marks)

Provided by dse.life

2. John writes a program to assist air traffic controllers at an airport to keep track of landing flights. The order of landing is handled on a first-come, first-served basis. Each flight is identified with a flight number, e.g. **A1**. John uses an array, F, to store a maximum of six flight numbers.

(a) F[i] stores the flight number of the flight that will land in the i-th position. i.e. F[1] stores the flight number of the flight that will land next.

Suppose that initially three flights **C3**, **A1** and **B2** will be landing, as shown below:

	F[1]	F[2]	F[3]	F[4]	F[5]	F[6]
Flight number	**C3**	**A1**	**B2**			

(i) (1) Flight **C3** has landed and flight **Z6** joins the queue for landing. Complete F below.

	F[1]	F[2]	F[3]	F[4]	F[5]	F[6]
Flight number	**A1**					

(2) Then, flight **A1** has landed and two more flights, **S19** and **T20** subsequently, join the queue for landing. Complete F below.

	F[1]	F[2]	F[3]	F[4]	F[5]	F[6]
Flight number						

(ii) Although the manipulation of F above is straightforward, it is not a good algorithm. Why not? Explain your answer briefly.

(3 marks)

Provided by dse.life

(b) Instead, John uses the following data structure to manipulate the order of landing. Two integer variables, X and Y, are used to hold two array indices of F.

	F[1]	F[2]	F[3]	F[4]	F[5]	F[6]
Flight number	**C3**	**A1**	**B2**			

X = 1   Y = 3

- After a flight has landed, F[X] will **not** be re-used. Then, X is increased by 1.

- When a flight joins the queue for landing, Y is increased by 1 and its flight number is assigned to F[Y].

(i) What are the purposes of X and Y in the implementation of the data structure?

_____

_____

(ii) Suppose that, at the beginning flights **C3**, **A1** and **B2** are subsequently waiting for landing with X = 1 and Y = 3.

(1) Flight **C3** has landed and flight **Z6** joins the queue for landing. Complete F, X and Y below.

	F[1]	F[2]	F[3]	F[4]	F[5]	F[6]
Flight number	**C3**					

X = [ ]   Y = [ ]

(2) Then, flight **A1** has landed and two more flights, **S19** and **T20**, subsequently join the queue for landing. Complete F, X and Y below.

	F[1]	F[2]	F[3]	F[4]	F[5]	F[6]
Flight number	**C3**					

X = [ ]   Y = [ ]

(iii) To determine whether all waiting flights have landed, what condition should be checked?

_____

(iv) What kind of error would occur if another flight **E5** joined the queue for landing after **T20** in (b)(ii)(2)?

_____

(8 marks)

(c) John wants to develop some new systems to replace the current systems in the airport. **Tasks 1**, **2** and **3** should start after having collected user requirements (**Task 0**).

Task	Weeks to complete	Description
Task 0	5	Collect user requirements.
Task 1	20	Write, test and debug **ATC** System for air traffic controllers to use.
Task 2	15	Install display panels for **FID** System as soon as the programmer starts working on **ATC** System.
Task 3	10	Write, test and debug programs for **FID** System, after **ATC** System is completed and the display panels are installed.

(i) Complete the Gantt chart for John below.

Task \ No. of weeks	5	10	15	20	25	30	35	40	45	50
Task 0	■									
Task 1										
Task 2										
Task 3										

(ii) Which strategy of systems conversion should John use? Explain your answer briefly.

_____

_____

_____

(4 marks)

Provided by dse.life

You are not allowed to add any new variables when answering Question 3. If variables are added, no marks will be awarded.

3. A program is written to emulate the selection of a track in a CD player. When the player loads a CD, the total number of tracks will be read and the default track number is 1. Pressing the buttons on the player results in the following actions:

Backward	Forward
When this button is pressed, the previous track will be played.	When this button is pressed, the next track will be played.

You are going to write some subprograms with the following variables to emulate the selection of a track.

Variable	Description
TrackNum	An integer variable to store the current track number
TrackTotal	An integer variable to store the total number of tracks

(a) Suppose the initial track number is 1 and total number of tracks is 13. Write a subprogram or a class, LoadInit, to initialise TrackNum and TrackTotal, and return the two values using call by reference.

(3 marks)

Provided by dse.life

(b) Write a function, `BackTrack`, to return the track number after the 'Backward' button is pressed. If the current track number is 1, it remains unchanged. `TrackNum` should be passed to this function using call by value.

(3 marks)

(c) Write a function, `NextTrack`, to return the track number after the 'Forward' button is pressed. If the next track number exceeds the total number of tracks, the track number is set to 1. `TrackNum` and `TrackTotal` should be passed to this function using call by value.

(2 marks)

(d) A new button, 'Shuffle', is to be emulated. When it is pressed, a track number will be randomly selected from 1 to `TrackTotal`.

A given function, `myrand`, without arguments can be called to return a random number r, where $0 \le r < 1$.

Write a function, `shuffle`, to emulate the 'Shuffle' button. `TrackTotal` should be passed to `shuffle` using call by value.

(2 marks)

(e) There should be a test plan to test the function written in Part (b). Suppose the total number of tracks is 13. For each of two different scenarios, suggest a test value and state the expected results.
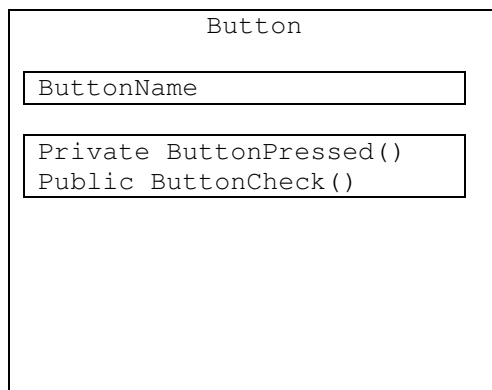
(1) Test value: _____

Expected result: _____

(2) Test value: _____

Expected result: _____

(2 marks)

(f) Suppose the program is written in an object-oriented programming language. The following *class* diagram represents button objects.

```
        Button

ButtonName

Private ButtonPressed()
Public ButtonCheck()



```

(i) How many methods are there in the class? _____

(ii) State the attribute of the class. _____

(iii) What is the class name? _____

(3 marks)

4. A gas company uses a text file, gas.txt, to store the accumulated meter readings of clients. Each record consists of two text fields for a client: accNum and accReading. accNum stores the account numbers of clients and accReading stores the corresponding accumulated meter readings. The following example of gas.txt, which consists of four records, is represented in the diagram below.

accNum						accReading			
1	2	3	4	5	0	1	5	2	7
2	9	6	9	7	4	0	3	4	4
6	7	8	9	0	0	9	9	9	8
9	0	1	3	3	2	0	0	2	6

accReading consists of a string of four characters and its numeric value ranges from 0000 to 9999. The consecutive value of 9999 in accReading is 0000.

A subprogram, usage, is written to evaluate the number of units of gas consumed. The gas meter reading of the current month, curReading, is passed to the subprogram. The number of units consumed is then calculated and assigned to a global variable, unitsConsumed.

[Pascal version]

Line	Content
1	`var unitsConsumed : integer;`
2	`procedure usage(clientNum : string; curReading : integer);`
3	`var infile : text;`
4	`    clientFound : Boolean;`
5	`    ClientST, accNum, accReading : string;`
6	`    accValue : integer;`
7	`begin`
8	`    assign(infile, 'gas.txt'); reset(infile);`
9	`    clientFound := false;`
10	`    while not clientFound do begin`
11	`        readln(infile, ClientST);`
12	`        accNum := copy(ClientST, 1, 6);`
13	`        accReading := copy(ClientST, 7, 4);`
14	`        if clientNum = accNum then begin`
15	`            ` Part (a)(v)
16	`            unitsConsumed := curReading - accValue;`
17	`            clientFound := true;`
18	`        end;`
19	`    end;`
20	
21	`    ` Part (c)
22	`end;`

[C version]

Line	Content
1	`int unitsConsumed;`
2	`void usage(char clientNum[], int curReading) {`
3	`    FILE *infile;`
4	`    int clientFound;`
5	`    char accNum[7], accReading[5];`
6	`    int accValue;`
7	
8	`    infile = fopen("gas.txt", "r");`
9	`    clientFound = 0;`
10	`    while (!clientFound)`
11	`    {`
12	`        fscanf(infile, "%6s%4s", accNum, accReading);`
13	`        if (strcmp(clientNum, accNum) == 0)`
14	`        {`
15	$\boxed{\text{Part (a)(v)}}$
16	`            unitsConsumed = curReading - accValue;`
17	`            clientFound = 1;`
18	`        }`
19	`    }`
20	
21	$\boxed{\text{Part (c)}}$
22	`}`

[Visual Basic version]

Line	Content
1	`Dim unitsConsumed As Integer`
2	`Sub usage(ByVal clientNum As String, ByVal curReading As Integer)`
3	`    Dim infile As IO.StreamReader`
4	`    Dim clientFound As Boolean`
5	`    Dim ClientST, accNum, accReading As String`
6	`    Dim accValue As Integer`
7	`    infile = IO.File.OpenText("gas.txt")`
8	
9	`    ClientST = infile.ReadLine()`
10	`    clientFound = False`
11	`    while Not clientFound`
12	`        accNum = ClientST.SubString(0, 6)`
13	`        accReading = ClientST.SubString(6, 4)`
14	`        If clientNum = accNum Then`
15	$\boxed{\text{Part (a)(v)}}$
16	`            unitsConsumed = curReading - accValue`
17	`            clientFound = True`
18	`        End If`
19	`        ClientST = infile.ReadLine()`
20	`    End While`
21	$\boxed{\text{Part (c)}}$
22	`End Sub`

11

Line	Content
1	`static int unitsConsumed;`
2	`static void usage(String clientNum, int curReading) throws IOException {`
3	`    boolean clientFound;`
4	`    String ClientST, accNum, accReading;`
5	`    int accValue;`
6	
7	`    BufferedReader infile = new BufferedReader(new`
8	`    FileReader("gas.txt"));`
9	`    ClientST = infile.readLine();`
10	`    clientFound = false;`
11	`    while (!clientFound) {`
12	`        accNum = ClientST.substring(0, 6);`
13	`        accReading = ClientST.substring(6, 10);`
14	`        if (clientNum.compareTo(accNum) == 0) {`
15	Part (a)(v)
16	`            unitsConsumed = curReading - accValue;`
17	`            clientFound = true;`
18	`        }`
19	`        ClientST = infile.readLine();`
20	`    }`
21	Part (c)
22	`}`

(a) (i) It is known that the last digit of `accNum` is a check digit. What is the purpose of this check digit?

_____

_____

(ii) In terms of scope, what kind of variable is declared from Line 3 to Line 6?

_____

_____

(iii) What is the purpose of `clientNum` in calculating the gas consumed?

_____

_____

(iv) What is the purpose of `clientFound` in calculating the gas consumed?

_____

_____

(v) In Line 15, what operation on `accReading` should be carried out?

_____

(5 marks)

(b) The gas meter reading of the client with the account number `678900` in the current month is `0012`.

    (i)   Suggest a problem that might be caused by the statement in Line 16.

    (ii) Insert an IF statement after Line 16 to solve this problem.

<div align="right">(3 marks)</div>

(c) Write a program statement in Line 21 to perform a proper file handling operation.

<div align="right">(1 mark)</div>

(d) The `while` loop might become an infinite loop.

    (i)   Why?

    (ii) Rewrite the first line of the `while` loop to prevent this problem.

<div align="right">(3 marks)</div>

(e) The gas company has decided to replace the old system with a new system. A team of three members is responsible for developing the new system, as shown below:

- a project manager (PM);
- a system analyst (SA); and
- a programmer (P)

Match the major duties with the team members. The first one is an example.

Major duties	Team member
Assign resources and roles to members of the development team.	PM
Collect user requirements and write the user requirement specification.	
Set essential milestones of the development plan.	
Code the program and carry out testing.	

<div align="right">(3 marks)</div>

END OF PAPER

Provided by dse.life

Do not write on this page.

Answers written on this page will not be marked.

Do not write on this page.

Answers written on this page will not be marked.

Do not write on this page.

Answers written on this page will not be marked.

鳴 謝
Acknowledgements