Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME	

CENTRE NUMBER						CANDIDATE NUMBER				

COMPUTING **9691/22**

Paper 2 **October/November 2014**

2 hours

Candidates answer on the Question Paper.

No additional materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
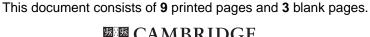You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **9** printed pages and **3** blank pages.

[Turn over

1 A sports club in a town organises an annual sports day for competitors aged 8 to 18. The organiser wants these competitors to enter the sports day events online.

(a) To enter an event, each competitor needs to supply the following information:

- Competitor name
- Age in years
- Whether or not they are a sports club member
- The letter code for the single event they want to enter:
  A 50 m race
  B 100 m race
  C Long jump
  D High jump
  E 5 km cycle race
  F 25 m swimming

The competitor confirms that their details are correct. Their computer calculates and displays the entry fee. Entries are free for sports club members.

(i) Draw a suitable screen layout.

Annual Sports Day Entry Form

[6]

(ii) Justify the design of your screen layout in **part (i)**.

....

....

....

....[2]

(b) The entries will be stored as records consisting of the following fields.

(i) Complete the following table. Give a single value for each Field size.

Field name	Data type	Field size (bytes)
CompetitorName		
CompetitorAge		
ClubMember		
EventEntered		
EntryFee		

[10]

(ii) Calculate the size of the file if 100 event entries are stored.

File size in bytes ....[3]

2 Nathan copied the following pseudocode from a computing textbook. He wants to find out what it does.

(a) Dry-run the pseudocode with s = 64, x = 1 and y = 15.

Complete the trace table.

Start a new row in the trace table every time round the loop.

```
z ← FALSE
REPEAT
  m ← (x + y) DIV 2
  IF List[m] = s
    THEN
       z ← TRUE
    ELSE
       IF List[m] > s
         THEN
            y ← m – 1
         ELSE
            x ← m + 1
       ENDIF
  ENDIF
UNTIL z = TRUE
OUTPUT m
```

	List
1	27
2	28
3	33
4	36
5	39
6	41
7	45
8	52
9	64
10	67
11	78
12	79
13	81
14	85
15	92

Trace table:

s	z	x	y	m	List[m]	List[m] = s	List[m] > s
64	–	1	15	–	–	–	–
	FALSE			–	–	–	–
		9		8	52	FALSE	FALSE
			11	12	79	FALSE	TRUE
			9	10	67	FALSE	TRUE
	TRUE			9	64	TRUE	

OUTPUT ....9..[8]

(b) What does this pseudocode do?

....

....[2]

3 A game is played by two players. Player A uses white tokens (◯). Player B uses black tokens (●). The players take turns dropping tokens into a vertical grid. The tokens fall straight down and occupy the next available space in the chosen column. The aim of the game is to connect four of one's own colour tokens. This must be done in a vertical, horizontal or diagonal line.

Here is one example after Player A has had 2 turns and Player B has had 1 turn:

Row 6
5
4
3
2 ●
1 ◯◯
Column 1 2 3 4 5 6 7

Nathan wants to write a program to allow two users to play the game on the computer.
The program will display a simplified version of the above grid which is redrawn after every turn.

(a) Before any tokens have been dropped into the grid, all grid cells are empty.

(i) Suggest values Nathan should use to represent:

Empty cell ....

White token ....

Black token ....[2]

(ii) The array `Grid` is to be used to represent the contents of the game grid.

In a high-level programming language, write statements to:

- declare the array `Grid`
- assign the value for an empty cell to all cells.

Language ....

Code ....

....

....

....

....[7]

(iii) Write the statement to assign the value for a black token to the cell shown in the diagram.

....[2]

(b) After a player takes their turn, the new state of the grid is to be displayed on the screen. The display will show only the cell contents.

Start

Loop from row
6 down to 1

Loop from
column
1 to 7

Output
contents of grid
cell for this row
and column

End of inner
loop?

No

Yes

End of outer
loop?

No

Yes

End

In a high-level language, write programming statements to implement the algorithm represented by the flowchart.

Ensure that your code demonstrates good programming practice.

Language ....

Code ....

....

....

....

....

....

....

....

....

....

....

....[4]

(c) To drop a token into the grid, the player enters the chosen column number.

The function `ColumnNumberValid` has a parameter `(x)` which is the chosen column number. The function returns:

- `TRUE` if `x` is between 1 and 7 inclusive and there is still space in the column
- `FALSE` otherwise

(i) Complete the pseudocode:

```
FUNCTION ColumnNumberValid(x : ...................................) RETURNS ..................................

    DECLARE Valid : .............................................................................................................................

    IF ................................................................................................ // x outside range?
       THEN
          Valid ← ................................................. // column number not within range
       ELSE
          IF Grid[6, x] = ................................................. // cell in top row empty?
             THEN
                Valid ← ............................................................................... // cell empty
             ELSE
                Valid ← ............................................................................... // cell not empty
          ENDIF
    ENDIF
    RETURN Valid
ENDFUNCTION
```
                                                                                                [8]

(ii) Nathan wants to test the validation of the parameter, `x`, by this function.

Give **three** different types of test data with an example of each.

Justify your choices.

Type of test data	Example test data	Justification

                                                                                                [9]

(d) The program stores in the variable `NextPlayer` the character 'A' or 'B' to show whose turn it is next.
The chosen column number is validated using the function from **part (c)(i)**.

The program then sets the relevant empty grid cell to the player's token value.

Complete the pseudocode:

```
01 REPEAT

02    INPUT ChosenColumnNumber

03 UNTIL ColumnNumberValid(................................................................................................................. )

04 Row ← 1          // start with bottom row and find first empty row

05 WHILE Grid[Row, ChosenColumnNumber] <> .................................................................

06    .......................................................................................................................................

07 ENDWHILE

08 IF .......................................................................................................................................

09    THEN

10       Grid[Row, ChosenColumnNumber] ← .......................................................................

11    ELSE

12       Grid[Row, ChosenColumnNumber] ← .......................................................................

13 ENDIF                                                                                    [5]
```

(e) Nathan wants a single player to play against the computer. He uses the built-in function `RANDOM(n)` to simulate the computer's choice of column. This function returns a whole number in the range 1 to `n` inclusive.

He writes the procedure `GetColumn` to input the next move either from the computer or Player 'B'. This procedure has two parameters which are passed either *by reference* or *by value*.

```
PROCEDURE GetColumn(Player : CHAR, Number : INTEGER)
  IF Player = 'A'        // Player 'A' is the computer.
    THEN
      Number ← RANDOM(7)
    ELSE
      INPUT Number
  ENDIF
ENDPROCEDURE
```

(i) State which method of parameter passing (by reference or by value) is used for each of `Player` and `Number`.

Player ....

Number ....[2]

(ii) Write the procedure call which will replace line `02` of the pseudocode in **part (d)**.

....[2]

(f) All programs should be maintainable.

List **three** features of maintainable programs used in the pseudocode in **part (d)**.

1 ....

2 ....

3 ....[3]

10

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12

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