

## CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

### MARK SCHEME for the May/June 2015 series

# 9691 COMPUTING

9691/22

Paper 2 (Written Paper), maximum raw mark 75

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1 (a) (i) 'F' [1]

(ii) Error [1]

(b) ThisDay  $\leftarrow$  MID(TodaysDate, 1, 2)  
 ThisMonth  $\leftarrow$  MID(TodaysDate, 3, 2)  
 ThisYear  $\leftarrow$  MID(TodaysDate, 5, 4) [3]

2 (a) (i)

x	Result	x < > -1
0	0	TRUE
3	3	TRUE
5	8	TRUE
2	10	TRUE
1	11	TRUE
-1	10	FALSE

1 mark per correct column [3]

OUTPUT: 10 [1]

(ii) Expected result: 11 [1]

(iii) The -1 is treated as though it was part of the sequence of numbers  
 // the dummy value is included in the calculation [1]

(iv) Logic (error) (Accept logical) [1]

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```
(b) DECLARE x : INTEGER
DECLARE Result : INTEGER
x ← 0
Result ← 0
INPUT x
WHILE x <> -1
Result ← Result + x
INPUT x
ENDWHILE
OUTPUT Result
```

Mark as follows:

If no change attempted – no marks

If a change has been attempted:

Correct declarations and output statements

1 mark

Moving INPUT x within the loop to the end of the loop

Or IF x <> -1 THEN

1 mark

If loop works and Initialisations correct

1 mark

[3]

3 (a) (i) Row 2  
Column 3

[1]

(ii) NULL / "" (empty string)/ any char other than '0', 'O' or 'X'

[1]

(iii) Mark as follows:

Correct identifier

Correct dimensions

Correct data type in declaration (Correct for initial value used below)

Correct outer loop

Correct inner loop

Correct indices for assignment (LH)

Assign initial value within loop (RH) if not a valid initial value

Example Pascal

```
VAR Grid : ARRAY [1..3, 1..3] OF CHAR;
FOR Row := 1 TO 3 DO
  FOR Column := 1 TO 3 DO
    Grid[Row, Column] := NULL;
```

[7]

(b) (i) Invalid with correct reason 1 mark each

2,2: valid

0,1: invalid because row below range

1 mark

1,1: valid

1 mark for the two valid cases

1,4: column above range

1 mark

4,1: row above range

1 mark

2,0: Column below range

1 mark

2,2: Cell already used (row & column within range)

1 mark

[6]

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(ii) **Mark as follows:**

- Correct function identifier and ending
- Function parameter and return data type
- Check row within range AND
- Check column within range
- Check cell is empty (requires correct logical structure)
- Correct return values (accept TRUE/FALSE as strings)

**Example Pascal**

```

FUNCTION IsInputValid (Row, Column : INTEGER) : BOOLEAN;
  VAR IsValid : BOOLEAN;
  BEGIN
    IsValid := FALSE;
    IF (Row>0) AND (Row<4)
      THEN
        IF (Column>0) AND (Column<4)
          THEN
            IF Grid[Row, Column] = NULL // or equivalent
              THEN IsValid := TRUE;
    IsValid := IsValid
  END;
```

[max 5]

(c) (i) Use of functions/procedures [1]

(ii) Easier to solve (by breaking down into sub-problems)

Can focus on one part at a time

easier to produce module code

[1]

(iii) Assignment: 1 / 2 / 10 / 15

Selection: 8(-20) / 13(-19)

Iteration: 5(-21) / 21

Function call: 8 / 13

Procedure call: 3 / 6 / 7 / 18

[5]

- (iv)
- indentation
  - meaningful identifier/variable names
  - keywords in capitals
  - inclusion of white space
  - initialising variables
  - one statement per line
  - use of functions/procedures with meaningful identifiers // use of structured constructs

[max 2]

(v)

Identifier	Variable or Procedure or Function or Array	Data Type	Description
GameEnd	Variable	BOOLEAN	FALSE if game in progress TRUE if there is a winner or the grid is full
Grid	ARRAY	CHAR character STRING(1)	To store the current state of the game
CurrentPlayer	Variable	CHAR character STRING(1)	The marker value ('O' or 'X') of the current player
PlayerTakesTurn	PROCEDURE	(ignore)	Current player chooses cell Program checks if it is valid and stores marker
DisplayGrid	PROCEDURE	(ignore)	Outputs the contents of the grid
HasPlayerWon	FUNCTION	BOOLEAN	Checks if the current player has completed a row, column or diagonal
GridFull	FUNCTION	BOOLEAN	Checks if the grid is full
SwapPlayer	PROCEDURE	(ignore)	Swaps the value of CurrentPlayer

[5]

(d) Mark as follows:

- Procedure heading and ending
- parameter given
- Byref (parameter)
- Parameter data type as CHAR (accept string)
- IF 'O' then 'X'
- IF 'X' then 'O'

```
PROCEDURE SwapPlayer (BYREF Player : CHAR)
  IF Player = 'O'
    THEN Player ← 'X'
    ELSE Player ← 'O'
  ENDIF
ENDPROCEDURE
```

[max 5]

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(e) FUNCTION HasPlayerWon() RETURNS BOOLEAN accept AS or : or just BOOLEAN

```

DECLARE WinningLine : BOOLEAN
DECLARE i : INTEGER
WinningLine ← FALSE
  // check both diagonals
IF   Grid[1,1] = Grid[2,2] AND Grid[1,1] = Grid[3,3]
  OR Grid[1,3] = Grid[2,2]
  AND Grid[1,3] = Grid[3,1]
THEN WinningLine ← TRUE
ELSE
  i ← 0
  REPEAT accept LOOP / DO // DO LOOP
  i ← i + 1
  // check a row
  IF   Grid[i,1] = Grid[i,2] AND Grid[i,1] =
  // check a column
  OR Grid[1,i] = Grid[2,i]
  AND Grid[1,i] = Grid[3,i]
  THEN WinningLine ← TRUE
  ENDIF
  UNTIL WinningLine = TRUE OR i=3
  ENDIF
RETURN WinningLine
ENDFUNCTION

```

} 1 mark

} 1 mark

Ensure the following elements have been checked:  
Grid[1,3]  
Grid[3,1]  
Grid[2,2]  
Grid[3,1] =

Ensure the following elements have been checked:  
Grid[1,i]  
Grid[2,i]  
Grid[3,i]  
Grid[3,1] =

[max 10]

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(f) Example Pascal:

```
PROCEDURE DisplayGrid;
BEGIN
  EmptyCell:= '' // value for empty cell see 3(a)(ii)
  FOR Row := 1 TO 3 DO
  BEGIN
    Line := ''; // build up a row for output
    FOR Column := 1 TO 3 DO
      IF Grid[Row, Column] = EmptyCell
      THEN
        Line := Line + ' : '
      ELSE
        Line := Line + ' ' + Grid[Row, Column] + ' ';
    WriteLn(Line);
  END;
END;
```

Mark as follows:

- Procedure header & ending
- Assign empty cell value to EmptyCell
- Correctly nested loops
- Correct Boolean expression in IF statement
- Correct string concatenation × 2
- Initialise line and output line

[max 5]

(g) Mark as follows:

- Display of 3×3 grid to represent the current state of the game
- Input box/ drop-down box for row number clearly labelled (Accept radio buttons)
- Input box/ drop-down box for column number clearly labelled (Accept radio buttons)
- Indication of which player's turn (Do not accept radio buttons / check boxes)
- Error message if invalid input

[max 4]

(h) Any **two** from:

- System testing
- Integration testing
- Black box testing
- White box testing // glass box testing

[max 2]