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**COMPUTER SCIENCE**

**9608/43**

Paper 4 Written Paper

**May/June 2016**

MARK SCHEME

Maximum Mark: 75

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**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

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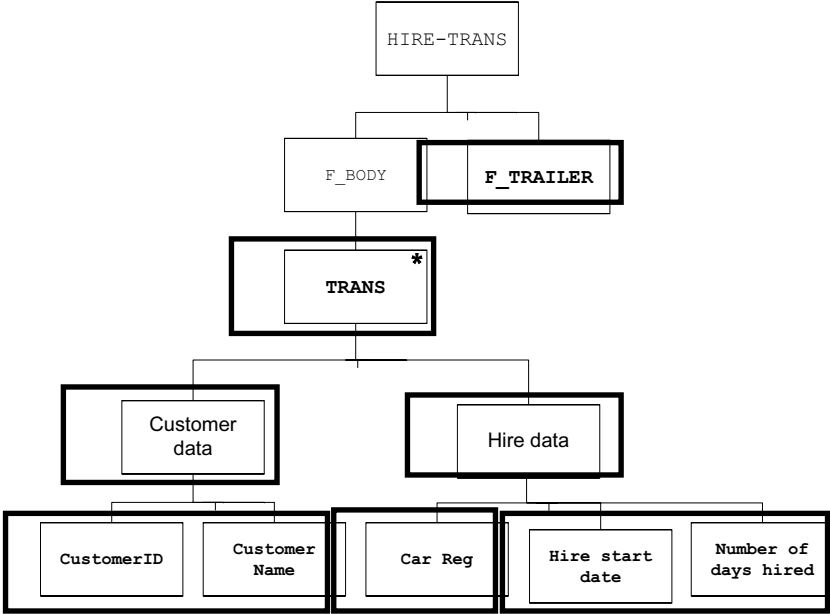
Page 2	Mark Scheme	Syllabus	Paper
	Cambridge International A Level – May/June 2016	9608	43

Question	Answer	Marks	
1 (a) (i)	<pre> TYPE LinkedList (DECLARE) Surname : STRING (DECLARE) Ptr : INTEGER ENDTYPE  Accept: LinkedList : RECORD  Surname : STRING Ptr : INTEGER ENDRECORD  Accept: TYPE LinkedList = RECORD  Surname : STRING Ptr : INTEGER ENDTYPE / ENDRECORD  Accept: STRUCTURE LinkedList (DECLARE) Surname : STRING (DECLARE) Ptr : INTEGER ENDSTRUCTURE  Accept AS / OF instead of :</pre>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	<b>3</b>
(ii)	<pre> (DECLARE) <u>SurnameList[1:5000]</u> : <u>LinkedList</u>  Accept AS / OF instead of : Accept () instead of [] Accept without lower bound Index separator can be , : ...</pre>		<b>2</b>
(b) (i)	<pre> Wu Accept with quotes</pre>		<b>1</b>
(ii)	6		<b>1</b>
(c) (i)	<pre> IsFound + relevant description BOOLEAN</pre>	<p>1</p> <p>1</p>	<b>2</b>

Page 3	Mark Scheme	Syllabus	Paper
	Cambridge International A Level – May/June 2016	9608	43

Question	Answer	Marks
(ii)	Accept () instead of [] 01 Current ← <u>StartPtr</u> 02 IF Current = 0 03 THEN 04 OUTPUT " <u>Empty List</u> " (or similar message) (accept without quotes) Reject "Error" 05 ELSE 06 IsFound ← <u>FALSE</u> 07 INPUT ThisSurname 08 REPEAT 09 IF <u>SurnameList[Current].Surname</u> = ThisSurname 10 THEN 11 IsFound ← TRUE 12 OUTPUT "Surname found at position ", Current 13 ELSE 14 // move to the next list item 15 <u>Current ← SurnameList[Current].Ptr</u> 16 ENDIF 17 UNTIL IsFound = TRUE OR <u>Current = 0</u> 18 IF IsFound = FALSE 19 THEN 20 OUTPUT "Not Found" 21 ENDIF 22 ENDIF	6
	Accept = for assignment	
2 (a) (i)	A procedure which is defined in terms of itself // A procedure which makes a call to itself // A procedure that calls itself	1
(ii)	08 // 8	1

Question	Answer	Marks																																																																																																																																
(b) (i)	<table border="1" style="display: inline-table; margin-right: 20px;"> <thead> <tr> <th>Index</th> <th>Item</th> </tr> </thead> <tbody> <tr><td>1</td><td>9</td></tr> <tr><td>2</td><td></td></tr> <tr><td>3</td><td></td></tr> <tr><td>4</td><td></td></tr> <tr><td>5</td><td></td></tr> <tr><td>6</td><td></td></tr> <tr><td>7</td><td></td></tr> <tr><td>8</td><td></td></tr> </tbody> </table> <table border="1" style="display: inline-table;"> <thead> <tr> <th colspan="10">MyList</th> </tr> <tr> <th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th> </tr> </thead> <tbody> <tr> <td>3</td><td>5</td><td>8</td><td>9</td><td>13</td><td>16</td><td>27</td><td>0</td><td>0</td><td>0</td> </tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table> <p>Note: Final mark only if no additional entries in table Accept last row to show all final values</p>	Index	Item	1	9	2		3		4		5		6		7		8		MyList										1	2	3	4	5	6	7	8	9	10	3	5	8	9	13	16	27	0	0	0																																																																																	4
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3	5	8	9	13	16	27	0	0	0																																																																																																																									
(ii)	<p>Any one from:</p> <p>Deletes/removes parameter value/ Item (from the array MyList) // Deletes the first entry (in MyList) that equals or is bigger than Item</p> <p>Overwrites Item by moving subsequent items up/down/across/left R right</p>	1																																																																																																																																

Question	Answer	Marks														
3 (a)	 <p><i>Mark as follows:</i></p> <table border="0"> <tr> <td>Label F_TRAILER</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Label TRANS</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Customer box (Accept label Customer)</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Hire box (Accept label Hire)</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Customer fields : Customer Name, CustomerID/IDnumber</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Hire fields: Car Reg</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Hire fields: Hire start date, Number of days hired</td> <td style="text-align: right;">1</td> </tr> </table> <p>accept level 5 fields in any order Ignore parent</p>	Label F_TRAILER	1	Label TRANS	1	Customer box (Accept label Customer)	1	Hire box (Accept label Hire)	1	Customer fields : Customer Name, CustomerID/IDnumber	1	Hire fields: Car Reg	1	Hire fields: Hire start date, Number of days hired	1	7
Label F_TRAILER	1															
Label TRANS	1															
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Customer fields : Customer Name, CustomerID/IDnumber	1															
Hire fields: Car Reg	1															
Hire fields: Hire start date, Number of days hired	1															

Question	Answer	Marks										
(b)	<p><i>Mark as follows:</i></p> <table border="0"> <tr> <td>Selection symbol x 2 (Car-hire / No car-hire)</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Labelling for CAR_HIRE / NO_HIRE (accept similar labels*)</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Labelling for <u>Car registration</u> and Car total / Total hires</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Iteration symbol for HIRE (accept in HIRE_LIST as a BOD)</td> <td style="text-align: right;">1</td> </tr> <tr> <td>Labelling for start date and number of days (as per diagram)</td> <td style="text-align: right;">1</td> </tr> </table> <p>* For CAR_HIRE label: Accept: Hires / hired / Car data / hire data / hire record / one or more hires</p>	Selection symbol x 2 (Car-hire / No car-hire)	1	Labelling for CAR_HIRE / NO_HIRE (accept similar labels*)	1	Labelling for <u>Car registration</u> and Car total / Total hires	1	Iteration symbol for HIRE (accept in HIRE_LIST as a BOD)	1	Labelling for start date and number of days (as per diagram)	1	5
Selection symbol x 2 (Car-hire / No car-hire)	1											
Labelling for CAR_HIRE / NO_HIRE (accept similar labels*)	1											
Labelling for <u>Car registration</u> and Car total / Total hires	1											
Iteration symbol for HIRE (accept in HIRE_LIST as a BOD)	1											
Labelling for start date and number of days (as per diagram)	1											

Question	Answer	Marks												
4 (a) (i)	a03, h07, a23 accept in any order, must be lower case	1												
(ii)	The car must <u>pass</u> (both) brake test <b>and</b> tyres test	1												
(b)	<pre> retestAllowed(<b>ThisCar</b>)                 1 If (<b>testBrakes(ThisCar, pass) and testTyres(ThisCar, fail)</b>)     <b>or (testBrakes(ThisCar, fail) and testTyres(ThisCar, pass))</b>                 1 </pre> <p>(one mark per bold underlined all correct) accept another variable instead of <b>ThisCar</b>, but must be same throughout.</p>	3												
(c) (i)	a07 [p03]  must be [] must be lower case, but don't penalise twice, so follow through from part(b)	2												
(ii)	[p05, m04]	1												
(iii)	[ ]	1												
(d)	[ ]	1												
5 (a) (i)	<table border="1"> <thead> <tr> <th>Mark</th> <th>Description</th> <th>Expected result (Grade)</th> </tr> </thead> <tbody> <tr> <td></td> <td>Normal</td> <td>FAIL/PASS/MERIT/DISTINCTION</td> </tr> <tr> <td></td> <td>Abnormal</td> <td>Error</td> </tr> <tr> <td></td> <td>Extreme/Boundary</td> <td>FAIL/PASS/MERIT/DISTINCTION</td> </tr> </tbody> </table> <p>3 × (mark + matching grade) for abnormal data accept negative values, non-integer values, Expected Result: Error 0 and marks above 100 are still acceptable values Do not accept FAIL in expected result column for Abnormal data</p>	Mark	Description	Expected result (Grade)		Normal	FAIL/PASS/MERIT/DISTINCTION		Abnormal	Error		Extreme/Boundary	FAIL/PASS/MERIT/DISTINCTION	3
Mark	Description	Expected result (Grade)												
	Normal	FAIL/PASS/MERIT/DISTINCTION												
	Abnormal	Error												
	Extreme/Boundary	FAIL/PASS/MERIT/DISTINCTION												
(ii)	(The programmer is) concerned only with the input (i.e. the mark) to the function and monitoring the expected output (i.e. the grade) // can compare expected result and actual result	1												
(b)	<p>Exception:</p> <ol style="list-style-type: none"> <li>situation causing a crash / run-time error / fatal error 1</li> </ol> <p>Exception handling:</p> <ol style="list-style-type: none"> <li>code which is called when a run-time error occurs 1</li> <li>... to avoid the program terminating/crashing 1</li> </ol>	3												

Question	Answer	Marks	
(c)	1 Open a non-existent file 2 Directory path does not exist 3 Attempt to read past the end of the file // attempt to read an empty file 4 Array subscript is out of range 5 Non-integer value / corrupt data read 6 File already open in a different mode // wrong file permissions	Max 3	
(d) (i)	09 // 9	1	
(ii)	1 Line 11 catches exceptions (only) between lines 05 and 10 2 Line 11 stops the program from crashing 3 Different exception types recognised 4 Each exception type has an appropriate message output 5 The program language has an (object) type EXCEPTION 6 ThisException is the instance of EXCEPTION which has been raised 7 EXCEPTION objects have a 'Message' property // the message property for ThisException is "Arithmetic operation resulted in an overflow"	1 1 1 1 1 1 1	Max 3
6 (a)	<p>Max 3 marks if extra states/transitions added.</p>	4	



Page 9	Mark Scheme	Syllabus	Paper
	Cambridge International A Level – May/June 2016	9608	43

Question	Answer	Marks
(b) (i)	Mark as follows: 1 Declaration for array (character or string data type) 2 FOR loop for x going from 1 to 8, generating column index used in array 3 FOR loop for y going from 1–2, 3–6, 7–8 (Accept all squares being set to 'E' and then overwritten with 'B', 'W' respectively) 4 Setting squares to 'B', 'E', 'W' (must be in quotes, accept single or double)	4
(ii)	Mark as follows: 1 Procedure heading and declaration of 2 local variables 1 2 Establishing the stopper colour – opposite to the mover 1 3 Test for piece in column 1 (x>1) // column 8 (x<8) 1 4 Test for 'E' 1 5 Correct method for moving left // for moving right 1 6 until edge of board reached 1 7 until other colour (stopper colour) encountered 1 8 until own colour encountered (PieceColour) 1 9 Correct output for cell indexes 1 (accept for moving in 1 direction only) 10 including the 'REMOVE' message 1  Note: must use given parameter identifiers: PieceColour, xCurrent, yCurrent	Max 5
(c) (i)	Classes could be designed for : <ul style="list-style-type: none"> <li>• the board</li> <li>• a piece</li> </ul> Containment (Board contains Pieces) The pieces are <u>instances/objects</u> (of the Piece class)	Max 2

Page 10	Mark Scheme	Syllabus	Paper
	Cambridge International A Level – May/June 2016	9608	43

Question	Answer	Marks
(ii)	<p>Accept any reasonable answer, for example:</p> <p>BOARD class:</p> <p>Properties:</p> <ul style="list-style-type: none"> <li>• Number of squares / size / dimensions</li> <li>• Current state of all squares</li> </ul> <p>Methods: –</p> <ul style="list-style-type: none"> <li>• Set the starting board</li> <li>• Capture the finishing state of the board</li> <li>• Display the state of the board after each move</li> </ul> <p>PIECE class:</p> <p>Properties:</p> <ul style="list-style-type: none"> <li>• Starting x position</li> <li>• Starting y position</li> <li>• Current x position</li> <li>• current y position</li> <li>• Colour</li> <li>• State / Removed / Active</li> </ul> <p>Methods:</p> <ul style="list-style-type: none"> <li>• Move piece</li> <li>• Remove piece</li> </ul> <p>Mark as follows: two correct responses are worth 1 mark</p> <p>Accept other classes: Game, Player</p>	Max 2

<b>Page 11</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International A Level – May/June 2016</b>	<b>9608</b>	<b>43</b>

## Programming code

### 6 (b) (i)

#### VB.NET

```
Dim Board(8, 8) As Char
Dim Row, Column As Integer
For Row = 1 To 2
    For Column = 1 To 8
        Board(Row, Column) = "B"
    Next
Next
For Row = 3 To 6
    For Column = 1 To 8
        Board(Row, Column) = "E"
    Next
Next
For Row = 7 To 8
    For Column = 1 To 8
        Board(Row, Column) = "W"
    Next
Next
```

#### PASCAL

```
var Row, Column : integer;
    Board : array[1..8, 1..8] of char;
begin
    for Row := 1 to 2 do
        for Column := 1 to 8 do
            Board[Row, Column] := 'B';
        end for;
    end for;
    for Row := 3 to 6 do
        for Column := 1 to 8 do
            Board[Row, Column] := 'E';
        end for;
    end for;
    for Row := 7 to 8 do
        for Column := 1 to 8 do
            Board[Row, Column] := 'W';
        end for;
    end for;
end.
```

<b>Page 12</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International A Level – May/June 2016</b>	<b>9608</b>	<b>43</b>

## PYTHON

```
Board = [["" for j in range(9)] for i in range(9)]
for Row in range(1, 3) :
    for Column in range(1, 9) :
        Board[Row][Column] = "B"
for Row in range(3, 7) :
    for Column in range(1, 9) :
        Board[Row][Column] = "E"
for Row in range(7, 9) :
    for Column in range(1, 9) :
        Board[Row][Column] = "W"
```

Alternative declarations of Board array :

```
Board = [[""] * 9 for i in range(9)]
```

```
Board = []
for i in range(9) :
    for j in range(9) :
        Board.append("")
```

Instead of initialising with empty string, could initialise with 'E'. this would then only require 'B' and 'W' loops later.

For example:

```
Board = [["E"] * 9 for i in range(9)] // Board = [["E"]*9]*9
for Row in range(1, 3) :
    for Column in range(1, 9) :
        Board[Row][Column] = "B"
for Row in range(7, 9) :
    for Column in range(1, 9) :
        Board[Row][Column] = "W"
```

```
Board = []
for i in range(9):
    Board.append(["E"]*9)
```

<b>Page 13</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International A Level – May/June 2016</b>	<b>9608</b>	<b>43</b>

**6 (b) (ii)**

**VB.NET**

```

Sub ValidMoves(ByVal PieceColour As Char, ByVal xCurrent As Integer,
ByVal yCurrent As Integer)
    Dim i As Integer
    Dim StopperColour As Char
    Dim NoFurther As Boolean
    If PieceColour = "B" Then
        StopperColour = "W"
    Else
        StopperColour = "B"
    End If
    Console.WriteLine("Possible moves are : ")
    If xCurrent <> 1 Then
        Console.WriteLine("Moving LEFT . . .")
        i = xCurrent - 1
        NoFurther = False
        do
            if Board(i, yCurrent) = "E" Then
                Console.WriteLine(i & " " & yCurrent)
            End If
            if Board(i, yCurrent) = StopperColour Then
                Console.WriteLine(i & " " & yCurrent & " REMOVE PIECE")
                NoFurther = True
            End If
            i = i - 1
        Loop Until i = 0 Or NoFurther = True
    End If
    if xCurrent <> 8 Then
        Console.WriteLine("Moving RIGHT . . .")
        i = xCurrent + 1
        NoFurther = False
        do
            if Board(i, yCurrent) = "E" :
                Console.WriteLine(i & " " & yCurrent)
            End If
            if Board(i, yCurrent) = StopperColour Then
                Console.WriteLine(i & " " & yCurrent & " REMOVE PIECE")
                NoFurther = True
            End If
            i = i + 1
        Loop Until i = 9 Or NoFurther = True
    End If
End Sub

```

<b>Page 14</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International A Level – May/June 2016</b>	<b>9608</b>	<b>43</b>

## PASCAL

```

procedure ValidMoves(PieceColour : char; xCurrent, yCurrent : integer);
var StopperColour : char;
    i : integer;
    NoFurther : boolean;
begin
    if (PieceColour = 'B') then
        StopperColour := 'W'
    else
        StopperColour := 'B';
    writeln('Possible moves are : ');
    if (xCurrent <> 1) then
        begin
            writeln('Moving LEFT . . . ');
            i := xCurrent - 1;
            NoFurther := false;
            repeat
                if (Board[i, yCurrent] = 'E') then
                    writeln(intToStr(i) + ' ' + intToStr(yCurrent));
                if (Board[i, yCurrent] = StopperColour) then
                    begin
                        writeln(intToStr(i) + ' ' + intToStr(yCurrent) + ' REMOVE
                            PIECE');
                        NoFurther := true;
                    end;
                i := i - 1;
            until ((i = 0) or (NoFurther = true));
        end;
    if (xCurrent <> 8) then
        begin
            writeln('Moving RIGHT . . . ');
            i := xCurrent + 1;
            NoFurther := false;
            repeat
                if (Board[i, yCurrent] = 'E') then
                    writeln(intToStr(i) + ' ' + intToStr(yCurrent));
                if (Board[i, yCurrent] = StopperColour) then
                    begin
                        writeln(intToStr(i) + ' ' + intToStr(yCurrent) + ' REMOVE
                            PIECE');
                        NoFurther := true;
                    end;
                i := i + 1;
            until ((i = 9) or (NoFurther = true));
        end;
end;

```

<b>Page 15</b>	<b>Mark Scheme</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>Cambridge International A Level – May/June 2016</b>	<b>9608</b>	<b>43</b>

## PYTHON

```
def ValidMoves(PieceColour, xCurrent, yCurrent) :
    if PieceColour == "B" :
        StopperColour = "W"
    else :
        StopperColour = "B"
    print("Possible moves are : ")
    if xCurrent != 1 :
        print("Moving LEFT . . .")
        i = xCurrent - 1
        NoFurther = False
        while i > 0 and NoFurther == False :
            if Board[i][yCurrent] == "E" :
                print(str(i) + " " + str(yCurrent))
            if Board[i][yCurrent] == StopperColour :
                print(str(i) + " " + str(yCurrent) + " REMOVE PIECE")
                NoFurther = True
            i = i - 1
    if xCurrent != 8 :
        print("Moving RIGHT . . .")
        i = xCurrent + 1
        NoFurther = False
        while i < 9 and NoFurther == False :
            if Board[i][yCurrent] == "E" :
                print(str(i) + " " + str(yCurrent))
            if Board[i][yCurrent] == StopperColour :
                print(str(i) + " " + str(yCurrent) + " REMOVE PIECE")
                NoFurther = True
            i = i + 1
```