Cambridge Assessment International Education

Cambridge International AS & A Level

COMPUTER SCIENCE **9608/22**

Paper 2 Written Paper **May/June 2020**

MARK SCHEME

Maximum Mark: 75

Published

Students did not sit exam papers in the June 2020 series due to the Covid-19 global pandemic.

This mark scheme is published to support teachers and students and should be read together with the question paper. It shows the requirements of the exam. The answer column of the mark scheme shows the proposed basis on which Examiners would award marks for this exam. Where appropriate, this column also provides the most likely acceptable alternative responses expected from students. Examiners usually review the mark scheme after they have seen student responses and update the mark scheme if appropriate. In the June series, Examiners were unable to consider the acceptability of alternative responses, as there were no student responses to consider.

Mark schemes should usually be read together with the Principal Examiner Report for Teachers. However, because students did not sit exam papers, there is no Principal Examiner Report for Teachers for the June 2020 series.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the June 2020 series for most Cambridge IGCSE™ and Cambridge International A & AS Level components, and some Cambridge O Level components.

[Turn over

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

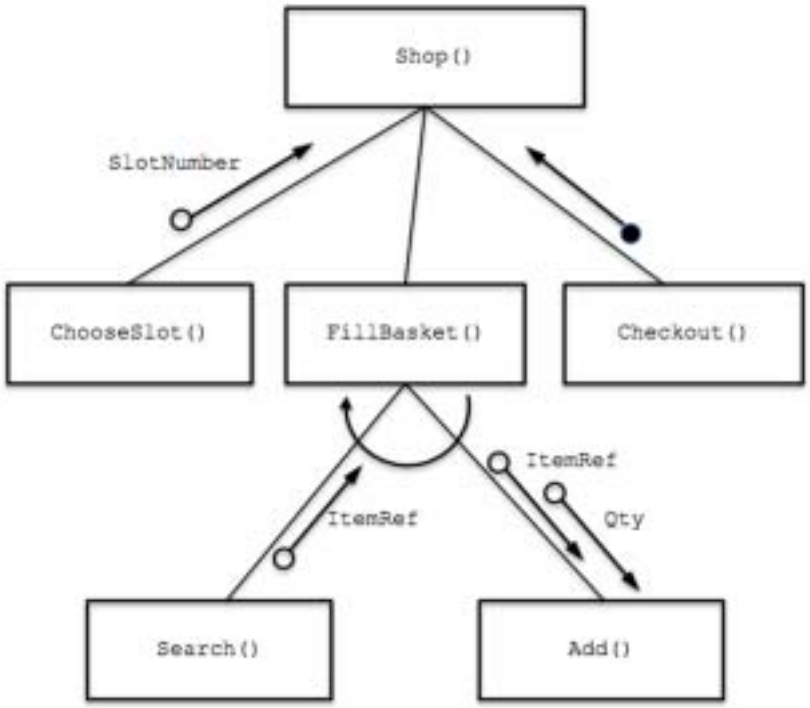
Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Question	Answer	Marks
1(a)	One mark for name Max two marks for description: one for each underlined word or phrase (or equivalent) Name: Sequence Description: Instructions / lines of code are executed in a fixed order OR Name: Assignment Description: A value is given to a variable	**3**
1(b)	One mark per bullet point: • Knowledge / experience of one programming language... • ... can be applied to an unknown language // will help recognise control structures (accept by example) in an unknown language	**2**
1(c)	One mark per bullet point: • Count controlled – the number of iterations is known / fixed • Post condition – the number of iterations depends on some condition being tested at the end / before the loop is repeated // at least one iteration is always executed For conditional: reject answer that also applies to pre-conditional	**2**
1(d)	Examples include: • context sensitive prompts • (dynamic) syntax checking • use of colours to highlight key words / pretty printing / highlighting unused variables (etc) • Formatting (incl. collapsing and expanding blocks) • (UML) modelling • Text editor (or by reference to a function such as copy & paste) • Built-in (library) functions Do not accept answers relating to debugging features Max 3	**3**

Question	Answer	Marks
2(a)	One mark per bullet point: • Parameters passed between modules // the interface between modules • Module Iteration • Module selection Max 2	**2**
2(b)(i)	Advantages include: • Easier to solve / implement / program the solution as online shopping is a complex task • Easier to debug / maintain as each module can be tested separately e.g. test `FillBasket()` first then test `Checkout()` • Tasks may be shared among a team of programmer. e.g. `Checkout()` and `Search()` modules could be developed in parallel / by teams with different expertise Note: Must include reference to given scenario to achieve all 3 marks - Max 2 if no reference.	**3**

Question	Answer	Marks
2(b)(ii)	 One Mark for 1 Three middle row boxes correctly labelled and connected to `Shop()` 2 Two bottom row boxes correctly labelled and connected to `FillBasket()` 3 Iteration arrow on `FillBasket()` 4 Return parameters from `ChooseSlot()` **and** `Checkout()` 5 Return parameters from `Search()` 6 Two input parameters to `Add()` Notes: Parameter types must be as shown but ignore parameter names (if given)	**6**

Question	Answer	Marks

3	`FUNCTION CheckCourse(Course : REAL) RETURNS INTEGER`
	`  DECLARE Adjust, Check : INTEGER`
	
	`  Check ← INT(Deviate(Course))`
	`  Adjust ← 255`
	
	`  CASE OF Check`
	`  -20 to -1: Adjust ← 10`
	`  0 : Adjust ← 0`
	`  1 to 20 : Adjust ← -10`
	`  OTHERWISE CALL Alert()`
	`  ENDCASE`
	
	`  RETURN Adjust`
	
	`ENDFUNCTION`
	
	1 mark for each of the following:
	
	1 `FUNCTION` heading and ending including parameter as given above
	2 Assign value to `Check` using integer conversion **and** intialise `Adjust` to 255
	3 `CASE ... ENDCASE`
	4 Conditions −20 to −1 **and** 1 to 20 (and corresponding assignments)
	5 Condition 0 (and corresponding assignment)
	6 `OTHERWISE`
	7 Return `Adjust`
		7

Question	Answer	Marks

4(a)	`DECLARE Random : ARRAY [1:10] OF INTEGER`
	`DECLARE NextNum, Index, Rnum : INTEGER`
	`DECLARE Exists : BOOLEAN`
	
	`NextNum ← 1 // index position for the next random number`
	
	`REPEAT`
	`  Rnum ← INT(RAND(100)) + 1 // from original question`
	`  Exists ← FALSE`
	`  FOR Index ← 1 to NextNum - 1 // search for Rnum`
	`  IF Random[Index] = Rnum`
	`  THEN`
	`  Exists ← TRUE`
	`  ENDIF`
	`  ENDFOR`
	
	`  IF Exists = FALSE`
	`  THEN`
	`  Random[NextNum] ← Rnum // store Rnum`
	`  NextNum ← NextNum + 1 // increment index`
	`  ENDIF`
	`UNTIL NextNum > 10`
	
	1 mark for each of the following:
	
	1 Conditional (outer) loop to generate 10 values
	2 Inner loop to search array for duplicate number
	3 Check for duplicate by comparing number generated with array element **in a loop**
	4 Avoid checking uninitialised elements // array initialisation to rogue value at start of algorithm
	5 If `Rnum` is a duplicate then repeat outer loop
	6 If `Rnum` **not** a duplicate then assign to array element **and** Increment index
	
	Notes:
	Max 5 if statement to generate random number (as given in Q) not present or incorrectly placed.
		6

4(b)	Adaptive Maintenance	**1**

Question	Answer	Marks
5(a)	Mark as follows: 1 SET `Name` to "" 2 SET `Index` to 1 3 SELECT the character from input parameter string at Index position 4 IF character is not colon then concatenate character with `Name` 5 …INCREMENT `Index` 6 …REPEAT from step 3 7 RETURN `Name` Alternative Solution: Mark as follows: 1 SET `Index` to 1 2 SELECT the character from input parameter string at Index position 3 IF character is colon then go to 5 4 Else INCREMENT `Index` and repeat from 2 5 Extract a substring from the left of the parameter string (and assign this to variable `Name`) 6 ...Using `Index -1` for the length 7 RETURN `Name` Note: Mark points may be combined for equivalent marks e.g a suitable structured English description of the pseudocode statement below satisfies MP 5, 6 and 7: `RETURN LEFT(ParamString, Index - 1)`	**7**
5(b)(i)	Description: • Reduce the number of items to be checked by one after each pass • Use a flag variable to stop the outer loop • ... after no more swaps made on a single pass of the inner loop • ... resetting before the inner loop starts, and setting it whenever a swap is made	**4**

Question	Answer	Marks

5(b)(ii)	'Pseudocode' solution included here for development and clarification of mark scheme.
	Programming language example solutions appear in the Appendix.
	
	`PROCEDURE BubbleSort()`
	`  DECLARE Temp : STRING`
	`  DECLARE NoSwaps : BOOLEAN`
	`  DECLARE Boundary, J : INTEGER`
	
	`  Boundary ← 999`
	`  REPEAT`
	`  NoSwaps ← TRUE`
	`  FOR J ← 1 TO Boundary`
	`  IF Contact[J] > Contact[J+1]`
	`  THEN`
	`  Temp ← Contact[J]`
	`  Contact[J] ← Contact[J+1]`
	`  Contact[J+1] ← Temp`
	`  NoSwaps ← FALSE`
	`  ENDIF`
	`  ENDFOR`
	`  Boundary ← Boundary - 1`
	`  UNTIL NoSwaps = TRUE`
	
	`ENDPROCEDURE`
	
	Mark as follows:
	
	1 Procedure heading and ending
	2 Outer loop
	3 Inner loop
	4 Correct comparison **in a loop**
	5 Correct swap of array elements **in a loop**
	6 'NoSwap' mechanism: Post-conditional outer loop including flag reset
	7 'NoSwap' mechanism: Set flag in inner loop to indicate swap
	8 Reducing Boundary **in the <u>outer</u> loop**
		8

Question	Answer	Marks

6(a)(i)	`FUNCTION AddTime(StartTime : STRING, Duration : INTEGER)_`
	`  RETURNS STRING`
	
	`  DECLARE NewTime : STRING`
	`  DECLARE StartMinutes, StartHours : INTEGER`
	`  DECLARE Total, NewMinutes, NewHours : INTEGER`
	
	`  StartHours ← STRING_TO_NUM(LEFT(StartTime,2))`
	`  StartMinutes ← STRING_TO_NUM(RIGHT(StartTime, 2))`
	`  Total ← (StartHours * 60) + StartMinutes + Duration`
	`  NewHours ← DIV(Total, 60)`
	`  NewMinutes ← MOD(Total, 60)`
	
	`  NewTime ← ""`
	
	`  IF NewHours < 10`
	`  THEN`
	`  NewTime ← '0'  // add leading zero to hours`
	`  ENDIF`
	
	`  NewTime ← NewTime & NUM_TO_STRING(NewHours) & ':'`
	
	`  IF NewMinutes < 10`
	`  THEN`
	`  NewTime ← NewTime & '0'// add leading zero`
	`  ENDIF`
	
	`  NewTime ← NewTime & NUM_TO_STRING(NewMinutes)`
	
	`  RETURN NewTime`
	
	`ENDFUNCTION`
	
	1 mark for each of the following:
	
	1 Function heading and ending including parameters
	2 Extract `StartHours` and convert to integer
	3 Extract `StartMinutes` and convert to integer
	4 Add `Duration` to `StartTime` in minutes
	5 Use `DIV()` to extract `NewHours`
	6 Use `MOD()` to extract `NewMinutes`
	7 Adding leading zeros when necessary to hours **and** minutes eg “09:05”
	8 Return concatentated string
	
	Note:
	Accept alternative methods for calculation of `NewHours` and `NewMinutes`
		8

6(a)(ii)	To test every path through the algorithm	**1**
6(a)(iii)	• Logical error • Algorithm is incorrect // program produces unexpected result / incorrect calculation is performed	**2**

Question	Answer	Marks
6(b)	Test data: Any string value where hours are > “24” or minutes > “59” Explanation: Suitable explanation Note: Accept times that would also be invalid for the given scenario.	**2**

6(c)	'Pseudocode' solution included here for development and clarification of mark scheme.
	Programming language example solutions appear in the Appendix.
	
	`PROCEDURE GetTotals()`
	
	`  DECLARE BoatNum : INTEGER`
	`  DECLARE Paid : REAL`
	`  DECLARE FileLine : STRING`
	
	`  FOR BoatNum ← 1 TO 17`
	`  Total[BoatNum] ← 0`
	`  ENDFOR`
	
	`  OPENFILE "Hirelog.txt" FOR READ`
	
	`  WHILE NOT EOF("Hirelog.txt")`
	`  READFILE "Hirelog.txt", FileLine`
	`  BoatNum ← STRING_TO_NUM(LEFT(FileLine, 2))`
	`  Paid ← STRING_TO_NUM (RIGHT(FileLine,__`
	`  LENGTH(Fileline) - 8))`
	`  Total[BoatNum] ← Total[BoatNum] + Paid`
	
	`  ENDWHILE`
	
	`  CLOSEFILE "Hirelog.txt"`
	
	`ENDPROCEDURE`
	
	One mark for each of the following:
	
	1 Procedure heading and ending (where appropriate) with no parameters
	2 Initialisation of elements in `Total` array
	3 `OPEN "Hirelog.txt"` in read mode and `CLOSE` after use
	4 Loop until `EOF()`
	5 Read line from file **in a loop**
	6 Extract **and** convert `BoatNum`
	7 Extract **and** convert `Paid`
	8 Update appropriate array total **in a loop**
		8

Program Code Example Solutions
To be reviewed at STM

Q5(b)(i): Visual Basic

```
Sub BubbleSort()
  Dim Temp As String
  Dim NoSwaps As Boolean
  Dim Boundary, J As Integer

  Boundary = 999
  Do
     NoSwaps = TRUE
     For J = 1 To Boundary
        If Contact(J) > Contact(J+1) Then
           Temp = Contact(J)
           Contact(J) = Contact(J+1)
           Contact(J+1) = Temp
           NoSwaps = FALSE
        End If
     Next
     Boundary = Boundary - 1
  Loop Until NoSwaps = TRUE

End Sub
```

Q5(b)(i): Pascal

```
procuedre BubbleSort()
var
  Temp : String;
  NoSwaps : Boolean;
  Boundary, J : Integer;

  Boundary := 999
  repeat
  begin
     NoSwaps := TRUE
     for J := 1 to Boundary do
     begin
        if Contact[J] > Contact[J+1]then
        begin
           Temp := Contact[J];
           Contact[J] := Contact[J+1];
           Contact[J+1] := Temp;
           NoSwaps := FALSE;
        end;
     end;

     Boundary := Boundary - 1
  end;
  until NoSwaps = TRUE;

End Sub
```

Q5(b)(i): Python

```
def BubbleSort()
  # Temp : String
  # NoSwaps : Boolean
  # Boundary, J : Integer

  Boundary = 999
  NoSwaps = TRUE

  while NoSwaps == TRUE:
     NoSwaps = TRUE
     For J in range(Boundary + 1)
        If Contact[J] > Contact[J+1]:
           Temp = Contact[J]
           Contact[J] = Contact[J+1]
           Contact[J+1] = Temp
           NoSwaps = FALSE

     Boundary = Boundary - 1

End Sub
```

Q6(c): Visual Basic

```
Sub GetTotals()

  Dim BoatNum As Integer
  Dim Paid As Real
  Dim File As StreamReader("Hirelog.txt")

  For BoatNum = 1 To 17
     Total(BoatNum) = 0
  Next


  Do While File.Peek >= 0
     FileLine = File.ReadLine()
     BoatNum = CInt(Left(FileLine, 2))
     Paid = CSng(Right(FileLine, Len(Fileline) - 8))
     Total(boatnumber) = Total(boatbnumber) + Paid
   Loop

   File.Close()

End Sub
```

Q6(c): Pascal

```
procedure GetTotals()

var
  BoatNum : Integer;
  Paid : Real;
  MyFile : testfile;


  for BoatNum := 1 to 17 do
     Total[BoatNum] := 0;


  assignFile(MyFile, "Hirelog.txt");
  reset(MyFile);

  while not eof(MyFile) do
  begin
     readln(MyFile, FileLine);
     BoatNum = StrToInt(copy(FileLine, 1, 2));
     Paid = StrToFloat(copy(FileLine, 9, length(Fileline) - 8));
     Total(boatnumber) = Total(boatbnumber) + Paid;
  end;

  close(MyFile)

end;
```

Alternative FreePascal string functions) :

```
   BoatNum := LeftStr(FileLine, 2);

   Paid := StrToFloat(RightStr(FileLine, length(Fileline) - 8));
```

Q6(c): Python

```
def GetTotals()

  # BoatNum : Integer
  # Paid : Real
  # File : File Handle
  # FileData : String


  For BoatNum in range (1, 18)
     Total[BoatNum] = 0
  Next

  File = open("Hirelog.txt", "r")
  FileData = File.readline()
     while FileData != "":
        FileLine = File.ReadLine()
        BoatNum = int(FileLine[1, 3])
        Paid = float(FileLine[8, len(Fileline) - 7))
        Total[boatnumber] = Total[boatbnumber] + Paid
        FileData = File.readline()

  File.Close()
```