Cambridge Assessment International Education

Cambridge International AS & A Level

COMPUTER SCIENCE **9608/23**

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

MARK SCHEME

Maximum Mark: 75

Published

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)	When: when designing a solution to a problem Purpose: to describe the solution as a sequence of steps / actions One mark per answer Accept equivalent phrase for 'purpose' but reject specific programming references	**2**
1(b)	Testing a condition to determine the sequence of execution One mark per underlined phrase (or equivalent)	**2**
1(c)	Explanation: Breaking a problem down into sub tasks Reason: Make the problem easier to solve // to make the solution easier to implement / test / maintain	**2**
1(d)	• Breakpoints • Single-stepping • Watch window Max 2	**2**

Question	Answer	Marks
2(a)	• Sequence of (module) execution • Module Iteration • Module selection One mark per item Max 2	**2**
2(b)(i)	`FUNCTION ModuleB (ParX : INTEGER) RETURNS BOOLEAN` One mark for each underlined part Ignore `BYVALUE` for `ParX`	**3**

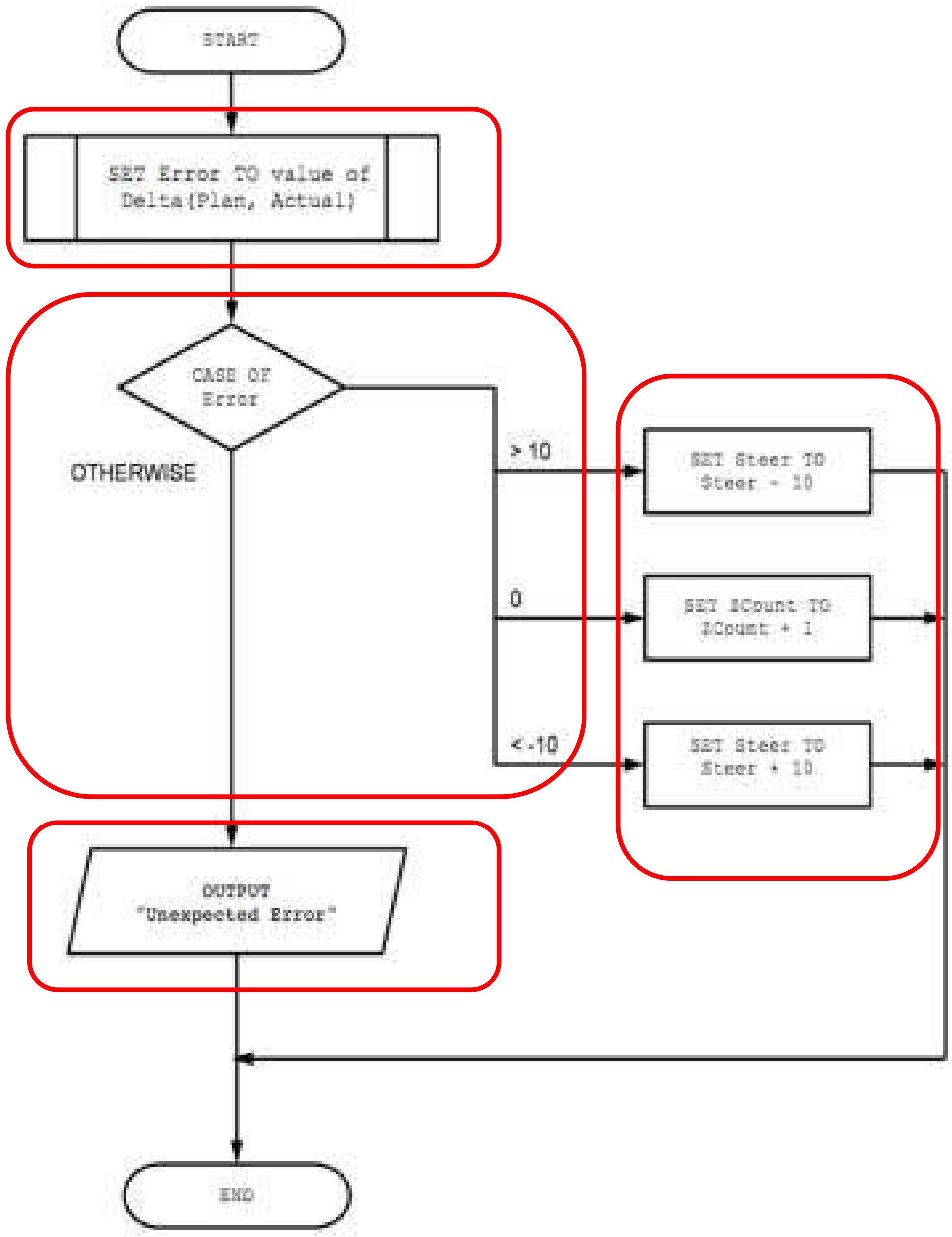
2(b)(ii)	`PROCEDURE ModuleC (BYREF ParW: REAL, BYVALUE ParZ : STRING)`
	
	One mark for each underlined part
	`BYVALUE` not essential for `ParZ`
		3

Question	Answer	Marks

2(c)	
	```
	DECLARE Index, Count : INTEGER
	Count ← 0
	FOR Index ← 1 TO 50
	   IF Item[Index, 1] = SearchString
	      THEN
	         Count ← Count + 1
	   ENDIF
	   IF Item[Index, 2] = SearchString
	      THEN
	         Count ← Count + 1
	   ENDIF

	ENDFOR

	OUTPUT "The number of times SearchString found: ", Count
	```
	Alternative
	```
	DECLARE I, J, Count : INTEGER
	Count ← 0
	FOR I ← 1 TO 50
	   FOR J ← 1 TO 2
	      IF Item[I, J] = SearchString
	         THEN
	            Count ← Count + 1
	      ENDIF
	    ENDFOR
	ENDFOR
	OUTPUT "The number of times SearchString found: ", Count
	```
	One mark for each of the following:
	
	1 Initialisation of `Count`
	2 `FOR` loop
	3 Check column 1 element **and** increment count
	4 Check column 2 element **and** increment count // nested loops
	5 OUTPUT Count together with suitable mesage
		5

Question	Answer	Marks
3(a)	 START SET Error TO value of Delta(Plan, Actual) CASE OF Error OTHERWISE > 10 0 < -10 SET Steer TO Steer - 10 SET $Count TO $Count + 1 SET Steer TO Steer + 10 OUTPUT "Unexpected Error" END Mark as follows: • One mark for START and END • One mark per area outlined All outputs from CASE must be labelled	5
3(b)(i)	Error 1 • Index stops at 5 – shoud go to 6. Fails to loop correctly through all characters of string (lines 26 to 38) // Final values for `NumUpper` is not as expected (because of loop error) Error 2 • Trace table row 12 – `NumOther` assigned wrong value. 0 expected not 3 One mark per bullet	2

Question	Answer	Marks
3(b)(ii)	**Error 1** Line Number: 26 Correction: `FOR Index ← 1 to StrLen` **Error 2** Line Number: 41 Correction: `NumOther ← StrLen –(NumDigit + NumUpper)` One mark for each line number with correction	**2**
3(c)	Data Structure	**1**

Question	Answer	Marks

4(a)	'Pseudocode' solution included here for development and clarification of mark scheme.
	Programming language example solutions appear in the Appendix.
	
	`FUNCTION Extract(InString : STRING) RETURNS STRING`
	`  DECLARE Name : STRING`
	`  DECLARE NextChar : CHAR`
	`  DECLARE Index : INTEGER`
	`  CONSTANT COLON = ':'`
	`  Index ← 1`
	`  Name ← ""`
	`  NextChar ← LEFT(InString, 1)`
	
	`   WHILE NextChar <> COLON`
	`      Name ← Name & NextChar`
	`      Index ← Index + 1`
	`      NextChar ← MID(InString, Index, 1)`
	`  ENDWHILE`
	
	`  RETURN Name`
	
	`ENDFUNCTION`
	
	Alternative:
	
	`FUNCTION Extract(InString : STRING) RETURNS STRING`
	`  DECLARE Name : STRING`
	`  DECLARE Index : INTEGER`
	`  CONSTANT COLON = ':'`
	`  Index ← 1`
	
	`  WHILE MID(InString, Index, 1)<> COLON`
	`      Index ← Index + 1`
	`  ENDWHILE`
	
	`  Name ← LEFT(InString, Index)`
	`  RETURN Name`
	
	`ENDFUNCTION`
	
	Mark as follows:
	1 Function heading and ending (where required) including parameters
	2 Extract (next) character from `InString`
	3 Conditional loop while character is not colon
	4 Append character to `Name` **and** increment `Index` **in a loop** // calculate substring length and use LEFT() **after loop**
	5 RETURN `Name` (may be combined with alternative mp 4)
		5

Question	Answer	Marks

4(b)	Two alternatives:
	
	Alternative #1
	
	Header:
	`PROCEDURE Extract (BYREF Name : STRING, BYREF Email : STRING, BYVALUE DataItem : STRING)`
	
	Explanation:
	Could additionally pass the name and email address to the procedure using BYREF. Procedure would extract name and email and assign values to BYREF parameters; these would then be available to calling program.
	
	Alternative #2
	
	Header:
	`PROCEDURE Extract (DataItem : STRING)`
	
	Explanation:
	
	Declare new global variables for the name and email address. These could be assigned values within the new procedure and these values would be used by the calling program.
	
	Mark as follows:
	• Two marks for header – must be a Procedure not a Function (but see note below)
	• Max Two marks for explanation
	
	Note:
	Allow solution based on user-defined record type / record item returned from modified function.
	
	Max 3
		3

Question	Answer	Marks

5(a)	
	```
	FUNCTION GetLastService(BoatNum : STRING) RETURNS STRING
	  DECLARE LastService, FileData : STRING

	  LastService ← ""

	  OPEN "ServiceLog.txt" FOR READ

	  WHILE NOT EOF("ServiceLog.txt")
	    READFILE "ServiceLog.txt", FileData
	    IF LEFT(FileData, 2) = BoatNum
	       THEN
	          LastService ← RIGHT(FileData, 8)
	    ENDIF

	  ENDWHILE

	Close "ServiceLog.txt"

	RETURN LastService

	// Most recent service will be the last one read

	ENDFUNCTION
	```
	1 mark for each of the following:
	
	1 Function heading and ending including parameters
	2 Declaration of variables for `LastService` and `FileData`
	3 Open file in read mode **and** close
	4 Conditional loop - while not `EOF()`
	5 Read line from file **in a loop**
	6 Compare `BoatNum` with data from file **in a loop**
	7 If matched, assign value to `LastService` **in a loop**
	8 Return `LastService`
		8

Question	Answer	Marks

5(b)(i)	
	```
	FUNCTION GetHours(BNum, SDate, : STRING)RETURNS REAL

	  DECLARE FileData, HString : STRING
	  DECLARE TotHours : REAL
	  DECLARE HLength : INTEGER

	  TotHours ← 0

	  OPEN "HireLog.txt" FOR READ

	  WHILE NOT EOF("HireLog.txt")
	    READFILE "HireLog.txt" FileData
	    IF MID(FileData, 9, 2) = BNum
	      THEN
	        IF LEFT(FileData, 8) > SDate
	          THEN
	            HLength ← LENGTH(Filedata) - 10
	            HString ← RIGHT(Filedata, HLength)
	            TotHours ← TotHours + STRING_TO_NUM(HString)
	        ENDIF
	    ENDIF

	  ENDWHILE

	Close "HireLog.txt"

	RETURN TotHours

	ENDFUNCTION
	```
	1 mark for each of the following:
	
	1 Function heading and ending including parameters
	2 Declaration of `TotHours` as integer
	3 ...and initialisation to zero
	4 Extract **and** compare `BoatNum` …
	5 … extract date **and** compare to `ServData` and if later then...
	6 ... extract `HireDuration` and …
	7 … convert `HireDuration` to REAL and sum `TotHours`
	8 Return `TotHours`
		8

Question	Answer	Marks
5(b)(ii)	Three *different* tests String example 1 • String: "007" • Reason: Too many characters String example 2 • String: "4x" • Reason: String does not represent a numeric value / contains an illegal character String example 3 • String: "25" • Reason: number outside range 1 to 20 Illegal character can only be used in one test One mark for string plus one for corresponding explanation	**6**

Question	Answer	Marks

5(c)	'Pseudocode' solution included here for development and clarification of mark scheme.
	Programming language example solutions appear in the Appendix.
	
	`PROCEDURE ServiceList(MaxHours : INTEGER)`
	
	  `DECLARE BoatNum, Hours : INTEGER`
	  `DECLARE LastService : STRING`
	  `DECLARE Due : BOOLEAN`
	
	  `Due ← FALSE`
	  `OUTPUT "Boat Service List"`
	
	  `FOR BoatNum ← 1 TO 20`
	    `LastService ← GetLastService(NUM_TO_STRING(BoatNum))`
	    `Hours ← GetHours(NUM_TO_STRING(BoatNum),LastService)`
	      `IF Hours > MaxHours`
	        `THEN`
	          `OUTPUT NUM_TO_STRING(Boatnum) & ": "__`
	                 `& NUM_TO_STRING(Hours)`
	          `Due ← TRUE`
	      `ENDIF`
	
	  `ENDFOR`
	
	  `IF Due = TRUE`
	    `THEN`
	      `OUTPUT "No boats are due to be serviced"`
	  `ENDIF`
	`ENDPROCEDURE`
	
	One mark for each of the following:
	
	1 Procedure heading and ending (where appropriate) including parameter
	2 Output "report header" line **not in a loop**
	3 Loop from 1 to 20
	4 Call `GetLastService`
	5 Call `GetHours`
	6 Check return value from `GetHours` > `MaxHours`
	7 Suitable Output statement **in a loop**
	8 Mechanism to initialise, count **and** produce final output if no boats to be serviced
		8

5(d)(i)	One mark per bullet point • The use of tried and tested (library) subroutines • The use of modular programming (to break the problem down and make it easier to solve) • The use of programming practice to make the code easier to read (e.g. format, use of sensible variable names) Max 2	**2**

Question	Answer	Marks
5(d)(ii)	One mark per bullet point • Testing may be carried out before the modules are developed // not ready for full testing • Module stubs contain simple code to provide a known response // temporary replacement for a called module / return a fixed value / output a message to confirm the module has been called	**2**
5(d)(iii)	One mark per bullet point • Executes a line of code at a time • Used to trace the path of execution (sequence) • Track variable values using a watch window Max 2	**2**

Program Code Example Solutions

Q4(a): Visual Basic

```
Function Extract(InString As String) As String
  Dim Name As String
  Dim NextChar As Char
  Dim Index As Integer
  Const COLON = ':'

  Index = 1
  Name = ""
  NextChar = Left(InString, 1)

   While NextChar <> COLON
      Name = Name & NextChar
      Index = Index + 1
      NextChar = Mid(Instring, Index, 1)
   Loop

  Return Name

End Function

Function Extract(InString As String) As String
  Return Mid(Instring, 1, Instring.IndexOf(":"))
End Function
```

Q4(a): Pascal

```
function extract(InString : string) : string;
var
   Name : string;
   NextChar : char;
   Index : integer;

const
  COLON = ':';

  Index := 1;
  Name := "";
  NextChar := copy(InString, 1, 1);

  While NextChar <> COLON do
  begin
     Name := Name & NextChar;
     Index := Index + 1;
     NextChar := copy(Instring, Index, 1);
  end;

  extract := Name;

end;
```

Q4(a): Python

```
def Extract(InString)
  # Name : String
  # NextChar : Char
  # Index : Integer

  COLON = ':'

  Index = 1
  Name = ""
  NextChar = InString[1:2]

   While NextChar <> COLON:
      Name = Name + NextChar
      Index = Index + 1
      NextChar = Instring[index, Index + 1]

  Return Name
```

Q5(c): Visual Basic

```
Sub ServiceList(MaxHours As Integer)

  Dim BoatNum, Due As Integer
  Dim LastService As String

  Due = 0
  console.writeline("Boat Service List")

  For BoatNum = 1 To 20
     LastService = GetLastService(CStr(BoatNum))
     Hours = GetHours(CStr(BoatNum), LastService)
     If Hours > MaxHours Then
        Console.Writeline(CStr(Boatnum) & ": " & CStr(Hours))
        Due = Due + 1
     End If
  Next

  If Due = 0 Then
     Console.Writeline("No boats are due to be serviced")
  End If

End Sub
```

Q5(c): Pascal

```
procedure ServiceList(MaxHours : Integer)

var
  BoatNum, Due : integer;
  LastService : string;

  Due := 0
  print("Boat Service List")

  for BoatNum := 1 to 20 do
  begin
     LastService := GetLastService(CInt(BoatNum));
     Hours := GetHours(BoatNum, Lastservice);
        If Hours > MaxHours then
        begin
           writeln(IntToStr(Boatnum) & ": " & IntToStr(Hours));
           Due := Due + 1;
        end;
  end;

  If Due = 0 then
     writeln ("No boats are due to be serviced")
  End If
End Sub
```

Q5(c): Python

```
def ServiceList(MaxHours)

  # BoatNum, Due : Integer
  # LastService : String

  Due = 0
  print("Boat Service List")

  For BoatNum in range(1, 21):
     LastService = GetLastService(str(BoatNum))
     Hours = GetHours(BoatNum, LastService)
     if Hours > MaxHours:
        print(str(Boatnum) & ": " & str(Hours))
        Due = Due + 1


  if Due == 0:
     print"No boats are due to be serviced")
```