Cambridge Assessment
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COMPUTER SCIENCE **9608/42**

Paper 4 Further Problem-solving and Programming Skills **May/June 2021**

MARK SCHEME

Maximum Mark: 75

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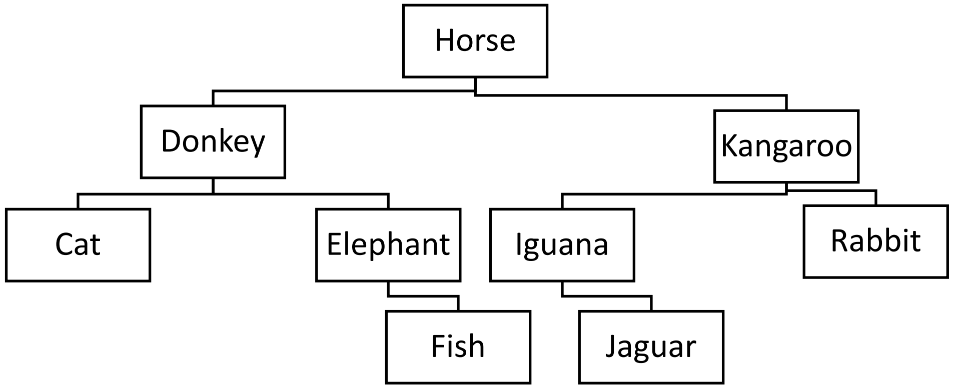
[Turn over

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)	Horse	**1**
1(b)	Cat // Elephant // Kangaroo	**1**
1(c)	1 mark for Iguana and Jaguar in the correct place 1 mark for Rabbit and Fish in the correct place  Horse Donkey Kangaroo Cat Elephant Iguana Rabbit Fish Jaguar	**2**
1(d)	1 mark per bullet point. Mark in pairs. • (Compare Elephant to horse) **Elephant/E** is **less** than **Horse/H** so check/go **left** … • … (Compare to Elephant to Donkey) **Elephant/E** is **greater** than **Donkey/D** so check/go **right** (Elephant found) or • Check if **Elephant/E** is **less than** or **greater than root** node … • … check **subtree**/follow pointer to next node to left/right **recursively** until **found** or **leaf**	**2**

Question	Answer	Marks

2(a)	1 mark each:
	• **booking** record declaration (and end) …
	• … defining all 4 fields with integer data types
	
	`TYPE Booking`
	`  DECLARE BookingID : INTEGER`
	`  DECLARE CustomerID : INTEGER`
	`  DECLARE ItemID : INTEGER`
	`  DECLARE Quantity : INTEGER`
	`ENDTYPE`
		2

2(b)(i)	1 mark per bullet point
	• Function header and close taking a booking ID as parameter **AND** return the calculated value
	• Calculating hash value correctly using parameter
	
	Example code
	VB.NET
	`Function Hash(BookingID)`
	`  Hash = BookingID Mod 100000 + 3`
	`End Function`
	
	Python
	`def Hash(BookingID):`
	`  HashV = BookingID % 100000 + 3`
	`     return HashV`
	
	Python alternative: `MOD(BookingID, 1000000) + 3`
	
	Pascal
	`Function Hash(BookingID:Integer):Integer`
	`begin`
	`  Hash := BookingID MOD 100000 + 3`
	`end;`
		2

Question	Answer	Marks
2(b)(ii)	1 mark for both correct hash values **Booking ID** / **Hash value** 5012345 / 12348 8212350 / 12353	**1**

Question	Answer	Marks

2(c)	1 mark per bullet point to max 7
	• Function heading, taking a booking record as parameter
	• Use `Hash()` to calculate hash with Booking ID of the parameter
	• … storing/using return value from `Hash()`
	• Open "`TheBookings.dat`" for **random** access
	• Go to location of returned hash value
	• Check if there is already a record present …
	• … if empty, put the record in the location **and** return `TRUE`
	• … otherwise return `FALSE` **and** do not store the
	• Close the opened file **in all circumstances**
	
	Example pseudocode
	`FUNCTION StoreBooking(BookingRecord : Booking) RETURNS Boolean`
	`  RecordLocation ← Hash(BookingRecord.BookingID)`
	`  Filename ← "TheBookings.dat"`
	`  OPENFILE Filename FOR RANDOM`
	`  SEEK Filename, RecordLocation`
	`  GETRECORD Filename, RecordData`
	`  IF RecordData = NULL`
	`    THEN`
	`      PUTRECORD Filename, BookingRecord`
	`      CLOSE Filename`
	`      RETURN True`
	`    ELSE`
	`      CLOSE Filename`
	`      RETURN False`
	`  ENDIF`
	`ENDFUNCTION`
		7

Question	Answer	Marks
2(d)	1 mark per bullet point to max 2 e.g. • Catch if the file does not exist // Catch wrong path … • Catch if at end of file // check if no data in file … • Check if file is already open … • … so the program does not crash • … output an appropriate message • … so null data is not accessed	**2**

Question	Answer	Marks

3(a)	1 mark per bullet point max 4
	• Class `QuizClass` header (and end where appropriate)
	• Constructor header (and end where appropriate) Ignore any parameters
	• Private questions array of size 20, of type `QuestionClass`
	• Private attribute `NumberOfQuestions` as type integer **and** initialising to 0 in constructor
	
	Example code
	
	VB.NET
	`Class QuizClass`
	`   Private Questions(19) As QuestionClass`
	`   Private NumberOfQuestions As Integer`
	
	`   Public Sub New()`
	`     NumberOfQuestions = 0`
	`   End Sub`
	`End Class`
	
	Python
	`class QuizClass():`
	`  #Private Questions[20] self.__QuestionClass`
	`  #Private self.__NumberOfQuestions Integer`
	`  def __init__(self):`
	`    self.__NumberOfQuestions = 0`
		4

Question	Answer	Marks

3(a)	**Pascal**
	`type QuizClass = class`
	`  private`
	`    NumberOfQuestions: Integer;`
	`    Questions : array[0..19] of QuestionClass;`
	`  public`
	`    Constructor init();`
	`  end;`
	`  Constructor QuizClass.init();`
	`  begin`
	`    NumberOfQuestions := 0;`
	`  end;`	

Question	Answer	Marks

3(b)	1 mark per bullet point to max 4
	• Function header and close, taking parameter of type `QuestionClass` if data type given
	• Checking if array is full …
	• …returning `FALSE` if it is full
	• (otherwise) store object in next position in array // append to array…
	• …increment `NumberOfQuestions` **and** return `TRUE`
	
	Example code
	
	VB.NET
	`Public Function AddQuestion(QuestionObject)`
	`  If NumberOfQuestions < 20 Then`
	`    Questions(NumberOfQuestions) = QuestionObject`
	`    NumberOfQuestions = NumberOfQuestions + 1`
	`    return True`
	`  Else`
	`    return False`
	`  End If`
	`End Function`
	
	Python
	`def AddQuestion(self, QuestionObject):`
	`  if self.__NumberOfQuestions < 20:`
	`    self.__Questions[self.__NumberOfQuestions] = QuestionObject`
	`    self.__NumberOfQuestions = self.__NumberOfQuestions + 1`
	`    return True`
	`  else:`
	`    return False`
		4

Question	Answer	Marks

3(b)	**Pascal**
	`Function AddQuestion(QuestionObject:QuestionClass):Boolean;`
	`begin`
	`  if NumberOfQuestions < 20 then`
	`    Questions[NumberOfQuestions] := QuestionObject;`
	`    NumberOfQuestions := NumberOfQuestions + 1;`
	`    return True;`
	`  else`
	`    return False;`
	`end;`	

3(c)	1 mark per bullet
	• Instance of `QuizClass` …
	• … with no parameters with identifier `FirstQuiz`
	• Instance of `QuestionClass` …
	• … with correct parameters and identifier `Question1`
	• Question added to `FirstQuiz` using function `AddQuestion`
	
	Example code
	
	VB.NET (Does not require New keyword)
	`Dim FirstQuiz As QuizClass = New QuizClass()`
	`Dim Question1 As QuestionClass = New QuestionClass("What is 100/5?", "20", 1)`
	`FirstQuiz.AddQuestion(Question1)`
	
	Python
	`FirstQuiz = QuizClass()`
	`Question1 = QuestionClass("What is 100/5?", "20", 1)`
	`FirstQuiz.AddQuestion(Question1)`
	
	Pascal
	`FirstQuiz := QuizClass.Create();`
	`Question1 := QuestionClass.Create("What is 100/5?", "20", 1);`
	`FirstQuiz.AddQuestion(Question1);`
		5

3(d)	Containment	**1**

Question	Answer	Marks
3(e)(i)	1 mark for interpreter, 1 mark for compiler Interpreter: • Writing the code // debugging // when testing for errors Compiler: • Program is complete // program needs distributing // program is bug-free // user acceptance stage // beta testing stage // writing the program // when debugging	**2**
3(e)(ii)	1 mark for each suitable facility to max 2 e.g. • Break-point • Stepping // step over // step through • (Variable/expression) watch window	**2**

Question	Answer	Marks
3(e)(iii)	1 mark per bullet point to max 2. Mark in pairs/groups. e.g. • Pretty print // colour coding • Colours key words in different colours • So you can see where there are errors • Syntax error highlighting // Dynamic syntax check • Highlights/underlines syntax errors • So you can correct them as you program • Auto-complete • automatically adds closing statements • Saves the user typing these terms • Context sensitive prompts • Displays possible code for the user to select from • So they do not make mistakes • Auto-indent • Moves the code to the correct location • So that it is easier to read • So that the correct code is inside each construct • Auto-correct • Changes spelling mistakes • To reduce syntax errors • Collapse/expand modules • Allows you to hide sections of code • To make it easier to read the code you are focused on	**2**

Question	Answer	Marks

4(a)	1 mark for correct items in the queue
	1 mark for correct `HeadIndex`
	1 mark for `TailIndex`
	
	| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
	| 50 | | | | 89 | 500 | 23 | 2 | 23 | 100 |
	
	`HeadIndex: 4`
	`TailIndex: 1`
		3

4(b)(i)	1 mark for each completed statement (in bold)
	
	`FUNCTION Enqueue(BYVAL DataToInsert : INTEGER) RETURNS BOOLEAN`
	`    IF NumberInQueue > `**`9  // = 10`**
	`      THEN`
	`         RETURN False`
	`      ELSE`
	`         MyNumbers[`**`TailIndex`**`] ← `**`DataToInsert`**
	`         TailIndex ← `**`TailIndex + 1`**
	
	`         IF TailIndex > 9`
	`            THEN`
	`               TailIndex ← `**`0`**
	`         ENDIF`
	`         NumberInQueue ← NumberInQueue + 1`
	`         RETURN True`
	`    ENDIF`
	`ENDFUNCTION`
		5

Question	Answer	Marks

4(b)(ii)	1 mark per bullet point max 5
	• Checking if queue is empty/full …
	• …and returning −1 if empty
	
	(Otherwise)
	• Incrementing `HeadIndex` …
	• …catching if it goes above 9 and setting to 0
	• Decrement `NumberInQueue`
	• returning **first** element
	
	Example pseudocode
	`FUNCTION Dequeue() RETURNS INTEGER`
	`  DECLARE ItemToReturn : INTEGER`
	`  IF NumberInQueue = 0`
	`    THEN`
	`      ItemToReturn ← -1`
	`    ELSE`
	`      ItemToReturn ← MyNumbers(HeadIndex)`
	`      IF HeadIndex = 9`
	`        THEN`
	`          HeadIndex ← 0`
	`        ELSE`
	`          HeadIndex ← HeadIndex + 1`
	`      ENDIF`
	`      NumberInQueue ← NumberInQueue - 1`
	`  ENDIF`
	
	`  RETURN ItemToReturn`
	`ENDFUNCTION`
		5

Question	Answer	Marks
5	1 mark for each completed statement (in bold)	**5**

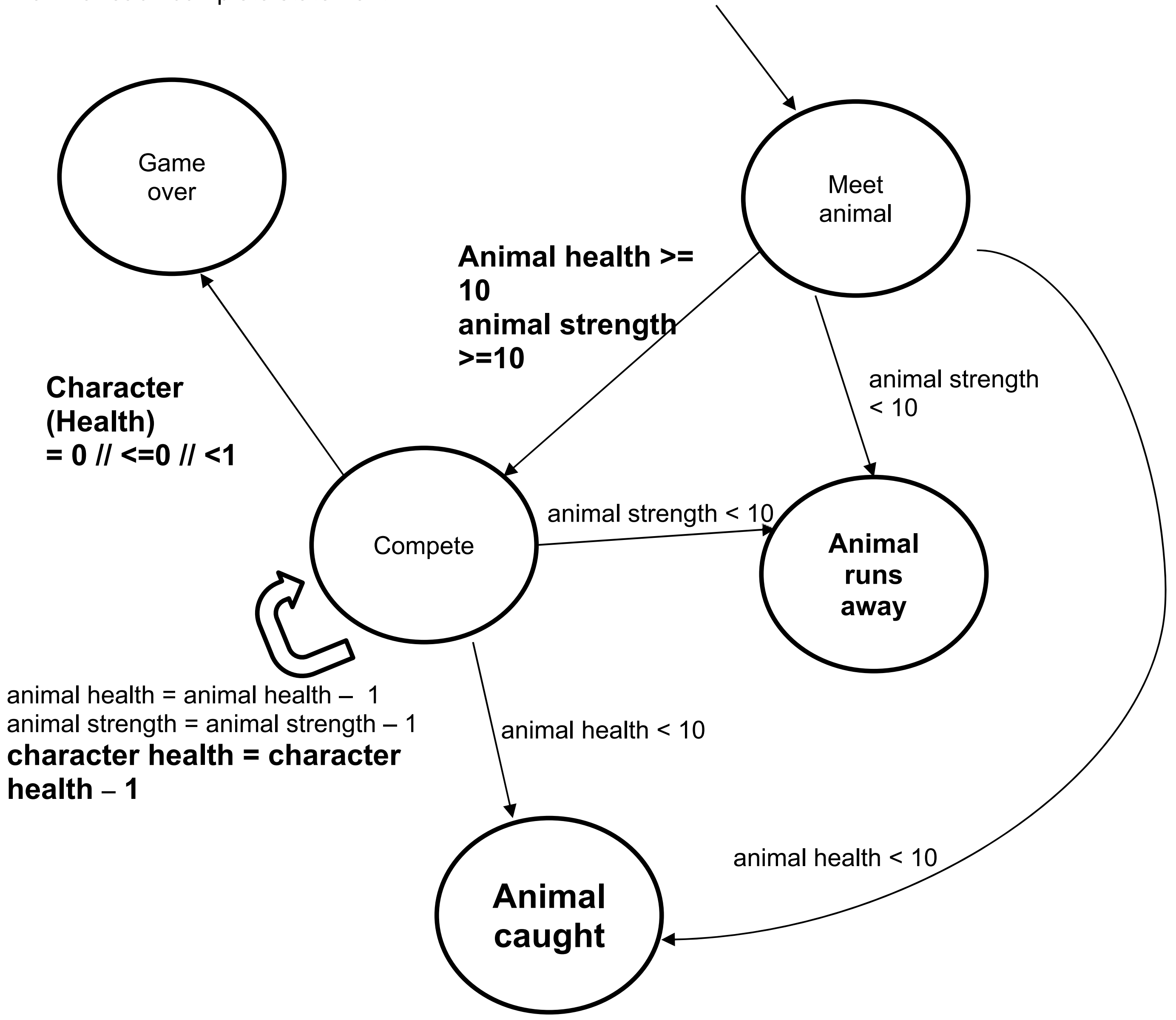
```
PROCEDURE InsertionSort()
  DECLARE Count : INTEGER
  DECLARE Counter : INTEGER
  DECLARE Temp : INTEGER

  Count ← 1
  WHILE Count < 10
    Temp = TheArray[Count]
    Counter = Count - 1

    WHILE Counter >= 0 AND TheArray[Counter] > Temp
      TheArray[Counter + 1] ← TheArray[Counter]
      Counter ← Counter - 1
    ENDWHILE
    TheArray[Counter + 1] ← Temp
    Count ← Count + 1
  ENDWHILE
ENDPROCEDURE
```

Question	Answer	Marks
6(a)	1 mark for each pair of columns/shaded area.	4

Available username	N	Y	N	Y	N	Y	N	Y
Suitable password	N	N	Y	Y	N	N	Y	Y
Age > 16	N	N	N	N	Y	Y	Y	Y
"Too young"	**Y**	**Y**	**Y**	**Y**	N	N	N	N
"Choose another username"	N	N	N	N	**Y**	N	**Y**	N
"Password does not meet requirements"	N	N	N	N	**Y**	**Y**	N	N

Question	Answer	Marks
6(b)	1 mark for each column	3

Available username	–	N	–					
Suitable password	–	–	N					
Age > 16	N	Y	Y					
"Too young"	Y	N	N					
"Choose another username"	N	Y	N					
"Password does not meet requirements"	N	N	Y					

Question	Answer	Marks
7	1 mark for each complete statement  Game over Meet animal Animal health >= 10 animal strength >=10 Character (Health) = 0 // <=0 // <1 animal strength < 10 Compete animal strength < 10 Animal runs away animal health = animal health – 1 animal strength = animal strength – 1 character health = character health – 1 animal health < 10 animal health < 10 Animal caught	**5**

Question	Answer	Marks
8	1 mark for each complete instruction, 1 mark for label LOOP	**5**

Instruction		
Label	**Op code**	**Operand**
	`LDR`	**`#0`**
`LOOP`	`LDX`	`character`
	`LSL`	**`#1`**
	`OUT`	
	`INC`	`IX`
	`LDD`	`count`
	`INC`	**`ACC`**
	`STO`	`count`
	`CMP`	`#3`
	`JPN`	`LOOP`
	`END`	
`count:`	`0`	
`Character:`	`B01000001`	
	`B10001110`	
	`B01000100`	