Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

8129320638

COMPUTER SCIENCE **0478/21**

Paper 2 Problem-solving and Programming **May/June 2021**

1 hour 45 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- **Do not attempt Tasks 1, 2 and 3** in the copy of the pre-release material on page 2; these are for information only.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- Calculators must **not** be used in this paper.

INFORMATION

- The total mark for this paper is 50.
- The number of marks for each question or part question is shown in brackets [ ].
- No marks will be awarded for using brand names of software packages or hardware.

This document has **16** pages. Any blank pages are indicated.

Section A

You are advised to spend no longer than 40 minutes answering this section.

Here is a copy of the pre-release material.

DO NOT attempt Tasks 1, 2 and 3 now.

Use the pre-release material and your experience from attempting the tasks before the examination to answer Question 1.

Pre-release Material

A system is required to record and count votes for candidates in school council elections. The voting system will allow for one representative to be elected from a tutor group. The school has between 28 and 35 students in each tutor group, five year groups named Year 7 to Year 11, and there are six tutor groups in each year group. Tutor group names are their year group followed by a single letter e.g. 7A, 7B, etc.

All students are allowed to vote in the system. Each student may only vote once for a representative from their tutor group in the election.

Write and test a program or programs for the voting system.

- Your program or programs must include appropriate prompts for the entry of data; data must be validated on entry.
- Error messages and other output need to be set out clearly and understandably.
- All variables, constants and other identifiers must have meaningful names.

You will need to complete these **three** tasks. Each task must be fully tested.

Task 1 – Setting up the voting system to allow a tutor group to elect a representative.
Write a program to:

- allow the tutor to enter the name of the tutor group
- allow the tutor to enter the number of students in the tutor group
- allow the tutor to enter the number of candidates in the election; maximum of four candidates
- allow the tutor to enter the names of the candidates and store them in a suitable data structure
- allow each student to input their vote or to abstain
- count the votes for each candidate and student abstentions.

When all students have voted, display the name of the tutor group, the votes for each candidate and the name of the candidate who has won the election. If there is a tie for first place, display all candidates with the equal highest number of votes.

Task 2 – Checking that students only vote once.
Each student is given a unique voter number by their teacher.
Extend **Task 1** to achieve the following:

- Allow students to enter their unique voter number before casting their vote.
- Check whether the student has already voted:
  - if so, supply a suitable message and do **not** allow them to vote.
  - if not, store the unique voter number, but **not** their vote, in a suitable data structure, and add their vote to the relevant candidate count or abstention.

Task 3 – Showing statistics and dealing with a tie.
Extend **Task 2** to achieve the following:

- Calculate the percentage of the votes that each candidate received from the number of votes cast, excluding abstentions.
- Display the name of each candidate, the number of votes and the percentage of votes they received from the number of votes cast, excluding abstentions.
- Display the total number of votes cast in the election and the number of abstentions.
- In the event of a tie, allow the election to be immediately run again, with only the tied candidates as candidates, and all the students from the tutor group voting again.

1 **(a)** All variables, constants and other identifiers must have meaningful names.

(i) Identify **one** constant you could have used for **Task 1**, give the value that would be assigned to it and its use.

Constant .....

Value .....

Use .....

.....

.....

[3]

(ii) Identify **one** variable and **one** array you could have used for **Task 1**.
Explain the use of each one.

Variable .....

Use .....

.....

.....

Array .....

Use .....

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[4]

(b) Explain how you should change your program in **Task 1** to allow a tutor to enter up to eight candidates for the election.

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(c) Write an algorithm using pseudocode, programming statements **or** a flowchart to show how your program completes these parts of **Task 2**:

- Allows students to enter their unique voter number before casting their vote.
- Checks whether the student has already voted:
  - if so, supplies a suitable message and does **not** allow them to vote.
  - if not, stores the unique voter number, but **not** their vote, in a suitable data structure.

It is **not** necessary to show parts completed in **Task 1**, including counting of votes for each candidate.

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[5]

(d) Explain how your program completes these parts of **Task 3**:

- Calculate the percentage of the votes that each candidate received from the number of votes cast, excluding abstentions.
- Display the name of each candidate, the number of votes and the percentage of votes they received from the number of votes cast, excluding abstentions.
- Display the total number of votes cast in the election and the number of abstentions.

Any programming statements used in your answer must be fully explained.

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Section B

2 Tick (✓) **one** box in each row to identify if the statement is about **validation**, **verification** or **both**.

Statement	Validation (✓)	Verification (✓)	Both (✓)
Entering the data twice to check if both entries are the same.			
Automatically checking that only numeric data has been entered.			
Checking data entered into a computer system before it is stored or processed.			
Visually checking that no errors have been introduced during data entry.			

[3]

3 Name and describe the most appropriate programming data type for each of the examples of data given. Each data type must be different.

Data: `37`

Data type name .....

Data type description .....

.....

.....

Data: `Cambridge2021`

Data type name .....

Data type description .....

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Data: `47.86`

Data type name .....

Data type description .....

.....

.....

[6]

4 The pseudocode algorithm shown has been written by a teacher to enter marks for the students in her class and then to apply some simple processing.

```
Count ← 0
REPEAT
  INPUT Score[Count]
  IF Score[Count] >= 70
    THEN
      Grade[Count] ← "A"
    ELSE
      IF Score[Count] >= 60
        THEN
          Grade[Count] ← "B"
        ELSE
          IF Score[Count] >= 50
            THEN
              Grade[Count] ← "C"
            ELSE
              IF Score[Count] >= 40
                THEN
                  Grade[Count] ← "D"
                ELSE
                  IF Score[Count] >= 30
                    THEN
                      Grade[Count] ← "E"
                    ELSE
                      Grade[Count] ← "F"
                  ENDIF
              ENDIF
          ENDIF
      ENDIF
  ENDIF
  Count ← Count + 1
UNTIL Count = 30
```

(a) Describe what happens in this algorithm.

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..... [3]

(b) Write the pseudocode to output the contents of the arrays `Score[]` and `Grade[]` along with suitable messages.

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(c) Describe how you could change the algorithm to allow teachers to use it with any size of class.

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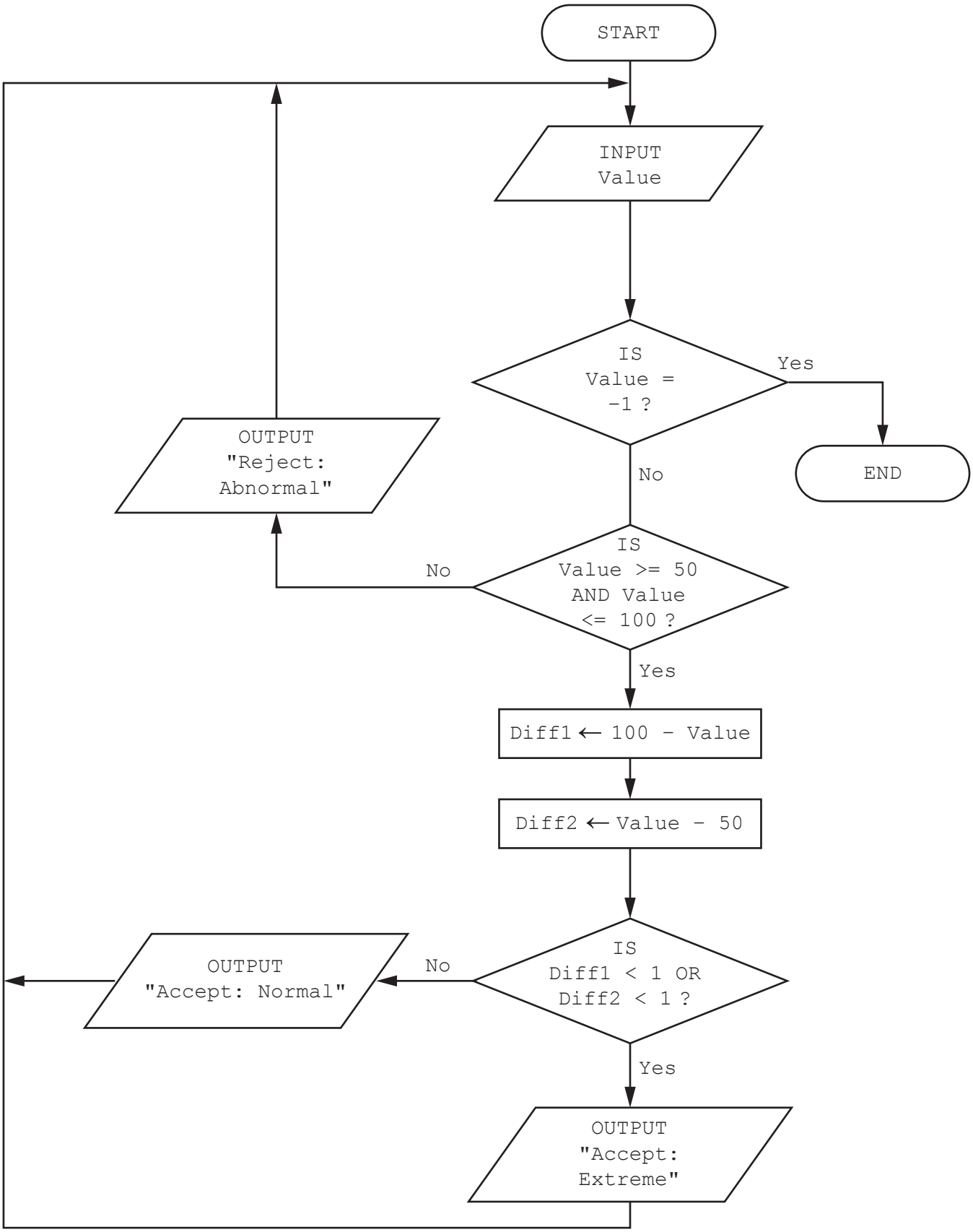
5 The flowchart represents an algorithm.

The algorithm will terminate if –1 is entered.



(a) Complete the trace table for the input data:

50, 75, 99, 28, 82, 150, –1, 672, 80

Value	Diff1	Diff2	OUTPUT

[4]

(b) Describe the purpose of the algorithm.

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..... [2]

6 A library uses a database table, GENRE, to keep a record of the number of books it has in each genre.

ID	GenreName	Total	Available	Loaned	Overdue
ABI	Autobiography	500	250	250	20
BIO	Biography	650	400	250	0
EDU	Education	20200	10000	10200	1250
FAN	Fantasy	1575	500	1075	13
GFI	General Fiction	35253	23520	11733	0
GNF	General Non-Fiction	25200	12020	13180	0
HFI	Historical Fiction	6300	3500	2800	0
HNF	Historical Non-Fiction	8000	1523	6477	0
HUM	Humour	13500	9580	3920	46
MYS	Mystery	26000	13269	12731	0
PFI	Political Fiction	23561	10523	13038	500
PNF	Political Non-Fiction	1823	750	1073	23
REF	Reference	374	374	0	0
ROM	Romance	18269	16800	1469	0
SAT	Satirical	23567	12500	11067	0
SCF	Science Fiction	36025	25000	11025	0
SPO	Sport	45720	32687	13033	3256
THR	Thriller	86000	46859	39141	0

(a) State the reason ID could be used as a primary key in the table GENRE.

.....

..... [1]

(b) State the number of records in the table GENRE.

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..... [1]

(c) Complete the query-by-example grid to display any genres with overdue books. Only display the ID, GenreName and Overdue fields in order of the number of books overdue from largest to smallest.

Field:					
Table:					
Sort:					
Show:	☐	☐	☐	☐	☐
Criteria:					
or:					

[4]

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Cambridge Assessment International Education

Cambridge IGCSE™

COMPUTER SCIENCE **0478/21**

Paper 2 **May/June 2021**

MARK SCHEME

Maximum Mark: 50

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 International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2021 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

[Turn over

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.

Please note the following further points:

The words in **bold** in the mark scheme are important text that needs to be present, or some notion of it needs to be present. It does not have to be the exact word, but something close to the meaning.

If a word is underlined, this **exact** word must be present.

A single forward slash means this is an alternative word. A double forward slash means that this is an alternative mark point.

Ellipsis (…) on the end of one-mark point and the start of the next means that the candidate **cannot** get the second mark point without being awarded the first one. If a MP has ellipsis at the beginning, but there is no ellipsis on the MP before it, then this is just a follow-on sentence and **can** be awarded **without** the previous mark point.

Question	Answer	Marks
	Section A	
1(a)(i)	Many correct answers. They must be meaningful and related to **Task 1.** The names are examples only. **One** mark per mark point • Constant MaxCandidates • Value 4 • Use The value of the maximum number of candidates for the election	**3**
1(a)(ii)	Many correct answers. They must be meaningful and related to **Task 1.** The names are examples only. **One** mark per mark point • Variable `NumberCandidates` • Use Storing the number of candidates in the election (for a tutor group) • Array `CandidateNames` • Use Storing the names of the candidates for the election	**4**
1(b)	**One** mark per mark point **(Max 4)** MP1 Change the value of the MaxCandidates constant/variable to 8 MP2 Change the input message to state the maximum number of candidates is 8 … MP3 …how your program changed the input message MP4 Change the loop limit to up to 8 … MP5 …how your program changed the loop limit MP6 Change the validation to allow input up to 8 … MP7 …how your program changed its validation check MP8 Change the array size(s) to ensure sufficient capacity to store up to 8 names … MP9 …how your program changed the array sizes MP10 Change the counters to ensure votes can be counted for up to 8 candidates … MP11 …how your program changed its counters	**4**

Question	Answer	Marks

1(c)	Any **five** from:
	MP1 Input with message to enter unique voter number
	MP2 Validation of (unique) voter number entered e.g. length check/type check/range check
	MP3 Attempt to check if voter number input is in list of possible voters
	MP4 Attempt to check if they have already voted
	MP5 If voter has already voted, message to warn them they can't vote
	MP6 Attempt at preventing them from voting
	MP7 Store voter number in a suitable data structure
	
	Example answer
	`OUTPUT "Please enter your unique voter number"`
	`INPUT UniqueVoterNumber`
	`FoundFlag ← False`
	`AllNumbersChecked ← False`
	`Counter ← 0`
	`WHILE FoundFlag = False AND AllNumbersChecked = False`
	`  IF StudentNumbers[Counter] = ""`
	`    THEN`
	`      AllNumbersChecked = True`
	`      StudentNumbers[Counter] ← UniqueVoterNumber`
	`    ELSE`
	`      IF UniqueVoterNumber = StudentNumbers[Counter]`
	`        THEN`
	`          FoundFlag = True`
	`          PRINT "Sorry, you have already voted"`
	`        ELSE`
	`          Counter = Counter + 1`
	`      ENDIF`
	`  ENDIF`
	`ENDWHILE`
	`IF FoundFlag = False`
	`  THEN`
	`    OUTPUT "Please enter the code of your chosen candidate"`
	`    INPUT Vote`
	`ENDIF`
		5

Question	Answer	Marks
1(d)	Explanation of how the program does the following: Any **four** from: MP1 Find out how many votes in total (for all candidates) were cast in the election. MP2 For each candidate MP3 … calculate the percentage of votes MP4 … excluding abstentions. MP5 Display the name of each candidate, the number of votes and the percentage of votes they received with appropriate messages. MP6 Display the number of votes cast and the number of abstentions with appropriate message.	**4**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td colspan="3">Section B</td></tr>
<tr><td>2</td><td>One mark per correct column
<table>
<tr><th>Statement</th><th>Validation</th><th>Verification</th><th>Both</th></tr>
<tr><td>Entering the data twice to check if both entries are the same.</td><td></td><td>✓</td><td></td></tr>
<tr><td>Automatically checking that only numeric data has been entered.</td><td>✓</td><td></td><td></td></tr>
<tr><td>Checking data entered into a computer system before it is stored or processed.</td><td></td><td></td><td>✓</td></tr>
<tr><td>Visually checking that no errors have been introduced during data entry.</td><td></td><td>✓</td><td></td></tr>
</table></td><td>3</td></tr>
</table>

Question	Answer	Marks

3	**One** mark per bullet point
	`37`
	• Data type name — Integer
	• Data type description — (Any) **whole number**
	
	`Cambridge2021`
	• Data type name — String
	• Data type description — A group of characters/text
	
	`47.86`
	• Data type name — Real
	• Data type description — (Any real) number that could be a whole number or a fraction
		6

Question	Answer	Marks
4(a)	**One** mark per mark point **(Max 3)** MP1 Marks input are **stored in the array** `Score[]` MP2 Marks are checked against a range of boundaries // allow example MP3 … and a **matching grade** is assigned to each mark that has been input MP4 … then **stored in the array** `Grade[]`… MP5 … at the same index as the mark input MP6 The algorithm finishes after 30 marks have been input // allows 30 scores to be entered	**3**

4(b)	**One** mark per mark point **(Max 3)**
	MP1 Correct loop, including counter if not a FOR loop
	MP2 Correct output of `Score[]`
	MP3 Correct output of `Grade[]`
	MP4 Suitable messages/text in output for both arrays
	
	Example answers
	`Count ← 0`
	`REPEAT`
	`  PRINT "Student: ", Count, " Mark: ", Score[Count], " Grade: ",Grade[Count]`
	`  Count ← Count + 1`
	`UNTIL Count = 30`
	
	`Count ← 0`
	`WHILE Count < 30 DO`
	`  PRINT "Student: ", Count, " Mark: ", Score[Count], " Grade: ",Grade[Count]`
	`  Count ← Count + 1`
	`ENDWHILE`
	
	`FOR Count ← 0 TO 29`
	`  PRINT "Student: ", Count, " Mark: ", Score[Count], " Grade: ", Grade[Count]`
	`NEXT`
		3

Question	Answer	Marks
4(c)	Any **three** correct statements **(Max 3)** e.g. MP1 Add an input facility to allow teachers to enter the class size MP2 Add a variable to store the input class size MP3 Use the class size variable as the terminating condition for the loop MP4 Make sure the arrays are sufficiently large to accommodate the largest possible class size	**3**

Question	Answer	Marks
5(a)	**One** mark for each correct column **(Max 4)**	**4**

`Value`	`Diff1`	`Diff2`	**OUTPUT**
50	50	0	Accept: Extreme
75	25	25	Accept: Normal
99	1	49	Accept: Normal
28			Reject: Abnormal
82	18	32	Accept: Normal
150			Reject: Abnormal
–1			

Question	Answer	Marks
5(b)	**One** mark per bullet point **(Max 2)** • To output the type of test data • … by performing a range check //… by checking if numbers are within the range 50 and 100 (inclusive) (or not).	**2**

Question	Answer	Marks
6(a)	The data in the ID column/field is unique/not repeated in each row/record	**1**
6(b)	18	**1**
6(c)		**4**

Field:	ID	GenreName	Overdue		
Table:	GENRE	GENRE	GENRE		
Sort:			Descending		
Show:	☑	☑	☑	☐	☐
Criteria:			>0		
or:					

One mark for the correct fields present and correctly named
One mark for correct table name and show box in all columns
One mark for correct sorting
One mark for correct search criterion