CAMBRIDGE IGCSE (0478)

Module O: Robust programs

Workbooklet · 6 parts · 125 marks

O1 and O4 are GCSE (OCR) only and not on 0478.

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	Total	**125**

MODULE O ROBUST PROGRAMS · O2

Input validation

Original practice questions · 21 marks · ~25 minutes · Cambridge 0478 syllabus 7.5(a), 7.7, 7.8, 7.9

Name _____ Date _____

Instructions. Answer all questions in the spaces provided. The marks for each part are shown in brackets [ ]. The total for this worksheet is **21 marks**. Write all algorithms in pseudocode. In all strings on this sheet, the first character is in position 1. All data on this sheet is made up.

1

Total: 2 marks

(a) Explain why a program should carry out validation checks on input data. **[2]**

2

Total: 4 marks

Each pseudocode statement in the table is used in a program to find invalid input data.

(a) Complete the table by writing the name of the validation check that each statement carries out. **[4]**

Pseudocode statement	Validation check
`IF (Height < 50) OR (Height > 250)`	
`IF LENGTH(TownName) > 30`	
`IF Surname = ""`	
`IF SUBSTRING(BatchCode, 3, 1) <> "/"`	

3 **Total: 4 marks**

A ferry company's booking system asks how many passengers are travelling in a vehicle. This algorithm validates the input.

```
01 REPEAT
02     INPUT Passengers
03     IF (Passengers < 1) OR (Passengers > 9)
04       THEN
05         OUTPUT "Error: enter a number from 1 to 9"
06     ENDIF
07 UNTIL (Passengers >= 1) AND (Passengers <= 9)
08 OUTPUT "Booked for ", Passengers, " passengers"
```

(a) Complete the trace table for the algorithm using the input data: 0, 12, 9, 4 **[3]**

You may not need to use all the rows.

Passengers	OUTPUT

(b) A user types the word `three` instead of a number. **[1]**

Identify the type of validation check that should be used to reject this input.

4

Total: 3 marks

A parcel locker asks a courier to enter the surname of the person a parcel is for. A surname must be from 2 to 30 characters long. This algorithm should keep asking until a valid surname is entered.

```
01 REPEAT
02     OUTPUT "Enter the surname"
03     INPUT Surname
04     IF (LENGTH(Surname) < 2) AND (LENGTH(Surname) > 30)
05       THEN
06         OUTPUT "Surname must be 2 to 30 characters"
07     ENDIF
08 UNTIL (LENGTH(Surname) > 2) AND (LENGTH(Surname) <= 30)
09 OUTPUT "Surname saved"
```

(a) There are **two** errors in the algorithm. **[2]**
Identify the line number of each error and suggest a correction for each error.

Line number	Correction

(b) Explain why the algorithm uses a `REPEAT ... UNTIL` loop and not only an `IF` statement. **[1]**

5

Total: 2 marks

A warehouse worker types the 7-digit product code `5018274` as `5081274`. Two of the digits have been swapped.

(a) Identify the validation check that could detect this error. **[1]**

(b) Explain why a length check would **not** detect this error. **[1]**

6 **Total: 6 marks**

An equipment-hire company puts an asset tag on each item it hires out. A valid asset tag:
- is exactly 7 characters long
- has the letter `H` as its first character, for example `H204913`.

(a) Write an algorithm using pseudocode to: **[6]**
- ask the user to enter an asset tag, and input it
- use a length check and a format check to validate the asset tag
- output an error message and make the user enter the asset tag again each time it is invalid
- output `Tag accepted` once a valid asset tag has been entered.

You do not need to declare any variables.

Total for this worksheet: 21 marks

MODULE O ROBUST PROGRAMS · O3

Validation vs verification

Original practice questions · 20 marks · ~25 minutes · Cambridge 0478 syllabus 7.5(b), 7.5(a), 7.7, 7.8, 7.9

Name _____ Date _____

Instructions. Answer all questions in the spaces provided. The marks for each part are shown in brackets [ ]. The total for this worksheet is **20 marks**. Write all algorithms in pseudocode. All data on this sheet is made up.

1

Total: 4 marks

(a) Tick (✓) **one** box in each row to show whether the statement describes **validation** or **verification**. **[4]**

Statement	Validation (✓)	Verification (✓)
The data shown on the screen is compared, by eye, with the paper form it was copied from.		
A delivery date is only accepted if it has been entered in the form DD/MM/YYYY.		
A check that the data entered is the same as the data that was meant to be entered.		
A quantity is rejected if it is not a whole number.		

2

Total: 4 marks

A clerk at a builders' merchant types the quantities from paper orders into a stock program. The program has a range check that accepts any quantity from 1 to 500 inclusive. One order is for 105 bags of sand, but the clerk types 150.

(a) Explain why the range check does not detect this mistake. **[2]**

(b) The program is changed so that the clerk must carry out a **visual check** on each quantity. Describe how the visual check would find this mistake. **[2]**

3

Total: 4 marks

A water company uses this algorithm when a customer service adviser enters a customer's account number.

```
01 DECLARE Entry1 : STRING
02 DECLARE Entry2 : STRING
03 DECLARE Attempts : INTEGER
04 Attempts ← 0
05 REPEAT
06     INPUT Entry1
07     INPUT Entry2
08     Attempts ← Attempts + 1
09     IF Entry1 <> Entry2
10       THEN
11         OUTPUT "Entries do not match, start again"
12     ENDIF
13 UNTIL Entry1 = Entry2
14 OUTPUT "Account number ", Entry1, " accepted after ", Attempts, " attempts"
```

(a) Complete the trace table for the algorithm using the input data: **[4]**

`58204, 58240, 58204, 52804, 58204, 58204`

The first row has been done for you. You may not need to use all the rows.

Entry1	Entry2	Attempts	OUTPUT
		0	

4 **Total: 5 marks**

A hotel receptionist copies each guest's car registration from a booking form into the car park program. The program uses a **visual check** to verify each registration.

(a) Write an algorithm using pseudocode to: **[5]**

- ask the receptionist to enter the car registration, and input it
- output the registration that was entered, and ask whether it matches the booking form (Y or N)
- input the reply
- repeat all of the steps above until the reply is Y
- then output a message to say the registration has been saved.

You do not need to declare any variables.

5 **Total: 3 marks**

A smart door lock lets its owner set a new PIN. The algorithm should use a **double entry check**: the PIN is entered twice, and it is only saved when the two entries are the same. The algorithm contains **three** errors.

```
01 REPEAT
02     OUTPUT "Enter the new PIN"
03     INPUT NewPin
04     OUTPUT "Enter the new PIN again"
05     ConfirmPin ← NewPin
06     IF NewPin = ConfirmPin
07       THEN
08         OUTPUT "The two entries are different, please try again"
09     ENDIF
10 UNTIL NewPin <> ConfirmPin
11 OUTPUT "New PIN saved"
```

(a) Identify the line numbers of the **three** errors and write the correct pseudocode for each line. **[3]**

Line number	Correct pseudocode

Total for this worksheet: 20 marks

MODULE O ROBUST PROGRAMS · O5

Why we test: testing in the coding and testing stages

Original practice questions · 20 marks · ~25 minutes · Cambridge 0478 syllabus 7.1 (with 7.6 and 7.8)

Name _____ Date _____

Instructions. Answer all questions in the spaces provided. The marks for each part are shown in brackets [ ]. The total for this worksheet is **20 marks**. All code on this sheet is written in Cambridge pseudocode.

A bike-hire company asks a programmer to develop a program that works out what customers pay to hire a bike. The program is written as separate modules: one checks the number of hours entered, one works out the cost and one outputs a receipt. All the questions on this worksheet are about this program.

1

Total: 4 marks

(a) The table describes four tasks. Tick (✓) **one** box in each row to show the stage of the program development life cycle in which each task is carried out. **[4]**

Task	Coding	Testing
The cost module is tested on its own as soon as it has been written.		
The complete program is run using a set of normal, abnormal, extreme and boundary test data.		
An error is corrected in the receipt module and that module is tested again before the next module is written.		
The complete program is checked to see that it meets all the requirements identified in the analysis stage.		

2

Total: 1 mark

(a) State the name given to the testing that is carried out on each module as the program code is written during the coding stage. **[1]**

3

Total: 6 marks

The company's charges are:

- hires of 5 hours or more cost $3 for each hour
- shorter hires cost $4 for each hour.

During the coding stage the programmer writes this function for the cost module. The parameter `Hours` is always a whole number from 1 to 8.

```
01 FUNCTION HireCost(Hours : INTEGER) RETURNS INTEGER
02     DECLARE Cost : INTEGER
03     IF Hours > 5
04       THEN
05         Cost ← Hours * 3
06       ELSE
07         Cost ← Hours * 4
08     ENDIF
09     RETURN Cost
10 ENDFUNCTION
```

The programmer tests the function as soon as it is written. The table shows the tests.

Test	Value of `Hours`	Expected result ($)	Actual result ($)
1	2	8	8
2	5		20
3	7		21

(a) Complete the table by writing the expected result for Test 2 and Test 3. **[2]**

(b) Identify the test that shows there is an error in the function. **[1]**

(c) Identify the line number of the error and suggest a correction. **[2]**

Line number .....

Correction

(d) State what the programmer does after correcting the error. **[1]**

4 **Total: 5 marks**

All the modules have been written and the program is complete. In the testing stage, the programmer tests the complete program with test data. The program must only accept a whole number of hours from 1 to 8.

(a) Complete the table. For each type of test data, give a suitable value for the number of hours and state whether the program should accept or reject it. **[3]**

Type of test data	Number of hours	Accept or reject
Normal		
Extreme		
Abnormal		

(b) Describe how the programmer uses the results of these tests. **[2]**

5 **Total: 4 marks**

(a) Explain the difference between the testing carried out in the coding stage and the testing carried out in the testing stage of the program development life cycle. Refer to the bike-hire program in your answer. **[4]**

Total for this worksheet: 20 marks

MODULE O ROBUST PROGRAMS · O6

Finding and correcting errors in programs

Original practice questions · 21 marks · ~25 minutes · Cambridge 0478 syllabus 7.8 (with 7.6, 7.7 and 4.2.3)

Name _____ Date _____

Instructions. Answer all questions in the spaces provided. The marks for each part are shown in brackets [ ]. Write any corrections using pseudocode. The total for this worksheet is **21 marks**.

1

Total: 4 marks

A programmer writes a program in a high-level language. The program contains **two** errors that break the rules of the language: one on line 8 and one on line 20.

(a) Tick (✓) **one** box in each row to show whether each statement describes how a **compiler** or an **interpreter** would report these errors. **[4]**

Statement	Compiler	Interpreter
The code on lines 1 to 7 is run before any error is reported.		
One error report lists both errors, for the whole code.		
The error on line 20 is only reported after the error on line 8 has been corrected.		
None of the program can be run until both errors are corrected.		

2

Total: 4 marks

Each pseudocode statement in the table contains **one** error. For the string, the first character is in position 1.

(a) Write a corrected pseudocode statement for each one. **[4]**

What the statement should do	Statement with an error	Corrected statement
Add 1 to the value in `Count`	`Count + 1 ← Count`	
Repeat once for each of the 24 hours in a day	`FOR Hour ← 1 TO 23`	
Check that `Length` is from 2 to 5 inclusive	`IF Length >= 2 AND <= 5`	
Store the first 3 characters of `Code` in `Prefix`	`Prefix ← SUBSTRING(Code, 3, 1)`	

3 **Total: 7 marks**

A ferry company weighs the vehicles before they board. This pseudocode algorithm should:
- input the weights of 20 vehicles, in whole kilograms
- only accept a weight from 500 to 4000 inclusive, and ask again until a weight in this range is input
- count the vehicles that weigh more than 3000 kg
- output this count.

```
01 DECLARE Vehicle : INTEGER
02 DECLARE Weight : INTEGER
03 DECLARE Heavy : INTEGER
04 Heavy ← 0
05 FOR Vehicle ← 1 TO 20
06     REPEAT
07         OUTPUT "Enter the vehicle weight in kg (500 to 4000)"
08         INPUT Weight
09     UNTIL Weight >= 500 OR Weight <= 4000
10     IF Weight > 3000
11       THEN
12         Heavy ← Heavy + 1
13     ENDWHILE
14 NEXT Weight
15 OUTPUT "Vehicles over 3000 kg: ", Weight
```

(a) Identify the line numbers of the **four** errors in the pseudocode and suggest a correction for each error. **[4]**

Line number	Correction

(b) Before it is corrected, the error on line 09 lets the algorithm accept weights that should be rejected. **[3]**

Suggest **one** weight that could be used as test data to show this error. State the type of test data and the expected result.

Weight	
Type of test data	
Expected result	

4 **Total: 6 marks**

A weather station stores the rainfall, in whole millimetres, for five days in the array `Rain`. This algorithm should count the number of days with **less than 5** mm of rain.

Rain[1]	Rain[2]	Rain[3]	Rain[4]	Rain[5]
3	8	4	15	2

```
01 Count ← 0
02 FOR Index ← 1 TO 5
03     IF Rain[Index] < 5
04       THEN
05         Count ← Count + Rain[Index]
06     ENDIF
07 NEXT Index
08 OUTPUT "Low rainfall days: ", Count
```

(a) Complete the trace table for the algorithm. You may not need to use all the rows. **[3]**

Index	Count	OUTPUT

(b) State the output the weather station expected from this data. **[1]**

(c) Identify the line number of the error and write a corrected pseudocode statement. **[2]**

Total for this worksheet: 21 marks

MODULE O ROBUST PROGRAMS · O7

Choosing test data

Original practice questions · 21 marks · ~25 minutes · Cambridge 0478 syllabus 7.6 (with 7.8)

Name _____ Date _____

Instructions. Answer all questions in the spaces provided. The marks for each part are shown in brackets [ ]. Use the Cambridge names for types of test data: **normal**, **abnormal**, **extreme** and **boundary**. Where you are asked for test data, give an actual value, not a description. Write any corrections using pseudocode. The total for this worksheet is **21 marks**.

1

Total: 3 marks

(a) State what is meant by **normal** test data. **[1]**

(b) Describe the difference between **extreme** test data and **boundary** test data. **[2]**

2

Total: 5 marks

A ferry company's booking program asks for the number of passengers in a booking. The number must be a **whole number** from **1 to 9** inclusive.

(a) Complete the table. For each item of test data, give the type of test data and whether the program should **accept** or **reject** it. **[5]**

Test data (passengers)	Type of test data	Accept or reject?
4		
9		
15		
four		
0		

3 **Total: 6 marks**

A bike-hire shop lets customers hire a bike for a whole number of hours from **1 to 8** inclusive. This algorithm should only accept a hire length in this range.

```
01 DECLARE Hours : INTEGER
02 REPEAT
03     OUTPUT "Enter hire length in hours (1 to 8)"
04     INPUT Hours
05     IF Hours < 1 OR Hours >= 8
06       THEN
07         OUTPUT "Invalid: enter 1 to 8"
08     ENDIF
09 UNTIL Hours >= 1 AND Hours < 8
10 OUTPUT "Hire booked for ", Hours, " hours"
```

(a) Give the **boundary** test data for the **upper** limit of the range. State the expected outcome for each value. **[2]**

(b) The algorithm is tested with your test data from part (a). Describe what happens, and explain what this shows about the algorithm. **[2]**

(c) Identify the **two** line numbers that need to be changed and write the corrected line for each. **[2]**

Line number	Corrected line

4 Total: 4 marks

A community radio station's staff log in to its music library. A password must be from **10 to 16 characters** long (inclusive).

(a) Give **one** example of **extreme** test data and **one** example of **abnormal** test data for the password length check. Give a reason for each choice. **[4]**

Extreme

Abnormal

5 Total: 3 marks

An online craft shop only accepts an order quantity that is a whole number from **1 to 20** inclusive. The programmer tests the program using only these three values: **5**, **10** and **15**.

(a) Explain why this testing is **not** enough. Include examples of other test data the programmer should use. **[3]**

Total for this worksheet: 21 marks

MODULE O ROBUST PROGRAMS · O8

Planning tests with test data

Original practice questions · 22 marks · ~25 minutes · Cambridge 0478 syllabus 7.6 (with 7.1, 7.8)

Name _____ Date _____

Instructions. Answer all questions in the spaces provided. All algorithms are written in Cambridge pseudocode. Use the Cambridge names for types of test data: **normal**, **abnormal**, **extreme** and **boundary**. Write actual values as test data, not descriptions. The marks for each part are shown in brackets [ ]. The total for this worksheet is **22 marks**.

1

Total: 4 marks

A coach company's booking program accepts the number of passengers for a trip. Only whole numbers from 10 to 40 inclusive are accepted.

Tick (✓) **one or more** boxes in each row to show the type(s) of test data that each value is, for this check. **[4]**

Test data	Normal	Abnormal	Extreme	Boundary
25				
40				
9				
forty				

2

Total: 5 marks

A garage's tyre-pressure program accepts a pressure, in psi, as a whole number from 20 to 45 inclusive. Any other input is rejected with the message `Pressure out of range` and the pressure is input again.

Complete the table of test data for this check. **[5]**

Test	Test data	Type of test data	Expected outcome
1	32	Normal	Accepted
2		Extreme	Accepted
3	46		Rejected, `Pressure out of range`
4	..... and	Boundary	
5		Abnormal	Rejected, `Pressure out of range`

3

Total: 3 marks

A ferry company uses this algorithm to work out the fare for a vehicle from its length in metres. Lengths have already been validated, so only lengths from 2.0 to 20.0 reach this algorithm.

```
01 INPUT Length
02 IF Length <= 5.0
03   THEN
04     Fare ← 30
05   ELSE
06     IF Length <= 12.0
07       THEN
08         Fare ← 55
09       ELSE
10         Fare ← 90
11     ENDIF
12 ENDIF
13 OUTPUT "Fare is ", Fare
```

Suggest test data that tests each of the three possible fares. Give a different length for each test and the expected output. **[3]**

Test	Test data (Length)	Expected output
1		
2		
3		

4

Total: 6 marks

A restaurant's table-booking algorithm should accept from 1 to 8 seats inclusive. It should keep asking for the number of seats until an acceptable value is input. In the testing stage of the program development life cycle, the program is tested with the test data in the table below.

```
01 REPEAT
02     OUTPUT "Enter number of seats (1 to 8)"
03     INPUT Seats
04 UNTIL Seats > 1 AND Seats <= 8
05 OUTPUT "Booking for ", Seats, " seats"
```

(a) Apply the test data to the algorithm. Complete the **Actual outcome** column for tests 2, 3 and 4. Test 1 has been done for you. **[3]**

Test	Test data	Type	Expected outcome	Actual outcome
1	4	Normal	Accepted	Accepted
2	1	Extreme	Accepted	
3	9	Abnormal	Rejected, asked again	
4	8	Extreme	Accepted	

(b) Identify the line number of the error in the algorithm and suggest a correction. **[2]**

Line number

Correction

(c) Explain why test 1 did **not** find the error. **[1]**

5

Total: 4 marks

A craft website's sign-up program has a length check on passwords: a password must be from 8 to 20 characters long (inclusive). A programmer chose this test data for the length check.

Test	Test data	Type	Expected outcome
1	`sunflower12` (11 characters)	Normal	Accepted
2	`riverbank` (9 characters)	Normal	OK
3	`cat` (3 characters)	Abnormal	Rejected

Identify **two** problems with this choice of test data. For each problem, suggest a change or extra test that would solve it. **[4]**

Problem 1

Change or extra test

Problem 2

Change or extra test

Total for this worksheet: 22 marks