T7

Algorithm design and problem solving

CHAPTER ASSIGNMENT · 76 MARKS

Name _____ Class _____ No. _____ Date _____

Answer every question in the space given. Show your working. You may use the chapter page to help you.

Questions from *Cambridge IGCSE and O Level Computer Science*, 2nd edition, David Watson and Helen Williams (Hodder Education), for classroom use.

Activities from the chapter

7.1 Using one of the computer systems that you identified, decompose it into its component parts of inputs, processes, outputs and storage.

7.2 Break down the 'Check time' sub-system from the smart phone alarm app into further sub-systems.

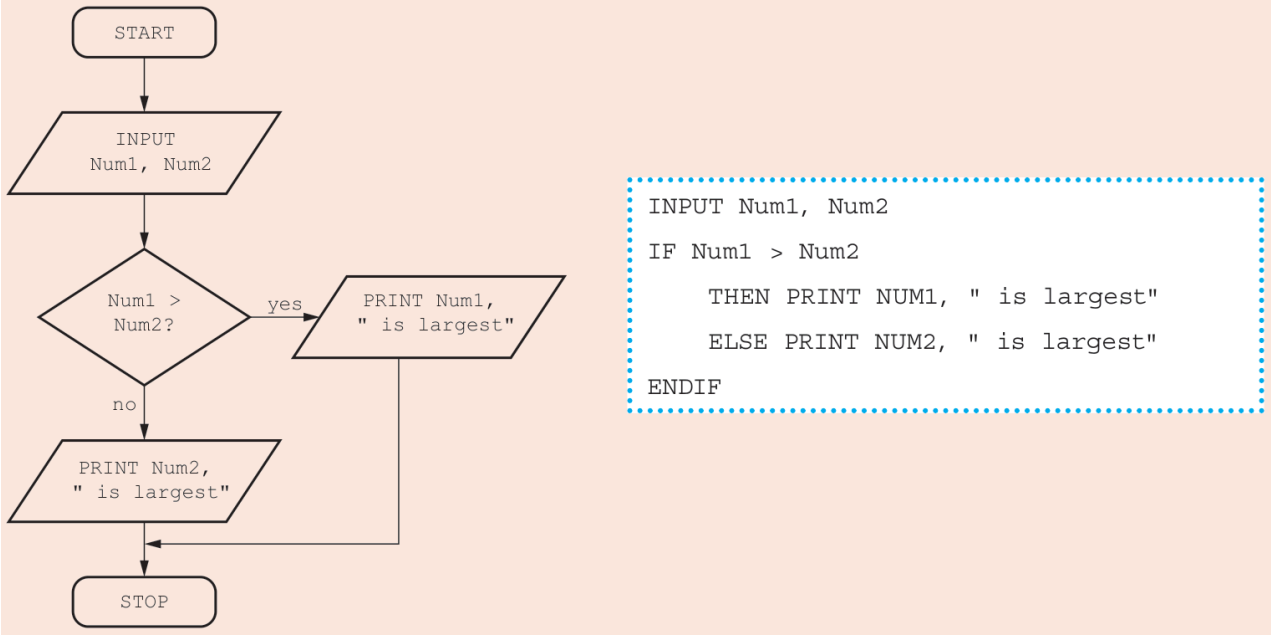
7.3 What values will the following variables have after the assignments have been completed?

```
Amount ← 100
TotalPrice ← Amount * 3.5
Discount ← 0.2
FinalPrice ← TotalPrice - TotalPrice * Discount
Name ← "Nikki"
Message ← "Hello " + Name
```

7.4 Re-write the algorithm to check for a mark between 0 and 20 and a pass mark of 10.

7.5 Use a **CASE** statement to display the day of the week if the variable **DAY** has a whole number value between **1** and **7** inclusive and an error message otherwise.

7.6 Have a look at the flowchart and pseudocode below: » identify the purpose of the algorithm that they both represent » identify the processes included in the algorithm. What would be output if the numbers 7 and 18 were input? ▲**Figure 7.11** Flowchart and pseudocode




```
INPUT Num1, Num2
IF Num1 > Num2
    THEN PRINT NUM1, " is largest"
    ELSE PRINT NUM2, " is largest"
ENDIF
```

7.7

(1) State, with reasons, which validation checks you could use for the following inputs. You may decide that more than one validation check is required. – Entering a telephone number – Entering a pupil's name – Entering a part number in the form XXX999, when X must be a letter and 9 must be a digit.

(2) Write an algorithm using pseudocode to check the age and height of a child who wants to go on a fairground ride. The age must be over 7 and under 12, the height must be over 110 centimetres and under 150 centimetres.

(3) Write an algorithm using pseudocode to check that the length of a password is between 8 and 12 characters inclusive.

7.8 Explain why the following input data also needs to be verified: » Entering a telephone number » Entering a pupil's name » Entering a part number in the form XXX999, when X must be a letter and 9 must be a digit.

7.9 Provide a more realistic set of test data and its expected result.

7.10 Provide some more erroneous/abnormal data and its expected results.

7.11

(1) Provide boundary data for the upper end of the range; assume that the percentage marks are always whole numbers.

(2) The end of term examinations are now marked out of twenty. Provide the following: – Two sets of normal data and their expected results – Some erroneous/abnormal data and their expected results – Two sets of boundary data and their expected results.

7.12 Use a trace table and the test data 400, 800, 190, 170, 300, 110, 600, 150, 130, 900 to record another dry run of the highest and lowest number flowchart from Section 7.7.

7.13 Use the trace table below and the test data 4, 8, 19, 17, 3, 11, 6, 1, 13, 9 to record a dry run of the pseudocode. ▼**Table 7.5** Trace table to complete for the pseudocode

A	B	C	X	OUTPUT
0	0	100		10

7.14 Draw a trace table for the bubble sort algorithm on page 276 and use the test data 35, 31, 32, 36, 39, 37, 42, 38 to record a dry run of the pseudocode.

7.15 Use a trace table and some negative test data to record another dry run of the pseudocode or flowchart. What error have you found?

7.16 Identify two numbers where the algorithm will still fail.

7.17 Rewrite the pseudocode so it works for every set of numbers like the flowchart above. Test your pseudocode algorithm with this set of test data: -97, 12390, 0, 77, 359, -2, -89, 5000, 21, 67

7.18 For the test data given in Example 1, identify the type of test data used and suggest some more test data and dry run the algorithm.

7.19

(1) Identify the changes you would need to make to the algorithm in Example 2 to reduce the number of students to 5 and the number of subjects to 2. Identify the test data needed to test Example 2 with the reduced number of students and subjects.

(2) With the set of test data you have chosen set up, complete a trace table so that you can compare your expected results with the actual results when you dry run the algorithm.

7.20

(1) Write pseudocode to input ten positive numbers and find the total and the average.

(2) Write pseudocode to input any number of positive numbers and find the total and the average. The user should enter '-1' when they have finished entering their list of positive numbers.

(3) Explain why you chose the loop structure for each task.

Exam-style questions

1 A solution to a problem is decomposed into its component parts. Name and describe the component parts. [8]

2 A computer system is to be developed to provide a modulo 11 check digit for numbers from 4 to 20 digits in length. Provide a structure diagram for this computer system. [6]

3 A phone app is being developed to split the cost of a restaurant bill between a given number of people. It is being designed to work for up to 12 diners and for bills from $10 to $500.

(a) What validation checks should be used for the number of diners and the size of the bill? [2]

(b) Provide two sets of normal data and their expected results. [4]

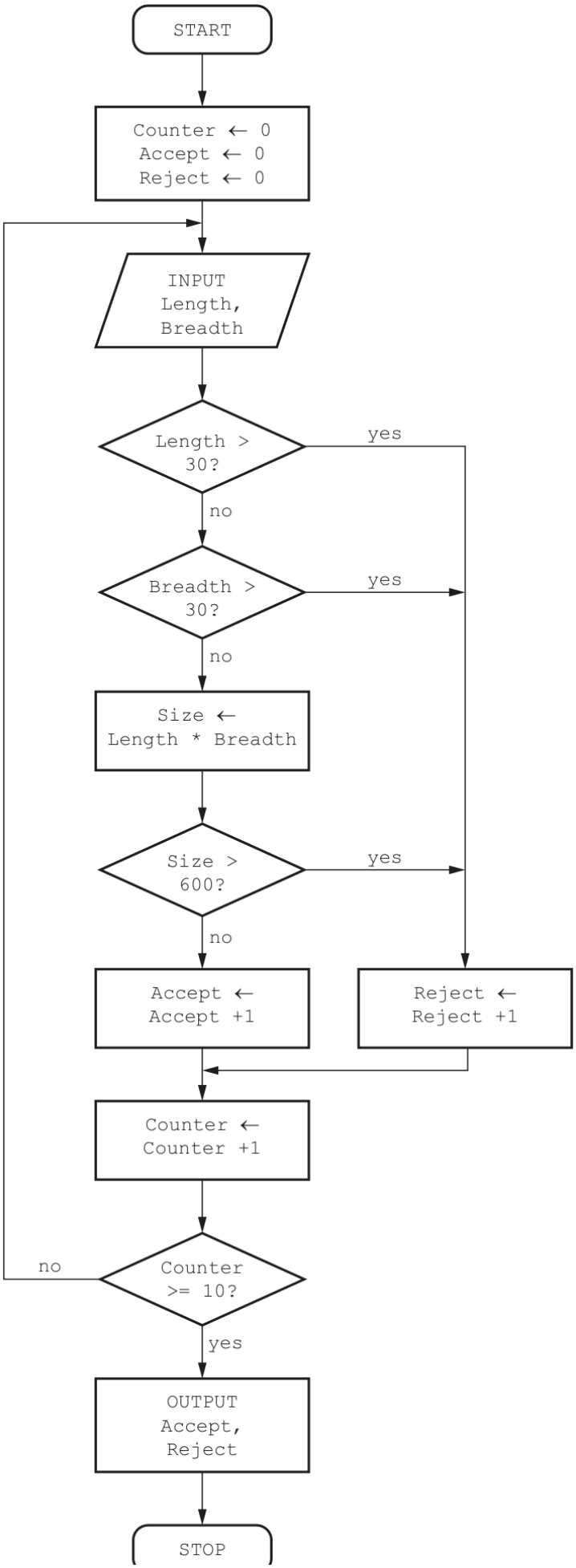
(c) Provide some abnormal/erroneous data. [1]

(d) Identify the boundary data required and the expected results. [4]

4 Explain what is meant by validation and verification. [4]

5 The following data is to be entered onto an online form: – Name – Date of birth – Password – Phone number. For each item state, with reasons, the validation and verification checks that should be used on the input data. [8]

6 The following algorithm, shown as a flowchart, checks the size of a consignment of ten parcels. The dimensions of each parcel are input in centimetres.


START
Counter ← 0
Accept ← 0
Reject ← 0
INPUT
Length,
Breadth
Length >
30?
yes
no
Breadth >
30?
yes
no
Size ←
Length * Breadth
Size >
600?
yes
no
Accept ←
Accept +1
Reject ←
Reject +1
Counter ←
Counter +1
Counter
>= 10?
no
yes
OUTPUT
Accept,
Reject
STOP

(a) Use this data and the following trace table to dry run the algorithm: 15, 10, 20, 17, 32, 10, 30, 35, 30, 15, 30, 28, 25, 25, 20, 15, 40, 20, 12, 10 [5]

Counter	Length	Breadth	Volume	OUTPUT

(b) State the processes included in this algorithm. [3]

(c) Identify the rules required to accept a parcel. [3]

7 The following algorithm written in pseudocode adds up 10 positive numbers and outputs the total. It contains several errors.

```
Counter ← 1
FOR Counter ← 1 TO 10
  REPEAT
    OUTPUT "Enter a positive whole number "
    INPUT Number
  UNTIL Number < 0
  Total ← Total + Counter
  Counter ← Counter + 1
  OUTPUT Total
NEXT Number
```

(a) Identify all the errors in the algorithm. [5]

(b) Rewrite the algorithm so that it is effective and error free. [4]

(c) Set up a trace table and some test data to dry run your rewritten algorithm. [4]

(d) Identify which items of your test data are normal, erroneous and extreme. [3]

8 This pseudocode algorithm inputs two non-zero numbers and a sign, and then performs the calculation shown by the sign. An input of zero for the first number terminates the process.
INPUT Number1, Number2, Sign WHILE Number <> 0 IF Sign = '+' THEN Answer ← Number1 + Number2 ENDIF IF Sign = '-' THEN Answer ← Number1 - Number2 ENDIF IF Sign = '*' THEN Answer ← Number1 * Number2 ENDIF IF Sign = '/' THEN Answer ← Number1 / Number2 ENDIF IF Sign <> '/' AND Sign <> '*' AND Sign <> '-' AND Sign <> '+' THEN Answer ← 0 ENDIF IF Answer <> 0 THEN OUTPUT Answer ENDIF INPUT Number1, Number2, Sign ENDWHILE

(a) Complete the trace table for the input data: 5, 7, +, 6, 2, -, 4, 3, *, 7, 8, ?, 0, 0, / [3]

Number1	Number2	Sign	Answer	OUTPUT

(b) Show how you could improve the algorithm written in pseudocode by writing an alternative type of conditional statement in pseudocode. [3]

Cambridge IGCSE Computer Science (0478) Paper 22 Q3, June 2018

9 A programmer has written a routine to store the name, email address and password of a contributor to a website's discussion group.

(a) The programmer has chosen to verify the name, email address and password. Explain why verification was chosen and describe how the programmer would verify this data. [4]

(b) The programmer has also decided to validate the email address and the password. Describe validation checks that could be used. [2]

Cambridge IGCSE Computer Science (0478) Paper 22 Q4, June 2018

End of assignment · Check your answers against the chapter at gurujazzy.com/subjects/computer-science/o-level/algorithm-design/