

2.1 Algorithm design and problem-solving

Sunday, 28 March 2021 8:05 PM



2.1

Algorithm



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Computer Science 2210

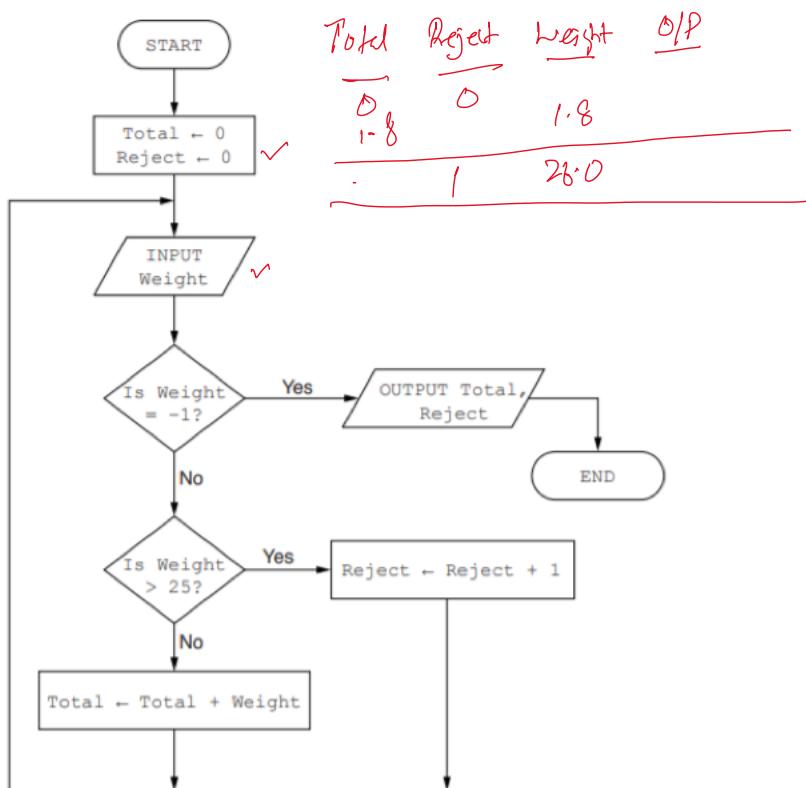
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Topic: 2.1 Algorithm design and problem-solving

May/June 2015 P21

- 3 The flowchart below inputs the weight of a number of parcels in kilograms. Parcels weighing more than 25 kilograms are rejected. A value of -1 stops the input.

The following information is output: the total weight of the parcels accepted and number of parcels rejected.



Complete the trace table for the input data:

1.8, 26.0, 7.0, 11.3, 10.0, 2.5, 25.2, 5.0, 19.8, 29.3, -1

✓ ✓



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Topic: 2.1 Algorithm design and problem-solving

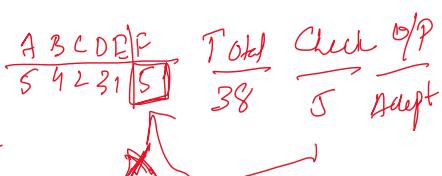
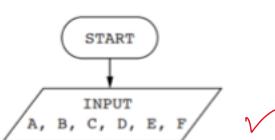
[5]

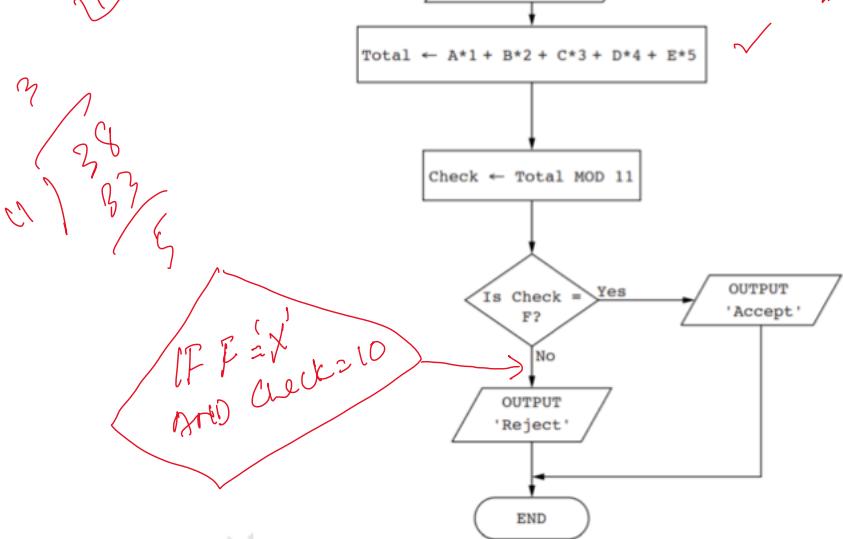
Topic: 2.1 Algorithm design and problem-solving

May/June 2015 P22

- 3 (a) The flowchart below inputs six single digit numbers. The predefined function MOD gives the value of the remainder, for example, $Y \leftarrow 10 \text{ MOD } 3$ gives the value $Y = 1$

3 10 a 2





Complete a trace table for each of the two sets of input data.

Set 1 5, 2, 4, 3, 1, 5 ✓

Set 2 3, 2, 1, 0, 7, 3

Trace table set 1 5, 2, 4, 3, 1, 5

A	B	C	D	E	F	Total	Check	Output

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Trace table set 2 3, 2, 1, 0, 7, 3

A	B	C	D	E	F	Total	Check	Output

[4]

(b) State the purpose of the flowchart in part (a).

[1]

(c) Identify a problem with this flowchart and explain how to correct it.

Problem

Solution

[3]

```

1 Total = 0
2 For Counter = 1 TO 50
3 INPUT Num
4 Total = Total + 1
5 Counter = Counter + 1
6 Average = Total/Counter
7 NEXT Counter
8 PRINT Average

```

There are **four** errors in this code.



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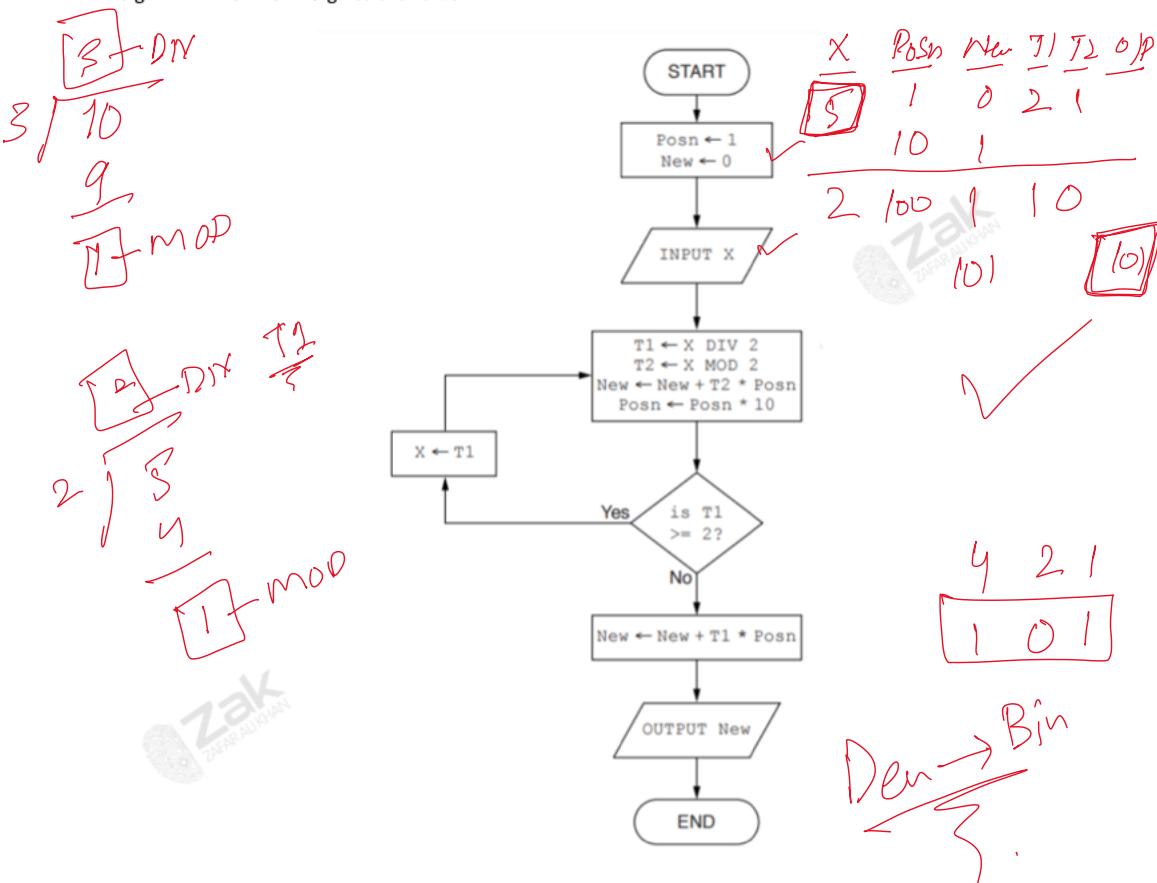
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Locate these errors and suggest code corrections to remove each error.

[4]

- 3 (a) The flowchart inputs an integer. The predefined function DIV gives the integer result of the division, e.g. $Y \leftarrow 10 \text{ DIV } 3$ gives the value $Y = 3$. The predefined function MOD gives the value of the remainder, e.g. $Y \leftarrow 10 \text{ MOD } 3$ gives the value $Y = 1$.



Complete a trace table for each of the **two** input values 5 and 12.



Give an example of each type of test data for this routine.

Normal 1.5
Extreme 0.5
Abnormal 123e

Normal's $\rightarrow >=0.5$ AND $<=2.0$ \rightarrow Abnormal
Range Check [3]
Validation

Oct/Nov 2015 P23

- 2 Read this section of program code that should input 50 numbers and then output the average of the positive numbers only.

```
1 Total = 0
2 PosCount = 0
3 FOR Counter = 1 TO 50
4     INPUT Num
5     IF Num < 0 THEN Total = Total + Num
6     IF Num > 0 THEN Counter = Counter + 1
7     Average = Total/PosCount
8 NEXT Counter
9 PRINT Num
```

There are **four** errors in this code.

Locate these errors and suggest code corrections to remove each error.

[4]



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- 4 A routine checks the age and height of children who are allowed to enter a play area. The children must be less than 5 years of age and under 1 metre in height.

(a) The first set of test data used is age 3 and height 0.82 metres.

State what type of test data this is.

Give a reason for using this test data.

Normal .

[2]

- (b) Provide two additional sets of test data. For each, give

- the type of each set of test data
- the reason why it is used

Set 1 Age 4 Height 0.9

Each type of test data and reason for use must be different.

Set 1

Type

Reason

Set 2

Type

Reason

[6]



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- 5 A motor boat hire company decides to set up a database to keep information about boats that are available

for hire. The database table, BOAT, will contain the following fields:

✓ ✓ ✓ Boat Name; Model; Engine Power (in hp); Number of Seats; Life Raft (whether there is a life raft kept on the boat); Day Price (price for a day's hire).

(b) State a validation check that you can perform on each of these fields. Each validation check must be different.

Boat Name *Prefix / Type /
Format / Type / Prefix / Length*
Model *Prefix / Type / Length*
Number of Seats *Type / Range /*
Day Price *Range / Type / Precise*

[4]

May/June 2016 P21

- 2 Read this section of program code that inputs 10 positive numbers and then outputs the smallest number input.

```
1 Small = 1000
2 Counter = 0
3 REPEAT
4     INPUT Num
5     IF Num < Small THEN Small = Num
6     Counter = Counter + 1
7 UNTIL Counter = 10
8 PRINT Small
```

(i) Identify three changes you would need to make to find the largest number input instead of the smallest number. *✓*

[3]

(ii) Rewrite the program code with your changes. *✓*

[3]

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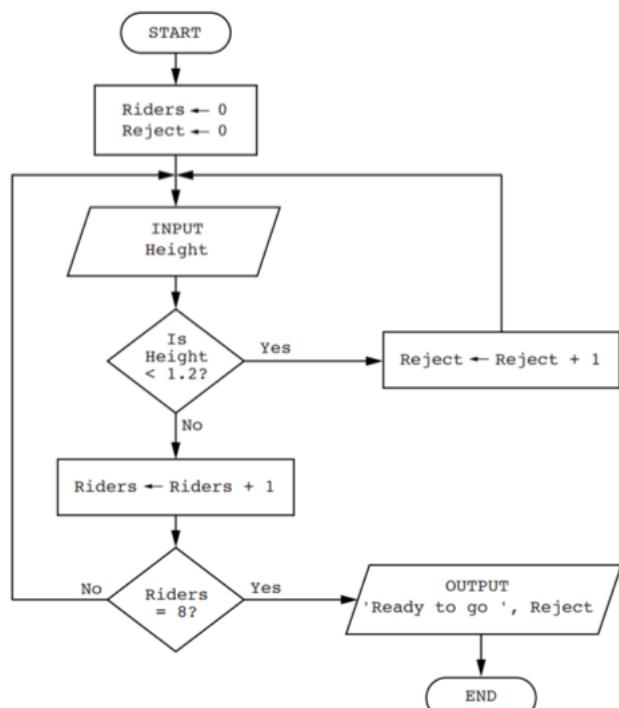
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- 4 The flowchart below inputs the height of children who want to ride on a rollercoaster. Children under 1.2 metres are rejected. The ride starts when eight children have been accepted.



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Complete the trace table for the input data:

1.4, 1.3, 1.1, 1.3, 1.0, 1.5, 1.2, 1.3, 1.4, 1.3, 0.9, 1.5, 1.6, 1.0

[4]

May/June 2016 P22

- 2** Read this section of program code that inputs 10 positive numbers and then outputs the total.

```
1 Total = 0
2 Counter = 0
3 REPEAT
4     INPUT Num
5     Total = Total + Num
6     PRINT Total
7     Counter = Counter + 1
8 UNTIL Counter = 10
```



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This code works, but it is inefficient.

- (i) Suggest **three** improvements that could be made.

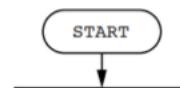
[3]

- (ii) Rewrite the program code with your improvements.

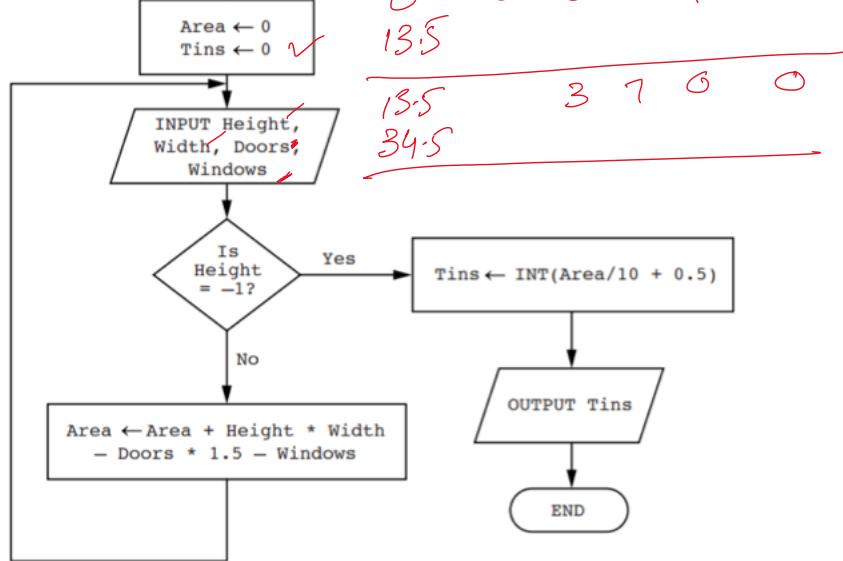
[3]

- 3 The flowchart below calculates the number of tins of paint required to paint walls. The flowchart inputs the height and width of a wall in metres, the number of doors and the number of windows. A value of -1 for the height stops the input.

35,10,37,00



Area Pins H W Doors Windows
15 0 3 5 1 0



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Complete the trace table for the input data:

3, 5, 1, 0, 3, 7, 0, 0, 3, 5, 0, 3, 3, 7, 1, 1, -1, 0, 0, 0

Area	Tins	Height	Width	Doors	Windows

[4]

Oct/Nov 2016 P22

- 2 Read this section of program code that inputs positive numbers, discards any negative numbers and then outputs the average. An input of zero ends the process.

```

1 Total = 0
2 Counter = 100
3 REPEAT
4     REPEAT
5         INPUT Num
6         UNTIL Num < 0
7     Output Total / Counter
8     Counter = Counter - 1
9 END

```

```

6      UNTIL Num < 0
7      Total = Total + 1
8      Counter = Counter + Num
9 UNTIL Num = 0
10 Average = Total / (Counter - 1)
11 Print Average

```

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There are four errors in this code.

Locate these errors and suggest a correction to remove each error.

Error 1

Correction

Error 2

Correction

Error 3

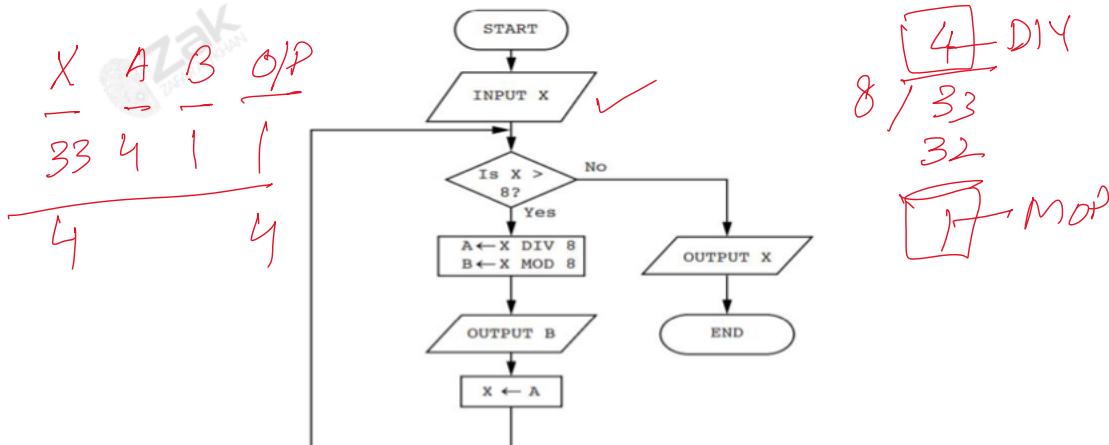
Correction

Error 4

Correction

[8]

- 3 The flowchart below inputs an integer. The predefined function DIV gives the value of the division, for example $Z \leftarrow 11 \text{ DIV } 3$ gives the value $Z = 3$. The predefined function MOD gives the value of the remainder, for example $Z \leftarrow 11 \text{ MOD } 3$ gives the value $Z = 2$.



**Topic: 2.1 Algorithm design and problem-solving**

Complete a trace table for each of the two input values **33** and **75**.

Trace table for input value **33**

~~Trace table for input value 33~~

X	A	B	OUTPUT

Trace table for input value **75**

X	A	B	OUTPUT

[4]

**Topic: 2.1 Algorithm design and problem-solving**

Oct/Nov 2016 P23

- 2 Read this section of program code that:

- inputs 10 numbers
- checks whether each number is within a specified range
- totals the numbers within the range and outside the range

```

1 InRange = 0
2 OutRange = 1000
3 FOR Count = 1 TO 10
4     INPUT Num
5     IF Num > 10 AND Num < 20 THEN InRange = InRange + 1
6     ELSE OutRange = OutRange - 1
7 Count = Count + 1
8 NEXT X
9 PRINT InRange, OutRange

```

(a) There are four errors in this code.

Locate these errors and suggest a correction to remove each error.

Error 1

Correction

Error 2

Correction

Error 3

Correction

Error 4

Correction

[4]

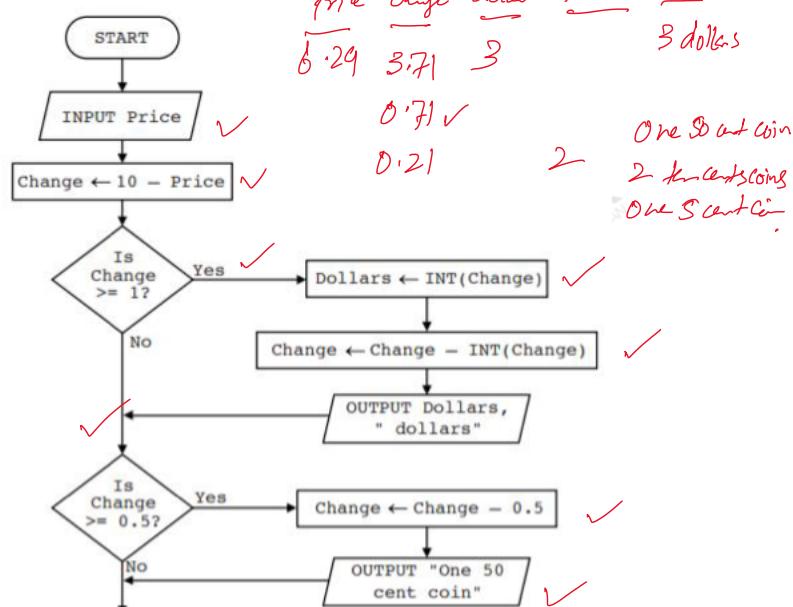
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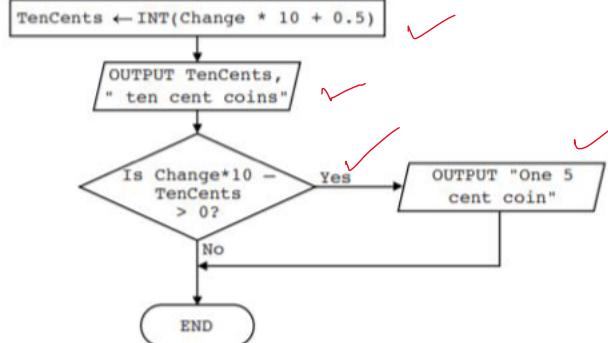
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- 3 The flowchart below inputs the price of an item under \$10. The change from a \$10 note is output. Any amount less than 5 cents is rounded up to 5 cents.

The predefined function INT rounds a number down to the nearest whole number; for example $Z \leftarrow \text{INT}(5.7)$ gives the value $Z = 5$





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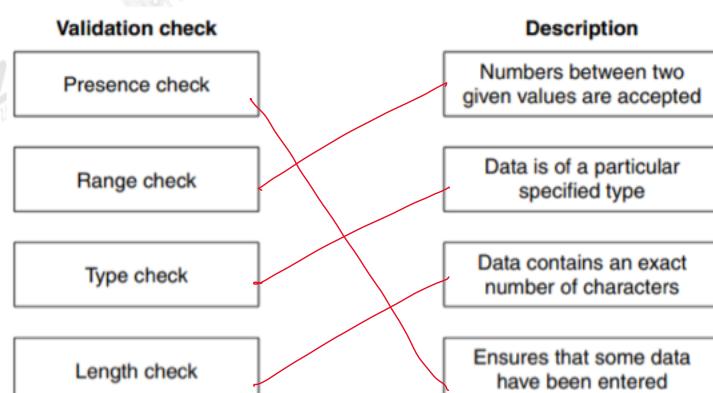
Topic: 2.1 Algorithm design and problem-solving

Complete the trace table for the input data: 6.29

[5]

- 4** Four validation checks and four descriptions are shown below.

Draw a line to link each validation check to the correct description.



[3]



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Topic: 2.1 Algorithm design and problem-solving*May/June 2017 P21*

- 2** This section of program code asks for 50 numbers to be entered. The total and average of the numbers are calculated.

```

1 Total = 0
2 Counter = 50
3 PRINT 'When prompted, enter 50 numbers, one at a time'
4 REPEAT
5 PRINT 'Enter a number'
6 INPUT Number
7 Total + Number = Total
8 Number = Number + 1
9 UNTIL Counter = 50
10 Average = Number * Counter
11 PRINT 'The average of the numbers you entered is ', Average

```

There are **four** errors in this code.

State the line number for each error and write the correct code for that line.

Error 1

Line number

Correct code

Error 2

Line number

Correct code

Error 3

Line number

Correct code

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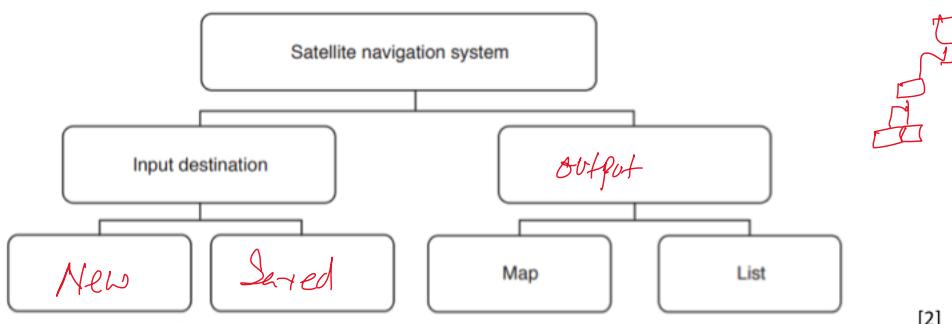
Error 4

Line number

- 3 A satellite navigation system works using destination details entered by the user, either a new destination or chosen from previously saved destinations. The satellite navigation system will then output directions to the destination in the form of either a visual map or a list of directions.

A satellite navigation system is an example of a computer system that is made up of sub-systems. This structure diagram shows some of its sub-systems.

Complete the diagram by filling in the empty boxes.



- 4 For each of the **four** statements in the table, place a tick in the correct column to show whether it is an example of validation or verification.

Statements	Validation	Verification
To automatically check the accuracy of a bar code	✓	
To check if the data input is sensible	✓	
To check if the data input matches the data that has been supplied	✓	✓
To automatically check that all required data fields have been completed	✓	

[4]



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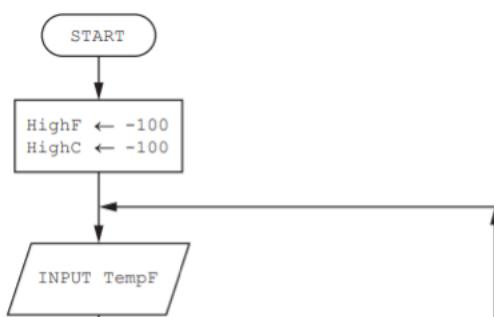
Topic: 2.1 Algorithm design and problem-solving

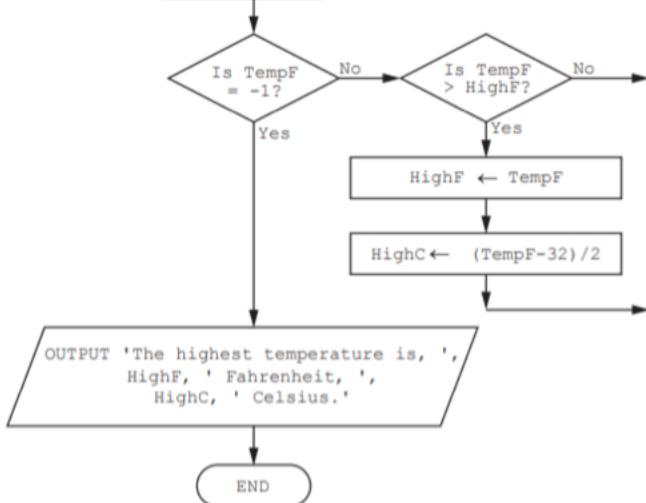
- 6 This flowchart inputs a range of temperatures in degrees Fahrenheit.

As each temperature is input, it is compared with the previous highest temperature. If it is higher than the current highest, it replaces the previous highest temperature and then it is converted to degrees Celsius.

For ease of calculation, the final step of the Fahrenheit to Celsius conversion has been approximated as division by 2.

When -1 is entered, the input process stops and the highest temperature (in both Fahrenheit and Celsius) is output.





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Complete the trace table for the input data:

68, 46, 50, 86, 65, 50, 40, 30, -1

[5]

INPUT N1,N2,N3
IF $N1 > N2$ AND $N1 > N3$ Then OUTPUT N1
IF $N2 > N1$ AND $N2 > N3$ Then OUTPUT N2
IF $N3 > N1$ AND $N3 > N2$ Then OUTPUT N3

May/June 2017, P22

- 2 (a) Write an algorithm to input three different numbers, and then output the largest number. Use either pseudocode or a flowchart.

[4]

(b) Give two sets of test data to use with your algorithm in part **(a)** and explain why you chose each set.

Test data set 1

Reason

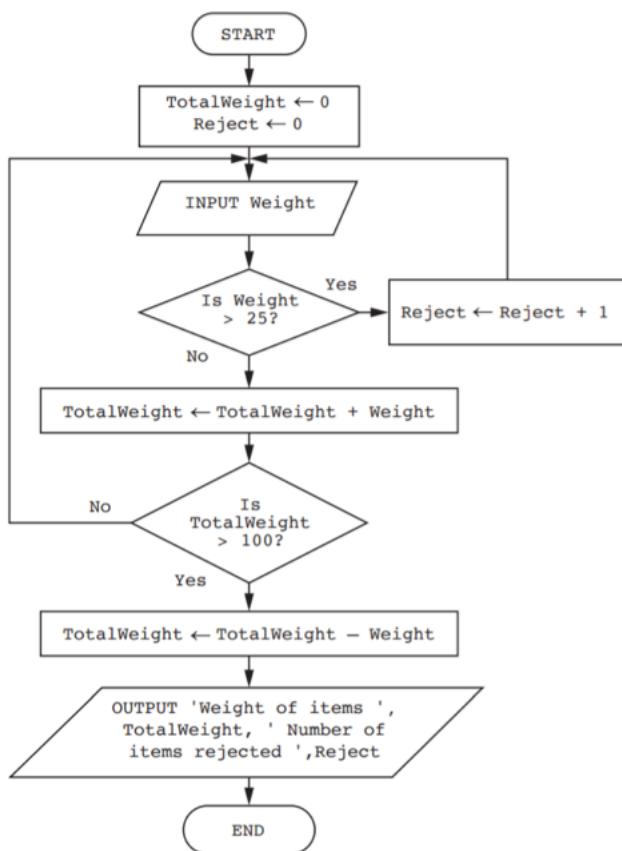
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Topic: 2.1 Algorithm design and problem-solving

- 3 This flowchart inputs the weight of items in kilograms to be loaded on a trailer. Any item over 25 kilograms is rejected. The trailer can take up to 100 kilograms.



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Topic: 2.1 Algorithm design and problem-solving

Complete the trace table for the input data:

13, 17, 26, 25, 5, 10, 15, 35, 20, 15

[5]



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Oct/Nov 2017.P22

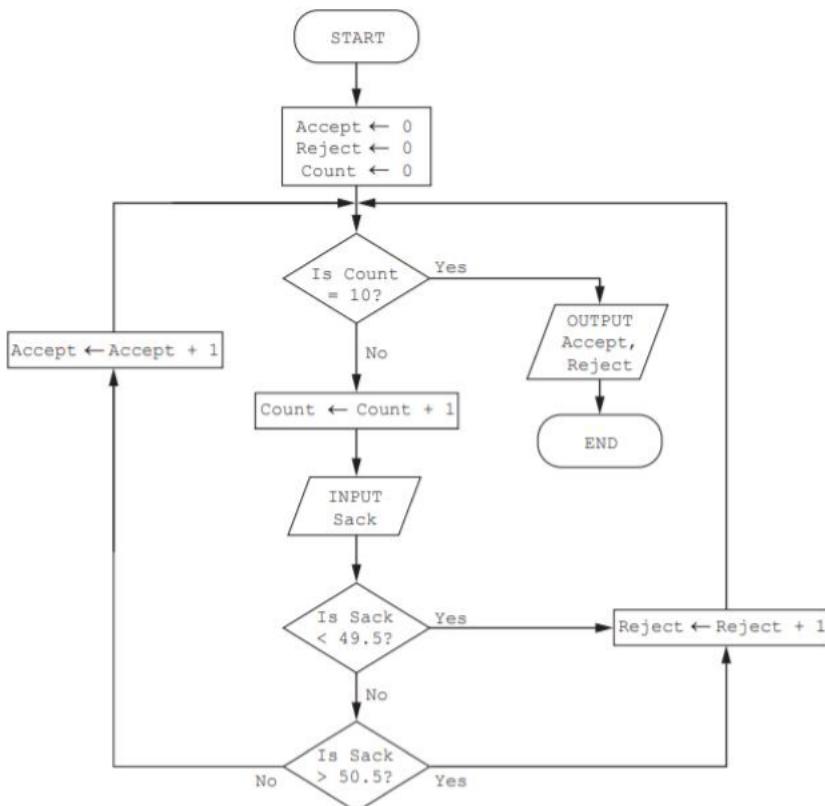
- 2 Write an algorithm using **either** pseudocode **or** a flowchart, to:

 - input a positive integer ✓
 - use this value to set up how many other numbers are to be input
 - input these numbers ✓
 - calculate and output the total and the average of these numbers

- 5 (a) This flowchart checks a batch of 10 rice sacks for weight. Sacks should weigh 50 kilograms each. Sacks weighing over 50.5 kilograms or less than 49.5 kilograms are rejected. The number of sacks accepted and the

PN = 0, Count = 0, Num = 0
 $TotSum = 0, Avg = 0.0$
INPUT PN
 ✓ For Count = 1 TO PN
 ✓ Input Num
 $Total \leftarrow Total + Number$
Next Count
 $Avg \leftarrow Total / PN$
OUTPUT Total, Avg.

number of sacks rejected is output.



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Complete the trace table for the input data:

50.4, 50.3, 49.1, 50.3, 50.0, 49.5, 50.2, 50.3, 50.5, 50.6

[5]

(b) The size of the batch has increased to 50 sacks. It has been decided to only reject sacks that are underweight.

State the changes that need to be made to the flowchart.

[2]



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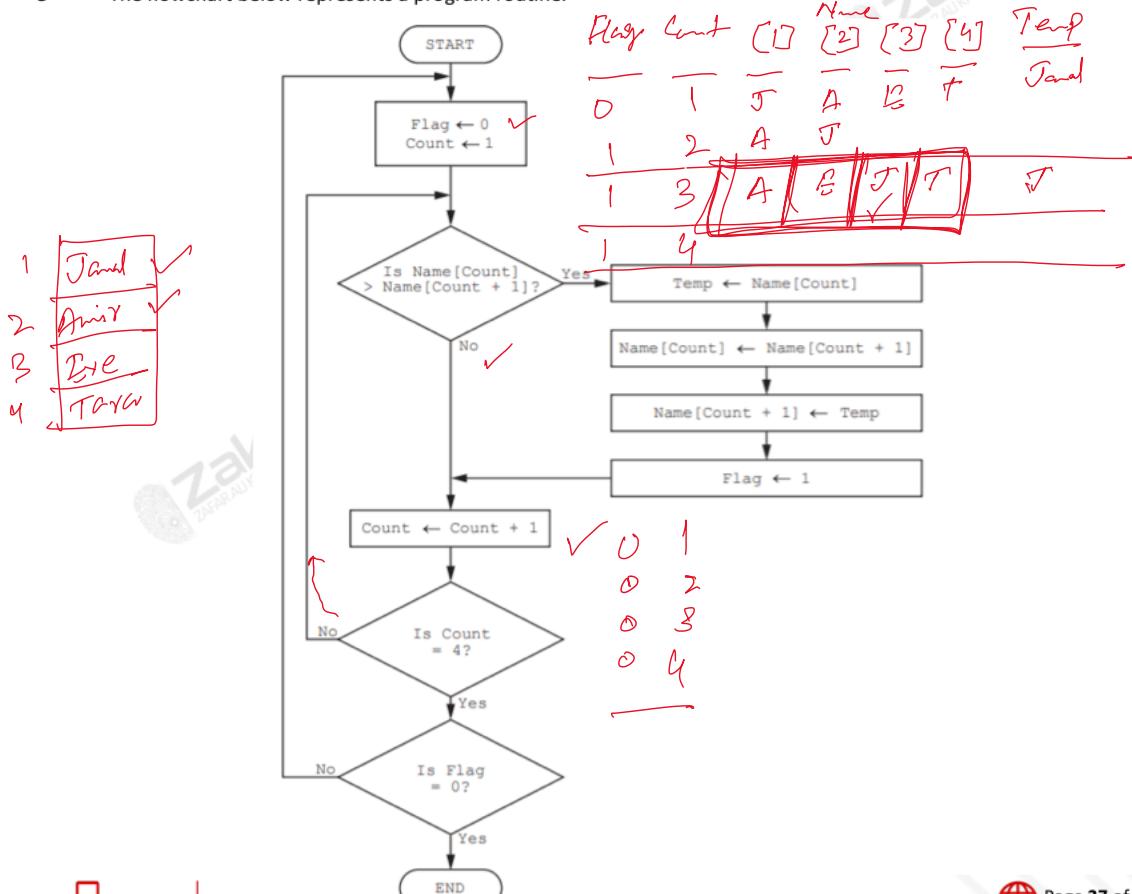
Oct/Nov 2017 P23

3 (a) Explain the difference between a validation check and a verification check. [2]

(b) Describe, using an example, how data could be verified on data entry. [2]

(c) Explain what is meant by the term library routine. [2]

5 The flowchart below represents a program routine.



- 4 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.

Email address

Password

[2]

- 5 A program checks that the weight of a basket of fruit is over 1.00 kilograms and under 1.10 kilograms. Weights are recorded to an accuracy of two decimal places and any weight not in this form has already been rejected.

Give **three** weights as test data and for each weight state a reason for choosing it. All your reasons must be different.

Weight 1

Reason

Weight 2

Reason

Weight 3

Reason

[3]



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Topic: 2.1 Algorithm design and problem-solving

Oct/Nov 2018 P22

- 2 (a) Write an algorithm, using pseudocode, to input three different numbers, multiply the two larger numbers together and output the result. Use the variables: Number1, Number2 and Number3 for your numbers and Answer for your result.

[5]

(b) Give **two** sets of test data to use with your algorithm in part (a) and explain why you chose each set.

Test data set 1

Reason

Test data set 2

Reason

[4]

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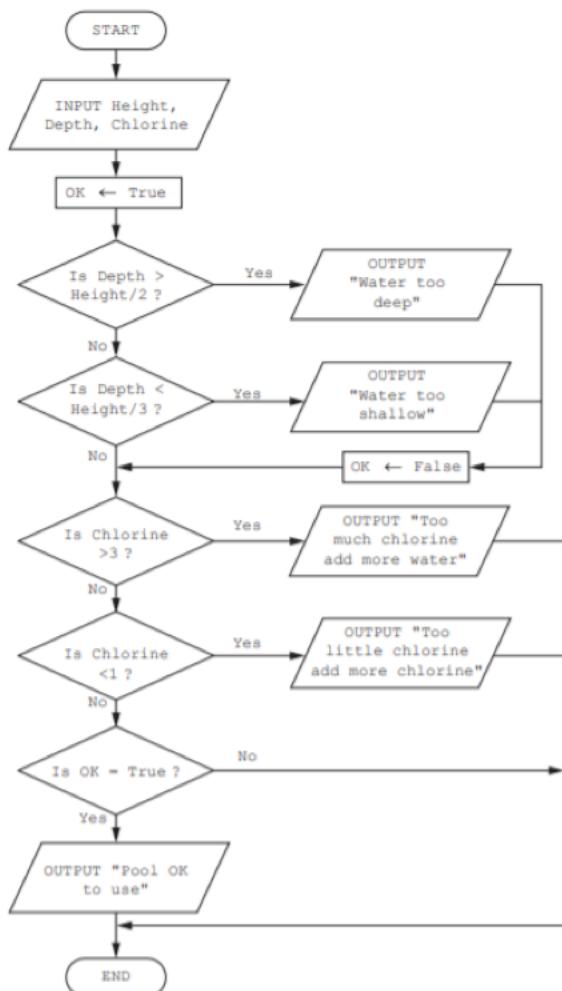
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- 5 The flowchart checks the level of chlorine and the depth of water compared to the height of the swimming pool. Error messages are output if a problem is found.



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Topic: 2.1 Algorithm design and problem-solving

(a) Complete the trace tables for each set of input data.

Input data: 6, 2.5, 2

Height	Depth	Chlorine	OK	OUTPUT

Input data: 4, 3, 1.5

Height	Depth	Chlorine	OK	OUTPUT

Input data: 6, 3.5, 4

Height	Depth	Chlorine	OK	OUTPUT

[6]

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Topic: 2.1 Algorithm design and problem-solving

(b) Identify a problem with the algorithm that the flowchart represents.

[1]

- 4 This section of program code may be used as a validation check.

```
1 PRINT "Input a value between 0 and 100 inclusive"
2 INPUT Value
3 WHILE Value < 0 OR Value > 100
4     PRINT "Invalid value, try again"
5     INPUT Value
6 ENDWHILE
7 PRINT "Accepted: ", Value
```

- (a) Give a name for this type of validation check.

[1]

- (b) Describe what is happening in this validation check.

[2]

- (c) Complete the trace table for this program code using the test data: 200, 300, -1, 50, 60

Value	OUTPUT

[3]



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- (d) Draw a flowchart to represent this section of program code.

- 2 (a) An algorithm has been written in pseudocode to input 100 numbers, select and print the largest number and smallest number.

```
Count ← 1
INPUT Number
High ← Number
Low ← Count
REPEAT
    INPUT Number
    IF Number > High
```

High Number

ENDIF

IF Number > Low

THEN

Low \leftarrow Number

ENDIF

Count \leftarrow Count + 1

UNTIL Count = 99

PRINT "Largest Number is ", Number

PRINT "Smallest Number is ", Low

Find the **four** errors in the pseudocode and suggest a correction for each error.

Error 1

Correction



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Error 2

Correction

Error 3

Correction

Error 4

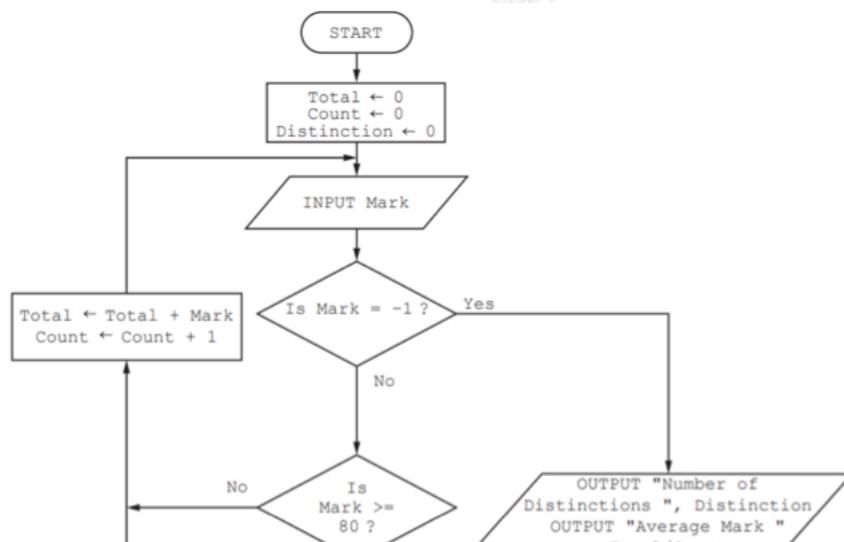
Correction

[4]

(b) Show how you would change the corrected algorithm to total the numbers and print the total. Use a variable Total.

[4]

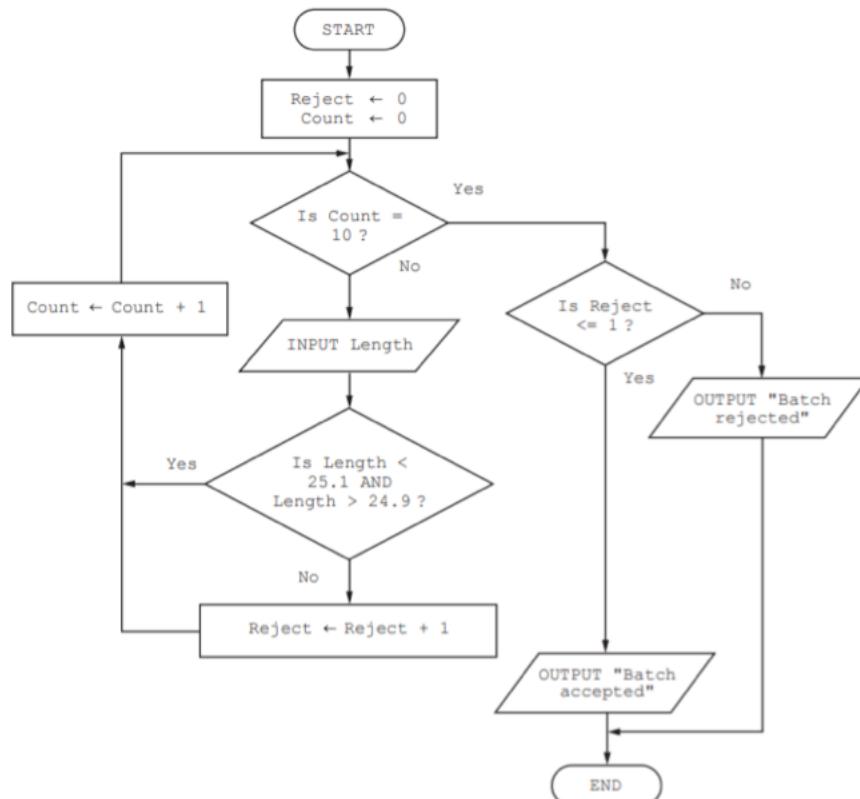
- 3 This flowchart inputs the marks gained in an examination. An input of -1 ends the routine.



Topic: 2.1 Algorithm design and problem-solving

Oct/Nov 2019.P22

- 3 (a) The flowchart checks the lengths of a batch of 10 ropes. For the batch to be accepted 90% of the lengths need to be between 24.9 and 25.1 metres.



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Topic: 2.1 Algorithm design and problem-solving

Complete the trace table for the input data:

24.88 25.01 24.98 25.00 25.05 24.99 24.97 25.04 25.19 25.07

(b) (i) It has been decided to only reject batches of rope that contain ropes that are too short. State the change required to the algorithm. [1]

(ii) Explain how the algorithm to reject batches could be improved to make it more effective. [2]

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- 4 Four validation checks and four descriptions are shown.

Draw a line to connect each validation check to the correct description.

Validation Check

Description

Range check

Checks that some data is entered.

Presence check

Checks for a maximum number of characters in the data entered.

Length check

Checks that the characters entered are all numbers.

Type check

Checks that the value entered is between an upper value and a lower value.

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Oct/Nov 2019 P23

- 2 Describe the use of a subroutine in a program. [2]
- 6 Draw four different flowchart symbols and describe how they are used in a program flowchart.

Flowchart symbol	Description of use

[4]

**Topic: 2.1 Algorithm design and problem-solving***May/June 2020/P21*

- 2 Tick **one** box in each row to identify if the statement about structure diagrams is true or false.

Statement	True (✓)	False (✗)
A structure diagram is a piece of code that is available throughout the structure of a program.		
A structure diagram shows the hierarchy of a system.		
A structure diagram is another name for an array.		
A structure diagram shows the relationship between different components of a system.		

[2]

- 3 Programs can perform validation and verification checks when data is entered.

(a) Give the names of **two** different validation checks and state the purpose of each one. [4]

(b) Give the name of one verification check. [1]

(c) Describe the difference between validation and verification. [2]

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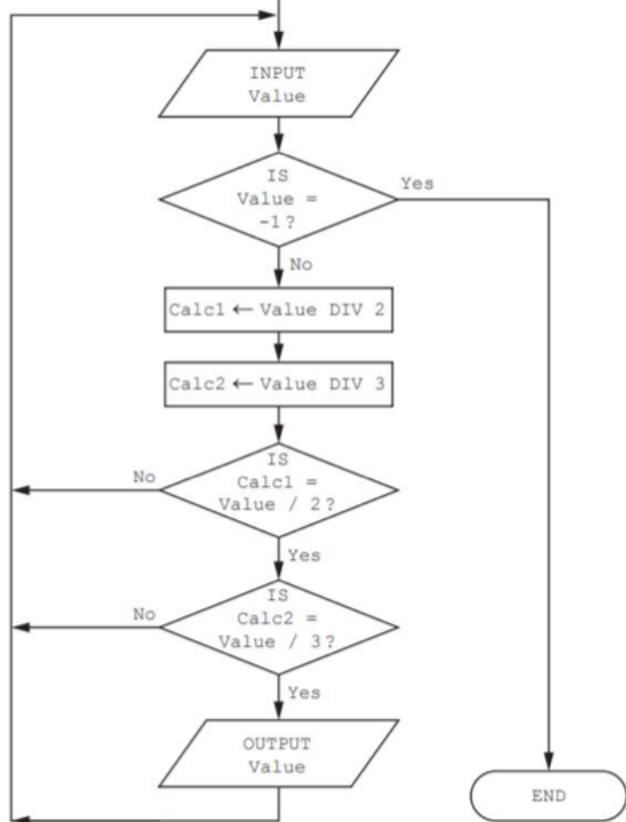
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**Topic: 2.1 Algorithm design and problem-solving**

- 5 The flowchart represents an algorithm.

The predefined function DIV gives the value of the result of integer division, for example, $y \leftarrow 9 \text{ DIV } 4$ gives y a value of 2.

An input value of -1 ends the algorithm.



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Topic: 2.1 Algorithm design and problem-solving

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

50, 33, 18, 15, 30, -1, 45, 12, 90, 6

Value	Calc1	Calc2	OUTPUT

[4]

(b) Describe the purpose of the algorithm.

[2]

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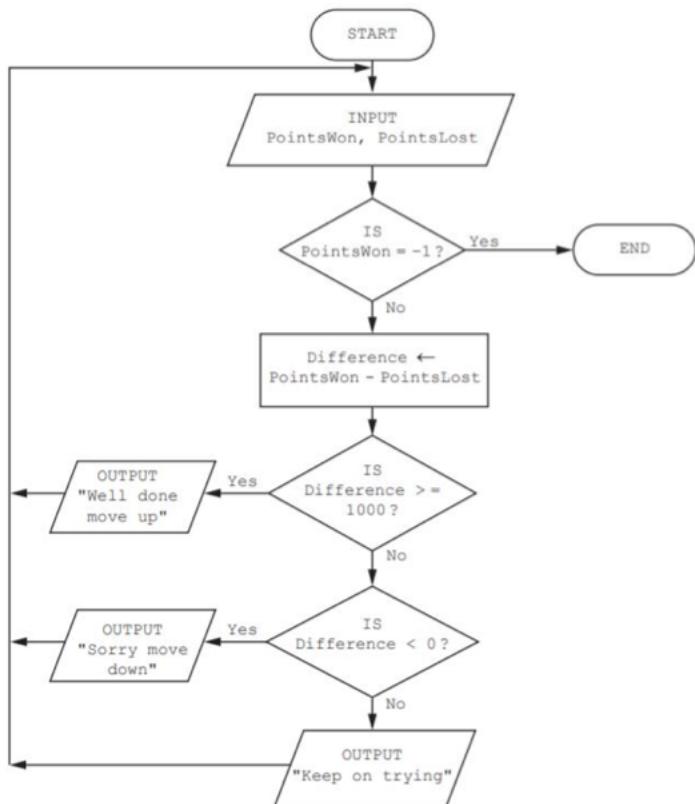


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Topic: 2.1 Algorithm design and problem-solving

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- 4 This flowchart inputs the points won and the points lost when playing a game. The difference between the points won and lost is calculated and depending on the result the player can: move up to the next level, stay at the same level, or move down to the previous level. The flowchart finishes when the input for points won is -1.



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Topic: 2.1 Algorithm design and problem-solving

- (a) Complete a trace table for this set of input data:

5000, 4474, 6055, 2000, 7900, 9800, 3000, 2150, -1, 6700, 7615

PointsWon	PointsLost	Difference	OUTPUT

[3]

- (b) The flowchart needs to be changed. When the difference is more than 5000 the output message is 'Fantastic leap up two levels'.

Describe the changes that will need to be made to the flowchart.

[3]