Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9–1)

Centre Number | | | | | |

Candidate Number | | | | |

Computer Science

Paper 2: Application of Computational Thinking

Thursday 17 May 2018 – Afternoon
Time: 2 hours

Paper Reference
1CP1/02

You do not need any other materials.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Use of a calculator is **prohibited**.

Information

- The total mark for this paper is 80.
- A pseudo-code command set is included at the back of this question paper.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

P52398A

1/1/1/1

P 5 2 3 9 8 A 0 1 2 8

Pearson

Answer ALL questions. Write your answers in the space provided.

Questions in this paper are based on a scenario.

Private Postal People (P-Cubed)

Private Postal People (P-Cubed) is a national delivery service specialising in small letters, large letters, small packages, and medium packages. The company has regional depots across the country. The company runs a fleet of delivery vans. It uses technology to help run the business. It does not deliver internationally.

P-Cubed has 2000 employees, some based in the head office, some working in the regional sorting offices and some driving the delivery vans.

1 P-Cubed stores information about its employees on a server.

(a) First name, last name, and start year are items that are stored as variables in an employee record.

State **two** other items that need to be stored as variables for each employee.

(2)

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2 .....

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(b) Employees earn days of holiday based on how long they have worked at P-Cubed.

- For the first two years, employees get 10 days of holiday each year.
- In subsequent years, employees get an additional 0.5 days of holiday for each year worked.
- The employee record has a variable called 'startYear'.

Construct a general expression to calculate the total number of days of holiday earned by an employee, for this year, who has worked for P-Cubed for more than two years.

(4)

(c) Each employee has an identification badge. There is a magnetic strip on the back of the badge. The badge is swiped in a card reader to get into the building. It can also be used to pay for meals in the company canteen, after it has been topped up with money.

Complete the table to show an input, a process and an output. The first row has been done for you.

(3)

Input(s)	Process	Output(s)
Location of card reader Numeric code from magnetic strip	Find out if this employee can go through this door	True, if entry permitted False, if entry not permitted
Cost of canteen meal Numeric code from magnetic strip		New balance, if paid Error, if not enough in account
Top-up amount Numeric code from magnetic strip	Add amount of top-up to make new balance	
	Check account balance	New balance

(Total for Question 1 = 9 marks)

2 P-Cubed sorts items by their address codes.

This is pseudo-code for an algorithm that forwards items to regional depots.

```
IF (code[0] >= "A" AND code[0] <= "I") THEN
    SEND "Midlands depot" TO DISPLAY
ELSE
    IF (code[0] >= "J" AND code[0] <= "R") THEN
        SEND "South depot" TO DISPLAY
    ELSE
        IF (code[0] >= "S" AND code[0] <= "Z") THEN
            SEND "North depot" TO DISPLAY
        ELSE
            SEND "Unknown code" TO DISPLAY
        END IF
    END IF
END IF
```

(a) Complete the table to show the output of the algorithm for the given inputs.

(3)

Code	Output displayed
QB7698RI	
VA2288ZA	
4W56AB92	

(b) All address codes have the same format. The first two positions are letters, followed by four digits, followed by two letters. "BH1634GQ" and "bh1634gq" are valid codes.

Complete the table to show different validation checks and test data caught by the validation check.

The first one has been done for you. The letter 'N' represents a number (0-9) and the letter 'L' represents a letter (A-Z or a-z).

(4)

Validation check	Test data
Pattern check ("LLNNNNLL")	"4W56AB92"

(Total for Question 2 = 7 marks)

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3 During the period leading up to the Christmas holidays, P-Cubed hires temporary staff. Staff are hired for each of the six weeks prior to Christmas week.

Here is the pseudo-code for an algorithm that calculates the number of additional staff needed for each week.

```
# Percentage of staff needed in 6 weeks prior to Christmas
SET weekNumber TO ["-6", "-5", "-4", "-3", "-2", "-1"]
SET staffRates TO [105, 110, 115, 120, 125, 130]
SET goodInput TO False

# Validate the input
WHILE (goodInput = False) DO
    SEND "Please enter the number of staff on week -7" TO DISPLAY
    RECEIVE currentCount FROM (INTEGER) KEYBOARD

    IF (currentCount >= 200) THEN
        SET goodInput TO True
        SEND "Staff on week -7 is " & currentCount TO DISPLAY
    ELSE
        SEND "Invalid input" TO DISPLAY
    END IF
END WHILE

# Print requirements
FOR i FROM 0 TO (LENGTH(weekNumber)-1)
    SET percentage TO staffRates[i] / 100
    SET neededStaff TO currentCount * percentage
    SEND "Week " & i & "needs " & neededStaff & "staff" TO DISPLAY
END FOR
```

(a) Programmers use basic programming constructs when they write code.

(i) Complete the table to identify line number(s) that illustrate an example of different programming constructs.

(4)

Programming construct	Line number(s)
A condition controlled loop	
A comment	
A selection construct	
A subprogram call	

(ii) State the data type of the variable 'goodInput'.

(1)

.....

(iii) State the data type of the variable 'percentage'.

(1)

.....

(b) Here is the pseudo-code algorithm again.

```
2  # Percentage of staff needed in 6 weeks prior to Christmas
3  SET weekNumber TO ["-6", "-5", "-4", "-3", "-2", "-1"]
4  SET staffRates TO [105, 110, 115, 120, 125, 130]
5  SET goodInput TO False
6
7  # Validate the input
8  WHILE (goodInput = False) DO
9      SEND "Please enter the number of staff on week -7" TO DISPLAY
10     RECEIVE currentCount FROM (INTEGER) KEYBOARD
11
12     IF (currentCount >= 200) THEN
13         SET goodInput TO True
14         SEND "Staff on week -7 is " & currentCount TO DISPLAY
15     ELSE
16         SEND "Invalid input" TO DISPLAY
17     END IF
18 END WHILE
19
20 # Print requirements
21 FOR i FROM 0 TO (LENGTH(weekNumber)-1)
22     SET percentage TO staffRates[i] / 100
23     SET neededStaff TO currentCount * percentage
24     SEND "Week " & i & "needs " & neededStaff & "staff" TO DISPLAY
25 END FOR
```

Complete the trace table to show execution of lines 21 to 25 of the pseudo-code for the fourth week before Christmas when the user enters the value 300.

(6)

currentCount	i	LENGTH(weekNumber)	percentage	staffRates[i]	neededStaff

(c) State the largest number the user could enter on line 10 to cause the message 'Invalid input' to be displayed.

(1)

.....

(Total for Question 3 = 13 marks)

4 P-Cubed classifies items as letters and packages according to their weight.

Here is the pseudo-code for an algorithm that determines the classification of an item.

```
2  SET maxWeights TO [0, 100, 750, 2000, 20000]
3  SET typeItem TO ["Too small", "Small letter", "Large letter",
4                   "Small package", "Medium package", "Too big"]
5  SET found TO False
6  SET i TO 0
7
8  SEND "Enter an item weight" TO DISPLAY
9  RECEIVE inWeight FROM (INTEGER) KEYBOARD
10
11 WHILE (found = True) AND (i < LENGTH(maxWeights)) DO
12     IF (inWeight > maxWeights[i]) THEN
13         SET i TO i + 1
14     ELSE
15         SET found TO True
16     END IF
17 END WHILE
18 SEND typeItem[i+1] TO DISPLAY
```

(a) The pseudo-code produces an incorrect output.

When the user enters 300, the algorithm outputs "Small letter". The correct output should be "Large letter".

State the name for this type of error.

(1)

(b) Line 11 and line 18 cause errors.

Identify the error in each line and construct new lines of pseudo-code that will correct the errors.

(4)

	Error	Correction
Line 11		
Line 18		

(Total for Question 4 = 5 marks)

5 P-Cubed uses automatic sorting machines.

The sorting machines can only handle items up to 1000 cubic centimetres (cm^3) in volume.

The volume of an item is calculated by this expression:

volume = width x height x length

Here is the partially completed pseudo-code for an algorithm that calculates the volume of an item.

```
FUNCTION calcVolume (                    )

BEGIN FUNCTION

    volume =

    RETURN

END FUNCTION

SEND "Enter width" TO DISPLAY
RECEIVE itemWidth FROM (INTEGER) KEYBOARD
SEND "Enter height" TO DISPLAY
RECEIVE itemHeight FROM (INTEGER) KEYBOARD
SEND "Enter length" TO DISPLAY
RECEIVE itemLength FROM (INTEGER) KEYBOARD

SET itemVolume TO calcVolume (                    )

SEND "Volume is " & itemVolume TO DISPLAY
```

(a) The function 'calcVolume' represents a generalisation that calculates the volume for any item.

Complete the pseudo-code by filling in the boxes.

(4)

(b) State the reason why 'calcVolume' is a function not a procedure.

(1)

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(c) State the name of a local variable in the pseudo-code.

(1)

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(d) State **two** benefits to the programmer of using libraries in a program.

(2)

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2 .....

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(Total for Question 5 = 8 marks)

6 P-Cubed uses GPS to track its delivery vans.

(a) Programmers are working on algorithms to track the mileage of the delivery vans. Programmers are testing the algorithms with small datasets to determine if they will work efficiently with the very large dataset.

(i) Here is the pseudo-code for an algorithm to find the number of mileages over 300.

```
SET maximum TO LENGTH (mileage)
SET i TO 0
SET count TO 0

WHILE (i < maximum) DO
    IF (mileage[i] > 300) THEN
        SET count TO count + 1
    END IF
    SET i TO i + 1
END WHILE
SEND "Mileage over 300: " & count TO DISPLAY
```

Here is a small dataset. It is stored in the array called 'mileage'.

257, 821, 377, 108, 755, 308

Describe **one** inefficiency when executing the algorithm with this dataset.

(2)

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(ii) Here is the pseudo-code for a different algorithm to find all the occurrences of mileage over 300.

```
SET count TO 0

FOR EACH entry FROM mileage DO
    IF (entry > 300) THEN
        SET count TO count + 1
    END IF
END FOREACH
SEND "Mileage over 300: " & count TO DISPLAY
```

Here is a small dataset. It is stored in the array called 'mileage'.

10, 20, 30, 40, 50, 60

Describe **one** inefficiency when executing the algorithm with this dataset.

(2)

(iii) The search algorithm will be used with a very large dataset.

The efficiency of a linear search algorithm can be improved by preprocessing the dataset.

State a type of pre-processing and explain how the algorithm in 6(a)(ii) could be changed to use the preprocessed data efficiently.

(3)

(b) Each delivery van has an identification number. Mileage is collected daily for every delivery van.

A two-dimensional array is used to hold the mileage information for each delivery van.

Complete the diagram to show column headings and example data for this data structure.

(2)

(c) The tracking system collects data about the location of vans at all times. The system calculates how long it takes to complete deliveries. Drivers can take the vans home in the evenings and at weekends.

Explain **two** reasons why drivers may not want the tracking system to be used in the vans.

(4)

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(Total for Question 6 = 13 marks)

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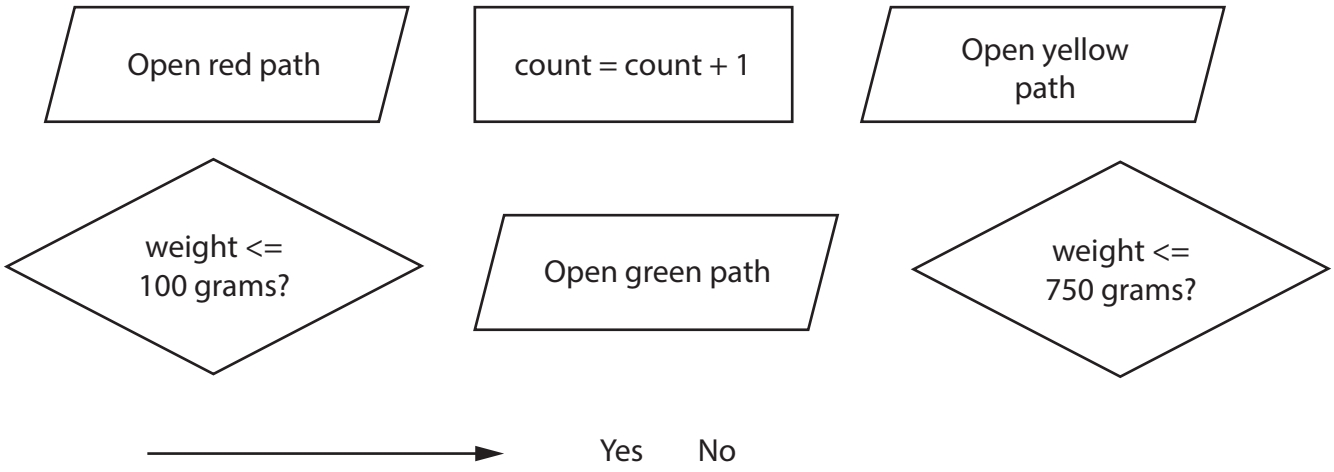
7 P-Cubed uses automatic sorting machines.

(a) Letters are unloaded onto an automatic sorting machine. The machine weighs each letter. Letters are sent along different paths based on their weight. After 1000 letters are sorted, a bell is sounded to alert an operator to load more letters.

1 to 100 grams	Green path
101 to 750 grams	Yellow path
751 grams or more	Red path to larger sorting machines

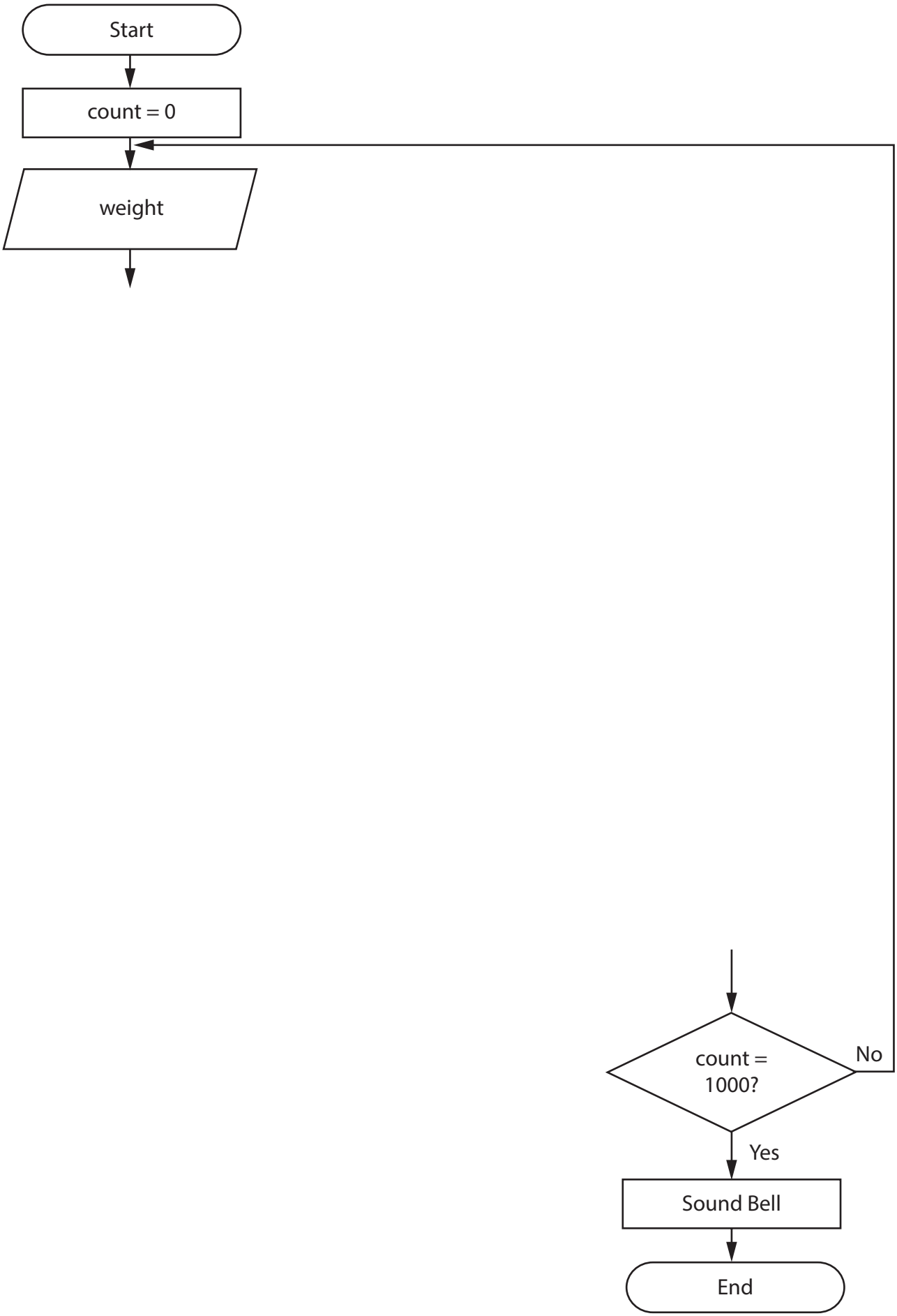
Here are some flowchart symbols.



Complete the flowchart to implement the letter sorting algorithm by using the symbols provided. Use all the symbols. Use each symbol only once. Use as many arrows and Yes/No labels as required.

This flowchart symbol is used to show input or output.

(6)



(b) P-Cubed stores data about the sorting machines in tables.

The primary key field for each table is shown in bold.

(i) State the purpose of a primary key in a database table.

(1)

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(ii) State the foreign key in tbl_Production.

(1)

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(iii) There is a one-to-many relationship between these tables.

Complete the diagram to show this relationship.

(2)

tbl_Machines
MachineNumber
PurchaseDate
ServiceDate
MachineName

tbl_Production
ProductionID
MachineNumber
EntryDate
ShiftNumber
OperatorNumber
CountSorted

(iv) Each year, P-Cubed gives an award to the operator who has sorted the most letters. It uses the records in tbl_Production to find the award winner.

Construct a flowchart to show an algorithm that outputs the total number of letters sorted by a single operator.

The operator number is provided.

(6)

(Total for Question 7 = 16 marks)

8 P-Cubed wants to know the weight of the heaviest item and the weight of the lightest item.

An operator enters weights for each item. The operator enters 0 when finished.

The algorithm will:

- Take the weights of an item from the user.
- Count the number of items.
- Tell the user if they have entered an invalid weight.
- Output the weight of the heaviest item.
- Output the weight of the lightest item.

Here is a sample output.

```
Enter the weight for the item, 0 to quit: 800

Enter the weight for the item, 0 to quit: -123
  Error.  No negatives allowed

Enter the weight for the item, 0 to quit: 500

Enter the weight for the item, 0 to quit: 200

Enter the weight for the item, 0 to quit: 0
```

Write an algorithm to meet the requirements.

Use pseudo-code or a programming language with which you are familiar.

(9)

(Total for Question 8 = 9 marks)

TOTAL FOR PAPER = 80 MARKS

Pseudo-code command set

The < > indicates where expressions or values need to be supplied. The < > symbols are not part of the pseudo-code.

Syntax	**Explanation of syntax**
SET Variable TO <value>	Assigns a value to a variable.
SET Variable TO <expression>	Computes the value of an expression and assigns to a variable.
SET Array[index] TO <value>	Assigns a value to an element of a one-dimensional array.
SET Array TO [<value>, …]	Initialises a one-dimensional array with a set of values.
SET Array [RowIndex, ColumnIndex] TO <value>	Assigns a value to an element of a two-dimensional array.
IF <expression> THEN <command> END IF	If <expression> is true then command is executed.

IF <expression> THEN
<command>
ELSE
<command> END IF
	If <expression> is true then first
	<command> is executed, otherwise second
	<command> is executed.

WHILE <condition> DO <command> END WHILE	Pre-conditioned loop. Executes <command> whilst <condition> is true.
REPEAT <command> UNTIL <expression>	Post-conditioned loop. Executes <command> until <condition> is true. The loop must execute at least once.
REPEAT <expression> TIMES <command> END REPEAT	Count controlled loop. The number of times <command> is executed is determined by the expression.

FOR <id> FROM <expression> TO <expression> DO <command> END FOR	Count controlled loop. Executes <command> a fixed number of times.
FOR <id> FROM <expression> TO <expression> STEP <expression> DO <command> END FOR	Count controlled loop using a step.
FOR EACH <id> FROM <expression> DO <command> END FOREACH	Count controlled loop. Executes for each element of an array.
SEND <expression> TO DISPLAY	Sends output to the screen.
RECEIVE <identifier> FROM (type) <device>	Reads input of specified type.
READ <File> <record>	Reads in a record from a <file> and assigns to a <variable>. Each READ statement reads a record from the file.
WRITE <File> <record>	Writes a record to a file. Each WRITE statement writes a record to the file.
PROCEDURE <id> (<parameter>, …) BEGIN PROCEDURE <command> END PROCEDURE	Defines a procedure.
FUNCTION <id> (<parameter>, …) BEGIN FUNCTION <command> RETURN <expression> END FUNCTION	Defines a function.
<id> (<parameter>, …)	Calls a procedure or a function.
LENGTH()	Returns the length of an array or string.
RANDOM(n)	This generates a random number from 0 to n.

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