w22 qp 21:

6 The following pseudocode algorithm attempts to check whether a string is a valid email address.

```
FUNCTION IsValid(InString : STRING) RETURNS BOOLEAN
   DECLARE Index, Dots, Ats, Others : INTEGER
   DECLARE NextChar : CHAR
   DECLARE Valid : BOOLEAN

   Index ← 1
   Dots ← 0
   Ats ← 0
   Others ← 0
   Valid ← TRUE

   REPEAT
      NextChar ← MID(InString, Index, 1)
      CASE OF NextChar
         '.' : Dots ← Dots + 1
         '@' : Ats ← Ats + 1
               IF Ats > 1 THEN
                  Valid ← FALSE
               ENDIF
         OTHERWISE : Others ← Others + 1
      ENDCASE

      IF Dots > 1 AND Ats = 0 THEN
         Valid ← FALSE
      ELSE
         Index ← Index + 1
      ENDIF

   UNTIL Index > LENGTH(InString) OR Valid = FALSE

   IF NOT (Dots >= 1 AND Ats = 1 AND Others > 8) THEN
      Valid ← FALSE
   ENDIF

   RETURN Valid

ENDFUNCTION
```

(b) **(i)** Complete the trace table by dry running the function when it is called as follows:

```
Result ← IsValid("Liz.123@big@net")
```

Index	NextChar	Dots	Ats	Others	Valid

[5]

(ii) State the value returned when `IsValid()` is called using the expression shown in **part (b)(i)**.

..... [1]

7 A simple arithmetic expression is stored as a string in the format:

<Value1><Operator><Value2>

An operator character is one of the following: '+' '−' '*' '/'

Example arithmetic expression strings:

```
"803+1904"
"34/7"
```

(b) A string representing an arithmetic expression could be in the correct format but be impossible to evaluate.

Give an example of a correctly formatted string and explain why evaluation would be impossible.

Example string .....

Explanation .....

.....

.....

[2]

8 A teacher is designing a program to perform simple syntax checks on programs written by students. Student programs are submitted as text files, which are known as project files.

A project file may contain blank lines.

The teacher has defined the first program module as follows:

Module	Description
`CheckFile()`	• takes the name of an existing project file as a parameter of type string • returns `TRUE` if the file is valid (it contains at least 10 non-blank lines), otherwise returns `FALSE`

Further modules are defined as follows:

Module	Description
`CheckLine()`	• takes a line from a project file as a parameter of type string • returns zero if the line is blank or contains no syntax error, otherwise returns an error number as an integer

`CountErrors()`	• takes two parameters:
	  ○ the name of a project file as a string
	  ○ the maximum number of errors as an integer
	• uses `CheckFile()` to test the project file. Outputs an error message and ends if the project file is not valid
	• calls `CheckLine()` for each line in the project file
	• counts the number of errors
	• outputs the number of errors or a warning message if the maximum number of errors is exceeded

(d) Module `CheckLine()` includes a check for syntax errors.

Two examples of syntax error that **cannot** be detected from examining a **single** line are those involving selection and iteration.

Give **two other** examples.

1 .....

.....

.....

2 .....

.....

.....

[2]

w22 qp 22:

1 **(a)** A programmer is developing an algorithm to solve a problem. Part of the algorithm would be appropriate to implement as a subroutine (a procedure or a function).

(b) The algorithm in **part (a)** is part of a program that will be sold to the public.
All the software errors that were identified during in-house testing have been corrected.

Identify **and** describe the additional test stage that may be carried out before the program is sold to the public.

Test stage .....

Description .....

.....

.....

.....

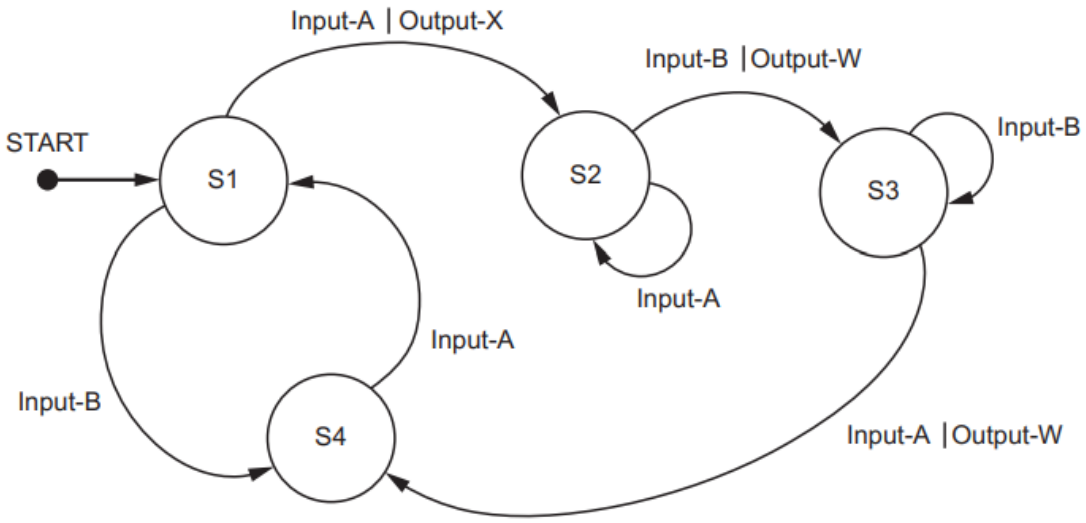
.....

.....

[4]

2 **(a)** An algorithm will process data from a test taken by a group of students. The algorithm will prompt and input the name and test mark for each of the 35 students.

(b) Examine the following state-transition diagram.



Complete the table to show the inputs, outputs and next states.

Input	Output	Next state
		S1
Input-A		
		S2
	Output-W	
	Output-W	

[4]

6 **(a)** The factorial of an integer number is the product of all the integers from that number down to 1.

In general, the factorial of n is $n \times (n-1) \times ... \times 2 \times 1$

For example, the factorial of 5 is $5 \times 4 \times 3 \times 2 \times 1 = 120$

In this question, n will be referred to as the `BaseNumber`.

A function `FindBaseNumber()` will:

- be called with a positive, non-zero integer value as a parameter
- return `BaseNumber` if the parameter value is the factorial of the `BaseNumber`
- return −1 if the parameter value **is not** a factorial.

For example:

Parameter value	Value returned
120	5
12	−1
6	3
1	1

`FindBaseNumber(12)` will return −1 because 12 is not a factorial.

(b) A program is written to allow a user to input a sequence of values to be checked using the function `FindBaseNumber()`.

The user will input one value at a time. The variable used to store the user input has to be of type string because the user will input 'End' to end the program.

Valid input will be converted to an integer and passed to `FindBaseNumber()` and the return value will be output.

Complete the table by giving **four** invalid strings that may be used to test distinct aspects of the required validation. Give the reason for your choice in each case.

Input	Reason for choice
	....
	....
	....
	....

[4]

w22 qp 23:

1 A program is required for a shopping website.

(b) The designer considers the use of a development life cycle to split the development of the website into several stages.

(i) State **one** benefit of a development life cycle when developing the website.

.....

..... [1]

(ii) Analysis is one stage of a development life cycle.

State **one** document that may be produced from the analysis stage of the website project.

.....

..... [1]

(c) The program will be developed using the Rapid Application Development (RAD) life cycle.

(i) State **one** principle of this life cycle.

.....

..... [1]

(ii) Give **two** benefits and **one** drawback of its use compared to the waterfall life cycle.

Benefit 1 .....

.....

Benefit 2 .....

.....

Drawback .....

.....

[3]

(d) Adaptive maintenance needs to be carried out on the website program.

Give **two** reasons why adaptive maintenance may be required.

1 .....

.....

2 .....

.....

[2]

5 **(a)** A text string contains three data items concatenated as shown:

<StockID><Description><Cost>

Item lengths are:

Item	Length
StockID	5
Description	32
Cost	the remainder of the string

A procedure `Unpack()` takes four parameters of type string. One parameter is the original text string. The other three parameters are used to represent the three data items shown in the table and are assigned values within the procedure. These values will be used by the calling program after the procedure ends.

(d) The program that includes `Unpack()` is tested using the walkthrough method.

Describe this method **and** explain how it can be used to identify an error.

.....

.....

.....

.....

.....

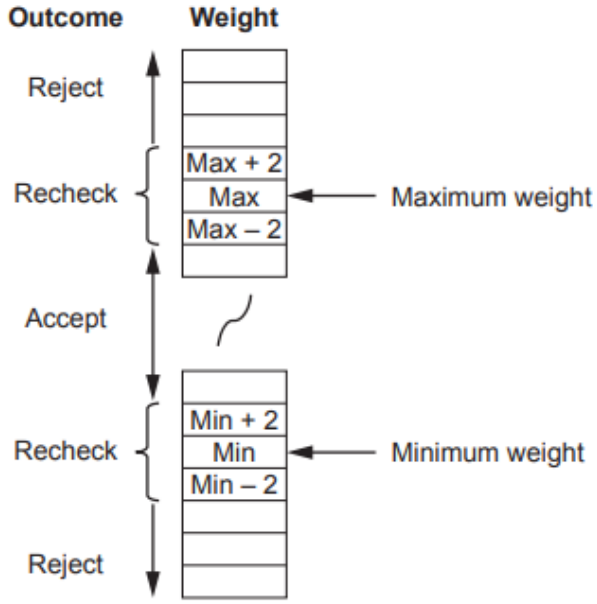
..... [3]

6 Components are weighed during manufacture. Weights are measured to the nearest whole gram.

Components that weigh at least 3 grams more than the maximum weight, or at least 3 grams less than the minimum weight, are rejected.

A component is rechecked if it weighs within 2 grams of either the maximum or minimum weight.

The final outcome of weighing each component is shown below:



A function `Status()` will be called with three parameters. These are integers representing the weight of an individual component together with the minimum and maximum weights.

The value returned from the function will be as follows:

Outcome	Return value
Accept	`'A'`
Reject	`'R'`
Recheck	`'C'`

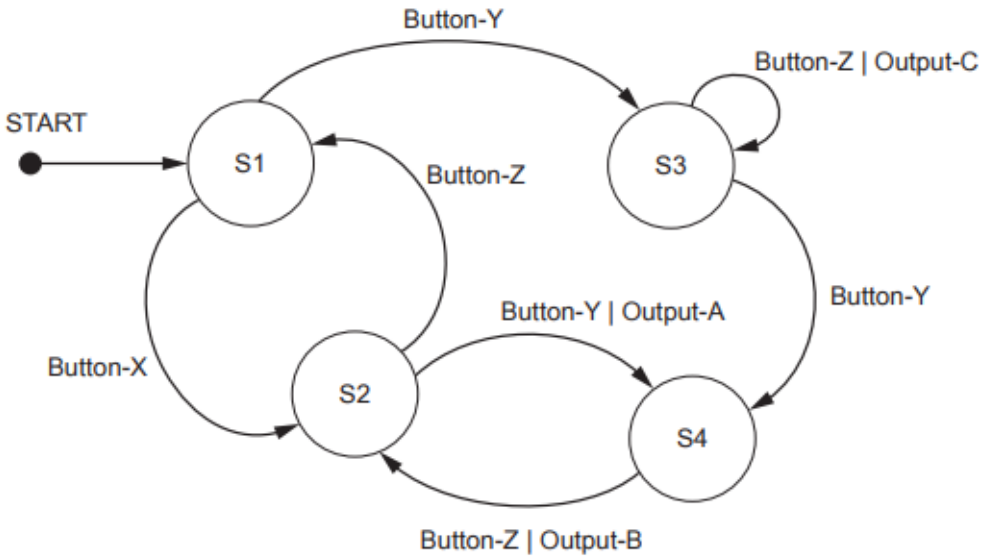
(a) Complete the following test plan for **five** tests that could be performed on function `Status()`. The tests should address all possible outcomes.

Test number	Component weight	Min	Max	Expected return value
1				`'A'`
2				
3				
4				
5				

[5]

s22 qp 21:

2 Examine the following state-transition diagram.



(a) Complete the table with reference to the diagram.

	Answer
The number of different inputs	
The number of different outputs	
The single input value that could result in S4	

[3]

(b) The initial state is S1.

Complete the table to show the inputs, outputs and next states.

Input	**Output**	**Next state**
Button-Y		
	none	
Button-Z		S2
	none	

[4]

8 A program allows a user to save passwords used to login to websites. A stored password is inserted automatically when the user logs into the corresponding website.

A student is developing a program to generate a password. The password will be of a fixed format, consisting of **three groups of four** alphanumeric characters. The groups are separated by the hyphen character '-'.

An example of a password is: "FxAf-3haV-Tq49"

A global 2D array `Secret` of type `STRING` stores the passwords together with the website domain name where they are used. `Secret` contains 1000 elements organised as 500 rows by 2 columns.

Unused elements contain the empty string (`""`). These may occur anywhere in the array.

An example of a part of the array is:

Array element	Value
`Secret[27, 1]`	"www.thiswebsite.com"
`Secret[27, 2]`	"••••••••••••••"
`Secret[28, 1]`	"www.thatwebsite.com"
`Secret[28, 2]`	"••••••••••••••"

Note:
- For security, passwords are stored in an encrypted form, shown as "••••••••••••••" in the example.
- The passwords cannot be used without being decrypted.
- Assume that the encrypted form of a password will **not** be an empty string.

The programmer has started to define program modules as follows:

Module	Description

`RandomChar()`	• Generates a single random character from within one of the following ranges:
	  ○ 'a' to 'z'
	  ○ 'A' to 'Z'
	  ○ '0' to '9'
	• Returns the character

`Encrypt()`	• Takes a password as a parameter of type string • Returns the encrypted form of the password as a string
`Decrypt()`	• Takes an encrypted password as a parameter of type string • Returns the decrypted form of the password as a string

For reference, relevant ASCII values are as follows:

Character range	ASCII range
'a' to 'z'	97 to 122
'A' to 'Z'	65 to 90
'0' to '9'	48 to 57

(c) The modules `Encrypt()` and `Decrypt()` are called from several places in the main program.

Identify a method that could have been used to test the main program before these modules were completed. Describe how this would work.

Method .....

Description .....

.....

.....

..... [3]

(d) A validation function is written to check that the passwords generated are valid.

To be valid, each password must:

- be 14 characters long
- be organised as three groups of four case-sensitive alphanumeric characters. The groups are separated by hyphen characters
- not include any duplicated characters, except for the hyphen characters.

Note: lower-case and upper-case characters are not the same. For example, 'a' is not the same as 'A'.

Give **two** password strings that could be used to test different areas of the validation rules.

Password 1 .....

Password 2 .....

[2]

s22 qp 22:

1 **(a)** A programmer is testing a program using an Integrated Development Environment (IDE). The programmer wants the program to stop when it reaches a specific instruction or program statement in order to check the value assigned to a variable.

Give the technical term for the position at which the program stops.

..... [1]

(b) The following table lists some activities from the program development life cycle.

Complete the table by writing the life cycle stage for each activity.

Activity	Life cycle stage
An identifier table is produced.	
Syntax errors can occur.	
The developer discusses the program requirements with the customer.	
A trace table is produced.	

[4]

3 **(a)** The module headers for five modules in a program are defined in pseudocode as follows:

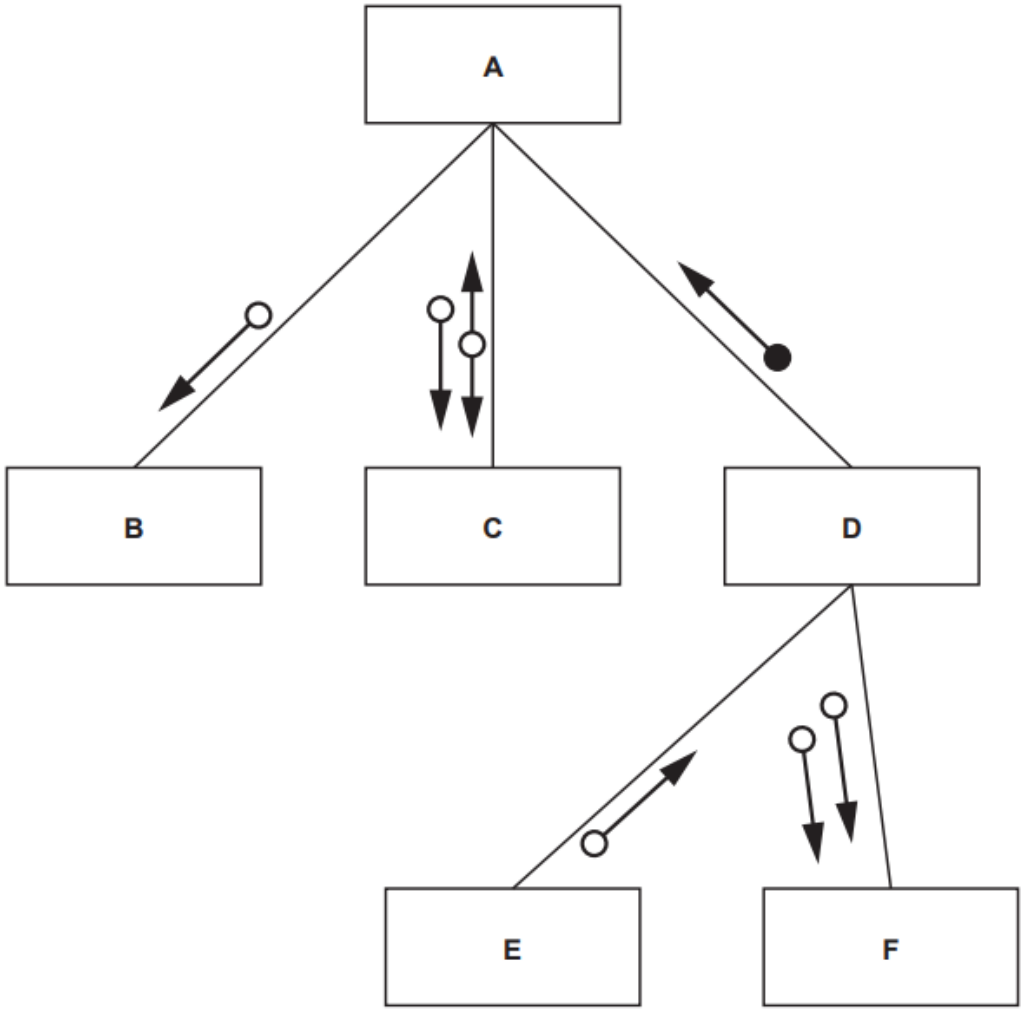
Pseudocode module header
`FUNCTION Mod_V(S2 : INTEGER) RETURNS BOOLEAN`
`PROCEDURE Mod_W(P4 : INTEGER)`
`PROCEDURE Mod_X(T4 : INTEGER, BYREF P3 : REAL)`
`PROCEDURE Mod_Y(W3 : REAL, Z8 : INTEGER)`
`FUNCTION Mod_Z(F3 : REAL) RETURNS INTEGER`

An additional module `Head()` repeatedly calls three of the modules in sequence.

A structure chart has been partially completed.

(i) Complete the structure chart to include the information given about the six modules.

Do **not** label the parameters and do **not** write the module names.



[3]

(ii) Complete the table using the information in **part 3(a)** by writing each module name to replace the labels **A** to **F**.

Label	Module name
A	
B	
C	
D	
E	
F	

[3]

5 Study the following pseudocode. Line numbers are for reference only.

```
10 PROCEDURE Encode()
11   DECLARE CountA, CountB, ThisNum : INTEGER
12   DECLARE ThisChar : CHAR
13   DECLARE Flag : BOOLEAN
14   CountA ← 0
15   CountB ← 10
16   Flag ← TRUE
17   INPUT ThisNum
18   WHILE ThisNum <> 0
19      ThisChar ← LEFT(NUM_TO_STR(ThisNum), 1)
20      IF Flag = TRUE THEN
21         CASE OF ThisChar
22            '1' : CountA ← CountA + 1
23            '2' : IF CountB < 10 THEN
24                     CountA ← CountA + 1
25                  ENDIF
26            '3' : CountB ← CountB - 1
27            '4' : CountB ← CountB - 1
28                  Flag ← FALSE
29            OTHERWISE : OUTPUT "Ignored"
30         ENDCASE
31      ELSE
32         IF CountA > 2 THEN
33            Flag ← NOT Flag
34            OUTPUT "Flip"
35         ELSE
36            CountA ← 4
37         ENDIF
38      ENDIF
39      INPUT ThisNum
40   ENDWHILE
41   OUTPUT CountA
42 ENDPROCEDURE
```

(b) Complete the trace table below by dry running the procedure `Encode()` when the following values are input:

```
12, 24, 57, 43, 56, 22, 31, 32, 47, 99, 0
```

The first row is already complete.

ThisNum	ThisChar	CountA	CountB	Flag	OUTPUT
		0	10	TRUE	

[6]

(c) Procedure `Encode()` is part of a modular program. Integration testing is to be carried out on the program.

Describe **integration testing**.

.....

.....

.....

..... [2]

7 A programming language has string functions equivalent to those given in the **insert**.

The language includes a `LEFT()` and a `RIGHT()` function, but it does **not** have a `MID()` function.

(a) Write pseudocode for an algorithm to implement your own version of the `MID()` function which will operate in the same way as that shown in the **insert**.

(b) The values passed to your `MID()` function in **part (a)** need to be validated.

Assume that the values are of the correct data type.

State **two** checks that could be applied to the values passed to the function.

1 .....

.....

2 .....

.....

[2]

s22 qp 23:

2 A program has been written to implement a website browser and maintenance is now required.

One type of maintenance is called perfective.

Name **two other** types of maintenance that the program may require **and** give a reason for each.

Type 1 .....

Reason .....

.....

.....

.....

Type 2 .....

Reason .....

.....

.....

.....

[4]

3 Four program modules are defined as follows:

Pseudocode module header
`PROCEDURE Sub1_A(XT : INTEGER, PB : STRING)`
`FUNCTION Sub1_B(RA : INTEGER) RETURNS BOOLEAN`
`PROCEDURE Sub1_C(SB : INTEGER, BYREF SA : STRING)`
`PROCEDURE Section_1()`

(a) A structure chart will be produced as part of the development process.

Describe the purpose of a structure chart.

.....

.....

.....

..... [2]

(b) Module `Section_1()` calls one of the other three modules. The module called will be selected when the program runs.

Draw the structure chart.

[5]

4 Items in a factory are weighed automatically. The weight is stored as an integer value representing the item weight to the nearest gram (g).

A function is written to validate the weight of each item. The function will return "PASS" if the weight of the item is within the acceptable range, otherwise the function will return "FAIL".

The acceptable weight range for an item is 150 g to 155 g inclusive.

The validation function is to be properly tested. Black-box testing will be used and a test plan needs to be produced.

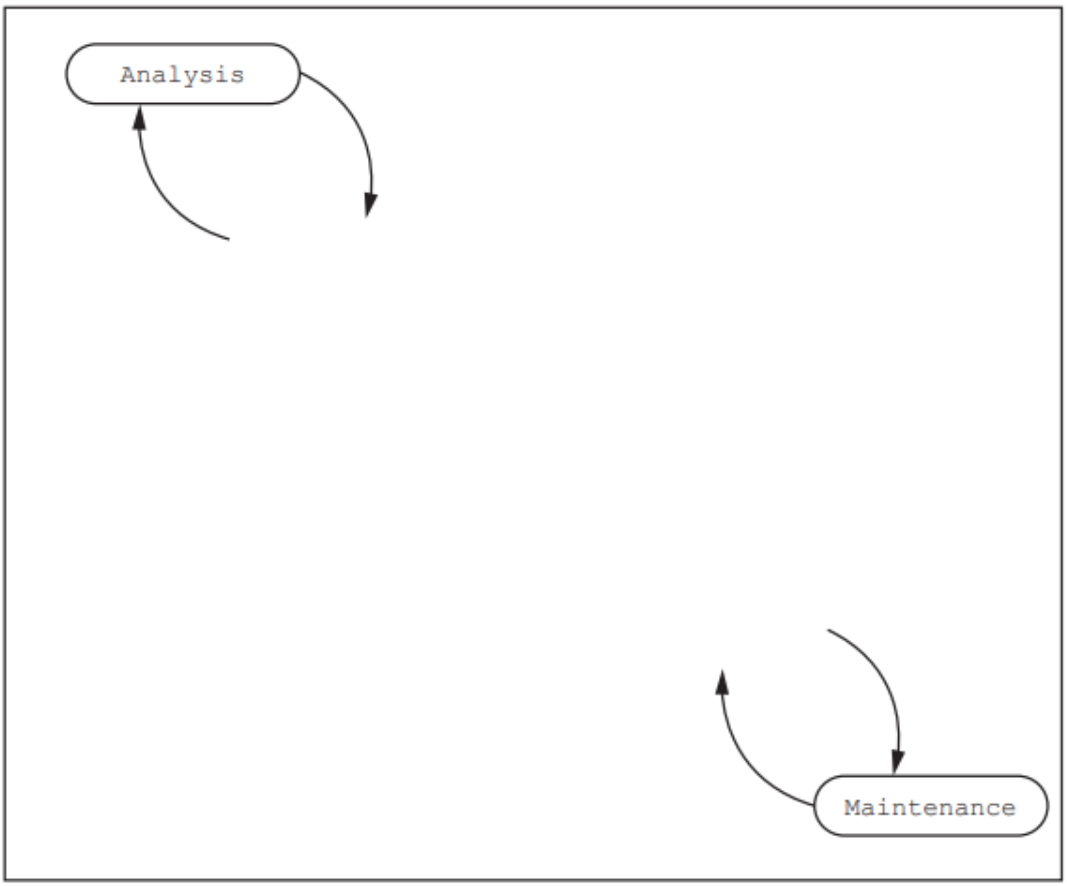
Complete the table by writing additional tests to test this function.

Type of test data	Example test value	Expected return value	Explanation
Normal	153	"PASS"	Value within the acceptable range

[4]

8 The following diagram shows the incomplete waterfall model of the program development life cycle.

(a) Complete the diagram.



[3]

[3]

(b) Explain the meaning of the downward and upward arrows.

Downward arrows .....

.....

.....

Upward arrows .....

.....

.....

[2]

(c) Identify another type of model for the program development life cycle.

..... [1]

w21 qp 21:

1 Sylvia is testing a program that has been written by her colleague. Her colleague tells her that the program does not contain any syntax errors.

(a) (i) State what her colleague means by "does not contain any syntax errors".

.....

.....

..... [1]

(ii) Identify **and** describe **one** other type of error that the program may contain.

Type of error .....

Description .....

.....

[2]

4 A program controls the heating system in a sports hall.

Part of the program involves reading a value from a sensor. The sensor produces a numeric value that represents the temperature. The value is an integer, which should be in the range 0 to 40 inclusive.

A program function has been written to validate the values from the sensor.

(a) A test plan is needed to test the function.

Complete the table. The first line has been completed for you.

You can assume that the sensor will generate only integer data values.

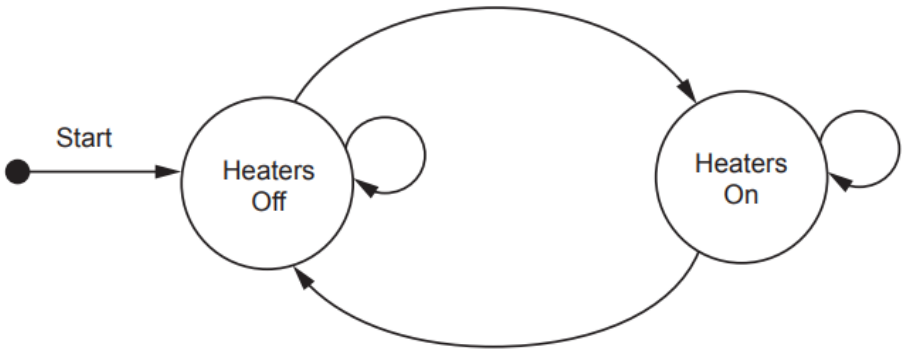
Test	Test data value	Explanation	Expected outcome
1	23	Normal data	Data is accepted
2			
3			
4			
5			

[4]

(b) A program module controls the heaters. This module operates as follows:

- If the temperature is below 10, switch the heaters on.
- If the temperature is above 20, switch the heaters off.

Complete the following state-transition diagram for the heating system:



[3]

w21 qp 22:

(b) A software company is working on a project to develop a website for a school.

The school principal has some ideas about the appearance of the website but is unclear about all the details of the solution. The principal would like to see an initial version of the website.

(i) Identify a life cycle method that would be appropriate in this case.

Give a reason for your choice.

Life cycle method .....

Reason .....

.....

.....

.....

[2]

(ii) The website project has progressed to the design stage.

State **three** activities that will take place during the design stage of the program development life cycle.

1 .....

2 .....

3 .....

[3]

s21 qp 21:

2 **(a)** Four program modules form part of a program for a library.

A description of the relationship between the modules is summarised as follows:

Module name	Description
`UpdateLoan()`	• Calls either `LoanExtend()` or `LoanReturn()`
`LoanExtend()`	• Called with parameters `LoanID` and `BookID` • Calls `CheckReserve()` to see whether the book has been reserved for another library user • Returns `TRUE` if the loan has been extended, otherwise returns `FALSE`
`CheckReserve()`	• Called with `BookID` • Returns `TRUE` if the book has been reserved, otherwise returns `FALSE`
`LoanReturn()`	• Called with parameters `LoanID` and `BookID` • Returns a `REAL` (which is the value of the fine to be paid in the case of an overdue loan)

Draw a structure chart to show the relationship between the four modules and the parameters passed between them.

[5]

4 Study the following pseudocode. Line numbers are for reference only.

```
10 FUNCTION Convert(Name : STRING) RETURNS STRING
11
12   DECLARE Flag: BOOLEAN
13   DECLARE Index : INTEGER
14   DECLARE ThisChar : CHAR
15   DECLARE NewName : STRING
16
17   CONSTANT SPACECHAR = ' '
18
19   Flag ← TRUE
20   Index ← 1
21   NewName ← ""       // formatted name string
22
23   WHILE Index <= LENGTH(Name)
24      ThisChar ← MID(Name, Index, 1)
25      IF Flag = TRUE THEN
26         NewName ← NewName & UCASE(ThisChar)
27         IF ThisChar <> SPACECHAR THEN
28            Flag ← FALSE
29         ENDIF
30      ELSE
31         NewName ← NewName & ThisChar
32      ENDIF
33      IF ThisChar = SPACECHAR THEN
34         Flag ← TRUE
35      ENDIF
36      Index ← Index + 1
37   ENDWHILE
38
39   RETURN NewName
40
41 ENDFUNCTION
```

(a) Complete the trace table below by dry running the function when it is called as follows:

```
Result ← Convert("∇in∇a∇∇Cup")
```

Note: The symbol `'∇'` has been used to represent a space character.
Use this symbol for any space characters in the trace table.

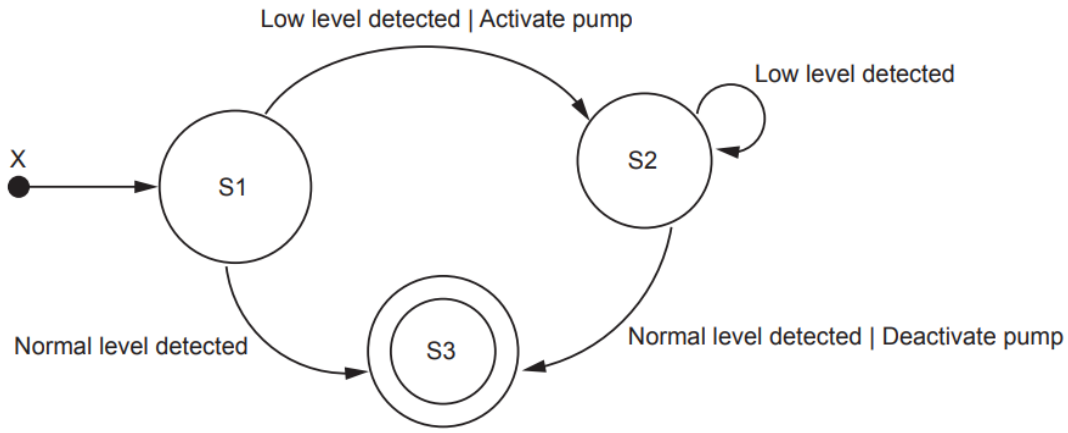
The first row has been completed for you.

Name	Flag	Index	NewName	ThisChar
"VinVaVVCup"				

[5]

s21 qp 22:

2 **(a)** Examine the following state-transition diagram.



(i) Complete the table with reference to the diagram.

	Answer
The number of transitions that result in a different state	
The number of transitions with associated outputs	
The label that should replace 'X'	
The final or halting state	

[4]

(ii) The current state is S1. The following inputs occur.

1. Low level detected
2. Low level detected
3. Low level detected
4. Low level detected

Give the number of outputs and the current state.

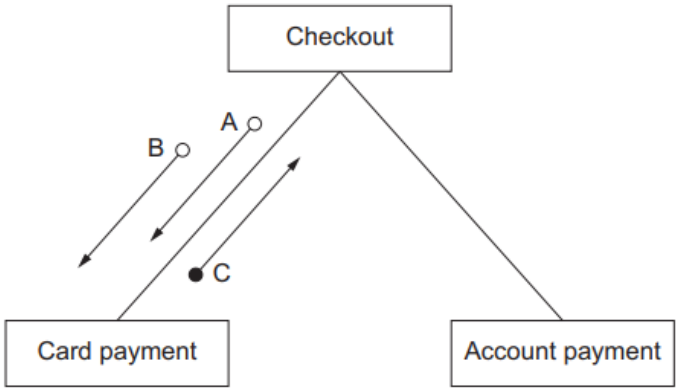
Number of outputs .....

Current state .....

[2]

specimen paper:

2 Roberta downloads music from an online music store. The diagram shows part of a structure chart for the online music store program.



(a) State **three** items of information that the diagram shows about the design of the program.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

6 Members of a family use the same laptop computer. Each family member has their own password.

To be valid, a password must comply with the following rules:

1 At least two lower-case alphabetic characters
2 At least two upper-case alphabetic characters
3 At least three numeric characters
4 Alpha-numeric characters only

A function, `ValidatePassword`, is needed to check that a given password follows these rules. This function takes a string, `Pass`, as a parameter and returns a boolean value:

- TRUE if it is a valid password
- FALSE otherwise

(b) The `ValidatePassword` function will be tested.

(i) Give a valid password that can be used to check that the function returns TRUE under the correct conditions.

Password1: ..... [1]

(ii) Password1 is modified to test each rule separately. Give **four** modified passwords and justify your choice.

Password to test rule 1: .....

Reason: .....

.....

.....

Password to test rule 2: .....

Reason: .....

.....

.....

Password to test rule 3: .....

Reason: .....

.....

.....

Password to test rule 4: .....

Reason: .....

.....

.....

[4]

(iii) When testing the `ValidatePassword` function a module it is necessary to test all possible paths through the code.

State the name given to this type of validation testing.

..... [1]

(iv) A program consisting of several functions can be tested using a process known as 'stub testing'

Explain this process.

.....

.....

.....

..... [2]