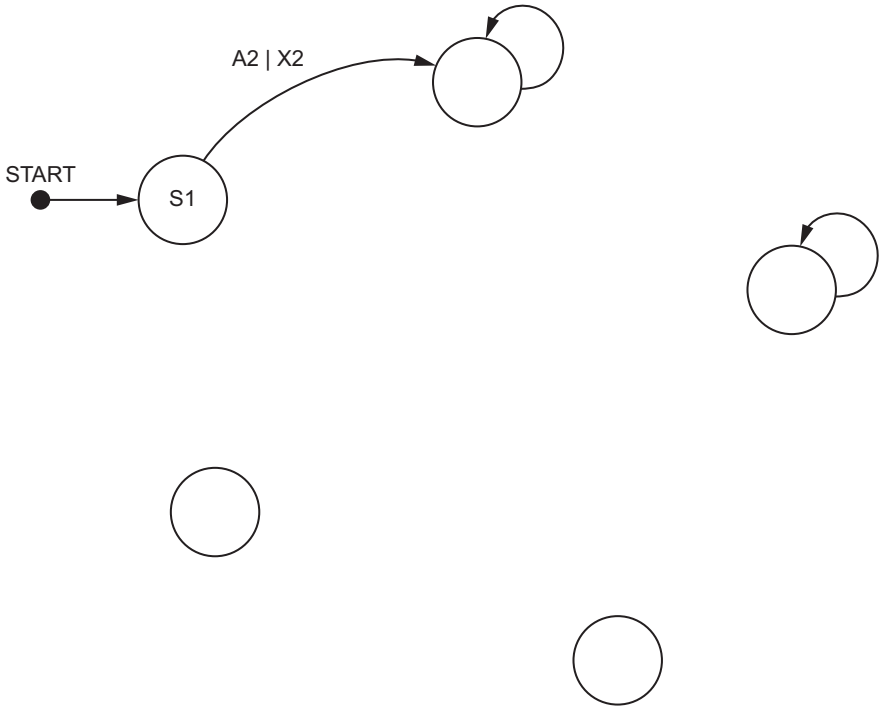
7 There are several different ways to express an algorithm during the design of a program.

(a) One part of the program contains an algorithm which is represented by a state-transition diagram.

The table shows the inputs, outputs and states for the algorithm:

Current state	Input	Output	Next state
S1	A2	X2	S3
S1	A1	X1	S2
S2	A4	X4	S5
S3	A1		S3
S3	A3	X3	S2
S3	A2	X4	S4
S4	A1	X1	S4
S4	A3		S2
S4	A4	X4	S5

Complete the state-transition diagram to represent the information given in the table.



[5]

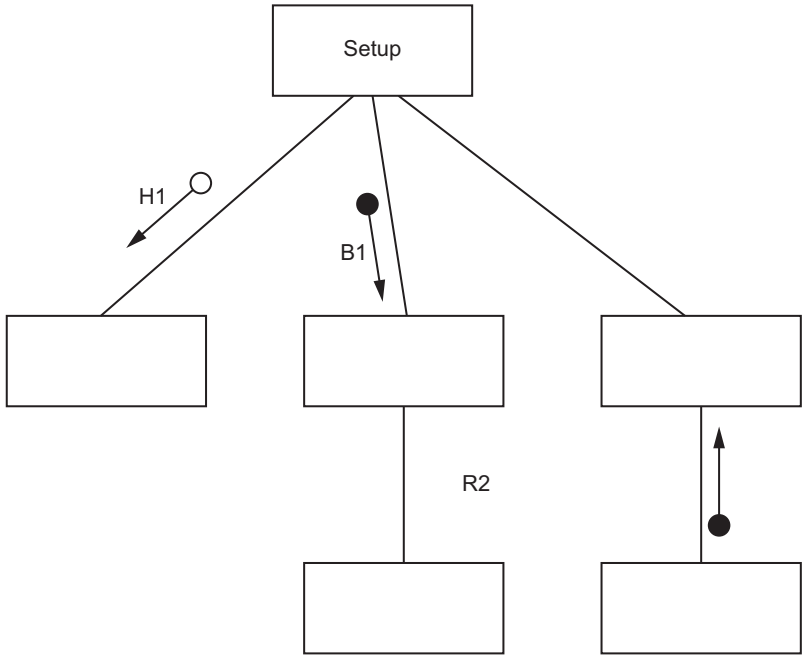
(b) A structure chart is used to document a different part of the program.

This part of the program contains six modules:

Pseudocode module header
`PROCEDURE Setup()`
`PROCEDURE Restart(H1 : STRING, C1 : INTEGER)`
`FUNCTION Modify(B1 : BOOLEAN) RETURNS INTEGER`
`PROCEDURE Final(T1 : INTEGER)`
`PROCEDURE Update(BYREF R2 : STRING)`
`FUNCTION Confirm() RETURNS BOOLEAN`

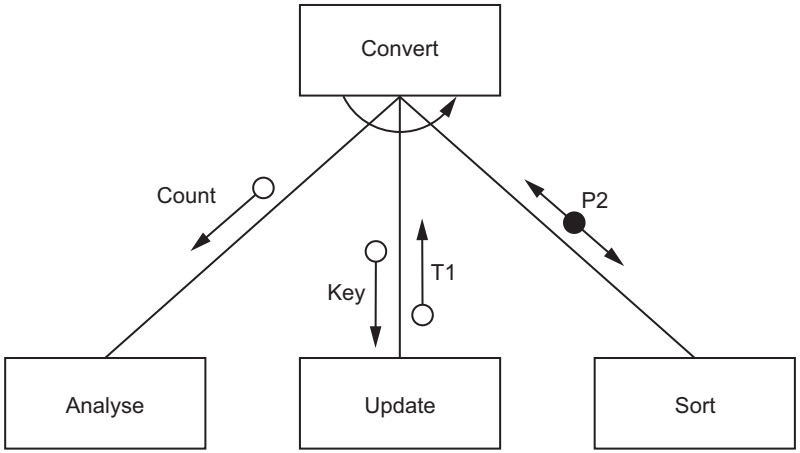
Module Setup will repeatedly call **three** of the modules.

Complete the structure chart to document the information given in the table.



[5]

7 The structure chart shows part of a program design:



(a) Explain the meaning of the curved arrow symbol in this structure chart.

.....

.....

.....

..... [2]

(b) The program designer has noted that:

- Count is the number of elements in an array
- T1 is a value representing the number of elements in an array that have been modified
- Key is of type `STRING`

Write the pseudocode module headers for analyse, update and sort.

Analyse:

.....

.....

Update:

.....

.....

Sort:

.....

..... [4]

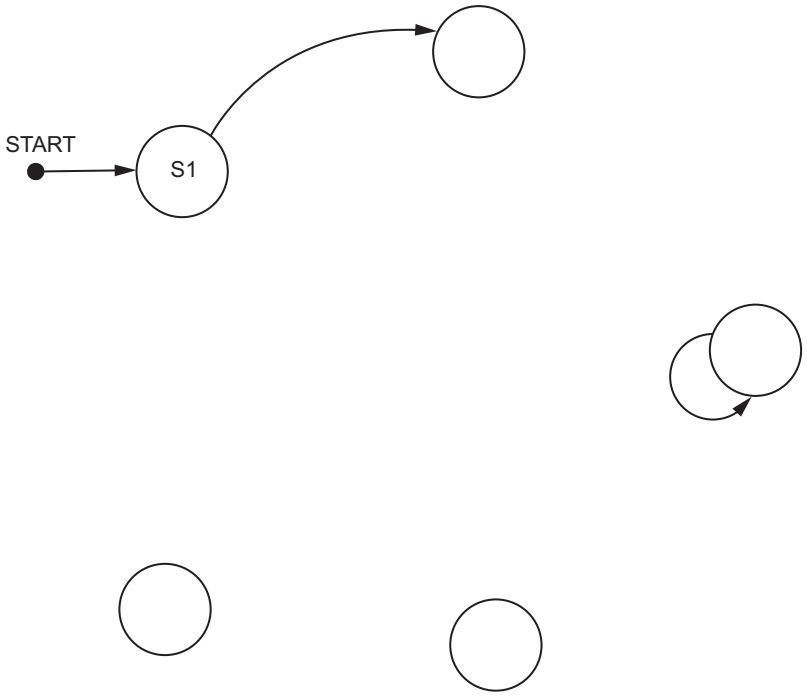
7 There are several different ways to express an algorithm during the design of a program.

(a) One part of the program contains an algorithm which is represented by a state-transition diagram.

The table shows the inputs, outputs and states for the algorithm:

Current state	Input	Output	Next state
S1	A1		S2
S2	A2	X4	S3
S3	A1	X1	S3
S3	A2	X1	S3
S3	A3	X3	S4
S3	A4		S2
S4	A3	X4	S5
S4	A4	X4	S5
S4	A1		S2

Complete the state-transition diagram to represent the information given in the table:



[5]

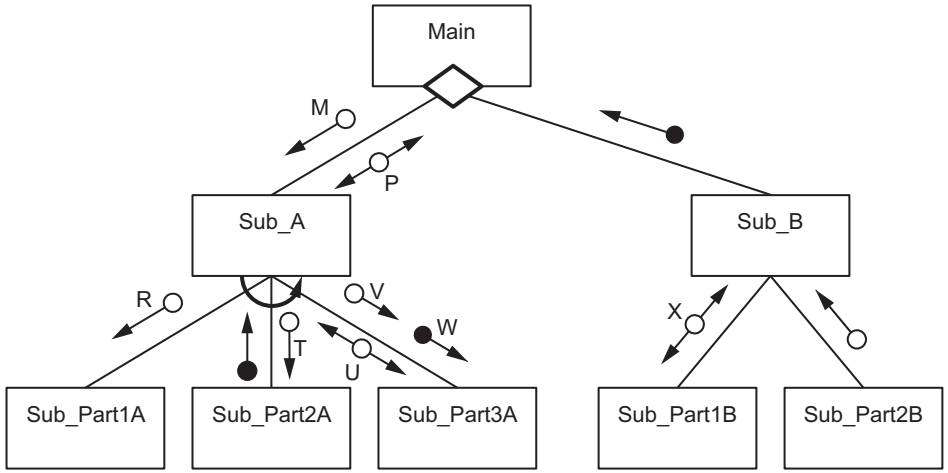
(b) A structure chart is used to document a different part of the program, made up of five modules.

Program notes:
- module Setup calls either module Restart, or module Confirm
- module Confirm takes a string as a parameter and returns an integer
- module Modify has no parameters and returns a Boolean
- module Update takes a string as a parameter
- module Restart repeatedly calls module Update followed by module Modify
- module Restart takes a string as a parameter that is passed by reference.

Draw a structure chart to represent the relationship between the **five** modules, including all parameters and return values.

[4]

6 Study the structure chart:



Some of the parameter data types are:

- R and V are of type `INTEGER`
- T is of type `REAL`
- U is of type `STRING`
- W is of type `BOOLEAN`.

Some of the modules in the structure chart are functions, others are procedures.

(a) Explain **one** difference between functions and procedures.

.....

..... [1]

(b) Write the pseudocode to define the module headers:

Sub_Part1A

.....

.....

Sub_Part2A

.....

.....

Sub_Part3A

.....

.....

(c) The structure chart uses the two symbols shown.

Complete the table to explain what each symbol means and how the relevant modules in the structure chart are affected.

Symbol	Explanation
	....
	....

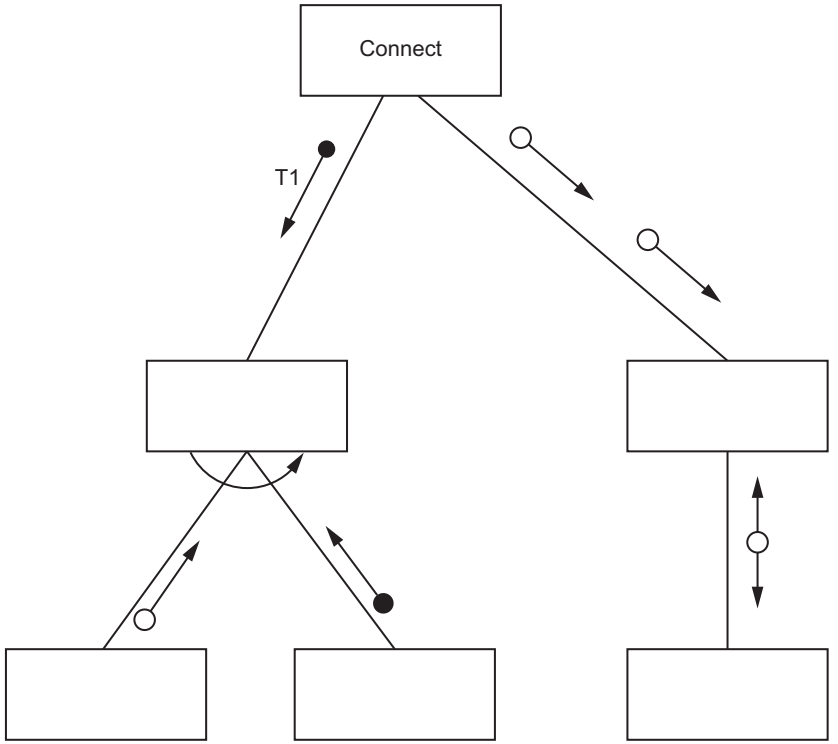
[3]

7 A program contains six modules with headers as follows:

Pseudocode module header
`PROCEDURE Connect()`
`FUNCTION Activate(H1 : STRING, Code : INTEGER) RETURNS BOOLEAN`
`FUNCTION Sync(T1 : BOOLEAN, S2 : REAL) RETURNS INTEGER`
`PROCEDURE Initialise(BYREF ID : INTEGER, BYVAL CC : INTEGER)`
`FUNCTION Reset(RA : STRING) RETURNS INTEGER`
`FUNCTION Enable(SA : INTEGER) RETURNS BOOLEAN`

Module `Connect()` will call either `Activate()` or `Sync()`. This is decided at run-time.

(a) Complete the structure chart for these modules.



[5]

(b) Explain the meaning of the curved arrow symbol used in the diagram in part **(a)**.

.....

..... [2]

7 A coffee shop runs a computerised loyalty card system.

Customers are issued with a loyalty card with their name together with a unique customer ID.

Loyalty points are added to their card each time they spend money at the shop.

The following information is stored for each customer: ID, name, home address, email address, mobile phone number, date of birth, number of points, date of last visit and amount of money spent at last visit.

A new module will generate a personalised email message to each loyalty card customer who has not visited the coffee shop in the last three months. The message will include a unique voucher code which can be used to authorise a discount if the customer goes to the shop within the next two weeks.

(a) Identify **three** items of customer information that will be used by the new module **and** justify your choices.

Item 1 .....

Justification .....

.....

Item 2 .....

Justification .....

.....

Item 3 .....

Justification .....

.....

[3]

(b) Identify the computational thinking skill that you needed to use to answer part **(a)**.

..... [1]

(c) It is decided to adopt a formal program development life cycle model for the development of the new module.

The analysis of the new module is complete and the project moves on to the design stage. During this stage all the necessary algorithms and module designs will be defined.

State **three other** items that will be defined for the new module during the design stage.

1 .....

2 .....

3 .....

[3]

(d) Part of the coffee shop program contains three program modules as follows:

- Module `Init()` has no parameters and returns a Boolean.
- Module `Reset()` takes a string as a parameter and returns an Integer.
- Module `Check()` repeatedly calls `Init()` followed by `Reset()`.

Draw a structure chart to represent the relationship between the **three** modules, including all parameters and return values.

[3]

7 A coffee shop owner wants to introduce a computerised loyalty card system.

A programmer discusses the details of the system with the shop owner.

(a) Identify the stage of the program development life cycle that this discussion is part of **and** give a document that will be produced during this stage.

Stage .....

Document .....

.....

[2]

(b) The shop will give each customer a loyalty card that displays a unique customer ID as a bar code. A customer will be able to present their card each time they make a purchase. The system will scan the bar code, calculate points, and add them to the customer's total. When the customer next makes a purchase and presents their card, they will have the option to exchange points for a discount.

The designer decides that this activity will be handled by a new module. Decomposition will be used to break the problem of designing the new module down into sub-problems (sub-modules).

Identify **four** sub-modules that could be used in the design of the new module **and** describe their use.

Sub-module 1 .....

Use .....

.....

Sub-module 2 .....

Use .....

.....

Sub-module 3 .....

Use .....

.....

Sub-module 4 .....

Use .....

.....

[4]