1(a). Students take part in a sports day. The students are put into teams.

Students gain points depending on their result and the year group they are in. The points are added to the team score.

The team with the most points at the end of the sports day wins.

Data about the teams and students is stored in a sports day program.

i. Identify the most appropriate data type for each variable used by the program.

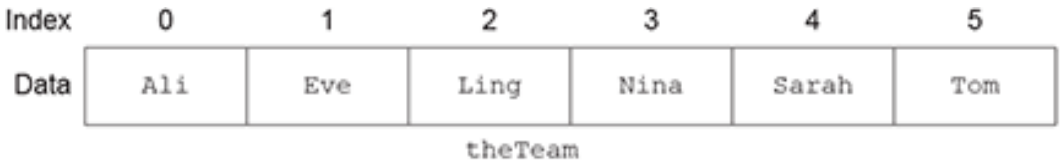
Each data type must be different.

Variable	Example	Data type
`teamName`	"Super-Team"	
`studentYearGroup`	11	
`javelinThrow`	18.2	

[3]

ii. The student names for a team are stored in an array with the identifier `theTeam`

An example of the data in this array is shown:



A linear search function is used to find whether a student is in the team. The function:

- takes a student name as a parameter
- returns `True` if the student name is in the array
- returns `False` if the student name is **not** in the array.

Complete the design of an algorithm for the linear search function.

```
function linearSearch(studentName)

  for count = 0 to ……..……..……

    if theTeam[……..……..……..……] == ……..……..…… then

      return ……..……..……

    endif

  next count

  return False

endfunction
```

[4]

(b). This algorithm calculates the number of points a student gets for the distance they throw in the javelin:

```
01  javelinThrow = input("Enter distance")
02  yearGroup = input("Enter year group")
03  if javelinThrow >= 20.0 then
04    score = 3
05  elseif javelinThrow >= 10.0 then
06    score = 2
07  else
08    score = 1
09  endif
10  if yearGroup != 11 then
11    score = score * 2
12  endif
13  print("The score is", score)
```

Complete the trace table for the algorithm when a student in year 10 throws a distance of 14.3

You may not need to use all the rows in the table.

Line number	javelinThrow	yearGroup	score	**Output**

[4]

(c). The height a student jumps in the high jump needs to be input and validated.
The height is entered in centimetres (cm) and must be between 40.0 and 180.0 inclusive.

i. Write an algorithm to:

Each data type must be different.

- take the height jumped as input
- output "`VALID`" **or** "`NOT VALID`" depending on the height input.

You must use **either**:
- OCR Exam Reference Language, **or**
- A high-level programming language that you have studied.

[4]

ii. The algorithm is tested using a range of tests.

Complete the table to identify an example of test data for each type of test.

Test data (height jumped in cm)	Type of test	Expected output
	Normal	"VALID"
	Boundary	"VALID"
	Erroneous	"NOT VALID"

[3]

(d). The individual results for each student in each event are stored in a database.

The database table TblResult stores the times of students in the 100 m race. Some of the data is shown:

StudentID	YearGroup	TeamName	Time
11GC1	11	Valiants	20.3
10VE1	10	Super-Team	19.7
10SM1	10	Super-Team	19.2
11JP2	11	Champions	19.65

Complete the SQL statement to show the Student ID and team name of all students who are in year group 11

```
SELECT StudentID, .....

FROM .....

.....
```

[4]

(e). Abstraction and decomposition have been used in the design of the sports day program.

i. Identify **one** way that abstraction has been used in the design of this program.

_____

[1]

ii. Identify **one** way that decomposition has been used in the design of this program.

_____

[1]

(f). An algorithm works out which team has won (has the highest score).

Write an algorithm to:

- prompt the user to enter a team name and score, or to enter "stop" to stop entering new teams
- repeatedly take team names and scores as input until the user enters "stop"
- calculate which team has the highest score
- output the team name and score of the winning team in an appropriate message.

You must use **either**:

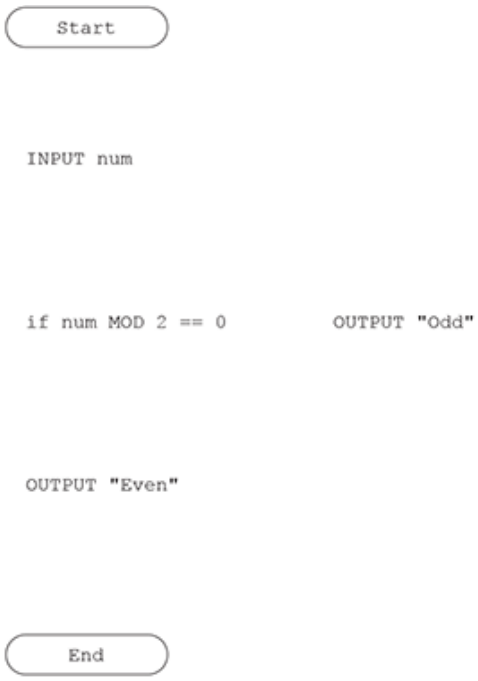
- OCR Exam Reference Language, **or**
- A high-level programming language that you have studied

[6]

2. An algorithm decides if a number is odd or even.
An odd number divided by 2 will give the remainder 1.

The flowchart statements have been written for the algorithm, but the flowchart is incomplete.

Complete the flowchart.



[4]

3.

i. Show how a binary search will be used to find the number 10 in the following data set:

1 2 5 6 7 10 20

[3]

ii. State **one** pre-requisite for a binary search algorithm.

[1]

iii. Tick (✓) **one** box to identify the name of the sorting algorithm that splits data into individual items before recombining in order.

- ☐ Bubble sort
- ☐ Insertion sort
- ☐ Merge sort

[1]

4. A program allows users to search for and watch videos. Users give a rating to the videos they watch.

Identify **one** input and **one** output for the program.

Input

Output

[2]

5(a). An array stores a collection of words. The array has the identifier data.

```
data = ["or", "and", "it", "when", "and", "or", "and", "it"]
```

A searching algorithm is used to find a word in the array data. The algorithm used to search for a word is shown.

```
word = input("Enter a word to find")
found = False
for i = 0 to 7
    if data[i] == word then
        found = True
    endif
next i
print(found)
```

State the name of this searching algorithm.

[1]

(b). Some words appear in the array more than once.

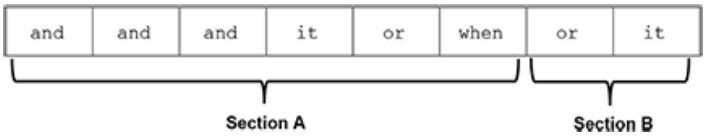
Refine the algorithm to:

- count the number of times a word appears in the array
- output this number.

For example, the algorithm should output 3 if the input is "and".

[4]

(c). An insertion sort is used to put the array with the identifier data into alphabetical order.
The diagram shows the array when the insertion sort is almost complete.



i. Explain why the array is shown with two sections.

[2]

ii. Describe the steps an insertion sort takes to complete sorting the array `data`.

[3]

(d). One sorting algorithm splits an array into single items and then combines them into an ordered array.

State the name of this sorting algorithm.

[1]

6. Complete the description of computational thinking using the given list of terms.

Not all terms will be used.

abstraction	algorithm	computation	decomposition
evaluation	flowchart	origin	program
pseudocode	research	sequence	thinking

Computational thinking is the process of analysing problems so that they can be solved in a logical way.

The process of …… breaks down a problem into smaller, more manageable parts.

The process of …….. removes unnecessary detail from the problem, so that the main components can be focused on.

Algorithmic …….. identifies the main steps needed to solve the problem and the …….. that the steps are completed.

[4]

7(a). OCR Drones flies goods around the country using drones.

Details about the drones that pilots fly are stored in a database table called TblDrone.
Some of the data stored in this table is shown.

DroneID	DroneType	Mileage	LastCheck
001	Quadcopter	65 032	65 000
002	Quadcopter	32 128	21 000
003	Octocopter	98 021	98 000

TblDrone

i. Complete the SQL statement to display `DroneID` and `Mileage` for all Octocopter type drones that have a mileage of greater than 50 000 miles.

```
SELECT ……

…… TblDrone

WHERE DroneType = "Octocopter" ……..…… Mileage ……..……..……
```

[4]

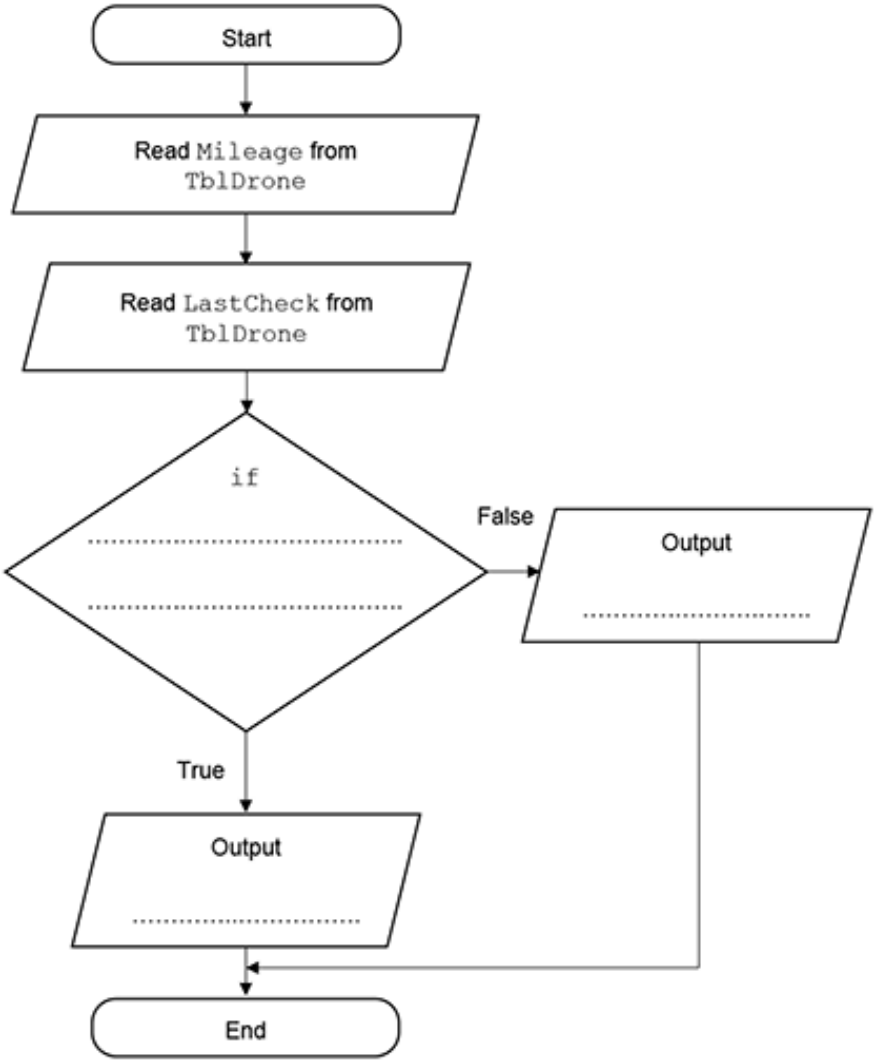
ii. Drones must be checked every 10 000 miles. If the difference between `Mileage` and `LastCheck` is greater than 10 000 then the drone needs to be checked.

A flowchart shows the steps needed to check a drone.

The flowchart outputs `"Check"` if the drone needs to be checked.

The flowchart outputs `"No Check"` if the drone does **not** need to be checked.

Complete the flowchart for the algorithm.



[2]

(b). A pilot code is automatically generated when a new pilot joins the company.

This algorithm generates a code for each pilot:

```
01    a = input("Enter first letter of first name")
02    b = input("Enter first letter of second name")
03    c = random(1,100)
04    while c < 100
05        c = c * 10
06    endwhile
07    pilotCode = a + b + str(c)
08    print(pilotCode)
```

Complete the trace table for the given algorithm.

Lines 01 to 03 have already been completed.

You may not need to use all rows in the trace table.

Line number	a	b	c	pilotCode	Output
01	H				
02		K			
03			9		

[4]

8(a). The variables num1 and num2 store integers.

Write pseudocode to add the integers stored in num1 and num2. Store the result in a variable with the identifier total

[1]

(b). Three incomplete pseudocode algorithms are given with a description of the purpose of each algorithm.

Write the missing arithmetic operator for each algorithm.

i. Outputting 12 to the power of 2.

```
print(12 ..... 2)
```

[1]

ii. Working out if a number is odd or even.

```
number = 53
if number ..... 2 == 0 then
 print("Even number")
else
 print("Odd number")
endif
```

[1]

iii. Finding the difference between two measurements.

```
measurement1 = 300
measurement2 = 100
difference = measurement1 ..... measurement2
```

[1]

(c). Read the following pseudocode algorithm:

```
01 start = 3
02 do
03   print(start)
04   start = start - 1
05 until start == -1
06 print("Finished")
```

Complete the following trace table for the given algorithm.

Line number	start	Output

[3]

9(a). An insertion sort is one type of sorting algorithm.

A student has written a pseudocode algorithm to perform an insertion sort on a 1D array names.

```
names = ["Kareem", "Sarah", "Zac", "Sundip", "Anika"]
for count = 1 to names.length - 1
  pos = count
  while (pos > 0 and names[pos] < names[pos - 1])
    temp = names[pos]
    names[pos] = names[pos - 1]
    names[pos - 1] = temp
    pos = pos - 1
  endwhile
next count
```

Describe the purpose of the variable temp in the insertion sort pseudocode algorithm.

[2]

(b). An insertion sort contains a nested loop; a loop within a loop. In this pseudocode algorithm the outer loop is a count-controlled loop and the inner loop is a condition-controlled loop.

Explain why the inner loop needs to be a condition-controlled loop.

[2]

(c). A bubble sort is a type of sorting algorithm.

i. Describe **one** difference between an insertion sort and a bubble sort.

[2]

ii. Describe **two** similarities between an insertion sort and a bubble sort.

1 _____

_____

2 _____

[2]

10. Write an algorithm to play a game with the following rules.

- the player is asked 3 addition questions
- each question asks the player to add together two random whole numbers between 1 and 10 inclusive
- if the player gets the correct answer, 1 is added to their score
- at the end of the game their score is displayed.

[6]

11. The table contains four statements about programming languages.

Tick (✓) **one** box in each row to identify whether each statement describes a low-level programming language or a high-level programming language.

Statement	Low-level	High-level
The same language can be used on computers that use different hardware		
It allows the user to directly manipulate memory		
It allows the user to write English-like words		
It always needs to be translated into object code or machine code		

[4]

12(a). Write pseudocode to increment a value held in a variable score by one.

[1]

(b). State the name of each of the following computational thinking techniques.

Breaking a complex problem down into smaller problems.

Hiding or removing irrelevant details from a problem to reduce the complexity.

[2]

13(a). A fast food restaurant offers half-price meals if the customer is a student or has a discount card. The offer is not valid on Saturdays.

The restaurant needs an algorithm designing to help employees work out if a customer can have a half price meal or not. It should:

- input required data
- decide if the customer is entitled to a discount
- output the result of the calculation.

Design the algorithm using a flowchart.

[5]

(b). The restaurant adds a service charge to the cost of a meal depending on the number of people at a table. If there are more than five people 5% is added to the total cost of each meal.

Customers can also choose to leave a tip, this is optional and the customer can choose between a percentage of the cost, or a set amount.

Identify **all** the additional inputs that will be required for this change to the algorithm.

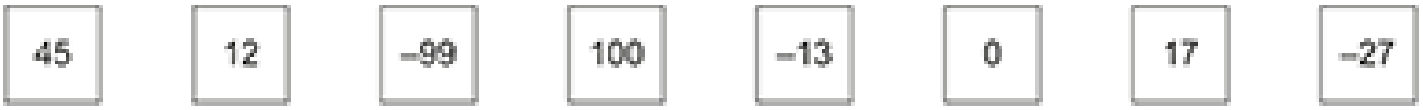
[2]

14(a). A program stores the following list of positive and negative numbers. The numbers need sorting into ascending order using a merge sort.

45	12	-99	100	-13	0	17	-27

The first step is to divide the list into individual lists of one number each. This has been done for you.

Complete the merge sort of the data by showing each step of the process.



[3]

(b). Once a list of numbers are in order, a binary search can be run on the data.

Describe the steps a binary search will follow to look for a number in a sorted list.

[4]

(c). A linear search could be used instead of a binary search.

Describe the steps a linear search would follow when searching for a number that is **not** in the given list.

[2]

15. Jack is writing a program to add up some numbers. His first attempt at the program is shown.

```
a = input("Enter a number")
b = input("Enter a number")
c = input("Enter a number")
d = input("Enter a number")
e = input("Enter a number")
f = (a + b + c + d + e)
print(f)
```

Jack decides to improve his program. He wants to be able to input how many numbers to add together each time the algorithm runs, and also wants it to calculate and display the average of these numbers.

Write an algorithm to:

- ask the user to input the quantity of numbers they want to enter and read this value as input
- repeatedly take a number as input, until the quantity of numbers the user input has been entered
- calculate and output the total of these numbers
- calculate and output the average of these numbers.

[6]

16(a). Customers at a hotel can stay between 1 and 5 (inclusive) nights and can choose between a basic room or a premium room.

When a new booking is recorded, the details are entered into a program to validate the values. The following criteria are checked:

- `firstName` and `surname` are not empty
- `room` is either "basic" or "premium"
- `nights` is between 1 and 5 (inclusive).

If any invalid data is found "NOT ALLOWED" is displayed.
If all data is valid "ALLOWED" is displayed.

i. Complete the following program to validate the inputs.

You must use **either**:

- OCR Exam Reference Language, **or**
- a high-level programming language that you have studied.

```
firstName = input("Enter a first name")

surname = input("Enter a surname")

room = input("Enter basic or premium")

nights = input("Enter between 1 and 5 nights")

stayComplete = False
```

[5]

ii. Complete the following test plan to check whether the number of nights is validated correctly.

Test data (number of nights)	Type of test	Expected output
2		ALLOWED
	Boundary	ALLOWED
	Erroneous / Invalid	NOT ALLOWED

[3]

(b). A Basic room costs £60 each night. A Premium room costs £80 each night.

i. Create a function, `newPrice()`, that takes the number of nights and the type of room as parameters, calculates and returns the price to pay.

You do **not** have to validate these parameters.

You must use **either**:

- OCR Exam Reference Language, **or**
- a high-level programming language that you have studied.

[4]

ii. Write program code, that uses `newPrice()`, to output the price of staying in a Premium room for 5 nights.

You must use **either**:

- OCR Exam Reference Language, **or**
- a high-level programming language that you have studied

[3]

(c). A hotel has nine rooms that are numbered from room 0 to room 8.

The number of people currently staying in each room is stored in an array with the identifier room.

The index of room represents the room number.

Array `room`

Index	0	1	2	3	4	5	6	7	8
Data	2	1	3	2	1	0	0	4	1

The following program counts how many people are currently staying in the hotel.

```
for count = 1 to 8

    total = 0

    total = total + room[count]

next count

print(total)
```

When tested, the program is found to contain **two** logic errors.

Describe how the program can be refined to remove these logic errors.

[2]

(d). A hotel car park charges £4 per hour. If the car is electric, this price is halved to £2 per hour.

Write an algorithm to:

- take as input the number of hours the user has parked and whether their car is electric or not
- calculate and output the total price
- repeat continually until the user enters 0 hours.

You must use **either**:

- OCR Exam Reference Language, **or**
- a high level programming language that you have studied.

[6]

17(a). A computer game is written in a high-level programming language.

State why the computer needs to translate the code before it is executed.

[1]

(b). Either a compiler or an interpreter can translate the code.

Describe **two** differences between how a compiler and an interpreter would translate the code.

1

2

[4]

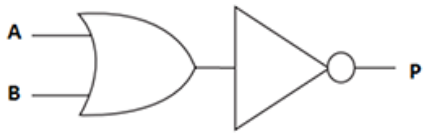
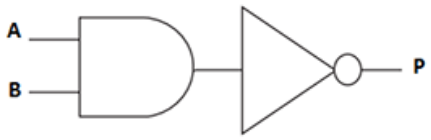
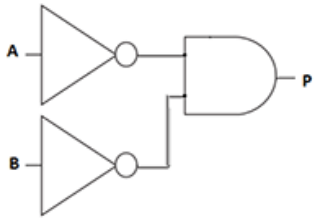
18(a). Complete the truth table in **Fig. 1** for the Boolean statement **P = NOT(A AND B).**

A	B	P
0	0	1
0	1	.....
1	0	.....
1	1	0

Fig. 1

[2]

(b). Tick (✓) **one** box to identify the correct logic diagram for **P = NOT(A AND B)**.

P = NOT(A AND B)	Tick (✓) one box
	
	
	

[1]

19(a). A program needs to perform the following tasks:

- Input two numbers from the user
- Compare both numbers and output the largest number.

Complete the pseudocode for this program.

```
num1 = input("enter first number")

num2 = input("enter second number")

.................. num1 > .................. then

    ....................................

else

    ....................................

endif
```

[4]

(b). A second program needs to perform the following tasks:

- Input a number from the user
- Double the number input and print the result
- Repeat bullets 1 and 2 until the user enters a number less than 0.

Write an algorithm for this program.

[5]

20(a). A program creates usernames for a school. The first design of the program is shown in the flowchart in **Fig. 2**.

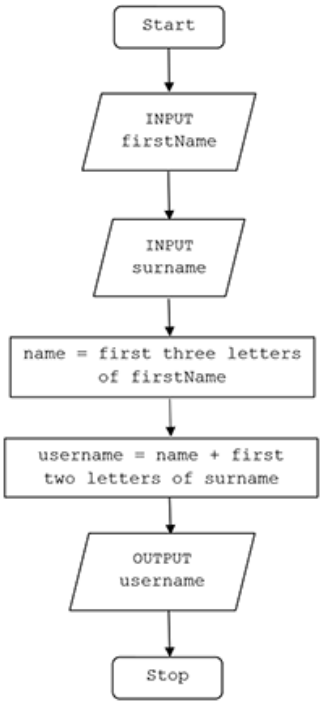


Fig. 2

For example, using the process in **Fig. 2**, Tom Ward's username would be TomWa.

State, using the process in **Fig. 2**, the username for Rebecca Ellis.

_____ **[1]**

(b). The program design is updated to create usernames as follows:

- If the person is a teacher, their username is the last 3 letters of their surname and then the first 2 letters of their first name.
- If the person is a student, their username is the first 3 letters of their first name and then the first 2 letters of their surname.

i. What would be the username for a teacher called Fred Biscuit using the updated process?

_____ **[1]**

ii. Write an algorithm for the updated program design shown in **(i)**.

[6]

21. A school uses a mobile phone app to allow parents to book appointments for parents' evenings.

Parents must log in before they can use the system. They then choose to book a new appointment, view all appointments already made or update their personal details. If parents choose to view their appointments, they can either view them on-screen or print them off.

Each teacher has the assessment grades for each student. These grades are stored in numerical order.

i. The grades for one student are shown:

2	**3**	**4**	**5**	**6**	**7**	**8**

Show the steps that a binary search would take to check whether the student has achieved a grade 7 in any assessment.

Your answer must refer to the grades provided.

[4]

ii. Explain how a binary search would determine that a value does not appear in a given array.

[2]

iii. Give **one** advantage of a binary search over a linear search.

[1]

22. A cinema uses the following criteria to decide if a customer is allowed to see a film that has a 15 rating:

Customers have to be 15 years of age or older to see the film. They also need to either have a ticket or have the money to buy a ticket.

The table shows the inputs to the system that will output whether the customer can watch the film.

Input	Criteria (True / False)
A	The customer is 15 or over
B	The customer has a ticket
C	The customer has the money to buy a ticket

Complete the following algorithm to output whether the customer is allowed to see the film or not.

```
A = input("Is the customer 15 or over?")
B = input("Does the customer have a ticket?")
C = input("Does the customer have money to buy a ticket?")
```

[3]

23(a). A car dealership uses a computer system to record details of the cars that it has for sale. Each car has a make, model, age and number of miles driven.

Each car is given a star rating of 1 to 5, based on the age of the car and the number of miles it has been driven. This rating is recorded in the computer system.

i. Define the term abstraction.

[1]

ii. Give **one** example of how abstraction has been used in the design of this star rating system.

[1]

iii. Explain how authentication could be used as part of the defensive design considerations for this computer system.

[2]

(b). The car dealership only sells cars that have fewer than 10 000 miles and are 5 years old or less.

i. Write an algorithm that will:

- ask the user to enter the number of miles and the age of a car
- validate the input to check that only sensible values that are in the given range are entered
- output `True` if valid data has been entered or `False` if invalid data has been entered.

[5]

ii. The validation routine from **part (i)** must be tested with normal, erroneous and boundary test data.

Identify suitable test data for each type of test.

	Miles	Age
Normal		
Erroneous		
Boundary		

[3]

iii. Identify when iterative testing is performed.

[1]

(c). The car dealership sells electric cars, which require charging before they can be driven. Charging the battery by 1% takes 10 minutes.

For example, a battery has 80% charge. It would take 200 minutes, or 3 hours and 20 minutes to charge to 100%.

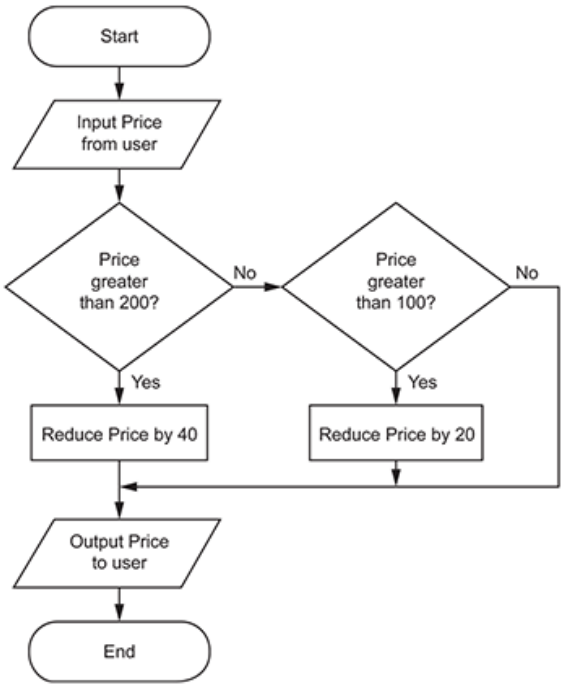
Write an algorithm that:

- asks the user for the current battery charge percentage
- outputs `"full"` for a battery currently at 100%
- calculates how long this battery would take to charge
- outputs this in hours and minutes.

[6]

24(a). OCR Tech is an online shop that sells electronics such as TVs and game consoles.

The following flowchart shows an algorithm to calculate the price of an item during a sale period.



i. Complete the following test plan for the algorithm.

Price input	Test type	Expected price output
50	Normal	
100	Boundary	
150	Normal	
200	Boundary	
250	Normal	

[3]

ii. Rewrite the algorithm above.

You must use **either:**

- OCR Exam Reference Language, **or**
- A high-level programming language that you have studied

[6]

(b). An item is classified as "In demand" if OCR Tech have between 5 and 25 inclusive in stock.

A program is written that allows the user to input the current stock level and output whether the item is in demand or not.

```
stocklevel = input("Enter stock level")
if stocklevel >= 5 or =< 25 then
        print(Not in demand)
else
        print(In demand)
endif
```

The program contains syntax and logic errors.

Refine the program to correct the errors and write the refined version of the program.

You must use **either:**

- OCR Exam Reference Language, **or**
- A high-level programming language that you have studied

[5]

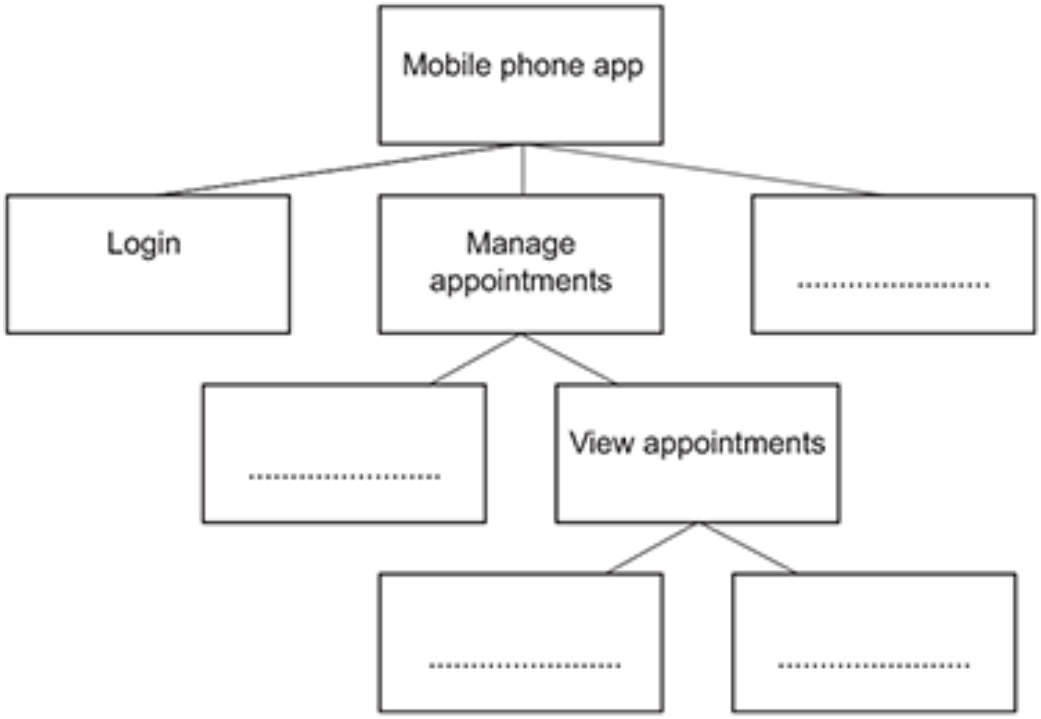
25(a). A school uses a mobile phone app to allow parents to book appointments for parents' evenings.

Parents must log in before they can use the system. They then choose to book a new appointment, view all appointments already made or update their personal details. If parents choose to view their appointments, they can either view them on-screen or print them off.

A structure diagram has been used to design the mobile phone app.

Write one letter from the following table in each space to complete the structure diagram.

Letter	Task
A	Book new appointment
B	Check attendance of child
C	Update personal details
D	View appointments on-screen
E	Log out of the system
F	Print a paper copy of appointments



[4]

(b). At the parents' evening, each parent can book up to five appointments with teachers.
Appointments for one student are stored in a one-dimensional array with the identifier appointments.

In the array, each element is either the name of a teacher or an empty string where no appointment has been made.

An example for one student is shown:

array appointments = ["Miss E", "", "Mr C", "Mr B", ""]

The following code shows an algorithm to count up how many empty slots remain in the array and output this value.

```
01 for i = 0 to 4
02     empty = 0
03     if appointments[i] == "" then
04        empty = empty + 1
05     endif
06 next i
07 print("empty")
```

i. The algorithm contains logic errors.

Define the term logic error.

_____

[1]

ii. Identify the line number of **two** logic errors in the code above and explain why each is an error.

Logic error 1 _____

_____

Explanation _____

_____

Logic error 2 _____

_____

Explanation _____

_____

[4]

26(a). A program uses a file to store a list of words that can be used in a game.

A sample of this data is shown in **Fig. 3**.

crime	bait	fright	victory	nibble	loose

Fig. 3

Show the stages of a bubble sort when applied to data shown in **Fig. 3**.

_____

_____

_____

_____

_____

_____

_____

[4]

(b). A second sample of data is shown in **Fig. 4**.

amber	house	kick	moose	orange	range	tent	wind	zebra

Fig. 4

Show the stages of a binary search to find the word zebra using the data shown in **Fig. 4**.

[4]

27(a). The program should only allow values from **0** to **300** inclusive as valid inputs. If the data entered breaks this validation rule, an error message is displayed.

i. Complete the following program to output "`Invalid input`" if the data does not meet the validation rule.

You must use **either**:

- OCR Exam Reference Language, **or**
- a high-level programming language that you have studied.

```
mins = input("Enter minutes played: ")

if mins < 0 ..................... mins ..................... then

    ..... ("Invalid input")

endif
```

[3]

ii. Complete the following test plan for the program in **(i)**.

Test data	Test type	Expected result
25	Normal	Value accepted
	Invalid	`Invalid input` message displayed
	Boundary	

[3]

(b). The following program uses a condition-controlled loop.

```
x = 15
y = 0
while x > 0

    y = y + 1
    x = x - y

endwhile
print(y)
```

Complete the trace table to test this program.

x	y	output

[4]

(c). A teacher writes an algorithm to store the name of the game a student plays each night (for example "OCR Zoo Simulator").

```
variable.length returns the number of characters in variable.
variable.upper returns the characters in variable in upper case.

    valid = false

    while(valid == false)

        gameName = input("Enter the game name")

        if (gameName.length > 0) AND (gameName.length < 20)

            gamesPlayed = gameName.upper

            valid = true

            print("Valid game name")

        else

            print("Game name is not valid")

        endif

    endwhile
```

The algorithm needs testing to make sure the IF-ELSE statement works correctly.

Identify **two** different pieces of test data that can be used to test different outputs of the algorithm. Give the output from the program for each piece of test data.

Test data 1 _____

Expected output _____

Test data 2 _____

Expected output _____

[4]

(d). A teacher researches the length of time students spend playing computer games each day.

The teacher asks students how long they spend completing homework. Students answer in minutes and hours (for example 2 hours 15 minutes).

The teacher would like to create an algorithm that will display students' inputs in minutes only.

i. Identify the input and output required from this algorithm.

Input _____

_____

Output _____

_____

[2]

ii. A program is created to convert hours and minutes into a total number of minutes.

The teacher wants to create a sub program to perform the calculation.

The program has been started but is not complete.

Complete the design for the program.

```
hours = input("Please enter number of hours played")
minutes = input("Please enter number of minutes played")
finalTotal = .....
print(finalTotal)

  function .....
           .....
           .....
           .....
           .....

  endfunction
```

[4]

iii. The following flowchart outputs a message depending on how long each person has spent playing computer games.

Rewrite the flowchart as a program.
You must use **either**:

- OCR Exam Reference Language, **or**
- a high-level programming language that you have studied.

[4]

END OF QUESTION PAPER