

2.2

PROGRAMMING

FUNDAMENTALS

TOPIC WISE EXAM QUESTIONS

GCSE

OCR

SPEC

2.2.1 Programming fundamentals

- The use of variables, constants, operators, inputs, outputs and assignments
- The use of the three basic programming constructs used to control the flow of a program:
 - o Sequence
 - o Selection
 - o Iteration (count- and condition-controlled loops)
- The common arithmetic operators
- The common Boolean operators AND, OR and NOT

Required

- ✓ Practical use of the techniques in a high-level language within the classroom
- ✓ Understanding of each technique
- ✓ Recognise and use the following operators:

Comparison operators		Arithmetic operators	
==	Equal to	+	Addition
!=	Not equal to	-	Subtraction
<	Less than	*	Multiplication
<=	Less than or equal to	/	Division
>	Greater than	MOD	Modulus
>=	Greater than or equal to	DIV	Quotient
		^	Exponentiation (to the power)

2.2.2 Data types

- The use of data types:
 - o Integer
 - o Real
 - o Boolean
 - o Character and string
 - o Casting

Required

- ✓ Practical use of the data types in a high-level language within the classroom
- ✓ Ability to choose suitable data types for data in a given scenario
- ✓ Understand that data types may be temporarily changed through casting, and where this may be useful

2.2.3 Additional programming techniques

- The use of basic string manipulation
- The use of basic file handling operations:
 - o Open
 - o Read
 - o Write
 - o Close
- The use of records to store data
- The use of SQL to search for data
- The use of arrays (or equivalent) when solving problems, including both one-dimensional (1D) and two-dimensional arrays (2D)
- How to use sub programs (functions and procedures) to produce structured code
- Random number generation

Required

- ✓ Practical use of the additional programming techniques in a high-level language within the classroom
- ✓ Ability to manipulate strings, including:
 - Concatenation
 - Slicing
- ✓ Arrays as fixed length or static structures
- ✓ Use of 2D arrays to emulate database tables of a collection of fields, and records
- ✓ The use of functions
- ✓ The use of procedures
- ✓ Where to use functions and procedures effectively
- ✓ The use of the following within functions and procedures:
 - local variables/constants
 - global variables/constants
 - arrays (passing and returning)
- ✓ SQL commands:
 - SELECT
 - FROM
 - WHERE
- ✓ Be able to create and use random numbers in a program

2023

OCR Security Services is a company that installs intruder alarm systems in commercial buildings.

The systems use a computer that is connected to the door sensors and window sensors.

The following data is stored in the system:

Data stored	Variable identifier	Example data
The user's name	UserName	Admin123
A telephone number to call when the alarm is activated	EmergencyPhoneNumber	+449999999999
Whether a door sensor is activated	DoorSensorActive	True
Whether a window sensor is activated	WindowSensorActive	True
A timer that counts, to the nearest second, how long a door sensor has been activated	DoorActiveTime	100
A timer that counts, to the nearest second, how long a window sensor has been activated	WindowActiveTime	100
Whether the system is armed	SystemArmed	True
Whether the system is in test mode	TestModeActive	True

(a) Below is a table showing some variables within the program.

Tick (✓) **one** box in each row to identify the most appropriate data type for each variable.

Variable	Boolean	Char	String	Integer	Real
UserName					
EmergencyPhoneNumber					
DoorSensorActive					
DoorActiveTime					

[4]

(b) The alarm has an algorithm that decides whether to sound the alarm by checking the data that is stored in the following three variables.

- `SystemArmed`
- `DoorSensorActive`
- `WindowSensorActive`

The alarm will only sound when the alarm has been activated **and** one or both of the door and window sensors are activated. When the system needs to sound the alarm it calls the pre-written procedure `SoundAlarm()`

Write a program that checks the data in the variables and calls `SoundAlarm()` when appropriate.

You must use **either**:

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

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- (c) The alarm system can also have motion sensors. Each type of sensor has a code. The code for each sensor is given in the table:

Code	Sensor
MS	Motion sensor
DS	Door sensor
WS	Window sensor

A program is written to reset the sensors. The program:

- asks the user to enter the code for the sensor they want to reset
- calls the prewritten function `CheckSensorCode()` to check whether the code entered is a valid code
- the sensor number is read as input if the code is valid and the function `ResetSensor()` is called for the sensor

```
01 sensorType = input("Enter code of the type of sensor to reset")
02 if(CheckSensorCode(sensorType)) then
03     sensorNumber = input("Please input the number of the sensor
                           to reset")
04     sensorID = sensorType + sensorNumber
05     ResetSensor(sensorID)
06 endif
```

- (i) Give the line number where there is concatenation.

..... [1]

- (ii) Give the identifier of a variable used in the program.

..... [1]

- (iii) Identify the data type of the data returned by the function `CheckSensorCode()`

..... [1]

- (iv) Give the line number that contains a function call.

..... [1]

- (v) Identify **two** programming constructs that have been used in the program.

1

2

[2]

(d) The alarm system has a log that stores a record each time a sensor is triggered. This is called an event. The record format is given in the table:

Fieldname	Description
Date	The date the event happened
SensorID	The sensor that was activated
SensorType	The type of sensor that was activated – Door, Motion or Window
Length	The number of seconds the sensor was triggered (to the nearest second)

The log is stored in a database table called `events`. The current contents of `events` is shown:

Date	SensorID	SensorType	Length
05/02/2023	WS2	Window	38
05/02/2023	MS1	Motion	2
06/02/2023	DS3	Door	1
06/02/2023	MS2	Motion	3
06/02/2023	MS1	Motion	2
07/02/2023	WS1	Window	24
07/02/2023	DS1	Door	1

Write an SQL statement to display the sensor IDs of the door sensors that have been triggered for more than 20 seconds.

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[3]

OCR Security Services need to identify the total number of seconds the sensors have been activated on a specific date.

The data from the database table `events` is imported into the program written in a high-level programming language.

The program stores the data in a two-dimensional (2D) string array with the identifier `arrayEvents`

The data to be stored is shown in the table.

Date	SensorID	SensorType	Length
05/02/2023	WS2	Window	38
05/02/2023	MS1	Motion	2
06/02/2023	DS3	Door	1
06/02/2023	MS2	Motion	3
06/02/2023	MS1	Motion	2
07/02/2023	WS1	Window	24
07/02/2023	DS1	Door	1

In this table, the value of `events[1, 1]` contains "MS1".

- (i) An array can only store data of one data type. Any non-string data must be converted to a string before storing in the array.

Identify the process that converts integer data to string data.

..... [1]

2022

- 1 (a) Tick (✓) **one** box in each row to identify whether the OCR Reference Language code given is an example of selection or iteration.

OCR Reference Language code	Selection	Iteration
<pre>for i = 1 to 10 print(i) next i</pre>		
<pre>while score != 0 playgame() endwhile</pre>		
<pre>if playerHit() then score = 0 endif</pre>		
<pre>switch bonus: case 0: score = 9 case 1: score = 7 case 2: score = 5 endswitch</pre>		

[4]

- (b) Write pseudocode to increment the value held in the variable `score` by one.

.....
 [1]

- (d) Each member of staff that works in the restaurant is given a Staff ID. This is calculated using the following algorithm.

```
01 surname = input("Enter surname")
02 year = input("Enter starting year")
03 staffID = surname + str(year)
04 while staffID.length < 10
05     staffID = staffID + "x"
06 endwhile
07 print("ID " + staffID)
```

- (i) Define the term **casting** and give the line number where casting has been used in the algorithm.

Definition

.....

Line number

[2]

(i) State the purpose of each of the arithmetic operators in the table.

Arithmetic operator	Purpose
*	
/	

[2]

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

(a) A typical booking record is shown in the table:

firstName	Amaya
surname	Taylor-Ling
nights	3
room	Premium
stayComplete	False

(i) State the most appropriate data type for the following fields:

Nights

Room

[2]

(ii) Give the name of **one** field that could be stored as a Boolean data type.

..... [1]

(iii) Booking records are stored in a database table called `TblBookings`.

The following SQL statement is written to display all customer bookings that stay more than one night.

```
SELECT ALL
FROM TblBookings
IF Nights < 1
```

The SQL statement is incorrect.

Rewrite the SQL statement so that it is correct.

.....

[4]

(d) The 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.

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[2]

SAMPLE

- 3 The database table `Results` stores the results for each student in each of their chosen subjects.

StudentName	Subject	Grade
Alistair	English	3
Jaxon	Art	5
Alex	Art	4
Anna	French	7
Ismaael	Art	9

Complete the SQL query to return all of the fields for the students who take Art.

```
SELECT .....
FROM .....
WHERE .....
```

[3]

- 7 The area of a circle is calculated using the formula $\pi \times r^2$ where π is equal to 3.142 and r is the radius.

A program is written to allow a user to enter the radius of a circle as a whole number between 1 and 30, then calculate and output the area of the circle.

```
01 radius = 0
02 area = 0.0
03 radius = input("Enter radius")
04 if radius < 1 OR radius > 30 then
05 print("Sorry, that radius is invalid")
06 else
07 area = 3.142 * (radius ^ 2)
08 print (area)
09 endif
```

(b) Identify **two** variables used in the program.

1

2

[2]

(c) (i) Identify **one** item in the program that could have been written as a constant.

..... [1]

(ii) Give **one** reason why you have identified this item as a constant.

..... [1]

(d) Tick (✓) **one** box in each row to identify whether each programming construct has or has **not** been used in the program.

	Has been used	Has not been used
Sequence		
Selection		
Iteration		

[3]

8 A teacher researches the length of time students spend playing computer games each day.

(a) Tick (✓) **one** box to identify the data type you would choose to store the data and explain why this is a suitable data type.

Data Type	Tick (✓) one box
String	
Integer	
Real	
Boolean	

Explanation:

.....

[2]

(c) Data for one week (Monday to Friday) is stored in a 2D array with the identifier `minsPlayed`.

The following table shows part of this array, containing 4 students.

		Students				
		Stuart	Wes	Victoria	Dan	
		0	1	2	3	
Days of the week	Mon	0	60	30	45	0
	Tue	1	180	60	0	60
	Wed	2	200	30	0	20
	Thu	3	60	10	15	15
	Fri	4	100	35	30	45

The teacher wants to output the number of minutes Dan (column index 3) played computer games on Wednesday (row index 2). The following code is written:

```
print (minsPlayed[3,2])
```

Write a line of code to output the number of minutes that Stuart played computer games on Friday.

You must use **either**:

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

.....

..... [1]

(d) The teacher writes a program to add up and print out the total number of minutes student 2 played computer games over 5 days (Monday to Friday).

```
total = 0  
total = total + minsPlayed[2,0]  
total = total + minsPlayed[2,1]  
total = total + minsPlayed[2,2]  
total = total + minsPlayed[2,3]  
total = total + minsPlayed[2,4]  
print(total)
```

Refine the program to be more efficient. Write the refined version of the algorithm.

You must use **either**:

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

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(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]

2021

3 Taylor is writing an algorithm to record the results of an experiment.

Taylor needs to be able to enter a numeric value which is added to a total which initially starts at 0.

Every time she enters a value, the total is output.

The algorithm repeats until the total is over 100.

(b) The input to the program could be an integer or real value.

(i) State what is meant by a real data type and give an example of this data type.

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..... [2]

(ii) State what is meant by an integer data type and give an example of this data type.

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..... [2]

4 A programmer declares the following variables.

```
first = "Computer Science"  
second = "is great"
```

(a) State one difference between a variable and a constant.

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..... [1]

(b) State the output from the following lines of program code.

(i) `print(first.length)`

..... [1]

(ii) `print(second.length DIV 3)`

..... [1]

(iii) `print(3 ^ 2)`

..... [1]

(c) Strings can be concatenated (joined together) using the + operator. For example, `print("Maths " + second)` will output `Maths is great`

Use string manipulation with the variables `first` and/or `second` to produce the following output.

(i) `great`

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..... [1]

(ii) `Computer`

.....
..... [1]

(iii) `Science is great`

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..... [1]

- 6 OCRBlocks is a game played on a 5×5 grid. Players take it in turns to place blocks on the board. The board is stored as a two-dimensional (2D) array with the identifier `gamegrid`

Fig. 6.1 shows that players A and B have placed three blocks each so far.

	0	1	2	3	4
0	A			B	
1					
2		B			
3	A		B		
4			A		

Fig. 6.1

The function `checkblock()` checks whether a square on the board has been filled. When `checkblock(4,2)` is called, the value "A" is returned.

```
function checkblock(r,c)
    if gamegrid[r,c] == "A" or gamegrid[r,c] == "B" then
        outcome = gamegrid[r,c]
    else
        outcome = "FREE"
    endif
    return outcome
endfunction
```


2020

- (b) (i) Write a pseudocode statement to assign the value 7.3 to a variable with the identifier `timer`

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..... [1]

- (ii) State the most appropriate data type for the variable `timer`.

.....
..... [1]

- (b) The algorithm for one section of the vending machine program is shown in pseudocode.

```
if money >= price then
    venditem()
    giveChange(money - price)
else
    print("Error - not enough money inserted")
endif
```

- (i) Give the identifier of **one** variable used in the algorithm.

..... [1]

- (ii) State how many parameters are passed into the `giveChange()` subroutine.

..... [1]

- (e) The vending machine stores the quantity of items available in a database table called ITEMS. The current contents of ITEMS is shown:

ItemCode	ItemName	Stock
A1	Crisps, bacon flavour	6
A2	Crisps, salted	2
B1	Chocolate bar	12
C1	Apple pieces	18
C2	Raisins	7

Complete the following SQL statement to display the item code for all items that have fewer than 10 in stock.

SELECT

FROM

[4]

- (f) The vending machine can be in one of three states: on, off or suspended. A user can change the state of the vending machine by using the following algorithm.

```

newstate = input("Enter the new state : ")
switch newstate:
    case "on":
        statevalue = 1
    case "off":
        statevalue = 2
    case "suspended":
        statevalue = 3
    default:
        print("Invalid state")
endswitch
    
```

Rewrite the algorithm to perform the same actions using IF statements in place of the switch statement.

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[5]

(d) DIV and MOD are both operators used in computing-related mathematics.

(i) State the value of $13 \text{ DIV } 4$

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..... [1]

(ii) State the value of $13 \text{ MOD } 4$

.....
..... [1]

(c) A school uses the array to call an attendance register every morning.

Write an algorithm using iteration to:

- display the name of each student one at a time from `studentnames`
- take as input whether that student is present or absent
- display the total number of present students and number of absent students in a suitable message, after all student names have been displayed.

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6 marks

2019

The number of goals scored in each football match is held in an array called `goals`. An example of this array is shown.

```
goals = [0, 1, 3, 0, 4, 5, 2, 0, 2, 1]
```

Elliott wants to count how many matches end with 0 goals.

(c) Complete the following pseudocode for an algorithm to count up how many matches with 0 goals are stored in the array and then print out this value.

```
01 nogoalscount = 0
02 for count = 0 to (goals.length-1)
03     if goals[.....] == 0 then
04         nogoalscount .....
05     endif
06 next count
07 print(.....)
```

[3]

(c) The symbol $^$ is used for exponentiation.

Give the result of a^b when $a = 3$ and $b = 2$.

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..... [1]

OCR Land is a theme park aimed at children and adults. Entrance tickets are sold online. An adult ticket to OCR Land costs £19.99, with a child ticket costing £8.99. A booking fee of £2.50 is added to all orders.

(a) A function, `ticketprice()`, takes the number of adult tickets and the number of child tickets as parameters. It calculates and returns the total price to be paid.

(i) Use pseudocode to create an algorithm for the function `ticketprice()`.

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6 marks

(ii) Tick (✓) **one** box to identify the data type of the value returned from the function `ticketprice()`, justifying your choice.

Data type of returned value	Tick (✓) one box
Integer	
Real	
Boolean	
String	

Justification

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2018

OCR High School uses a computer system to store data about students' conduct. The system records good conduct as a positive number and poor conduct as a negative number. A TRUE or FALSE value is also used to record whether or not a letter has been sent home about each incident.

An example of the data held in this system is shown below in Fig. 1:

StudentName	Detail	Points	LetterSent
Kirstie	Homework forgotten	-2	FALSE
Byron	Good effort in class	1	TRUE
Grahame	100% in a test	2	FALSE
Marian	Bullying	-3	TRUE

Fig. 1

(a) State the most appropriate data type used to store each of the following items of data.

- StudentName
- Points
- LetterSent

[3]

(b) The data shown above in Fig. 1 is stored in a database table called **Conduct**.

(i) Write an SQL statement to select the StudentName field for all records that have negative Points.

.....
.....
..... [3]

(ii) State the wildcard that can be used in SQL to show all fields from a table.

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..... [1]

2 A programmer has written an algorithm to output a series of numbers. The algorithm is shown below:

```
01 for k = 1 to 3
02     for p = 1 to 5
03         print (k + p)
04     next p
05 next k
06 m = 7
07 print m * m
```

(a) (i) Give the first **three** numbers that will be printed by this algorithm.

..... [1]

(ii) State how many times line **03** will be executed if the algorithm runs through once.

..... [1]

(b) Identify **two** basic programming constructs that have been used in this algorithm.

1

.....

2

..... [2]

(c) (i) Describe what is meant by a variable.

.....

.....

..... [2]

(ii) Identify **two** variables that have been used in the algorithm above.

1

2

[2]

(b) Using pseudocode, write an algorithm that will use a count-controlled loop to print out the numbers 1 to 10 in ascending order.

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[3]

7 Victoria is writing a program using a high level language to display the meaning of computer science acronyms that are entered. The code for her first attempt at this program is shown below.

```
01 a = input("Enter an acronym")
02 if a == "LAN" then
03     print("Local Area Network")
04 elseif a == "WAN" then
05     print("Wide Area Network")
06 .....
07 .....
08 endif
```

(a) (i) Complete the code above to print out an "unknown" message if any other acronym is entered by the user. [2]

2017

- 3 An algorithm is written that finds the mean average (i.e. the total of the numbers divided by how many numbers there are) of a set of 10 numbers stored in an array `NumberArray`.

```
const Quantity = 10
for Count = 0 to Quantity
    Total = Total + NumberArray(.....)
next Count
Mean = .....
output Mean
```

- (a) Complete the algorithm by adding the missing pseudocode statements. [2]

- (b) Define the term constant, giving an example from the algorithm.

Definition

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.....

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Example..... [3]

- (c) Identify the most appropriate data type for `Mean`. Justify your choice.

Data type

Justification

..... [2]

- (d) The algorithm uses iteration.

- (i) Describe what is meant by iteration.

.....

.....

..... [2]

- (ii) Identify **two** forms of iteration that are **not** used in this algorithm.

1

2

[2]

2016

- 4 Joseph is an author and programmer, and he needs to estimate how many pages his new book will have.

Each page has an average of 300 words. Each chapter starts with a chapter title page.

The number of pages is estimated by;

- dividing the number of words by 300
- ignoring the decimal part of the division
- adding the number of chapters to this total.

Joseph uses the algorithm below to estimate the number of pages, but his algorithm does not give the correct result.

```
01 INPUT numberOfWords
02 INPUT numberOfChapters
03 CONST wordsPerPage = 300
04 numberOfPages = RoundDown(numberOfWords / wordsPerPage)
05 numberOfPages = numberOfWords + numberOfChapters
06 OUTPUT numberOfPages
```

Joseph has used a RoundDown function to remove the decimal part of the division, e.g. RoundDown(6.2) would return 6, RoundDown(7.8) would return 7.

- (a) State whether this algorithm uses selection, sequence or iteration.

..... [1]

- (b) Line 03 defines a constant. Describe what is meant by a constant.

.....
.....
..... [2]

- (c) There is an error in line 05 of the algorithm.

Write a corrected line of code to replace line 05.

..... [1]

(d) Identify the most appropriate data type for the following variable `numberOfWords`. Give a reason for your choice.

Data type

Reason [2]

(e) Joseph is changing his algorithm and needs to store the name and price of his book in new variables. State the most appropriate data type(s) for these variables.

Name

Price [2]

9 A memory game is played where:

- three players (A, B and C) have to choose a number between 0 and 100
- if the number has already been chosen, a message is displayed that says "taken"
- if the number has not already been chosen, the player's letter is placed next to it
- the quantity of numbers that have not yet been chosen is displayed.

The winner is the player who has chosen the most unique numbers by the end of the game.

The numbers are stored in an array; `numbers()`. A number that has not yet been chosen is stored as an empty string "". The players are represented by "A", "B" and "C".

Fig. 5 shows an extract from the array:

Number:	0	1	2	3	4	99	100
Player:	A	C	B		A			B	

Fig. 5

You have been asked to program part of the game.

Write an algorithm for player A's turn, which;

- takes as an input the number that player A chooses
- if it has not already been chosen, stores an "A" in that array element
- if it has already been chosen, outputs "taken"
- counts and outputs the quantity of numbers left that have not been chosen. [6]

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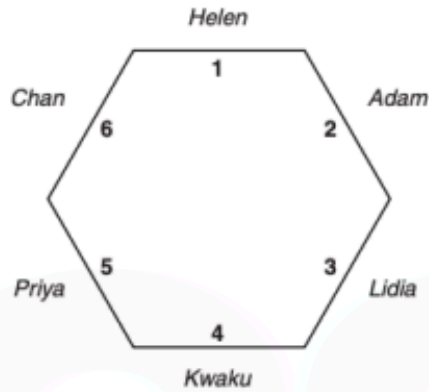
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2015

10 A game on a computer shows six players around a table on seats. They are numbered 1 to 6 as shown below.



The names of the players are stored in an array with six elements called `PlayerName`. The index position of the array is used to indicate the seat number. For example, the value of `PlayerName(1)` is "Helen".

(a) State the value of `PlayerName(3)`.

..... [1]

(b) Describe what will happen if the code for the game includes an instruction to print the value of `PlayerName(7)`.

.....
.....
.....
..... [2]

(c) During the game, each player sometimes moves clockwise by a given number of places.

For example, if the number of places is 2, Helen will move to seat 3, Priya will move to seat 1 etc.

Write an algorithm that will update the contents of the array `PlayerName` after a move has occurred. Your algorithm should:

- allow the number of places to move to be input
- use iteration
- ensure that all of the existing players' names are moved to the correct position in the array.

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6 marks

EXTRA

(i) Describe the use of local variables.

[4]

(ii) State two features of global variables that distinguish them from local variables.

1

2

[2]

13(a) A procedure takes as input a number between 1 and 100. It calculates and outputs the square of each number starting from 1, to the number input. The square of a number is the result of multiplying a number by itself.

```
procedure squares()  
do  
    number = int(input("Enter a number between 1 and 100"))  
until number >= 1 AND number <= 100  
  
for x = 1 to number  
    print(x * x)  
next x  
endprocedure
```

The procedure uses one programming construct twice.

State whether the construct that is used twice, is iteration or branching.

----- [1]

(b). State why the algorithm is a procedure and not a function.

----- [1]

8. Programming languages consist of three basic programming constructs. For each construct, state its name and give a working example.

Construct 1:

Example:

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

Construct 2:

Example:

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

Construct 3:

Example:

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

[6]

18. Describe one difference between a global and a local variable.

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

[2]

Describe what is meant by a function.

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

[2]

**If you found this
useful, drop a follow
to help me out!**

THANK YOU!

GCST