Cambridge Assessment International Education

CS BY AQIB KHAN

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

1281968342

COMPUTER SCIENCE **9618/21**

Paper 2 Fundamental Problem-solving and Programming Skills **May/June 2023**

2 hours

You must answer on the question paper.

You will need: Insert (enclosed)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use an HB pencil for any diagrams, graphs or rough working.
- Calculators must **not** be used in this paper.

INFORMATION

- The total mark for this paper is 75.
- The number of marks for each question or part question is shown in brackets [ ].
- No marks will be awarded for using brand names of software packages or hardware.
- The insert contains all the resources referred to in the questions.

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This document has **20** pages. Any blank pages are indicated.

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Refer to the **insert** for the list of pseudocode functions and operators.

1 A programmer has written a program which includes the function `Calculate()`.
When the program is run, the function returns an unexpected value.

(a) Describe how a typical Integrated Development Environment (IDE) could be used to help debug the program to find the errors in the function `Calculate()`.

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..... [4]

(b) The algorithm for function `Calculate()` contains the three pseudocode statements shown.

Describe the error in each statement or write 'no error' if the statement contains no error.

Assume any variables used are of the correct type for the given function.

Statement 1: `Index ← STR_TO_NUM(("27") + 2)`

Error .....

.....

Statement 2: `Index ← STR_TO_NUM(MID("CPE1704TKS", 4, 2))`

Error .....

.....

Statement 3: `IF MONTH(ThisDate) > '6' THEN`

Error .....

.....

[3]

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(c) The program contains variables with values as follows:

Variable	Value
Active	TRUE
Points	75
Exempt	FALSE

(i) Complete the table by evaluating each expression.

	Expression	Evaluation
1	(Points > 99) OR Active	
2	(Points MOD 2 = 0) OR Exempt	
3	(Points <= 75) AND (Active OR Exempt)	
4	(Active OR NOT Active) AND NOT Exempt	

[2]

(ii) Write expression **4** from the table in part **(c)(i)** in its simplest form.

..... [1]

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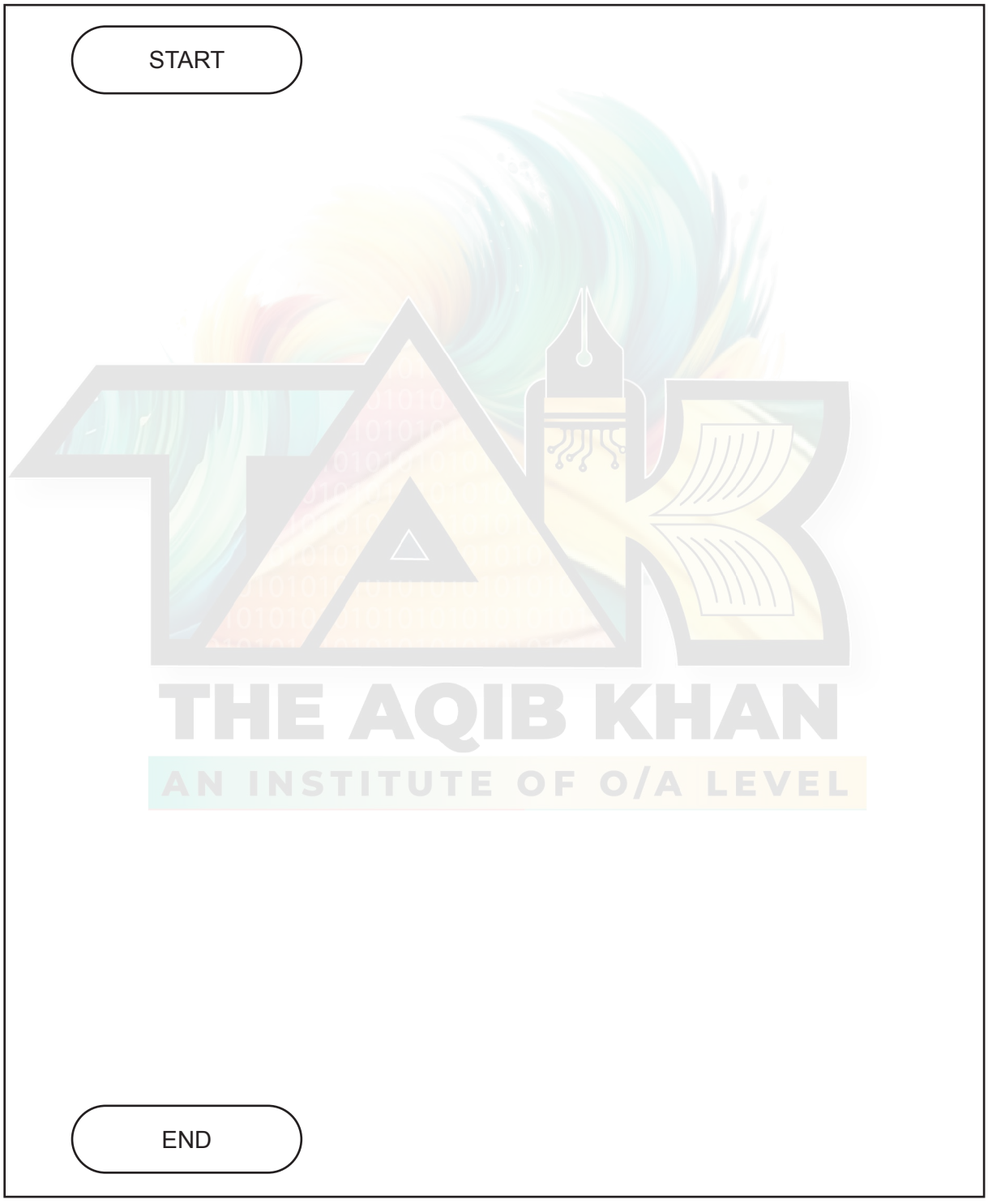
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2 A program contains an algorithm to output a string of a specified length containing identical characters.

(a) The algorithm is described as follows:

1. prompt and input a character and store in `MyChar`
2. prompt and input an integer and store in `MyCount`
3. generate a string consisting of `MyChar` repeated `MyCount` times
4. output the string.

Draw a program flowchart to represent the algorithm.



[4]

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(b) A different part of the program uses the variable `StartDate`.

Write pseudocode statements to declare `StartDate` **and** assign to it the date corresponding to 15/11/2005.

Declaration .....

Assignment .....

[3]

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3 Customers collect points every time they make a purchase at a store.

A program is used to manage the points system and the table lists some of the information stored for one customer.

Information	Data type required
Name	String
Number of points collected	Integer
Date of birth	Date

(a) (i) Identify a suitable structure for storing the information for one customer. Explain the advantage of using this structure.

Structure .....

Advantage .....

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..... [4]

(ii) Describe a data structure that could be used to store the information for **all** customers.

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..... [2]

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(b) Customers receive points depending on the amount they spend. The number of points depends on the band that the amount falls into:

Band	Amount	Points
1	Less than $10	5 per whole dollar ($)
2	Between $10 and $100 inclusive	7 per whole dollar ($)
3	Over $100	10 per whole dollar ($)

For example, if the amount is $99.77, this amount is in band 2 and therefore the number of points is 7 × 99, which is 693 points.

The algorithm to calculate the points from a given amount is expressed as follows:

- work out the appropriate band
- calculate and output the number of points.

Apply the process of stepwise refinement to increase the detail of the algorithm. Structure your algorithm into a sequence of five steps that could be used to produce pseudocode.

Write the **five** steps.

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[5]

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4 Function `Replace()` will:

1. take three parameters:
   - a string (the original string)
   - a char (the original character)
   - a char (the new character)
2. form a new string from the original string where all instances of the original character are replaced by the new character
3. return the new string.

Write pseudocode for function `Replace()`.

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5 Several companies are developing websites to market a new type of games console. The company that is first to create a website that can demonstrate the interactive features of the games console will have an advantage over the others. The requirements for the website are likely to change as more information about the features of the console are made available.

One company has decided to develop their website using a program development life cycle based on the waterfall model.

(a) (i) Give **two** reasons why this may **not** be the most appropriate model to use in this case.

Reason 1 .....

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Reason 2 .....

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[2]

(ii) Identify a **more appropriate** program development life cycle model for this scenario.

..... [1]

(b) The website has been running in test mode for several weeks.

Identify **and** describe a final stage of testing that should take place before the website is made available to all customers.

Stage .....

Description .....

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6 A video-conferencing program supports up to six users. Speech from each user is sampled and digitised (converted from analogue to digital). Digitised values are stored in array `Sample`.

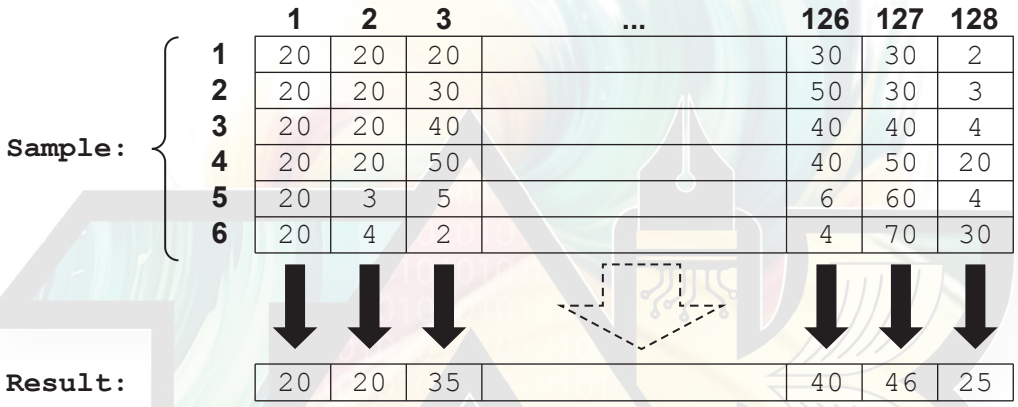
The array `Sample` consists of 6 rows by 128 columns and is of type integer. Each row contains 128 digitised sound samples from one user.

The digitised sound samples from each user are to be processed to produce a single value which will be stored in a 1D array `Result` of type integer. This process will be implemented by procedure `Mix()`.

A procedure `Mix()` will:

- calculate the average of each of the 6 sound samples in a column
- ignore sound sample values of 10 or less
- store the average value in the corresponding position in `Result`
- repeat for each column in array `Sample`

The diagram uses example values to illustrate the process:



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Write pseudocode for procedure `Mix()`.

Assume `Sample` and `Result` are global.

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7 A school has a computerised library system that allows students to borrow books for a fixed length of time. The system uses text files to store details of students, books and loans.

A new module is to be written which will generate emails to each student who has an overdue book.

(a) Decomposition will be used to break down the problem of designing the new module into sub-problems.

Identify **three** program modules that could be used in the design **and** describe their use.

Module 1 .....

Use .....

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Module 2 .....

Use .....

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Module 3 .....

Use .....

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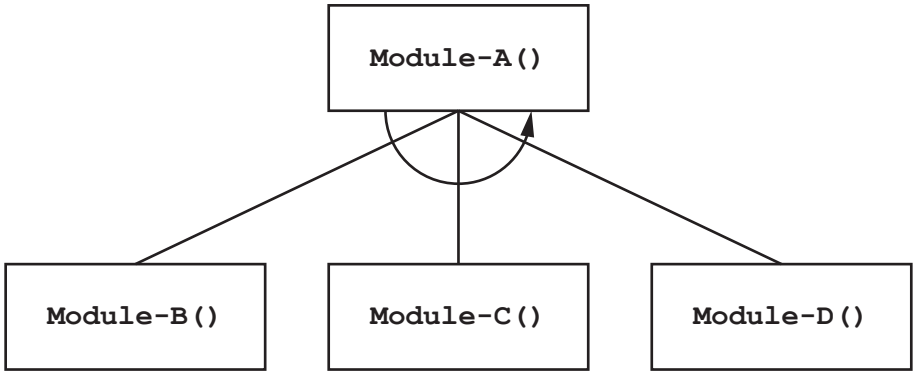
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[3]

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(b) The program designer produces a structure chart for the new module. Part of the structure chart is shown:



(i) Explain the relationship between the four modules shown.

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(ii) Two new modules are added: `Module-X()` and `Module-Y()`.

- `Module-X()` has no parameters.
- `Module-Y()` will take a string and a real number as parameters and return a Boolean value.
- `Module-D()` will call either `Module-X()` or `Module-Y()`.

Draw **only** the part of the structure chart that represents the relationship between `Module-X()`, `Module-Y()` and `Module-D()`.

[3]

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8 A computer shop assembles computers using items bought from several suppliers. A text file `Stock.txt` contains information about each item.

Information for each item is stored as a single line in the `Stock.txt` file in the format:

```
<ItemNum><SupplierCode><Description>
```

Item information is as follows:

	Format	Comment
`ItemNum`	4 numeric characters	unique for each item in the range "0001" to "5999" inclusive
`SupplierCode`	5 alphabetic characters	to identify the supplier of the item
`Description`	a string	a minimum of 12 characters

The file is organised in ascending order of `ItemNum` and does **not** contain all possible values in the range.

A programmer has started to define program modules as follows:

Module	Description
`SuppExists()` (already written)	• called with a parameter of type string representing a supplier code • returns `TRUE` if the supplier code is already in use, otherwise returns `FALSE`
`IsNewSupp()`	• called with a parameter of type string representing a new supplier code • returns `TRUE` if the string only contains alphabetic characters (either upper or lower case) and the supplier code is **not** already in use, otherwise returns `FALSE`

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(a) Write pseudocode for module `IsNewSupp()`.

Module `SuppExists()` has already been written and should be used as part of your solution. Module `SuppExists()` will generate a run-time error if the given parameter is not 5 characters in length.

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(b) A new module has been defined:

Module	Description
`CheckNewItem()`	• called with a parameter of type string representing a line of item information • checks to see whether an item with the same `ItemNum` already exists in the file • returns `TRUE` if the `ItemNum` is not already in the file, otherwise returns `FALSE`

Write **efficient** pseudocode for module `CheckNewItem()`.

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..... [7]

(c) The program modules `SuppExists()`, `IsNewSupp()` and `CheckNewItem()` are part of a group of modules that are combined to create a complete stock control program.

Each module in the program is tested individually during development and is debugged as necessary. It is then added to the program and further testing performed.

(i) Identify this method of testing.

..... [1]

(ii) One of the modules does not work properly when it is added to the program.

Describe a testing method that can be used to address this problem so that testing can continue and other modules can be added.

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..... [2]

(d) A new module `AddItem()` will be used to add information to the `Stock.txt` file.

State the file mode that should be used for the algorithm within this module.

..... [1]

(e) A new module `FindItem()` searches for a given item in the `Stock.txt` file, which is already organised in ascending order of `ItemNum`.

Describe how this organisation may improve the efficiency of the algorithm.

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