Cambridge Assessment International Education

CS BY AQIB KHAN

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8416100942

COMPUTER SCIENCE **9618/21**

Paper 2 Fundamental Problem-solving and Programming Skills **May/June 2024**

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 **24** pages. Any blank pages are indicated.

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

1 An algorithm is developed in pseudocode before being coded in a programming language.

(a) The following table shows four valid pseudocode assignment statements.

Complete the table by giving an appropriate data type to declare each of the variables `A`, `B`, `C` and `D`.

Assignment statement	Data type
`A ← LEFT(MyName, 1)`	
`B ← Total * 2`	
`C ← INT(ItemCost) / 3`	
`D ← "Odd OR Even"`	

[4]

(b) Other variables in the program have example values as shown:

Variable	Value
`Sorted`	`False`
`Tries`	`9`
`ID`	`"ZGAC001"`

Complete the table by evaluating each expression, using the example values.

Expression	Evaluates to
`Tries < 10 AND NOT Sorted`	
`Tries MOD 4`	
`TO_LOWER(MID(ID, 3, 1))`	
`LENGTH(ID & "xx") >= Tries`	

[4]

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(c) The variable names `A`, `B`, `C` and `D` in part **(a)** are **not** good programming practice.

(i) State why these variable names are **not** suitable.

.....

..... [1]

(ii) Identify **one** problem that these variable names might cause.

.....

..... [1]

(iii) The choice of suitable variable names is one example of good programming practice.

Give **one other** example.

.....

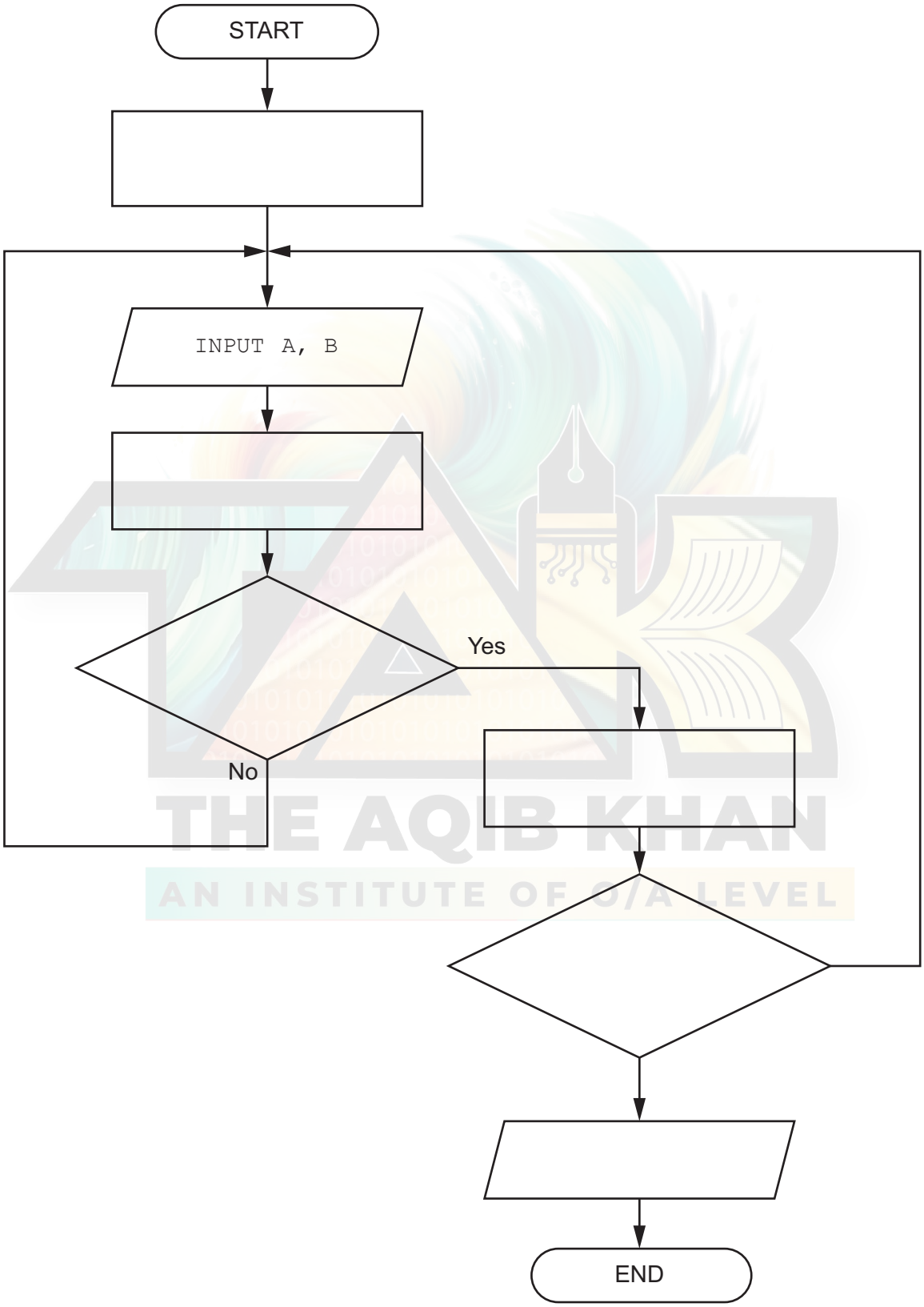
..... [1]

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2 An algorithm has three steps. It will:

1. repeatedly input a pair of numeric values `A` and `B`
2. count the number of pairs that are input until `A` has been greater than `B` 10 times
3. output the number of pairs that were input.

(a) Complete the program flowchart.



[5]

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(b) Step 1 of the algorithm is changed.

A variable `ThisSequence` is used to enter a sequence of 10 pairs of numeric values, using a single input statement.

Following the input of `ThisSequence` the revised algorithm will extract the pairs of numbers.

Describe the variable `ThisSequence` and how the numbers are extracted.

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.....

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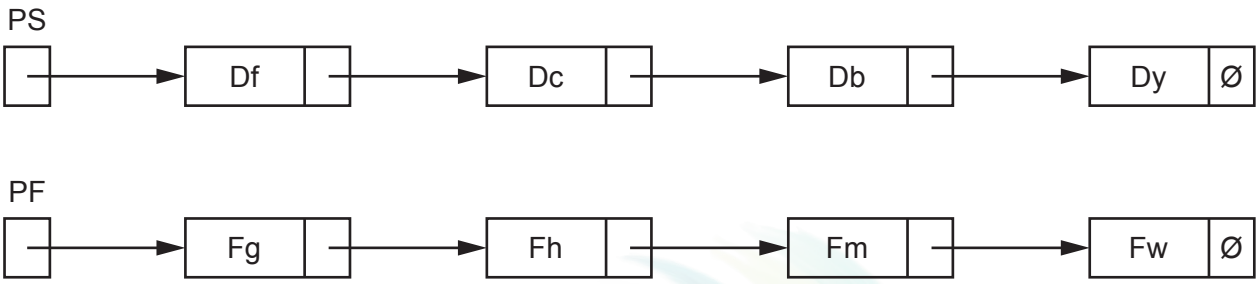
..... [2]

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3 The diagram shows an Abstract Data Type (ADT) representation of a linked list after data items have been added.

- PS is the start pointer.
- PF is the free list pointer.
- Labels Df, Dc, Db and Dy represent the data items of nodes in the list.
- Labels Fg, Fh, Fm and Fw represent the data items of nodes in the free list.
- The symbol Ø represents a null pointer.



(a) Describe the linked list immediately after initialisation, before **any** data items are added.

.....

.....

.....

.....

.....

..... [3]

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(b) A program will be written to include a linked list to store alphanumeric user IDs.

The design uses two variables and two 1D arrays to implement the linked list.
Each array element contains data of a single data type and **not** a record.

The statements below describe the design.

Complete the statements.

The two variables will be of type ..... .

The two variables will be used as ..... to the arrays.

The values stored in the two variables will indicate .....

..... .

The first 1D array will be of type ..... .

The first 1D array will be used to ..... .

The second 1D array will be of type ..... .

The second 1D array will be used to ..... .

[5]

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4 A global 1D array `Data` contains 100 elements of type integer.

A function `Check()` will:

- total the element values in odd index locations (1, 3, 5 ... 97, 99)
- total the element values in even index locations (2, 4, 6 ... 98, 100)
- return one of three strings 'Odd', 'Even' or 'Same' to indicate which total is the greater, or whether the totals are the same.

Write pseudocode for the function `Check()`.

[6]

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5 A global 1D array of strings contains three elements which are assigned values as shown:

```
Data[1] ← "aaaaaa"
Data[2] ← "bbbbbb"
Data[3] ← "cccccc"
```

Procedure `Process()` manipulates the values in the array.

The procedure is written in pseudocode as follows:

```
PROCEDURE Process(Format : STRING)
    DECLARE Count, Index, L : INTEGER
    DECLARE Result : STRING
    DECLARE C : CHAR

    Result ← "****"

    FOR Count ← 1 TO LENGTH(Format) STEP 2
        C ← MID(Format, Count, 1)
        L ← STR_TO_NUM(MID(Format, Count + 1, 1))

        Index ← (Count + 1) DIV 2

        CASE OF C
            'X' : Result ← TO_UPPER(Data[Index])
            'Y' : Result ← TO_LOWER(Data[Index])
            'Z' : Result ← "**" & Data[Index]
        ENDCASE

        Data[Index] ← LEFT(Result, L)
    NEXT Count

ENDPROCEDURE
```

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

```
CALL Process("X3Y2W4")
```

Count	C	L	Index	Result	Data[1]	Data[2]	Data[3]

[6]

(b) The procedure is to be modified. If variable `C` is assigned a value other than `'X'`, `'Y'` or `'Z'`, then procedure `Error()` is called and passed the value of variable `C` as a parameter.

This modification can be implemented by adding a **single line** of pseudocode.

(i) Write the single line of pseudocode.

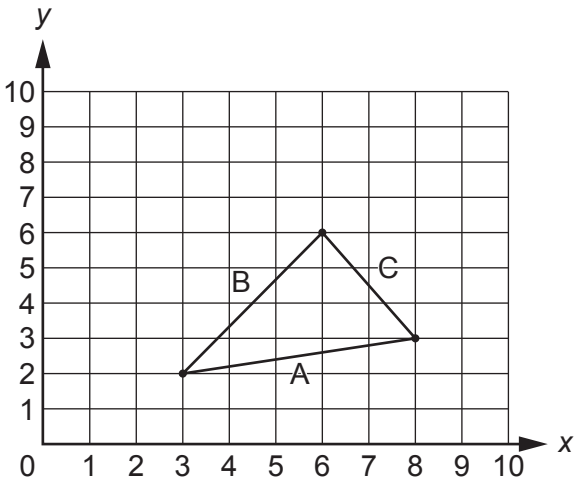
..... [1]

(ii) State where this new line should be placed.

..... [1]

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6 Three points on a grid form a triangle with sides of length A, B and C as shown in the example:



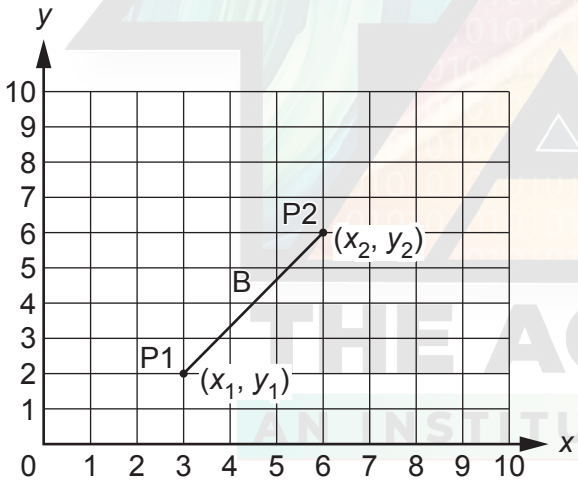
A triangle is said to be right-angled if the following test is true (where A is the length of the longest side):

$A^2 = B^2 + C^2$

A^2 means A multiplied by A, for example 3^2 means 3×3 which evaluates to 9

You can calculate A^2, B^2 and C^2 by using the coordinates of the endpoints of each line.

For example, B^2 is calculated as follows:



The endpoints, P1 and P2, have the coordinates (3, 2) and (6, 6).

The value B^2 is given by the formula:

$B^2 = (x_1 - x_2)^2 + (y_1 - y_2)^2$

In this example:

$B^2 = (3 - 6)^2 + (2 - 6)^2$
$B^2 = (-3)^2 + (-4)^2$
$B^2 = 9 + 16$
$B^2 = 25$

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(a) A function `IsRA()` will:

- take three sets of integers as parameters representing the coordinates of the three endpoints that form a triangle
- return `TRUE` if the endpoints form a right-angled triangle, otherwise return `FALSE`.

In pseudocode, the operator '^' represents an exponent, which is the number of times a value is multiplied by itself. For example, the expression Value^2 may be written in pseudocode as `Value ^ 2`

Complete the pseudocode for the function `IsRA()`.

```
FUNCTION IsRA(x1, y1, x2, y2, x3, y3 : INTEGER) RETURNS BOOLEAN
```

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```
ENDFUNCTION
```

[6]

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(b) The test used to check if a triangle is right-angled can be written in two ways:

$A^2 = B^2 + C^2$

or

$A = \sqrt{(B^2 + C^2)}$

The symbol √ represents the square root operation. For example, √81 = 9

A new function `SQRT()` is written to perform the square root operation. The function takes an integer number as a parameter and returns a positive real value representing the square root of the number.

During testing it is found that the `SQRT()` function returns a value that is only accurate to 4 decimal places.

For example, `SQRT(25)` returns 5.0000125 rather than the correct value of 5.0

The function `IsRA()` from part **(a)** is modified to use the new `SQRT()` function to test if a triangle is right-angled.

Describe a problem that might occur when using the modified `IsRA()` function **and** suggest a solution that still allows the `SQRT()` function to be used.

Problem .....

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Solution .....

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[2]

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7 A fitness club has a computerised membership system. The fitness club offers a number of different exercise classes.

The following information is stored for each club member: name, home address, email address, mobile phone number, date of birth and the exercise(s) they are interested in.

(a) When an exercise class is planned, a new module will send personalised text messages to each member who has expressed an interest in that exercise. Members wishing to join the class send a text message back. Members may decide **not** to receive future text messages by replying with the message 'STOP'.

The process of abstraction is used to filter out unnecessary information.

(i) State **one** advantage of applying abstraction to this problem.

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..... [1]

(ii) Identify **three** items of information that will be required by the new module.
Justify your choices with reference to the given scenario.

Item 1 required .....

Justification .....

.....

Item 2 required .....

Justification .....

.....

Item 3 required .....

Justification .....

.....
[3]

(iii) Identify **two** operations that would be required to process data when the new module receives a text message back from a member.

Operation 1 .....

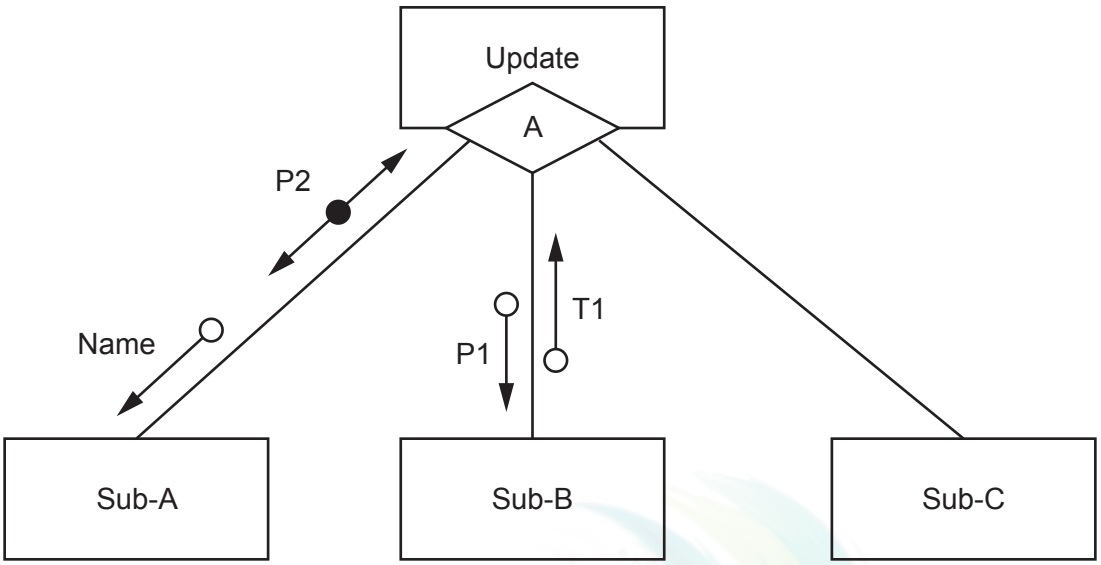
.....

Operation 2 .....

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[2]

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(b) The structure chart illustrates part of the membership program:



Data item notes:

- Name contains the name of a club member
- P1 and T1 are of type real.

(i) Explain the meaning of the diamond symbol (labelled with the letter A) in the chart.

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(ii) Write the pseudocode module headers for Sub-A and Sub-B.

Sub-A

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Sub-B

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[4]

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8 A teacher is designing a program to process pseudocode projects written by her students.

Each student project is stored in a text file.

The process is split into a number of stages. Each stage performs a different task and creates a new file named as shown:

File name	Comment
`MichaelAday_src.txt`	student project file produced by student Michael Aday
`MichaelAday_S1.txt`	file produced by stage 1
`MichaelAday_S2.txt`	file produced by stage 2

The teacher has defined the first program module as follows:

Module	Description
`DeleteComment()`	• called with a parameter of type string representing a line of pseudocode from a student's project file • returns the line after removing any comments Note on comments: A comment starts with two forward slash characters and includes all the remaining characters on the line. The following example shows a string before and after the comment has been removed: Before: `IF X2 > 13 THEN  //check if limit exceeded` After: `IF X2 > 13 THEN`

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(a) Complete the pseudocode for module `DeleteComment()`.

```
FUNCTION DeleteComment(Line : STRING) RETURNS STRING
```

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```
ENDFUNCTION
```

[8]

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(b) A second module is defined:

Module	Description
`Stage_1()`	• called with a parameter of type string representing a student name • creates a new stage 1 file • copies each line from the student's project file to the stage 1 file after removing any comment from each line • does **not** write blank lines to the stage 1 file • returns the number of lines written to the stage 1 file

Write pseudocode for module `Stage_1()`.

Module `DeleteComment()` must be used in your solution.

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..... [7]

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