Cambridge Assessment International Education

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CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

0832918086

COMPUTER SCIENCE **9618/23**

Paper 2 Fundamental Problem-solving and Programming Skills **May/June 2022**

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.

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) The following table contains pseudocode examples.

Each example may include all or part of:

- selection
- iteration (repetition)
- assignment.

Complete the table by placing **one or more** ticks (✓) in each row.

Pseudocode example	Selection	Iteration	Assignment

`FOR Index ← 1 TO 3`
`  Safe[Index] ← GetResult()`
`NEXT Index`			

`OTHERWISE : OUTPUT "ERROR 1202"`			
`REPEAT UNTIL Index = 27`			
`INPUT MyName`			

`IF Mark > 74 THEN`
`  Grade ← 'A'`
`ENDIF`			

[5]

(b) (i) Program variables have values as follows:

Variable	Value
AAA	TRUE
BBB	FALSE
Count	99

Complete the table by evaluating each expression.

Expression	Evaluation
`AAA AND (Count > 99)`	
`AAA AND (NOT BBB)`	
`(Count <= 99) AND (AAA OR BBB)`	
`(BBB AND Count > 50) OR NOT AAA`	

[2]

(ii) Give an example of when a variable of type Boolean would be used.

.....

..... [1]

2 A program has been written to implement a website browser and maintenance is now required.

One type of maintenance is called perfective.

Name **two other** types of maintenance that the program may require **and** give a reason for each.

Type 1 .....

Reason .....

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.....

.....

Type 2 .....

Reason .....

.....

.....

.....

[4]

3 Four program modules are defined as follows:

Pseudocode module header
`PROCEDURE Sub1_A(XT : INTEGER, PB : STRING)`
`FUNCTION Sub1_B(RA : INTEGER) RETURNS BOOLEAN`
`PROCEDURE Sub1_C(SB : INTEGER, BYREF SA : STRING)`
`PROCEDURE Section_1()`

(a) A structure chart will be produced as part of the development process.

Describe the purpose of a structure chart.

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..... [2]

(b) Module `Section_1()` calls one of the other three modules. The module called will be selected when the program runs.

Draw the structure chart.

[5]

4 Items in a factory are weighed automatically. The weight is stored as an integer value representing the item weight to the nearest gram (g).

A function is written to validate the weight of each item. The function will return "PASS" if the weight of the item is within the acceptable range, otherwise the function will return "FAIL".

The acceptable weight range for an item is 150 g to 155 g inclusive.

The validation function is to be properly tested. Black-box testing will be used and a test plan needs to be produced.

Complete the table by writing additional tests to test this function.

Type of test data	Example test value	Expected return value	Explanation
Normal	153	"PASS"	Value within the acceptable range

[4]

5 A program will store attendance data about each employee of a company.

The data will be held in a record structure of type `Employee`. The fields that will be needed are as shown:

Field	Typical value	Comment
`EmployeeNumber`	`123`	A numeric value starting from 1
`Name`	`"Smith,Eric"`	Format: <last name>','<first name>
`Department`	`"1B"`	May contain letters and numbers
`Born`	`13/02/2006`	Must not be before 04/02/1957
`Attendance`	`97.40`	Represents a percentage

(a) (i) Write pseudocode to declare the record structure for type `Employee`.

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..... [4]

(ii) A 1D array `Staff` containing 500 elements will be used to store the employee records.

Write pseudocode to declare the `Staff` array.

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..... [2]

(b) There may be more records in the array than there are employees in the company. In this case, some records of the array will be unused.

(i) State why it is good practice to have a standard way to indicate unused array elements.

.....

..... [1]

(ii) Give **one** way of indicating an unused record in the `Staff` array.

.....

..... [1]

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(c) A procedure `Absentees()` will output the `EmployeeNumber` and the `Name` of all employees who have an `Attendance` value of 90.00 or less.

Write pseudocode for the procedure `Absentees()`.

Assume that the `Staff` array is global.

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..... [4]

6 **(a)** The factorial of a number is the product of all the integers from 1 to that number.

For example:

factorial of 5 is given by $1 \times 2 \times 3 \times 4 \times 5 = 120$
factorial of 7 is given by $1 \times 2 \times 3 \times 4 \times 5 \times 6 \times 7 = 5040$
factorial of 1 = 1

Note: factorial of 0 = 1

A function `Factorial()` will:

- be called with an integer number as a parameter
- calculate and return the factorial of the number
- return −1 if the number is negative.

Write pseudocode for the function `Factorial()`.

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..... [6]

(b) A procedure `FirstTen()` will output the factorial of the numbers from 0 to 9. The procedure will use the function from **part (a)**.

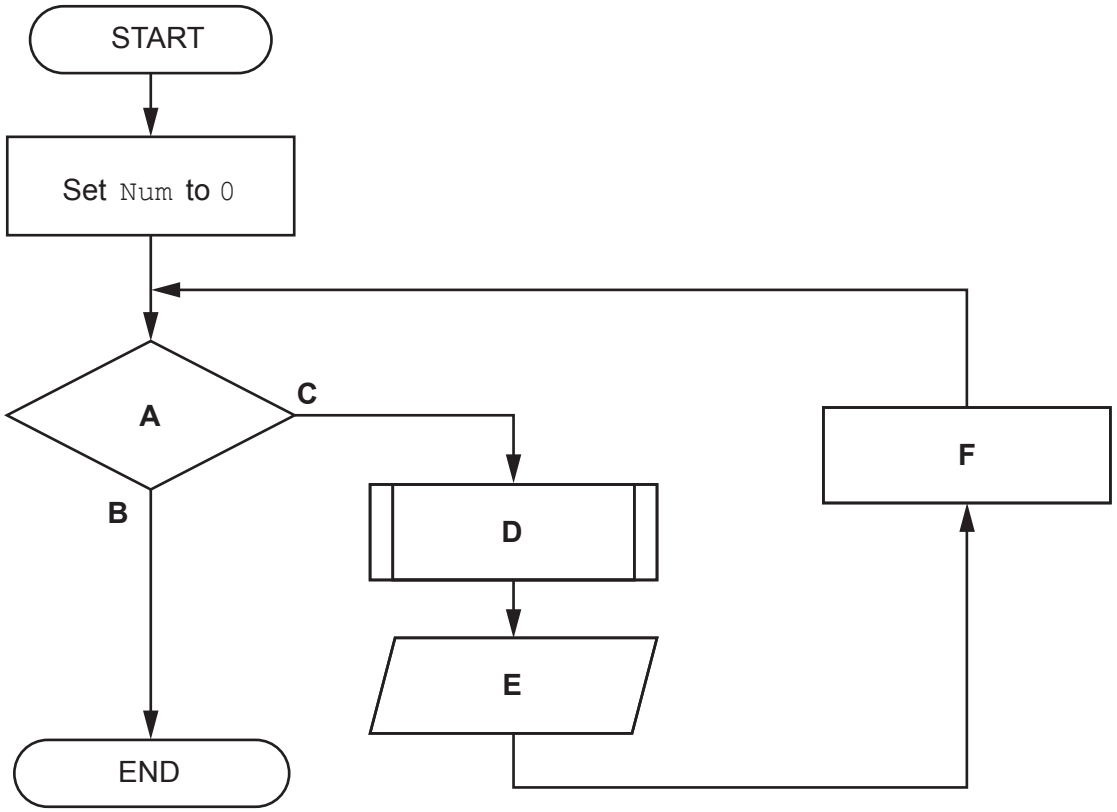
The required output is:

```
Factorial of 0 is 1
Factorial of 1 is 1
Factorial of 2 is 2
```



```
Factorial of 9 is 362880
```

The program flowchart represents an algorithm for `FirstTen()`.



Complete the table by writing the text that should replace each label **A** to **F**.

Label	Text
A	
B	
C	
D	
E	
F	

[4]

7 The following pseudocode represents an algorithm intended to output the last three lines as they appear in a text file. Line numbers are provided for reference only.

```
10  PROCEDURE LastLines(ThisFile : STRING)
11     DECLARE ThisLine : STRING
12     DECLARE Buffer : ARRAY[1:3] OF STRING
13     DECLARE LineNum : INTEGER
14     LineNum ← 1
15     OPENFILE ThisFile FOR READ
16
17     WHILE NOT EOF(ThisFile)
18        READFILE Thisfile, ThisLine // read a line
19        Buffer[LineNum] ← ThisLine
20        LineNum ← LineNum + 1
21        IF LineNum = 4 THEN
22           LineNum ← 1
23        ENDIF
24     ENDWHILE
25
26     CLOSEFILE ThisFile
27     FOR LineNum ← 1 TO 3
28        OUTPUT Buffer[LineNum]
29     NEXT LineNum
30  ENDPROCEDURE
```

(a) There is an error in the algorithm. In certain cases, a text file will have at least three lines but the output will be incorrect.

(i) State how the output may be incorrect.

.....

..... [1]

(ii) Describe the error in the algorithm **and** explain how it may be corrected.

Description .....

.....

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.....

Explanation .....

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.....

[4]

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(b) The original algorithm is implemented and sometimes the last three lines of the text file are output correctly.

State the condition that results in the correct output.

.....

..... [1]

(c) Lines 20 to 23 inclusive could be replaced with a single pseudocode statement.

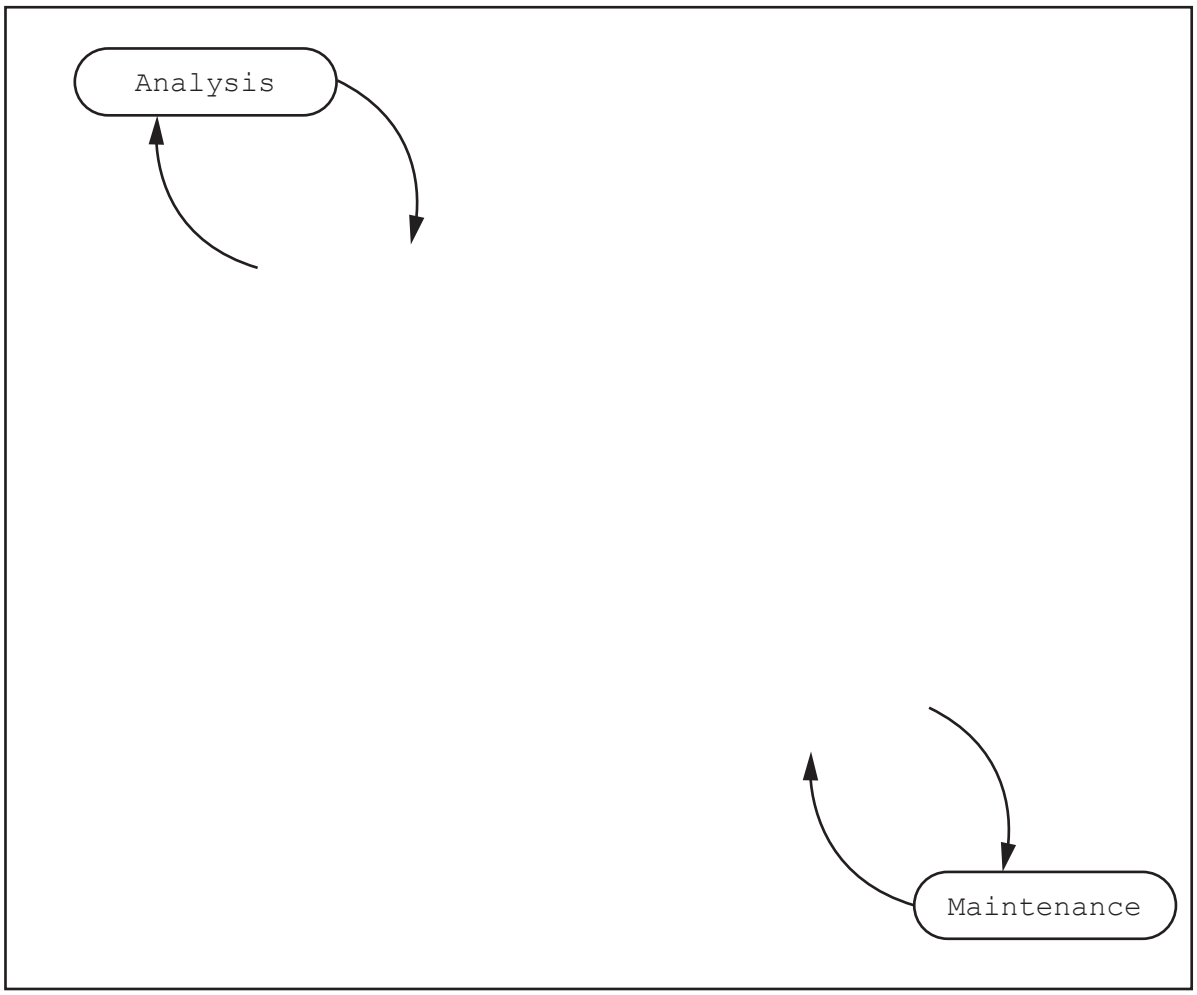
Write the pseudocode statement.

.....

..... [2]

8 The following diagram shows the incomplete waterfall model of the program development life cycle.

(a) Complete the diagram.



[3]

(b) Explain the meaning of the downward and upward arrows.

Downward arrows .....

.....

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Upward arrows .....

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[2]

(c) Identify another type of model for the program development life cycle.

..... [1]

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9 A program allows a user to save passwords used to log in to websites. A stored password is then inserted automatically when the user logs in to the corresponding website.

A student is developing a program to generate a strong password. The password will be of a fixed format, consisting of **three groups of four** alphanumeric characters, separated by the hyphen character '-'.

An example of a password is: "FxAf-3hzV-Aq49"

A valid password:

- must be 14 characters long
- must be organised as three groups of four alphanumeric characters. The groups are separated by hyphen characters
- may include duplicated characters, **provided** these appear in different groups.

The programmer has started to define program modules as follows:

Module	Description
`RandomChar()`	• Generates a single random character from within one of the following ranges: ○ 'a' to 'z' ○ 'A' to 'Z' ○ '0' to '9' • Returns the character
`Exists()`	• Takes two parameters: ○ a string ○ a character • Performs a case-sensitive search for the character in the string • Returns `TRUE` if the character occurs in the string, otherwise returns `FALSE`
`Generate()`	• Generates a valid password • Uses `RandomChar()` and `Exists()` • Returns the password

Note: in a case-sensitive comparison, 'a' is not the same as 'A'.

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(a) Write pseudocode for the module `Generate()`.

[7]

(b) A global 2D array `Secret` of type `STRING` stores the passwords together with the website domain name where they are used. `Secret` contains 1000 elements organised as 500 rows by 2 columns.

Unused elements contain the empty string (`""`). These may occur anywhere in the array.

An example of part of the array is:

Array element	Value
`Secret[27, 1]`	`"www.thiswebsite.com"`
`Secret[27, 2]`	`"●●●●●●●●●●●●"`
`Secret[28, 1]`	`"www.thatwebsite.com"`
`Secret[28, 2]`	`"●●●●●●●●●●●●"`

Note:

- For security, the passwords are stored in an encrypted form, shown as `"●●●●●●●●●●●●"` in the example.
- The passwords cannot be used without being decrypted.
- You may assume that the encrypted form of a password will **not** be an empty string.

Additional modules are defined as follows:

Module	Description
`Encrypt()`	• Takes a password as a string • Returns the encrypted form of the password as a string
`Decrypt()`	• Takes an encrypted password as a string • Returns the decrypted form of the password as a string
`FindPassword()`	• Takes a website domain name as a string • Searches for the website domain name in the array `Secret` • If the website domain name is found, the decrypted password is returned • If the website domain name is not found, an empty string is returned
`AddPassword()`	• Takes two parameters as strings: a website domain name and a password • Searches for the website domain name in the array `Secret` and if not found, adds the website domain name and the encrypted password to the array • Returns `TRUE` if the website domain name and encrypted password are added to the array, otherwise returns `FALSE`

The first three modules have been written.

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Write pseudocode for the module `AddPassword()`.

.... [6]

(c) The content of the array `Secret` is to be stored in a text file for backup.

It **must** be possible to read the data back from the file and extract the website domain name and the encrypted password.

Both the website domain name and encrypted password are stored in the array as strings of characters.

The encrypted password may contain any character from the character set used and the length of both the encrypted password and the website domain name is variable.

Explain how a single line of the text file can be used to store the website domain name and the encrypted password.

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..... [3]

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