Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4860204797

COMPUTER SCIENCE **9608/22**

Paper 2 Fundamental Problem-solving and Programming Skills **May/June 2020**

2 hours

You must answer on the question paper.

No additional materials are needed.

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.

This document has **20** pages. Blank pages are indicated.

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1 **(a)** Selection and repetition are basic constructs of an algorithm.

Name **and** describe **one other** construct.

Name .....

Description .....

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[3]

(b) Program coding is a transferable skill.

Explain the term **transferable skill**.

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..... [2]

(c) Count-controlled and post-condition are two types of loop.

Describe the characteristics of each of these types of loop.

Count-controlled .....

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Post-condition .....

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[2]

(d) Name **three** features provided by an Integrated Development Environment (IDE) that assist in the coding and **initial** error detection stages of the program development cycle.

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2 .....

3 .....
[3]

2 **(a)** A structure chart is often produced as part of a modular program design. The chart shows the hierarchy of modules and the sequence of execution.

Give **two other** features the structure chart can show.

Feature 1 .....

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Feature 2 .....

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[2]

(b) Six program modules implement part of an online shopping program. The following table gives the modules and a brief description of each module:

Module	Description
`Shop()`	Allows the user to choose a delivery slot, select items to be added to the basket and finally check out
`ChooseSlot()`	Allows the user to select a delivery time. Returns a delivery slot number
`FillBasket()`	Allows the user to select items and add them to the basket
`Checkout()`	Completes the order by allowing the user to pay for the items. Returns a Boolean value to indicate whether or not payment was successful
`Search()`	Allows the user to search for a specific item. Returns an item reference
`Add()`	Adds an item to the basket. Takes an item reference and a quantity as parameters

(i) The online shopping program has been split into sub-tasks as part of the design process.

Explain the advantages of decomposing the program into modules. Your explanation should refer to the scenario and modules described in **part (b)**.

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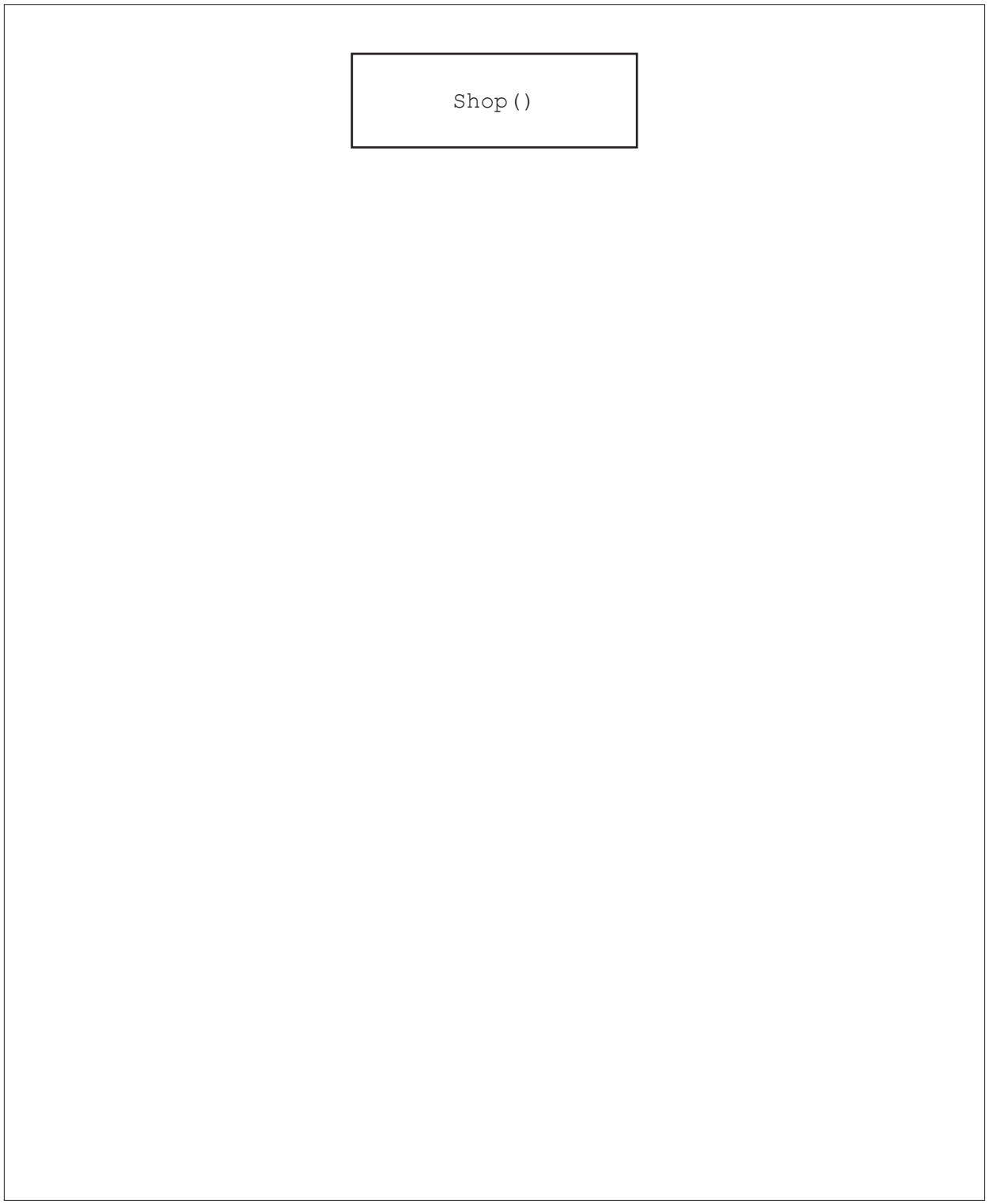
(ii) Complete the structure chart for the six modules described in **part (b)**.

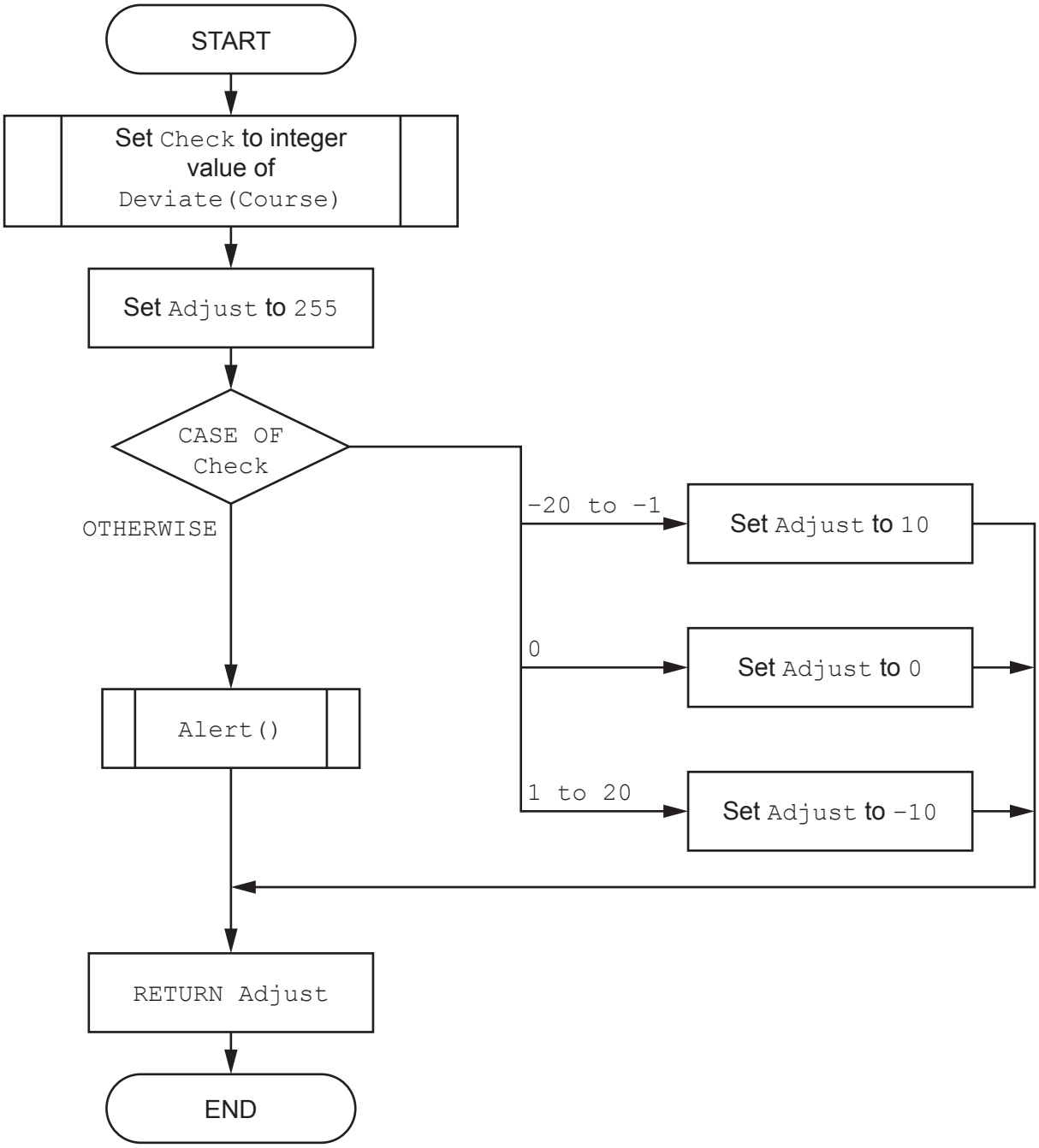


[6]

3 A navigation program includes a function, `CheckCourse()`. This function is called with a real value, `Course`, and returns an integer value.

The identifier table and the program flowchart for the function are shown as follows:

Identifier	Type	Description
`Course`	`REAL`	The value passed to `CheckCourse()`
`Adjust`	`INTEGER`	The value returned by `CheckCourse()`
`Check`	`INTEGER`	A local variable
`Deviate()`	`FUNCTION`	A function that is passed a `REAL` value representing the course and returns a `REAL` value representing the current deviation
`Alert()`	`PROCEDURE`	A procedure that generates a warning



Write **pseudocode** to implement the function `CheckCourse()`. The pseudocode must follow the algorithm represented by the flowchart. Declare any local variables used.

Refer to the **Appendix** on page 19 for a list of built-in pseudocode functions and operators.

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4 **(a)** Mustafa has developed the following pseudocode to generate ten random integers in the range 1 to 100.

```
DECLARE Random : ARRAY [1:10] OF INTEGER
DECLARE Count, RNum : INTEGER

FOR Count ← 1 TO 10
   Rnum ← INT(RAND(100)) + 1
   Random[Count] ← RNum
ENDFOR
```

Refer to the **Appendix** on page 19 for a list of built-in pseudocode functions and operators.

Rewrite the pseudocode so that there are no duplicated numbers in the list of random numbers.

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(b) The changes made to the pseudocode in **part (a)** were as a result of changes to the program requirement.

Give the term used to describe changes made for this reason.

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5 A global 1D array, `Contact`, of type `STRING` is used to store a list of names and email addresses.

There are 1000 elements in the array. Each element stores one data item. The format of each data item is as follows:

```
<Name>':'<EmailAddress>
```

`Name` and `EmailAddress` are both variable-length strings.

For example:

```
"Sharma Himal:hsharma99@stlmail.com"
```

A function, `GetName()`, is part of the program that processes the array. A data item string will be passed to the function as a parameter. The function will return the `Name` part. Validation is **not** necessary.

(a) Use **structured English** to describe the algorithm for the function `GetName()`.

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(b) (i) The array is to be sorted using an efficient bubble sort algorithm. An efficient bubble sort reduces the number of unnecessary comparisons between elements.

Describe how this could be achieved.

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(ii) A procedure, `BubbleSort()`, is needed to sort the 1D array `Contact` into ascending order of `Name` using an efficient bubble sort algorithm.

Write **program code** for the procedure `BubbleSort()`.

Visual Basic and Pascal: You should include the declaration statements for variables.
Python: You should show a comment statement for each variable used with its data type.

Programming language .....

Program code .....

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Question 6 begins on the next page.

6 A company hires out rowing boats on a lake. The company has 17 boats numbered from 1 to 17.

Boats may be hired between 9:00 and 18:00, with a maximum hire duration of 90 minutes.

The company is developing a program to help manage and record the boat hire process.

The programmer has decided to store all values relating to hire time as strings. The program will use a 24-hour clock format. For example:

Time (in words)	String value
Nine o'clock in the morning	`"09:00"`
Five minutes past ten o'clock in the morning	`"10:05"`
Ten minutes before three o'clock in the afternoon	`"14:50"`

The programmer has defined the first module as follows:

Module	Description
`AddTime()`	• Takes two parameters: ◦ `StartTime`: a `STRING` value representing a time as described ◦ `Duration`: an `INTEGER` value representing a duration in minutes • Adds the duration to the time to give a new time • Returns the new time as a `STRING`

(a) (i) Write **pseudocode** for the module `AddTime()`. Assume both input parameters are valid.

Refer to the **Appendix** on page 19 for a built-in list of pseudocode functions and operators.

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(ii) `AddTime()` will be tested using white-box testing.

State the reason for using white-box testing.

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(iii) A run-time error is one type of error that black-box testing can reveal.

Describe **one other** type of error that black-box testing can reveal.

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..... [2]

(b) The user will input the desired start time of a hire. A new module will be written to validate the input string as a valid time in 24-hour clock format.

The string is already confirmed as being in the format `"NN:NN"`, where `N` is a numeric character.

Give an example of suitable test data that is in this format but which is **invalid**. Explain your answer.

Test data .....

Explanation .....

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[2]

(c) Each time a boat is hired out, details of the hire are added to a text file, `Hirelog.txt`. Each line of the text file corresponds to information about one hire session.

The format of each line is as follows:

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<BoatNumber><Date><AmountPaid>
```

- `BoatNumber` is a two-digit numeric string
- `Date` is a six-digit numeric string in the format DDMMYY
- `AmountPaid` is a variable-length string representing a numeric value, for example `"12.75"`

The total hire amount from each boat is to be stored in a global array, `Total`. This array is declared in pseudocode as follows:

```
DECLARE Total : ARRAY [1:17] OF REAL
```

The programmer has defined module `GetTotals()` as follows:

Module	Description
`GetTotals()`	• Search through the file `Hirelog.txt` • Extract the `AmountPaid` each time a boat is hired • Store the total of `AmountPaid` for each boat in the array

Write **program code** for the module `GetTotals()`.

Visual Basic and Pascal: You should include the declaration statements for variables.
Python: You should show a comment statement for each variable used with its data type.

Programming language .....

Program code

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Appendix

Built-in functions (pseudocode)

Each function returns an error if the function call is not properly formed.

`LENGTH(ThisString : STRING) RETURNS INTEGER`
returns the integer value representing the length of `ThisString`

Example: `LENGTH("Happy Days")` returns `10`

`LEFT(ThisString : STRING, x : INTEGER) RETURNS STRING`
returns leftmost `x` characters from `ThisString`

Example: `LEFT("ABCDEFGH", 3)` returns `"ABC"`

`RIGHT(ThisString: STRING, x : INTEGER) RETURNS STRING`
returns rightmost `x` characters from `ThisString`

Example: `RIGHT("ABCDEFGH", 3)` returns `"FGH"`

`INT(x : REAL) RETURNS INTEGER`
returns the integer part of `x`

Example: `INT(27.5415)` returns `27`

`RAND(x : INTEGER) RETURNS REAL`
returns a real number in the range `0` to `x` (not inclusive of `x`)

Example: `RAND(87)` could return `35.43`

`MOD(ThisNum : INTEGER, ThisDiv : INTEGER) RETURNS INTEGER`
returns the integer value representing the remainder when `ThisNum` is divided by `ThisDiv`

Example: `MOD(10,3)` returns `1`

`DIV(ThisNum : INTEGER, ThisDiv : INTEGER) RETURNS INTEGER`
returns the integer value representing the whole number part of the result when `ThisNum` is divided by `ThisDiv`

Example: `DIV(10,3)` returns `3`

`NUM_TO_STRING(x : REAL) RETURNS STRING`
returns a string representation of a numeric value.

Example: If `x` has the value `87.5` then `NUM_TO_STRING(x)` returns `"87.5"`
Note: This function will also work if `x` is of type `INTEGER`

`STRING_TO_NUM(x : STRING) RETURNS REAL`
returns a numeric representation of a string.

Example: If `x` has the value `"23.45"` then `STRING_TO_NUM(x)` returns `23.45`
Note: This function will also work if `x` is of type `CHAR`

Operators (pseudocode)

Operator	Description
`&`	Concatenates (joins) two strings Example: `"Summer" & " " & "Pudding"` produces `"Summer Pudding"`
`AND`	Performs a logical `AND` on two Boolean values Example: `TRUE AND FALSE` produces `FALSE`
`OR`	Performs a logical `OR` on two Boolean values Example: `TRUE OR FALSE` produces `TRUE`

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