Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6567705812

COMPUTER SCIENCE **9608/32**

Paper 3 Advanced Theory **October/November 2021**

1 hour 30 minutes

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 **16** pages. Any blank pages are indicated.

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1 Data types can be defined using pseudocode.

The data type, `BicycleRecord`, is defined in pseudocode as:

```
TYPE BicycleRecord

   DECLARE BicycleID        :  INTEGER

   DECLARE BicycleAvailable :  BOOLEAN

   DECLARE BicycleLocation  :  (RiverSide, BusStation, TrainStation,
                                TownSquare, Library)

   DECLARE DateChecked      :  DATE

ENDTYPE
```

A variable, `LoanBicycle`, is declared in pseudocode as:

```
DECLARE LoanBicycle : BicycleRecord
```

(a) Write **pseudocode** statements to assign `567` to the `BicycleID` of `LoanBicycle` **and** `FALSE` to the `BicycleAvailable` of `LoanBicycle`.

.....

..... [2]

(b) The type definition for `BicycleRecord` is changed.

(i) The definition has been extended to include borrower identification numbers, `BorrowerID`, for the last 10 people who borrowed a bicycle. Each identification number is an integer.

Write the **pseudocode** statement needed in the type definition of `BicycleRecord`.

.....

..... [1]

(ii) The values for the field `BicycleID` must be between `500` and `599` inclusive.

Rewrite **one pseudocode** line from the type definition of `BicycleRecord` to implement the change.

.....

..... [1]

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(c) Data about all the bicycles are stored in a file that uses random file organisation.

`BicycleID` is used as the key field.

Explain how a program could add an extra record to this file.

.....

.....

.....

.....

.....

..... [3]

2 The TCP/IP protocol suite can be viewed as a stack with four layers.

(a) Complete the diagram of the stack by writing the names of the **three** missing layers.

Layer
Internet / Network

[3]

(b) Describe the TCP and IP protocols.

TCP .....

.....

.....

.....

IP .....

.....

.....

.....

[4]

3 **(a)** The truth table for a logic circuit with four inputs is shown.

INPUT				OUTPUT
P	**Q**	**R**	**S**	**X**
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

(i) Write the Boolean algebraic expression for the truth table as a sum-of-products.

X = ... [2]

(ii) Complete the following Karnaugh Map (K-map) for the truth table.

		PQ			
		00	**01**	**11**	**10**
RS	**00**				
	01				
	11				
	10				

[2]

(iii) The K-map can be used to simplify the expression in **part (a)(i)**.

Draw loop(s) around appropriate groups in the K-map to produce an optimal sum-of-products. [2]

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(iv) Write the simplified sum-of-products from the K-map.

X = ... [2]

(b) Simplify the expression for **X**, represented by the truth table in **part (a)**, using Boolean Algebra.

.....

.....

.....

..... [2]

4 Babar is building a wireless Local Area Network (LAN).

(a) Identify **two** differences between a wireless network and a wired network.

1 .....

.....

.....

2 .....

.....

.....
[2]

(b) Identify the hardware device needed to connect the wireless LAN to the Internet. Justify your choice.

Device .....

Justification .....

.....

.....
[2]

5 **(a)** Flora has written a program that uses the variables `p`, `q`, `r` and `s`.

Part of the program contains the following calculations:

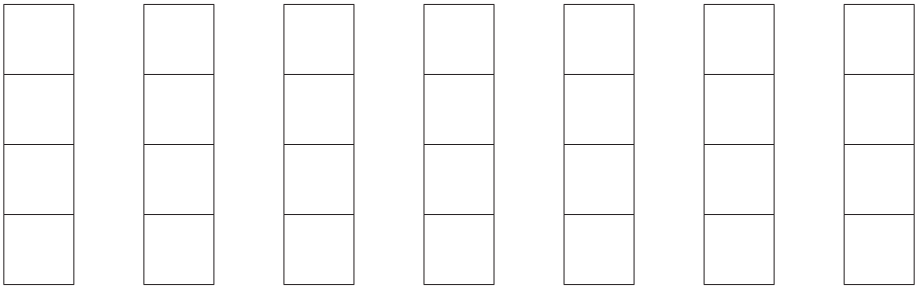
```
p = 5
q = 4
r = 1
s = p * (p - q + r)
```

(i) Write the Reverse Polish Notation (RPN) for the expression:

```
p * (p - q + r)
```

..... [2]

(ii) Show the changing contents of the stack as the value for `s` is calculated from the RPN expression.



[4]

(b) Convert this RPN expression back to its original infix form.

```
p q * p q r + - + p /
```

.....

.....

.....

.....

..... [3]

(c) Syntax analysis is one stage of the compilation of a program.

Identify **and** describe **two other** stages of compilation.

Stage 1 .....

Description .....

.....

.....

Stage 2 .....

Description .....

.....

.....

[4]

6 Lara wants to send an important message to her bank over the Internet.

(a) Explain why the bank requires a digital signature for the message.

.....

.....

.....

..... [2]

(b) Asymmetric key cryptography is used to keep Lara's message secure during transmission over the Internet.

Describe this process of encrypting and decrypting Lara's message.

.....

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..... [5]

(c) Lara has received an email message that appears to be from her bank. She is not sure whether it is authentic.

State **two** problems that could occur if Lara opens and responds to this suspicious email message.

1 .....

.....

2 .....

.....

[2]

7 A virtual machine is the software emulation of a computer system using another computer system.

Describe **two** benefits and **two** limitations of using a virtual machine.

Benefit 1 .....

.....

.....

Benefit 2 .....

.....

.....

Limitation 1 .....

.....

.....

Limitation 2 .....

.....

.....

[4]

8 A large car park has 6 floors.

There is a large screen at the entrance to the car park. This screen displays the number of empty parking spaces on each floor.

- There are 256 parking spaces for cars on each floor.
- Each parking space has a sensor that detects if a car is parked on it.
- Data from the sensors are read and processed by a computer system.

(a) (i) Identify the type of system described.

..... [1]

(ii) Justify your answer to **part (a)(i)**.

.....

.....

.....

..... [2]

(iii) Identify **two** types of sensor that could be used by this system.

Sensor 1 .....

Sensor 2 .....
[2]

(b) A program regularly checks each sensor's readings.

The number of empty parking spaces is displayed on the screen for each floor. If there are no empty parking spaces on a floor, a message is displayed on the screen to show that the floor is full.

The pseudocode algorithm to display this information has been written using these identifiers.

Identifier	Data type	Description
`FloorNumber`	`INTEGER`	Floor number
`SpaceNumber`	`INTEGER`	Parking space number
`SpaceAvailable`	`INTEGER`	Counts number of empty parking spaces on a floor
`ForEver`	`BOOLEAN`	Value to ensure continuous loop

The pseudocode algorithm uses the function `CheckSpace(Floor, Space)`. This function returns `TRUE` if the parking space is empty and `FALSE` otherwise.

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(i) Complete the following **pseudocode** algorithm to check the number of parking spaces available.

```
01 ForEver ← ……
02 REPEAT
03   FOR FloorNumber ← 1 TO ……
04     SpaceAvailable ← 0
05     FOR SpaceNumber ← 1 TO ……
06       IF CheckSpace(FloorNumber, SpaceNumber)
07         THEN
08           SpaceAvailable ← SpaceAvailable + 1
09       ENDIF
10     ENDFOR
11     IF SpaceAvailable > ……
12       THEN
13         OUTPUT "Floor ", ……,
                 " empty parking spaces "……
14       ELSE
15         OUTPUT "Floor ", ……, " full"
16     ENDIF
17   ENDFOR
18
19 // delay loop
20 // delay loop
21 UNTIL ……
```

[6]

(ii) Write a delay loop in **pseudocode** for lines `19` and `20` of the pseudocode algorithm.

.....

.....

.....

..... [2]

(iii) State why a delay loop is used in this system.

.....

..... [1]

(c) When a car is parked in a parking space, a bit is set in the appropriate memory location.

- 32 memory locations are used for each floor with address `X01` to `X32`, where `X` is the number of the floor.
- Each location is one byte in length to hold the data for 8 parking spaces.

For example, memory location `101` is used for parking spaces 1 to 8 and memory location `102` is used for parking spaces 9 to 16.

The table shows part of floor 1 with cars parked in parking spaces 4, 11, 16 ... and 255.

Memory location	Bits								Parking space number
101	0	0	0	0	1	0	0	0	**8 – 1**
102	1	0	0	0	0	1	0	0	**16 – 9**
…	…	…	…	…	…	…	…	…	**…**
132	0	1	0	0	0	0	0	0	**256 – 249**

(i) The data in memory location `604` is shown.

604	1	0	0	0	0	0	0	1

State what this data represents.

.....

.....

.....

..... [2]

(ii) Explain the way in which the parking space 254 on floor 5 can be checked to see if it is empty.

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..... [5]

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