Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

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.

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]

(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
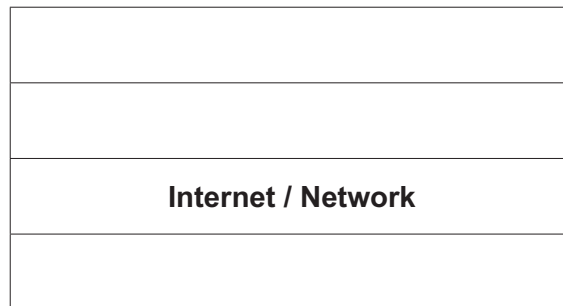
[3]

(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
	00				
	01				
RS	**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]

(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.
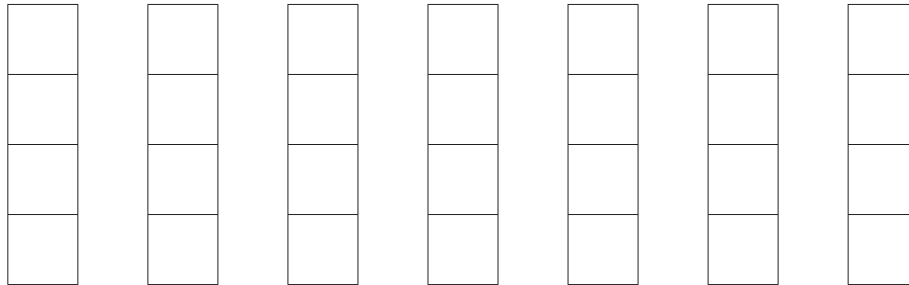
Part of the program contains the following calculations:

```
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.

....

....

....

....

....

....

....

....

....

.... [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.

(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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