Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

1710814632

COMPUTER SCIENCE **9608/31**

Paper 3 Advanced Theory **October/November 2020**

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 **12** pages. Blank pages are indicated.

[Turn over

1 In a particular computer system, real numbers are stored using floating-point representation with:

- 12 bits for the mantissa
- 4 bits for the exponent
- two's complement form for both mantissa and exponent.

(a) The following floating-point number stored is not normalised.

Calculate the denary value for the floating-point number. Show your working.

Mantissa												Exponent			
0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	1

Working .....

.....

.....

.....

Denary value .....

[3]

(b) **(i)** Normalise the floating-point number given in **part (a)**.

Write your answer in the following boxes.

Mantissa												Exponent			

[2]

(ii) Describe **one** problem that can occur when floating-point numbers are not normalised.

.....

.....

..... [2]

2 Data types can be classified as composite or non-composite.

A record is declared of type `box` using the following pseudocode.

```
TYPE size = (small, medium, large)

TYPE box

   DECLARE volume : size

   DECLARE price : REAL

   DECLARE colour : STRING

ENDTYPE

DECLARE myBox : ARRAY [1:6] OF box
```

(a) (i) Identify **one** composite and **three** non-composite data types used in the pseudocode.

Composite data type .....

Non-composite data type 1 .....

Non-composite data type 2 .....

Non-composite data type 3 .....

[4]

(ii) Identify the data type in the pseudocode that is enumerated.

..... [1]

(b) A box is red, with medium volume and a price of $10.99.

Write **pseudocode** to store the details of this box in the first element of the array.

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..... [3]

3 The use of the TCP/IP protocol suite is essential for successful communication over the Internet.

(a) (i) Describe the TCP/IP protocol suite.

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..... [5]

(ii) A group of over 100 students has produced a movie. The size of the movie file is very large.

The students would like to use peer-to-peer file sharing to share this file with friends and family.

Identify the **most appropriate** TCP/IP protocol for sharing this file over the Internet **and** describe the way this protocol works.

Protocol .....

Description .....

.....

.....

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.....

[5]

(b) (i) Files shared over the Internet are sent using packet switching or circuit switching methods.

Identify **and** describe the **most suitable** method for the large movie file from **part (a)(ii)**.

Method .....

Description .....

.....

.....

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.....

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[4]

(ii) State **one** benefit and **one** drawback of the method you identified in **part (b)(i)**.

Benefit .....

.....

Drawback .....

.....

[2]

4 The following truth table represents a logic circuit with three inputs and two outputs.

INPUT			OUTPUT	
A	**B**	**C**	**X**	**Y**
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

(a) Write the Boolean expressions for the truth table as sum-of-products.

X = ...

.....

Y = ...

.....

[4]

(b) Complete the Karnaugh Maps (K-maps) for the truth table.

OUTPUT X

C \ AB	00	01	11	10
0				
1				

OUTPUT Y

C \ AB	00	01	11	10
0				
1				

[2]

(c) The K-maps can be used to simplify **one** of the expressions in **part (a)**.

(i) Draw loop(s) around appropriate group(s) of 1s to produce an optimal sum-of-products for the single output table that can be simplified in **part (b)**. [3]

(ii) Write the simplified sum-of-products expressions for this output from **part (c)(i)**.

..... [3]

(d) Identify the common logic circuit given by the truth table in **part (a)**. Give the use of each output.

Logic circuit .....

Use of **X** .....

Use of **Y** .....

[3]

5 Complete these statements about a virtual machine.

A virtual machine is ..... that emulates a

..... computer system.

A virtual machine allows multiple ..... operating systems to run

on one computer using a ..... operating system.

[4]

6 Anita is studying computer science and she is confused about some of the computer security terminology as some of the words are similar.

Anita wants to know the similarities (features that are the same) and differences (features that are different) between some of the terms.

(a) Give the similarities **and** differences between a **public key** and a **private key**.

Similarities .....

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.....

.....

Differences .....

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[4]

(b) Give the similarities **and** differences between a **digital certificate** and a **digital signature**.

Similarities .....

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Differences .....

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[4]

(c) Give the similarities **and** differences between **phishing** and **pharming**.

Similarities .....

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Differences .....

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[4]

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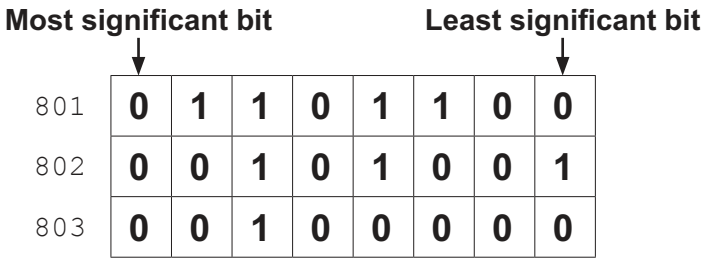
7 A company has a number of lorries that deliver items around the country. The items in each lorry are its load. Each lorry has a monitoring system that provides information to the driver about the state of the load and other data from each trip.

- Data is stored in three memory locations with addresses `801` to `803`.
- Location `801` contains the distance travelled in kilometres for the current trip, stored as a binary integer.
- Location `802` contains the quantity of fuel used in litres for the current trip, stored as a fixed-point binary number with six places before the binary point and two places after the binary point.
- The four most significant bits of location `803` are flags used to identify problems with the load, for example it is too heavy. A flag is set to 1 if there is a problem, or 0 if not.
  The problems are:
  - Bit 7 – load too heavy
  - Bit 6 – load too high
  - Bit 5 – load unstable
  - Bit 4 – load not secured (risk of the load falling off)
  - Bits 0 to 3 are not used

(a) The current contents of addresses `801` to `803` are:



State the information that the current contents of addresses `801` to `803` will provide to the driver.

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.....

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..... [3]

(b) A lorry has a load that is too heavy and is not secured. It has travelled 120 kilometres and used 35.25 litres of fuel.

Complete the contents of the addresses to record this information.

801								
802								
803								

[3]

(c) The following table shows the instructions for the lorry load monitoring system in assembly language. There is one general purpose register, the Accumulator (ACC).

Table 7.1

Instruction			Explanation
Label	**Op code**	**Operand**	
	LDM	#n	Load the number n to ACC
	LDD	<address>	Load the contents of the location at the given address to ACC
	STO	<address>	Store the contents of ACC at the given address
	AND	#n	Bitwise AND operation of the contents of ACC with the operand
	CMP	#n	Compare the contents of ACC with number n
	JPE	<address>	Following a compare instruction, jump to <address> or <label> if the compare was True
	JMP	<address>	Jump to the given address or label
<label>:	<op code>	<operand>	Labels an instruction

Note:

# denotes immediate addressing
B denotes a binary number, for example B01001010
& denotes a hexadecimal number, for example &4A

(i) Write **assembly language** instructions to set the contents of addresses 801 and 802 to zero, and set all four most significant bits of the contents of address 803 to one.
Use the instruction set from **Table 7.1**.

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..... [3]

(ii) A program written in assembly language, continuously checks the flags. If a flag is set, the program jumps to the error-handling routine at the specified label. For example, if the load is too heavy, the program jumps to the error-handling routine with the label `TOOHEAVY`. The error-handling routine instructions have not been provided.

A programmer has written most of the instructions for the program in the following table. There are four missing operands.

Complete the assembly language program by writing the **four** missing operands.

Label	Op code	Operand
CHECKLOAD:	LDD	803
	AND	&F0
	STO	TEMP
	AND	&80
	CMP	&80
	JPE	TOOHEAVY
	LDD	TEMP
	AND	&40
	CMP	
	JPE	TOOHIGH
	LDD	TEMP
	AND	
	CMP	&20
	JPE	UNSTABLE
	LDD	
	AND	&10
	CMP	&10
	JPE	NOTSECURED
	JMP	
TEMP:		

[4]