Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER			

COMPUTER SCIENCE **9608/03**

Paper 3 Advanced Theory **For Examination from 2015**

SPECIMEN PAPER

1 hour 30 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces at the top of this page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.
No marks will be awarded for using brand names for software packages or hardware.
No calculators allowed.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **15** printed pages and **1** blank page.

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[Turn over

1 Floating-point is to be used to represent real numbers with:

- 8 bits for the mantissa, followed by
- 4 bits for the exponent
- two's complement used for both mantissa and exponent

(a) (i) Consider this binary pattern.

0	1	1	0	1	0	0	0	0	1	0	0

What number is this in denary? Show your working.

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..... [3]

(ii) The representation shown in **part (a)(i)** is normalised.

Explain why floating-point numbers are normalised.

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..... [1]

(iii) Show the binary pattern for the smallest positive number which can be stored using a normalised 12-bit floating-point representation.

Mantissa:

Exponent:

Work out its denary value.

Denary: ..... [3]

(b) The developer of a new programming language decides that all real numbers will be stored using 20-bit normalised floating-point representation. She cannot decide how many bits to use for the mantissa and how many for the exponent.

Explain the trade-off between using either a large number of bits for the mantissa, or a large number of bits for the exponent.

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..... [2]

2 **(a)** Complete the diagram to show how the layers of the TCP/IP protocol are related.

Choose from the terms: Internet Layer, Presentation Layer, Data Link Layer, Application Layer, Transport Layer.

Network Access Layer

[3]

(b) Give the names of **two** LAN network technologies that the Network Access Layer has to interface with.

Network technology 1: .....

Network technology 2: ..... [2]

One layer of the protocol makes use of IP addresses. An IP address is a 32-bit number; for example, 205.123.4.192 is an IP address.

Part of the IP address is used for the network ID, and part of the address is used for the host ID.

(c) **(i)** Explain the terms:

network ID: .....

.....

host ID: .....

..... [2]

Most IP addresses fall into one of three classes:

- If the 32-bit address starts with a 0 bit, the address is a Class A address.
- If the 32-bit address starts with the bits 10, the address is a Class B address.
- If the 32-bit address starts with bits 110, the address is a Class C address.

(ii) Show how to determine whether 205.123.4.192 is a Class A, Class B or Class C address.

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..... [2]

(iii)
- In a Class A address, the first byte represents the network ID and the remaining three bytes represent the host ID.
- In a Class B address, the first two bytes represent the network ID and the remaining two bytes represent the host ID.
- In a Class C address, the first three bytes represent the network ID and the remaining byte represents the host ID.

For the address 205.123.4.192 state the:

network ID: .....

host ID: ..... [2]

3 A zoo reptile house has sixteen tanks which accommodate its reptiles. Each tank has to have its own microclimate where the appropriate levels of heat and humidity are crucial. The zoo implements a computer system which supplies the conditions in each of the tanks to a terminal in a central area. Warning messages are flashed up on the screen if any condition arises which requires the intervention of a zoo-keeper.

(a) State the name of the type of computing system described.

.....[1]

(b) State **two** items of hardware which need to be present in the tanks for this system to function correctly.

1 .....

2 .....[2]

(c) This is the polling routine which is used to run the system indefinitely.

```
01 REPEAT
02   FOR i ← 1 TO ..........
03     READ Condition1, Condition2 in tank(i)
04     IF Condition1 < Extreme[i,1] OR Condition1 > Extreme[i,2]
05       THEN
06         OUTPUT "Warning! Problem in Tank ", i
07     ENDIF
08     IF Condition2 < Extreme[i,3] OR Condition2 > Extreme[i,4]
09       THEN
10         OUTPUT "Warning! Problem in Tank ", i
11     ENDIF
12   ENDFOR
13
14   FOR i ← 1 TO 999999
15   ENDFOR
16 UNTIL ..............................
```

(i) Fill in the gaps in the pseudocode. [2]

(ii) Explain what is stored in the array `Extreme`.

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.....[2]

(iii) Explain what happens in lines `04` to `11`.

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..... [3]

(iv) Explain the purpose of the loop in lines `14` to `15`.

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..... [1]

(d) The zoo decides that the computer system needs to be updated. The computer system will now make use of actuators. These actuators will operate devices which adjust the microclimate.

Actuators can be in two states, on or off. Whether an actuator is on or off is determined by a single bit value (0 means off, 1 means on) in a specific 8-bit memory location.

The actuators to control the climate in Tank 4 use memory location 0804. Bit 5 of this memory location controls the heater.

7	6	**5**	4	3	2	1	0	bit number
0	0	**1**	1	0	1	0	1	value

Use some of the assembly language instructions to write the instructions that will ensure bit 5 of location 0804 is set to 1.

Instruction		Explanation
Op Code	Operand	
`LDM #n`		Immediate addressing. Load the number n to ACC
`LDD <address>`		Direct addressing. Load the contents of the given address to ACC
`STO <address>`		Store the contents of ACC at the given address
`OUT`		Output to the screen the character whose ASCII value is stored in ACC
`AND #n`		Bitwise AND operation of the contents of ACC with the operand
`AND <address>`		Bitwise AND operation of the contents of ACC with the contents of <address>
`XOR #n`		Bitwise XOR operation of the contents of ACC with the operand
`OR #n`		Bitwise OR operation of the contents of ACC with the operand

[6]

4 **(a)** Explain what is meant by an *interrupt*.

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..... [2]

(b) An operating system uses interrupts which have priorities.

Describe the sequence of steps which would be carried out by the interrupt handler software when an interrupt is received and serviced.

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..... [6]

(c) Modern personal computer operating systems support multi-tasking.
One of the modules of such an operating system will be for memory management.

Describe **two** different strategies which could be used to manage the available main memory.

1 .....

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2 .....

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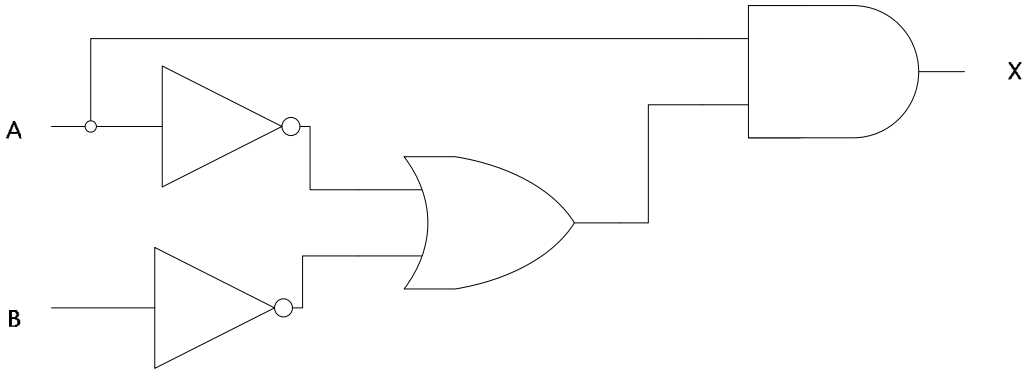
..... [6]

5 **(a)** Write the Boolean expression that corresponds to the logic circuit.



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..... [3]

(b) Use Boolean algebra to simplify the expression.

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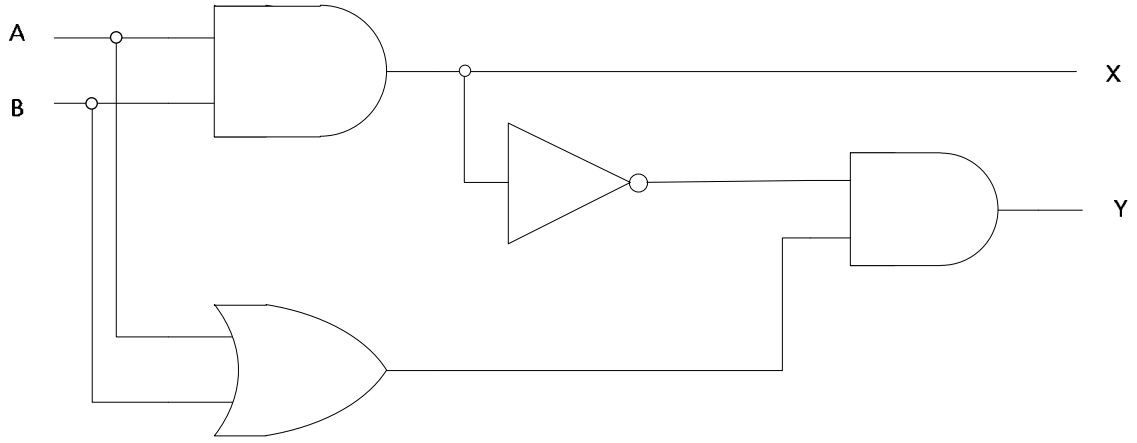
..... [3]

(c) Draw the logic circuit that corresponds to your simplified expression.

[3]

(d) Complete the truth table for the logic circuit:



A	B	Work space	X	Y
0	0			
0	1			
1	0			
1	1			

[4]

(e) What is the name given to a logic circuit that has this truth table?

.....

[1]

6 Raz and Tan wish to exchange some sensitive information via a message in an email. Initially, Raz wants to send the message to Tan in such a way that Tan can be assured that the message did come from Raz.

(a) The steps are as follows.

1. Raz creates a **<answer 1>** using a **<answer 2>** function on the message.
2. Raz encrypts the **<answer 1>** using his **<answer 3>** key. This is the digital **<answer 4>** for the message.
3. Raz sends both the message and the digital **<answer 4>** to Tan.
4. Tan decrypts the digital **<answer 4>** using Raz's **<answer 5>** key.
5. Tan repeats what Raz did in Step 1 to the message.

Select from the list of terms to complete the five statements.

signature hash message-digest encryption private public email

<answer 1> .....

<answer 2> .....

<answer 3> .....

<answer 4> .....

<answer 5> ..... [5]

(b) Tan finds that her results in Step 5 do not match her results in Step 4.

Give **two** possible reasons for this.

1 .....

.....

2 .....

..... [2]

(c) Even though Tan's results in Step 5 match the results in Step 4, she is still concerned that anybody receiving the message can actually read the contents.

Explain what Raz and Tan need to do so that only Tan can read the message.

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..... [3]

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