Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5669936588 5

COMPUTER SCIENCE **9608/31**

Paper 3 Advanced Theory **May/June 2018**

1 hour 30 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

No calculators allowed.

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.
DO **NOT** WRITE IN ANY BARCODES.

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

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.

The maximum number of marks is 75.

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

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

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

(a) Find the denary value for the following binary floating-point number.

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

Show your working.

Working .....

.....

.....

.....

.....

Answer .....

[3]

(b) Calculate the normalised floating-point representation of 5.25 in this system. Show your working.

Working .....

.....

.....

.....

.....

.....

Mantissa												Exponent			

[3]

(c) The size of the mantissa is decreased and the size of the exponent is increased.

State how this affects the range and precision of the numbers that the computer system can represent.

.....

.....

.....

.....[2]

2 A programmer uses non-composite and composite data types to create a program.

(a) Define the term **non-composite data type**.

.....

.....[1]

(b) Describe **two** different non-composite data types.

Data type 1 .....

Description .....

.....

.....

Data type 2 .....

Description .....

.....

.....

[4]

(c) Define the term **composite data type**.

.....

.....[1]

(d) Describe **two** different composite data types.

Data type 1 .....

Description .....

.....

.....

Data type 2 .....

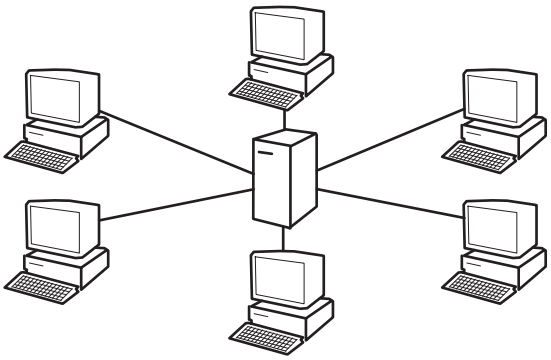
Description .....

.....

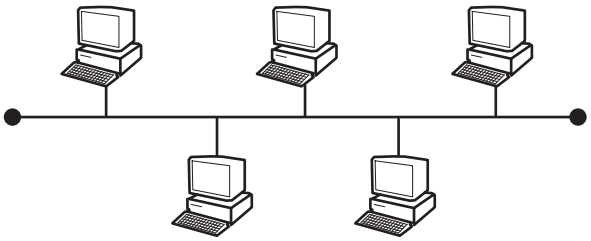
.....

[4]

3 Star and bus are two types of topology that can be used in a Local Area Network (LAN).



Star topology



Bus topology

(a) (i) State **one** benefit and **one** drawback of the star topology.

Benefit .....

.....

Drawback .....

.....

[2]

(ii) State **one** benefit and **one** drawback of the bus topology.

Benefit .....

.....

Drawback .....

.....

[2]

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(b) The sequence of steps 1 to 7 describes what happens when the LAN transmits data from Computer X to Computer Y using circuit switching. Four statements (4 to 7) are missing from the sequence.

A	Computer X sends the data.
B	The sender signals node to deallocate resources.
C	Computer Y sends a receipt signal.
D	If available, Computer X sets up path between nodes.

Write **one** letter (**A** to **D**) in the appropriate space to complete the sequence.

1 Computer X sends a connection request to Computer Y.

2 Computer Y sends ready or busy signal.

3 If busy, Computer X waits and then resends the connection request to Computer Y.

4 ……

5 ……

6 ……

7 ……

[3]

(c) **(i)** Protocols are essential for successful transmission of data over a network. The TCP/IP protocol suite operates on many layers.

State the appropriate layer for each protocol in the following table.

Protocol	Layer
TCP	
IP	
SMTP	

[3]

(ii) Peer-to-peer (P2P) file sharing uses the BitTorrent protocol.

Explain how the BitTorrent protocol allows files to be shared.

.....

.....

.....

.....

.....

.....[3]

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Question 4 begins on the next page.

4 **(a)** A Boolean expression produces the following truth table.

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

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

X = ...[2]

(ii) Complete the Karnaugh Map (K-map) for the truth table in **part (a)(i)**.

		AB			
		00	**01**	**11**	**10**
C	**0**				
	1				

[1]

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

(iii) Draw loop(s) around appropriate group(s) of 1s to produce an optimal sum-of-products for the table in **part (a)(ii)**. [2]

(iv) Write the simplified sum-of-products expression for your answer to **part (a)(iii)**.

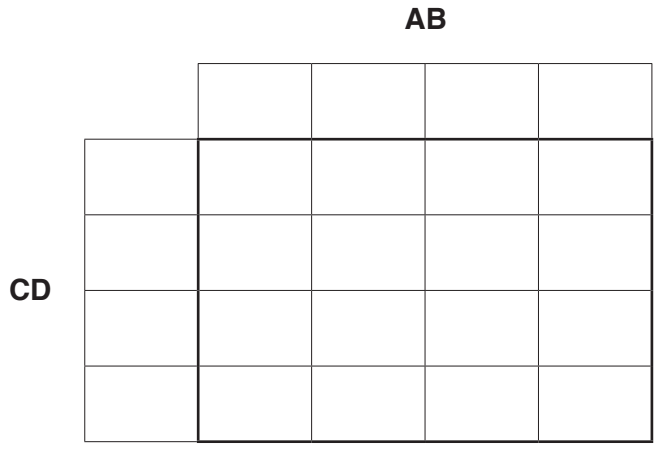
X = ...[2]

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(b) A logic circuit with four inputs produces the following truth table.

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

(i) Complete the K-map that corresponds to the truth table.



[4]

(ii) Draw loop(s) around appropriate group(s) of 1s to produce an optimal sum-of-products for the table in **part (b)(i)**. [2]

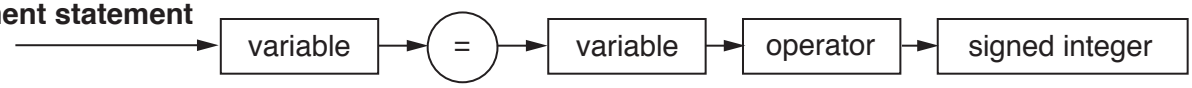
(iii) Write the simplified sum-of-products expression for your answer to **part (b)(ii)**.

X = ...[2]

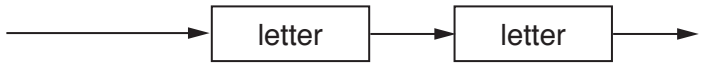
5 The following syntax diagrams show the syntax of:

- an assignment statement
- a variable
- a signed integer
- a letter
- a digit
- an operator

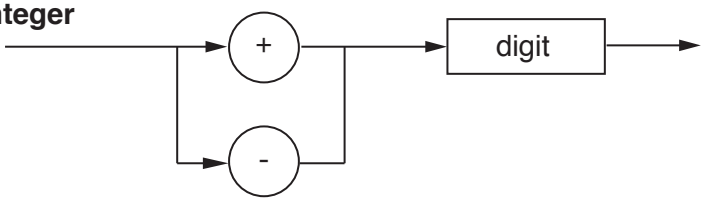
assignment statement



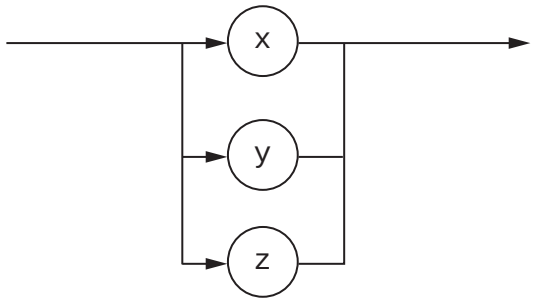
variable



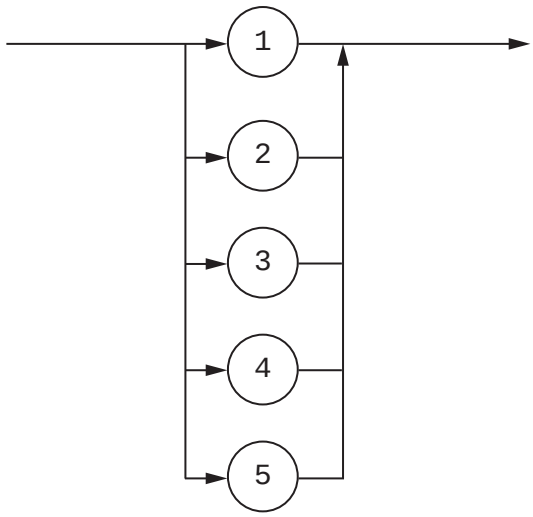
signed integer



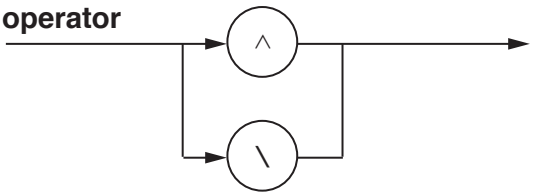
letter



digit



operator



(a) The following assignment statements are invalid.

Give the reason in each case.

(i) `xy = xy ^ c4`

Reason .....

.....[1]

(ii) `zy = zy \ 10`

Reason .....

.....[1]

(iii) `yy := xz ^ - 6`

Reason .....

.....[1]

(b) Complete the Backus-Naur Form (BNF) for the syntax diagrams on the opposite page.

`<assignment statement> ::=`

.....

`<variable> ::=`

.....

`<signed integer> ::=`

.....

`<operator> ::=`

.....
[4]

(c) Rewrite the BNF rule for a variable so that it can be any number of letters.

`<variable> ::=`

.....[2]

6 A company specialises in educational software.

(a) The company is concerned that malware might disrupt their business.

(i) Add appropriate descriptions and terms in the table.

	Description	Term
A	Redirection to a bogus website that appears to be legitimate to gain confidential data.	.....
B	Use email to attempt to gain a user's confidential data.	.....
C	....	**Spyware**
D	....	**Worm**

[4]

(ii) A member of staff is using the Internet to carry out research. They are worried about the threat from terms **A** and **B**.

Identify **one** solution to the each of the threats.

Term **A** .....

.....

Term **B** .....

.....

[2]

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(b) A customer downloads a new educational software package from the company.

Explain how the customer's and the company's computers use a hashing algorithm to assure the customer that:

- the software has come from the company (is authentic) and
- no one has altered it.

.....

.....

.....

.....

.....

.....

.....

.....[4]

7 A museum stores antique items that need to be kept at constant temperature.

The museum is not sure about the actual temperatures. The museum installs some equipment. This records the temperatures every hour and ensures the temperature stays within a set range.

(a) Identify the type of system described.

.....[1]

(b) The system has a temperature sensor.

Identify **two** other items of hardware that the museum can use for the type of system identified.

Describe the purpose of each item.

Item 1 .....

Purpose .....

.....

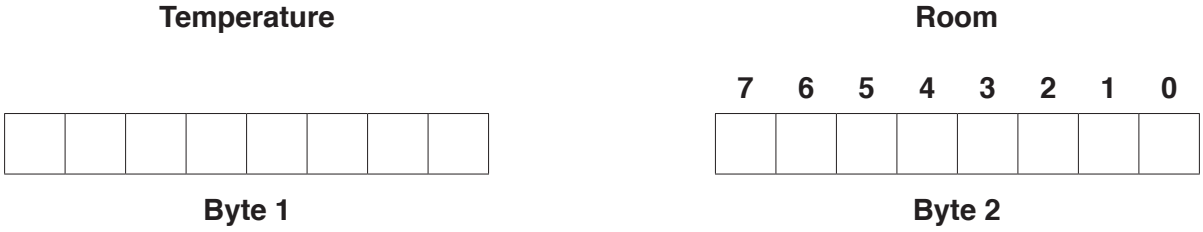
Item 2 .....

Purpose .....

.....
[4]

(c) The equipment records the temperature in all seven rooms in the museum.

Each recording is stored as two successive bytes in memory. The format is as shown.



The room is indicated by the setting of one of the bits in **Byte 2** to 1. For example, room 7 is indicated by setting bit 7 to 1.

Bit 0 of **Byte 2** is a flag:

- The flag's initial value is zero.
- When the reading has been processed, the flag's value is set to 1.

Byte 1 contains the temperature reading as an unsigned integer.

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One reading returns the following binary data.

Temperature

1	0	1	1	0	0	1	1

Byte 1

Room

7	6	5	4	3	2	1	0
0	0	1	0	0	0	0	1

Byte 2

(i) Analyse the data contained in the two bytes.

.....

.....

.....

.....

.....[3]

(ii) The system receives a temperature reading of 238 from room number 4.

Complete the bytes to show the two bytes for this recording. The reading has not yet been processed.

Byte 1

7	6	5	4	3	2	1	0

Byte 2

[2]

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