Cambridge International A Level

Cambridge International Examinations
Cambridge International Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

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9438678873

COMPUTER SCIENCE **9608/31**

Paper 3 Advanced Theory **May/June 2015**

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.

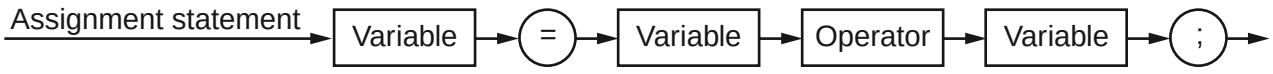
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

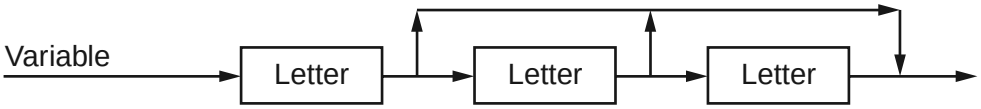
The maximum number of marks is 75.

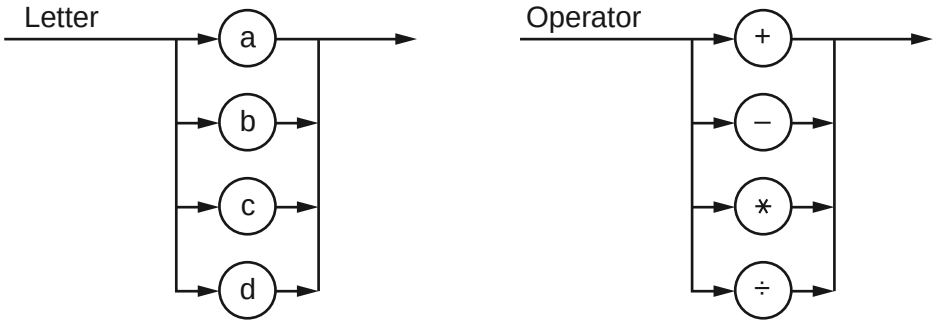
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1 The following syntax diagrams, for a particular programming language, show the syntax of:

- an assignment statement
- a variable
- a letter
- an operator







(a) The following assignment statements are invalid.

Give the reason in each case.

(i) `a = b + c`

Reason .....

.....[1]

(ii) `a = b – 2;`

Reason .....

.....[1]

(iii) `a = dd * cce;`

Reason .....

.....[1]

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

<assignmentstatement> ::=

.....

<variable> ::=

.....

<letter> ::=

.....

<operator> ::=

.....[6]

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

<variable> ::=

.....[2]

(d) Programmers working for a software development company use both interpreters and compilers.

(i) The programmers prefer to debug their programs using an interpreter.

Give **one** possible reason why.

.....

.....[1]

(ii) The company sells compiled versions of its programs.

Give a reason why this helps to protect the security of the source code.

.....

.....[1]

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[Turn over

2 The incomplete table below shows descriptions and terms relating to malware.

(a) Complete the table with appropriate descriptions and terms.

	Description	Term
A	Unsolicited emails containing advertising material sent to a distribution list.	.....
B	A standalone piece of malicious software that can reproduce itself automatically.	.....
C	....	Pharming
D	....	Phishing

[4]

(b) For one of the terms, describe:

- a problem that might arise for a user
- a possible solution to the problem

Choose between the terms:

A / B (circle your choice)

Problem .....

.....

Solution .....

.....[2]

(c) Explain the following terms:

Encryption .....

.....

.....

.....

Public key .....

.....

.....

.....[2]

(d) A user downloads software from the Internet.

(i) State what should be part of the download to provide proof that the software is authentic.

.....[1]

(ii) Describe the process for ensuring that the software is both authentic and has not been altered.

.....

.....

.....

.....

.....

.....

.....

.....[4]

3 **(a)** A particular programming language allows the programmer to define their own data types.

`ThisDate` is an example of a user-defined structured data type.

```
TYPE ThisDate
   DECLARE ThisDay    :  (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12,
                         13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23,
                         24, 25, 26, 27, 28, 29, 30, 31)
   DECLARE ThisMonth  :  (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug,
                         Sep, Oct, Nov, Dec)
   DECLARE ThisYear   :  INTEGER
ENDTYPE
```

A variable of this new type is declared as follows:

```
DECLARE DateOfBirth : ThisDate
```

(i) Name the non-composite data type used in the `ThisDay` and `ThisMonth` declarations.

.....[1]

(ii) Name the data type of `ThisDate`.

.....[1]

(iii) The month value of `DateOfBirth` needs to be assigned to the variable `MyMonthOfBirth`.

Write the required statement.

.....[1]

(b) Annual rainfall data from a number of locations are to be processed in a program.

The following data are to be stored:

- location name
- height above sea level (to the nearest metre)
- total rainfall for each month of the year (centimetres to 1 decimal place)

A user-defined, composite data type is needed. The programmer chooses `LocationRainfall` as the name of this data type.

A variable of this type can be used to store all the data for one particular location.

(i) Write the definition for the data type `LocationRainfall`.

.....

.....

.....

.....

.....

.....

.....[5]

(ii) The programmer decides to store all the data in a file. Initially, data from 27 locations will be stored. More rainfall locations will be added over time and will never exceed 100.

The programmer has to choose between two types of file organisation. The two types are serial and sequential.

Give **two** reasons for choosing serial file organisation.

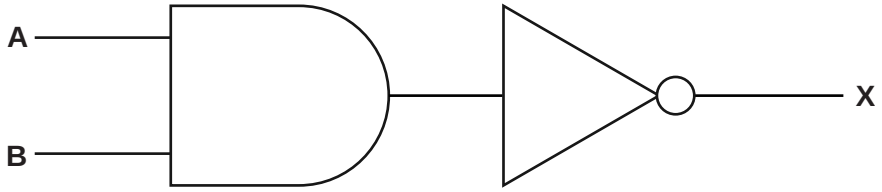
.....

.....

.....

.....[2]

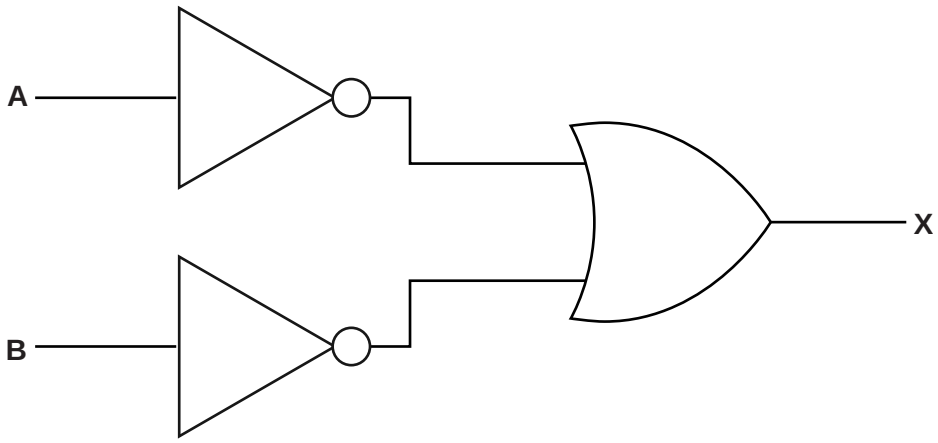
4 (a) (i) Complete the truth table for this logic circuit:



A	B	Working space	X
0	0		
0	1		
1	0		
1	1		

[1]

(ii) Complete the truth table for this logic circuit:



A	B	Working space	X
0	0		
0	1		
1	0		
1	1		

[1]

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(b) A student decides to write an equation for **X** to represent the full behaviour of each logic circuit.

(i) Write the Boolean expression that will complete the required equation for **X** for each circuit:

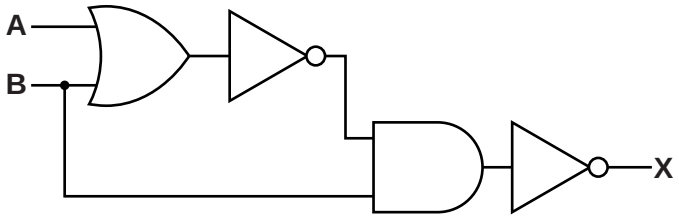
Circuit 1: **X** = ...

Circuit 2: **X** = ...[2]

(ii) Write the De Morgan's Law which is shown by your answers to **part (a)** and **part (b)(i)**.

.....[1]

(c) Write the Boolean algebraic expression corresponding to the following logic circuit:



.....[3]

(d) Using De Morgan's laws and Boolean algebra, simplify your answer to **part (c)**.

Show all your working.

.....

.....

.....

.....

.....

.....[3]

5 A gardener grows vegetables in a greenhouse. For the vegetables to grow well, the temperature needs to always be within a particular range.

The gardener is not sure about the actual temperatures in the greenhouse during the growing season. The gardener installs some equipment. This records the temperature every hour during the growing season.

(a) Name the type of system described.

.....[1]

(b) Identify **three** items of hardware that would be needed to acquire and record the temperature data. Justify your choice for each.

Item 1 .....

Justification .....

.....

Item 2 .....

Justification .....

.....

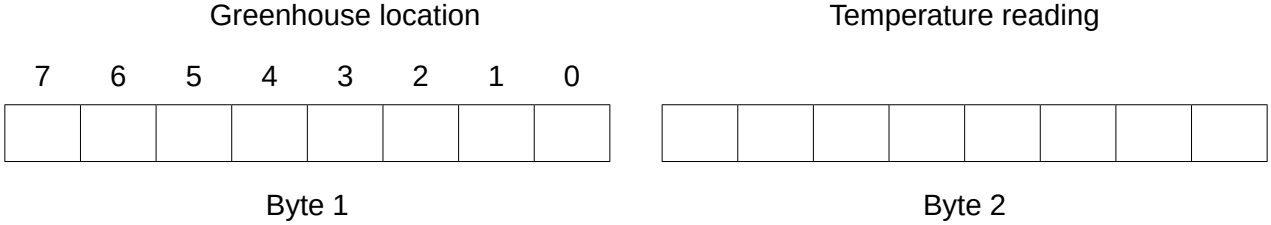
Item 3 .....

Justification .....

.....[6]

(c) The equipment records temperatures in the greenhouse. It does this for seven locations.

Each recording is stored as two successive bytes. The format is shown below:



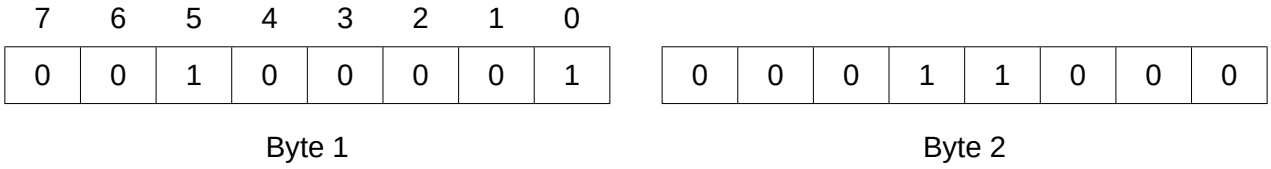
The location is indicated by the setting of one of the seven bits in byte 1. For example, location 4 is indicated by setting bit 4.

Bit 0 of byte 1 acts as a flag:

- the initial value is zero
- when the reading has been processed it is set to 1

Byte 2 contains the temperature reading (two's complement integer).

(i) Interpret the data in byte 1 shown below:



.....

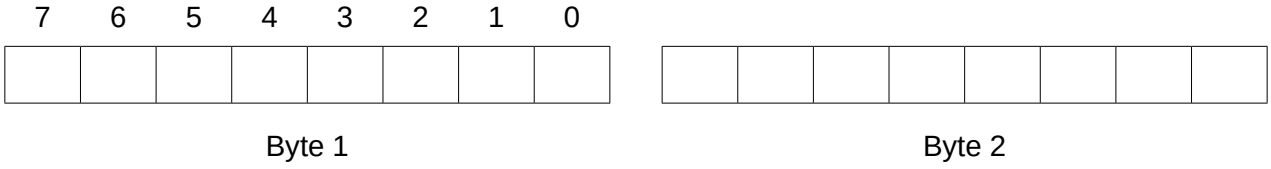
.....

.....

.....[2]

(ii) The system receives a temperature reading of –5 degrees from sensor 6.

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



[2]

(d) (i) The accumulator is loaded with the value of byte 1 from location 106.

Write the assembly language instruction to check whether the reading in byte 2 came from location 4.

```
LDD 106            // data loaded from address 106
```

.....[4]

(ii) Write the assembly language instruction to set the flag (bit 0) of the byte contained in the accumulator to 1.

.....[2]

6 **(a)** Four descriptions and three protocols are shown below.

Draw a line to connect each description to the appropriate protocol.

Description	Protocol used
email client downloads an email from an email server	HTTP
email is transferred from one email server to another email server	POP3
email client sends email to email server	SMTP
browser sends a request for a web page to a web server	

[4]

(b) Downloading a file can use the client-server model. Alternatively, a file can be downloaded using the BitTorrent protocol.

Name the model used.

.....[1]

(c) For the BitTorrent protocol, explain the function of each of the following:

(i) Tracker .....

.....

.....[2]

(ii) Seed .....

.....

.....[2]

(iii) Swarm .....

.....

.....[2]

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