Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3020014690

COMPUTER SCIENCE **9608/32**

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 **12** printed pages.

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1 Data types can be defined in a programming language.

The data type, `StudentRecord`, is defined by the code:

```
TYPE StudentRecord
   DECLARE StudentID        : INTEGER
   DECLARE StudentFirstName : STRING
   DECLARE StudentSurname   : STRING
   DECLARE StudentDOB       : DATE
   DECLARE StudentCourse    : ARRAY[1:10] OF STRING
ENDTYPE
```

A variable, `CollegeStudent`, is declared with the code:

```
DECLARE CollegeStudent : StudentRecord
```

(a) Write a pseudocode statement to assign 6539 to the `StudentID` of `CollegeStudent`.

.....[1]

(b) The type definition for `StudentRecord` is changed.

(i) Students can take six courses from: Computer Science, Engineering, Science, Maths, Physics, Chemistry, Music, Drama and English Language.

Rewrite **one** line from the type definition of `StudentRecord` to implement the change.

`DECLARE` .....

.....

.....

.....[2]

(ii) The values for the field `StudentID` must be between `1` and `8000` inclusive.

Rewrite **one** line from the type definition of `StudentRecord` to implement the change.

`DECLARE` .....[1]

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(c) A programmer is asked to write a program to process the assessment data for each student. Students sit one exam in every course they take.

A composite data type, `StudentAssessment`, needs to be defined with the following three fields.

- a student assessment code (a unique code of three letters and two digits)
- the marks for the six exams
- the average mark of the six exams

(i) Write **pseudocode** to define the data type `StudentAssessment`.

.....

.....

.....

.....

.....

.....[4]

(ii) Data about all students and their assessments are stored in a file that uses random organisation. The `StudentID` is used as the key field.

The program allows a user to enter data for a new student.

Explain how the program adds the new data to the file.

.....

.....

.....

.....

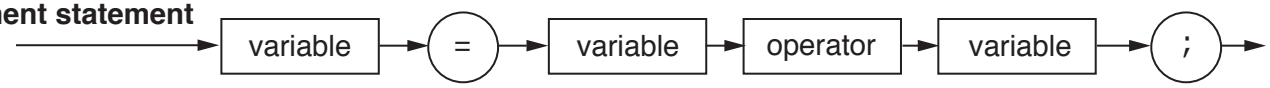
.....

.....[3]

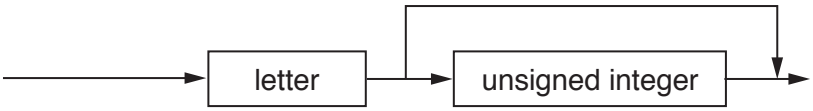
2 The following syntax diagrams show the syntax of:

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

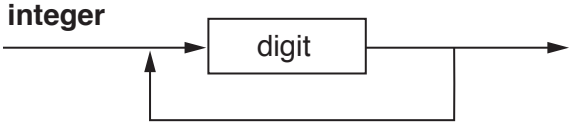
assignment statement



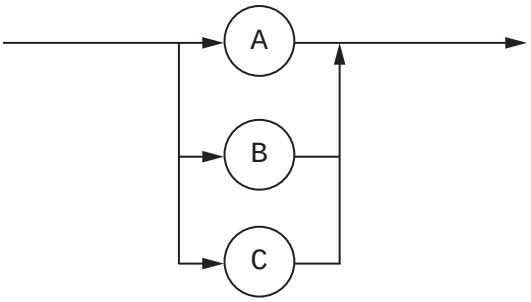
variable



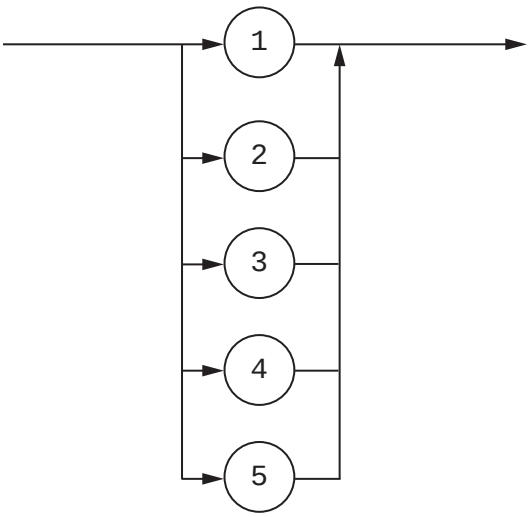
unsigned integer



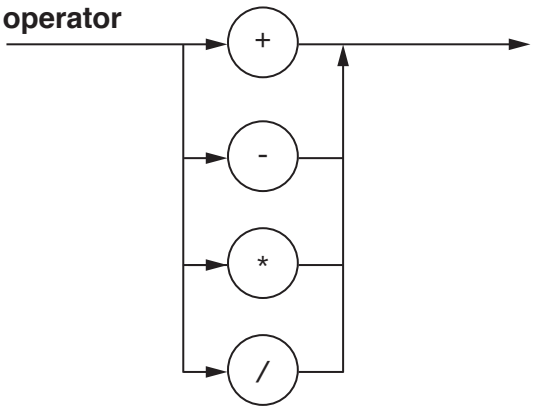
letter



digit



operator



(a) The following assignment statements are invalid.

Give the reason in each case.

(i) `A = B + 5;`

Reason .....

.....[1]

(ii) `A = B - D;`

Reason .....

.....[1]

(iii) `C4 = B2 - A1 + C3;`

Reason .....

.....[1]

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

<assignment statement> ::=

.....

<variable> ::=

.....

<unsigned integer> ::=

.....

<operator> ::=

.....

[6]

(c) The syntax of **variable** is changed to allow one or more letters followed by an unsigned integer.

Draw a syntax diagram for the new syntax of the variable.

[3]

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

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

(a) Calculate the normalised floating-point representation of + 21.75 in this system. Show your working.

Working .....

.....

.....

.....

.....

.....

Mantissa								Exponent			

[3]

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

Mantissa							
1	0	1	1	0	0	0	0

Exponent			
1	1	1	0

Show your working.

Working .....

.....

.....

.....

.....

Answer .....

[3]

4 The TCP/IP protocol suite is used on the Internet.

(a) The table has statements about transmitting data across the Internet.

Put a tick (✓) in each row to identify whether the responsibility belongs to TCP or IP.

Responsibility	TCP	IP
Correct routing		
Host to host communication		
Communication between networks		
Retransmitting missing packets		
Reassembling packets into the correct order		

[5]

(b) Identify **two** other internet protocols. State a use for each protocol.

Protocol 1 .....

.....

Use .....

.....

Protocol 2 .....

.....

Use .....

.....
[4]

(c) State the name of the TCP/IP layer that uses IP addresses.

.....[1]

(d) Emails are transmitted across the Internet using packet switching and routing tables.

(i) Give **four** items of data in an IP data packet.

1 .....

2 .....

3 .....

4 .....
[4]

(ii) Describe **two** benefits of using packet switching.

Benefit 1 .....

.....

.....

.....

Benefit 2 .....

.....

.....

.....
[4]

(iii) Give **two** items of data stored in a routing table.

1 .....

2 .....
[2]

5 Katarina works for a company specialising in the sale of computer parts and accessories. She works in the London office and her colleague Lucy works in the Hong Kong office. Katarina emails confidential information to Lucy so that only Lucy can read the information.

(a) Explain how public and private keys are used to ensure that only Lucy has a readable copy of the confidential information.

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.....[4]

(b) Julio is buying items from the online shop. He already has an account with the shop.

Explain how the use of Secure Socket Layer (SSL) or Transport Layer Security (TLS) helps to keep Julio's confidential information secure.

.....

.....

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.....

.....[3]

(c) The manager of the company is concerned about the threat of malware.

State **three** vulnerabilities that a malware can exploit.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

6 **(a)** There are five scenarios on the left and two types of system on the right.

Draw a line to link each scenario to its correct type of system.

Scenario	System
Car speed display	
Aeroplane autopilot	Control
Rollercoaster	Monitoring
Recording the rainfall at a weather station	
Robot loading a part onto a conveyor belt	

[2]

(b) Mary has six fish tanks. The temperature of the water in each tank needs to be within a specific range.

Identify **three** items of hardware that Mary can add to her tanks to help maintain the temperature. Describe the purpose of each item.

Item 1 .....

Purpose .....

.....

Item 2 .....

Purpose .....

.....

Item 3 .....

Purpose .....

.....

[6]

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(c) A temperature reading is taken from each tank once per minute. The temperature reading is stored as two successive bytes. The format is shown:

Fish tank

7	6	5	4	3	2	1	0

Byte 1

Temperature reading

Byte 2

The fish tank number is indicated by setting one of the bits in **Byte 1** to 1. For example, fish tank number 5 is indicated by setting bit 5 to 1.

Bit 7 of **Byte 1** is a flag:

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

Bit 0 of **Byte 1** is unused.

Byte 2 contains the temperature reading as a two's complement integer.

(i) After a temperature reading has been taken, the bytes contain the following data.

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

Byte 1

0	0	0	0	1	0	1	1

Byte 2

Analyse the data contained in the two bytes.

.....

.....

.....

.....

.....

.....[3]

(ii) The system receives a temperature reading of –2 from fish tank number 4.

Complete the bytes to show the values for this reading after it has been processed.



[2]

(d) A hardware device to affect the temperature of each tank is on or off depending on the value of a bit in memory location 6753.

If bit 4 is 1, then the hardware device in fish tank 4 is on.

Write **assembly language** instructions to set bit 4 of memory location 6753 to 1 without changing any other bits. Use the instruction set provided.

.....

.....

.....

.....[3]

Instruction set

Instruction		Explanation
Op code	**Operand**	
LDD	<address>	Direct addressing. 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.
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.
OR	<address>	Bitwise OR operation of the contents of ACC with the contents of <address>. <address> can be an absolute address or a symbolic address.

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