Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

7825200973

COMPUTER SCIENCE **9608/32**

Paper 3 Advanced Theory **October/November 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 **13** printed pages and **3** blank pages.

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CAMBRIDGE International Examinations

1 **(a)** A computer system uses floating-point representation to store real numbers. The floating-point numbers have:

- 8 bits for the mantissa
- 8 bits for the exponent

The mantissa and exponent are both in two's complement form.

(i) Calculate the denary value of the following floating-point number. It is **not** in normalised form.

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

Show your working.

Working .....

.....

.....

.....

.....

Answer .....

[3]

(ii) Convert the denary number +7.5 into a normalised floating-point number.

Show your working.

Mantissa								Exponent							

Working .....

.....

.....

.....

.....

[3]

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(iii) Convert the denary number –7.5 into a normalised floating-point number.

Show your working.

Mantissa								Exponent							

Working .....

.....

.....

.....

.....

[3]

(b) A normalised floating-point number is shown.

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

(i) State the significance of this binary number.

.....

.....[1]

(ii) State what will happen if a positive number is added to this number.

.....

.....[1]

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[Turn over

2 **(a)** A network can be set up using a star topology.

Give **three** features of a star topology.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

(b) **(i)** Describe what is meant by **circuit switching**.

.....

.....

.....

.....[2]

(ii) The table shows statements that relate to circuit switching, packet switching or both.

Tick (✓) **one or more** boxes in each row to show whether the statement applies to circuit switching, packet switching or both.

Statements	Circuit switching	Packet switching
Shares bandwidth		
Data may arrive out of order		
Data can be corrupted		
Data are less likely to get lost		

[4]

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3 **(a)** Consider the following Boolean expression.

$$A \,.\, \overline{B} \,.\, \overline{C} + A \,.\, B \,.\, \overline{C} + A \,.\, B \,.\, C$$

Use Boolean algebra to simplify the expression.

.....

.....

.....

.....

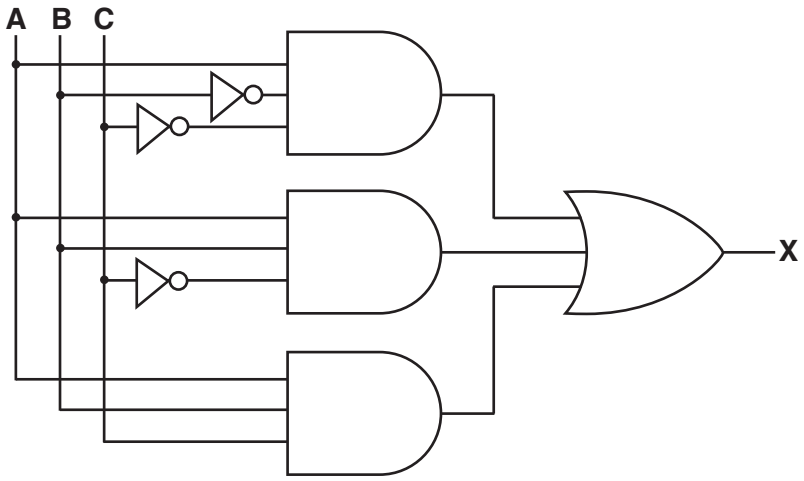
.....

.....

.....

.....[4]

(b) (i) Complete the truth table for the following logic circuit.



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

[2]

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

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

[1]

(iii) Draw loops around appropriate groups of 1s in the table in **part (b)(ii)** to produce an optimal sum-of-products. [2]

(iv) Using your answer to **part (b)(iii)**, write a simplified sum-of-products Boolean expression.

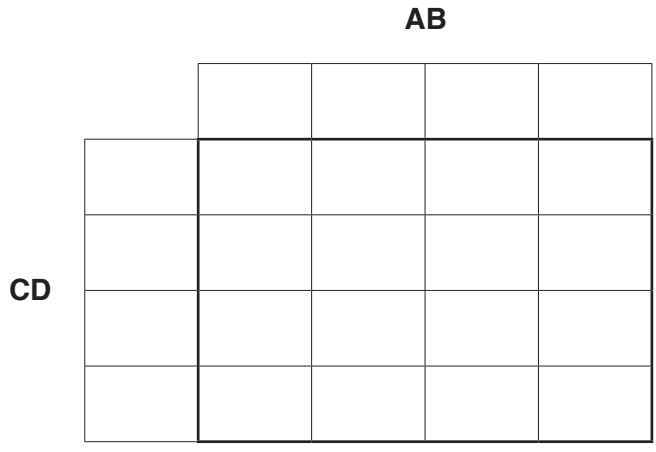
X = ...[2]

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(c) The truth table for a logic circuit with four inputs is shown.

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

(i) Complete the K-map for the truth table in **part (c)**.



[4]

(ii) Draw loops around appropriate groups of 1s in the table in **part (c)(i)** to produce an optimal sum-of-products. [2]

(iii) Using your answer to **part (c)(ii)**, write a simplified sum-of-products Boolean expression.

X = ...[2]

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4 A compiler uses a keyword table and a symbol table. Part of the keyword table is shown.

- Tokens for keywords are shown in hexadecimal.
- All of the keyword tokens are in the range `00 – 5F`.

Keyword	Token
←	01
+	02
=	03
IF	4A
THEN	4B
ENDIF	4C
ELSE	4D
FOR	4E
STEP	4F
TO	50
INPUT	51
OUTPUT	52
ENDFOR	53

Entries in the symbol table are allocated tokens. These values start from `60` (hexadecimal).

Study the following code.

```
INPUT Number1
INPUT Number2
INPUT Answer
IF Answer = Number1 + Number2
   THEN
      OUTPUT 10
   ELSE
      OUTPUT 0
ENDIF
```

(a) Complete the symbol table to show its contents after the lexical analysis stage.

Symbol	Token	
	Value	Type
Number1	60	Variable
Number2	61	Variable

[3]

(b) The output from the lexical analysis stage is stored in the following table. Each cell stores one byte of the output.

Complete the output from the lexical analysis. Use the keyword table and your answer to **part (a)**.

51	60																	

[2]

(c) A student uses the compiler to compile some different code.

After the syntax analysis is complete, the compiler generates object code.

The following line of code is compiled: `X ← A + B + C – D`

The compilation produces the following assembly language code.

```
LDD 236      // loads value A into accumulator
ADD 237      // adds value B to accumulator
ADD 238      // adds value C to accumulator
STO 540      // stores accumulator in temporary location
LDD 540      // loads value from temporary location into accumulator
SUB 239      // subtracts value D from accumulator
STO 235      // stores accumulator in X
```

(i) Identify the final stage in the compilation process that follows this code generation stage.

.....[1]

(ii) Rewrite the equivalent code following the final stage.

.....

.....

.....

.....

.....

.....

.....

.....[3]

(iii) State **two** benefits of the process that is carried out in the final stage.

Benefit 1 .....

.....

Benefit 2 .....

.....

[2]

(d) An interpreter is executing a program. The program uses the variables `a`, `b`, `c` and `d`.

The program contains an expression that is written in infix form. The interpreter converts the infix expression to RPN.

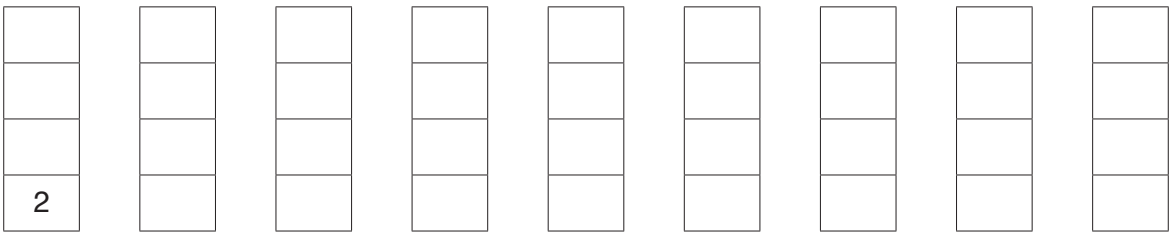
The RPN expression is: `b a c + * d + 2 -`

The interpreter evaluates this RPN expression using a stack.

The current values are: `a = 1` `b = 2` `c = 2` `d = 3`

Show the changing contents of the stack as the interpreter evaluates the expression.

The first entry on the stack has been done for you.



[4]

5 **(a)** Most desktop or laptop computers use CISC (Complex Instruction Set Computing) architecture. Most smartphones and tablets use RISC (Reduced Instruction Set Computing).

State **four** features that are different for the CISC and RISC architectures.

1 .....

.....

2 .....

.....

3 .....

.....

4 .....

.....

[4]

(b) In a RISC processor, four instructions (**A**, **B**, **C**, **D**) are processed using pipelining.

The following table shows five stages that take place when instructions are fetched and executed. In time interval **1**, instruction **A** has been fetched.

(i) In the table, write the instruction labels (**A**, **B**, **C**, **D**) in the correct time interval for each stage. Each operation only takes one time interval.

Stage	Time interval								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Fetch instruction	**A**								
Decode instruction									
Execute instruction									
Access operand in memory									
Write result to register									

[3]

(ii) When completed, the table in **part (b)(i)** shows how pipelining allows instructions to be carried out more rapidly. Each time interval represents one clock cycle.

Calculate how many clock cycles are saved by using pipelining in the example in **part (b)(i)**.

Show your working.

Working .....

.....

.....

Answer .....

[3]

(c) The table shows four statements about computer architecture.

Put a tick (✓) in each row to identify the computer architecture associated with each statement.

Statement	Architecture		
	SIMD	**MIMD**	**SISD**
Each processor executes a different instruction			
There is only one processor			
Each processor executes the same instruction input using data available in the dedicated memory			
Each processor typically has its own partition within a shared memory			

[4]

6 **(a)** The following table shows descriptions and terms relating to data transmission security.

Add appropriate descriptions and terms to complete the table.

	Description	**Term**
A	The result of encryption that is transmitted to the recipient.	.....
B	The type of cryptography used where different keys are used; one for encryption and one for decryption.	.....
C	....	**Digital certificate**
D	....	**Private key**

[4]

(b) The sequence of steps 1 to 7 describes what happens when setting up a secure connection using Secure Socket Layer (SSL).

Four statements are missing from the sequence.

A	If the browser trusts the certificate, it creates, encrypts and sends the server a symmetric session key using the server's public key.
B	Server sends the browser an acknowledgement, encrypted with the session key.
C	Server sends a copy of its SSL Certificate and its public key.
D	Server decrypts the symmetric session key using its private key.

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

1. Browser requests that the server identifies itself.
2. ……
3. Browser checks the certificate against a list of trusted Certificate Authorities.
4. ……
5. ……
6. ……
7. Server and browser now encrypt all transmitted data with the session key.

[3]

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