

Cambridge
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AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

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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.

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 |
| 0 | 0 |
| 1 | 0 |
| 0 | 0 |
| 1 | 0 |
| 0 | 1 |
| 1 | 0 |
| 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]

(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]

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]

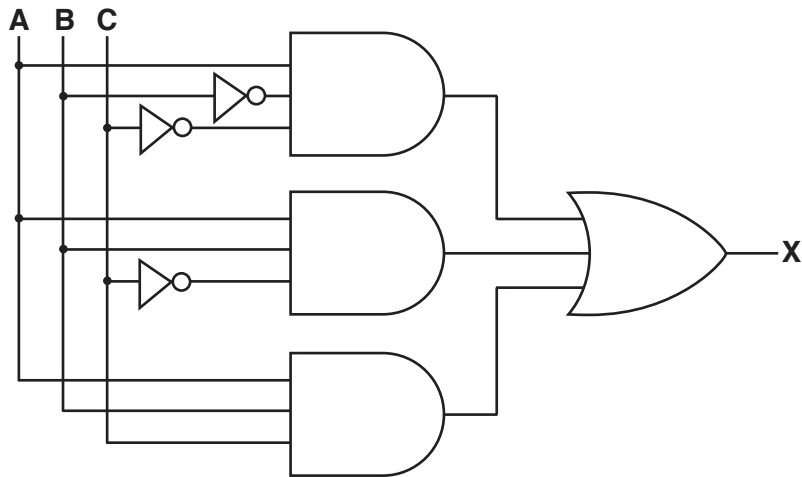
(ii) The table shows statements that relate to circuit switching, packet switching or both.

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]

(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]

(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)**.

| | | | | | |
|-----------|--|-----------|--|--|--|
| | | AB | | | |
| | | | | | |
| CD | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

[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]

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]

(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.

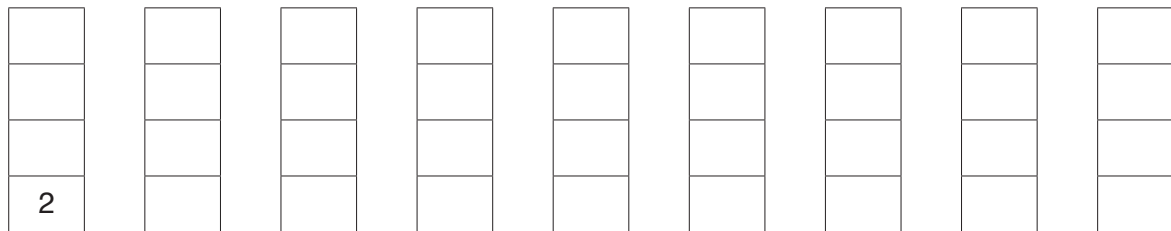
The RPN expression is: b a c + * d + 2 -

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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