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COMPUTER SCIENCE

9618/11

Paper 1 Theory Fundamentals

May/June 2025

1 hour 30 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use an HB pencil for any diagrams, graphs or rough working.
- Calculators must **not** be used in this paper.

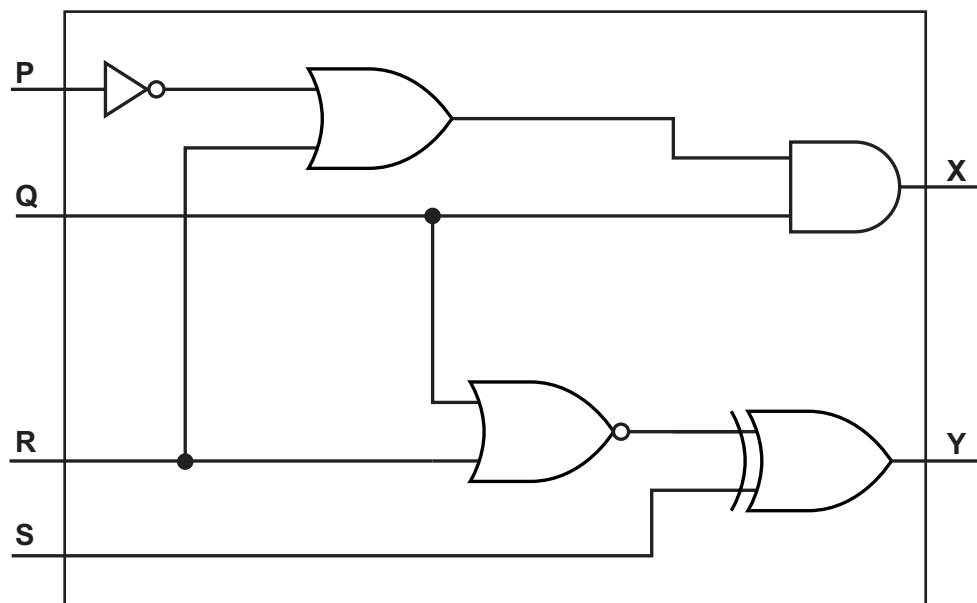
INFORMATION

- The total mark for this paper is 75.
- The number of marks for each question or part question is shown in brackets [].
- No marks will be awarded for using brand names of software packages or hardware.

This document has **20** pages. Any blank pages are indicated.



- 1 (a) Write the logic expressions for the following logic circuit.



X =

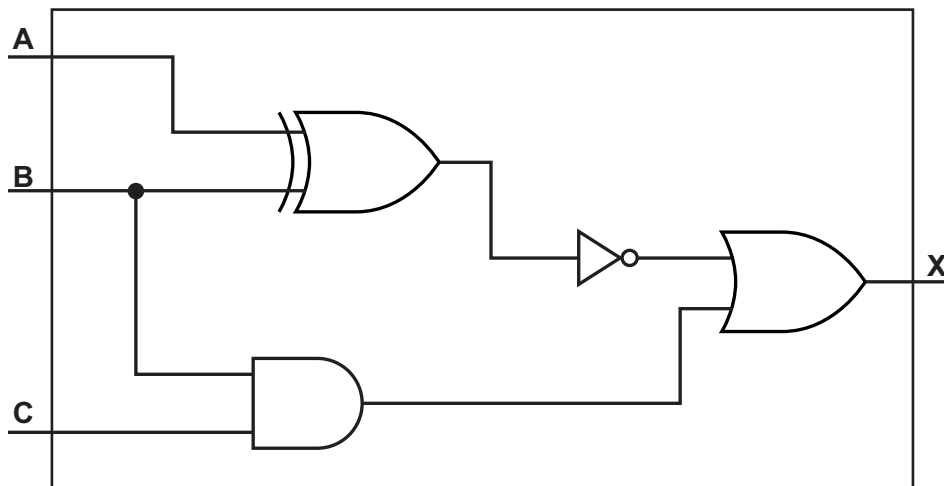
Y =

[2]





(b) 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]





- 2 Programmers in a software development company take part in live video conferences to discuss their work.

The live video conferences take place using real-time bit streaming. The video is compressed before it is transmitted.

- (a) Explain how data is transferred using real-time bit streaming.

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..... [4]

- (b) (i) Explain the reasons why a video is compressed before it is transmitted using real-time bit streaming.

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..... [4]





- (ii) Identify whether the lossy or lossless compression method is more appropriate for real-time bit streaming. Justify your answer.

Compression method

Justification

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[3]

- (c) The video conference is accessed over the internet.

Complete the table by stating how modems **and** dedicated lines are used when data is transmitted over the internet.

| Hardware | Use |
|-----------------|----------------|
| modems | |
| dedicated lines | |

[2]



3 A computer stores images and text files.

(a) One of the images is a bitmapped image.

Complete the table by writing the answer for each statement.

| Statement | Answer |
|--|--------|
| the term for the smallest element that makes up an image | |
| the largest number of different colours that can be represented with a bit depth of 8 bits | |
| the term for the dots per inch (dpi) when an image is displayed | |

[3]

(b) The text in the files is stored using the Unicode character set.

(i) Give **two** advantages of using the Unicode character set instead of using the ASCII character set.

- 1
-
- 2
-

[2]

(ii) The Unicode character 'Ƨ' has the binary value: 0010 0111 0110 1110

Convert the binary value for the character 'Ƨ' into denary.

..... [1]

(iii) The Unicode character 'Σ' has the hexadecimal value 2140

Convert the hexadecimal code for the character 'Σ' into denary.

..... [1]





- The new system:

- identifies customers when they enter the shop and matches them to their account
- prevents a customer from walking through the automatic barriers if they do not have an account
- automatically detects the items that a customer has taken from a shelf and charges these to the customer's account.

- (a)** The new system uses digital cameras and Artificial Intelligence (AI) to identify the customers.

Explain how the new system uses AI to identify each customer.

[4]

- (b)** The new system uses sensors to identify the items taken from a shelf.

Identify **one** type of sensor that can be used in this new system.

State how the sensor can be used to identify the items taken from a shelf.

Sensor

Use

[2]



- 5 A company builds and sells furniture to customers. The company stores data about customers, their payment cards and their furniture orders in a database.

The database, FURNITURE, has the following tables:

CUSTOMER(CustomerID, Name, Phone)

CUSTOMER_CARD_DATA(CardID, CustomerID, CardType, CardNumber, EndDate)

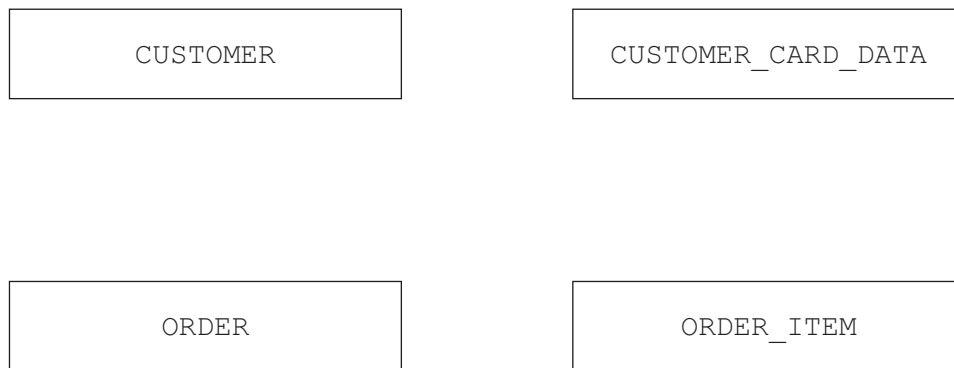
ORDER(OrderID, CustomerID, TotalCost, Paid, OrderDate, Complete)

ORDER_ITEM(OrderItemID, OrderID, Type, Height, Width, Depth, Details)

The primary keys are underlined in each table.

The attribute `Complete` in the table `ORDER` stores the Boolean value `TRUE` if the order has been built and `FALSE` if the order has not been built.

- (a) Complete the entity-relationship (E-R) diagram for the database.



[3]

- (b) Identify **one** attribute in the table `CUSTOMER_CARD_DATA` that could be a candidate key.

..... [1]

- (c) Identify **two** tables in the database that contain one or more foreign keys.
Give **one** attribute that is a foreign key in each table.

| | Table | Foreign key |
|---|-------|-------------|
| 1 | | |
| 2 | | |

[2]





- (d) Explain the reasons why the data in the table `ORDER_ITEM` cannot be stored in the table `ORDER`

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..... [3]

- (e) Write an Structured Query Language (SQL) script to output the customer ID, the customer's name and the total cost of the customer's orders that have **not** been paid.

The output of the total cost must have an appropriate title.

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..... [4]



6 A programmer is buying a new computer.

(a) The programmer is considering the following two computers:

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|------------|--|
| Computer 1 | Quad-core 2.2 GHz processor 16-bit architecture 1 GB Random Access Memory (RAM) 500 GB magnetic hard disk |
| Computer 2 | Dual-core 3.8 GHz processor 32-bit architecture 2 GB RAM 500 GB solid state drive (SSD) |

(i) Computer 1 has a magnetic hard disk.

Complete the description of the principal operation of a magnetic hard disk by writing the missing words.

The magnetic hard disk has one or more that can be magnetised. These are mounted on a and rotate at high speed.

A is moved across the surface on an arm.

When data is read, the changes in the produce a change in the electric current.

[4]

(ii) The two computers have different amounts of RAM.

Explain how different amounts of RAM affect the performance of a computer.

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 [3]





(iii) The two computers have different bus widths.

Explain how different bus widths affect the performance of a computer.

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..... [2]

(b) Both computers have an Operating System (OS).

Describe the purpose of an OS in a computer.

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..... [5]



(a) The banker needs to transfer confidential data across the internet.

Method

Description

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Explain how a digital signature can make sure the data has **not** been changed during transmission.

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[5]



(c) The data that is transferred can also be verified using a checksum.

Explain how data can be verified using a checksum.

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..... [3]





- 8 (a) The following table shows part of the instruction set for a processor. The processor has two registers: the Accumulator (ACC) and an Index Register (IX).

| Instruction | | Explanation |
|--|------------|--|
| Opcode | Operand | |
| LDM | #n | Immediate addressing. Load the number n to ACC |
| LDD | <address> | Direct addressing. Load the contents of the location at the given address to ACC |
| LDI | <address> | Indirect addressing. The address to be used is at the given address. Load the contents of this second address to ACC |
| INC | <register> | Add 1 to the contents of the register (ACC or IX) |
| STO | <address> | Store the contents of ACC at the given address |
| ADD | #n/Bn/&n | Add the number n to the ACC |
| DEC | <register> | Subtract 1 from the contents of the register (ACC or IX) |
| JMP | <address> | Jump to the given address |
| CMP | <address> | Compare the contents of ACC with the contents of <address> |
| JPE | <address> | Following a compare instruction, jump to <address> if the compare was True |
| END | | Return control to the operating system |
| ACC denotes Accumulator <address> can be an absolute or a symbolic address # denotes a denary number, e.g. #123 B denotes a binary number, e.g. B01001010 & denotes a hexadecimal number, e.g. &4A | | |





The current contents of memory are:

address Instruction

| | |
|------------|---------|
| 80 | 10 |
| 81 | 8 |
| 82 | 80 |
| 83 | 81 |
| ... | |
| 200 | LDD 81 |
| 201 | INC ACC |
| 202 | STO 83 |
| 203 | LDI 82 |
| 204 | CMP 83 |
| 205 | JPE 209 |
| 206 | LDD 83 |
| 207 | ADD #10 |
| 208 | JMP 210 |
| 209 | DEC ACC |
| 210 | STO 81 |
| 211 | END |

Trace the program currently in memory using the following trace table.

| Instruction address | ACC | Memory address | | | |
|---------------------|-----|----------------|----|----|----|
| | | 80 | 81 | 82 | 83 |
| | | 10 | 8 | 80 | 81 |
| | | | | | |
| | | | | | |
| | | | | | |
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[4]





- (b) The table shows part of the instruction set for a processor. The processor has one register: the Accumulator (ACC).

| Instruction | | Explanation |
|---|-----------|--|
| Opcode | Operand | |
| AND | #n/Bn/&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/Bn/&n | Bitwise XOR operation of the contents of ACC with the operand |
| XOR | <address> | Bitwise XOR operation of the contents of ACC with the contents of <address> |
| OR | #n/Bn/&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> |
| LSL | #n | Bits in ACC are shifted logically n places to the left. Zeros are introduced on the right-hand end |
| LSR | #n | Bits in ACC are shifted logically n places to the right. Zeros are introduced on the left-hand end |
| <address> can be an absolute or symbolic address # denotes a denary number, e.g. #123 B denotes a binary number, e.g. B01001010 & denotes a hexadecimal number, e.g. &4A | | |



- (i) Write the bit manipulation instruction that can be used to set the least significant bit to 1 in an 8-bit register. All other bits must remain unchanged.

The instruction needs to work on a register that contains any 8-bit binary number.

..... [1]

- (ii) The ACC currently contains the following binary value.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
|---|---|---|---|---|---|---|---|

Write the result after the instruction `XOR &FE` is run.

| | | | | | | | |
|--|--|--|--|--|--|--|--|
| | | | | | | | |
|--|--|--|--|--|--|--|--|

[1]

- (iii) The ACC currently contains the following binary value.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
|---|---|---|---|---|---|---|---|

Write the result after the instruction `LSR #5` is run.

| | | | | | | | |
|--|--|--|--|--|--|--|--|
| | | | | | | | |
|--|--|--|--|--|--|--|--|

[1]









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