Cambridge Assessment International Education

# Cambridge International AS & A Level

Done

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**COMPUTER SCIENCE** **9618/13**

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.

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


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1 (a) A student paints a picture in an art class.

The student takes a photograph of the picture using a digital camera. The digital camera creates an image with a resolution of 2 million pixels and uses a bit depth of 16 bits.

(i) Calculate the file size of the image created by the digital camera in megabytes (MB).

Show your working.

Working space 2000000 x 16 / 8 x 1000 x 1000

14 MB

Answer 4 MB

[2]

(ii) The student takes a second photograph with a lower bit depth.

Explain the effect of decreasing the bit depth on the image and on the image file.

Effect on image There will be fewer shades available so the image does not match the original.

Effect on image file Fewer bits are used to store each pixel so less data is stored that's why the file size is reduced.

[4]

(b) A teacher records an audio file of the student playing the piano during a music lesson.

Complete the table by giving the term for each description about sound representation on a computer.

| Description | Term |
|---|---|
| the number of times the amplitude is measured per time interval | Sampling Rate |
| the number of bits used to store each amplitude measurement | Sampling resolution |
| the type of sound wave before it is recorded by a computer | Analogue |

[3]

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**(c)** The student types a report on a computer in a history lesson.

**(i)** The computer uses the Unicode character set.

Give **two** characteristics of the Unicode character set.

1 It represents $2^8$ characters

2 Represents every language and other characters.

[2]

**(ii)** Some of the school's computers use the extended ASCII character set.

The table gives some characters from the extended ASCII character set, their denary, 8-bit binary and hexadecimal numbers.

Complete the table by filling in the missing numbers.

| Character | Denary | 8-bit Binary | Hexadecimal |
|---|---|---|---|
| ! | 33 | 00100001 | 21 |
| L | 76 | 01001100 | 4C |
| ü | 252 | 11111100 (128 64 32 16 8 4 2 1 → F C) | FC |

[3]

33 → 128 64 32 16 8 4 2 1 : 0 0 1 0 0 0 0 1

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2 A computer has a processor.

**(a)** The processor has a Control Unit (CU) and system clock.

**(i)** Explain how the CU and the system clock work together.

The system clock sends regular timing signals to processor. The control unit use clock pulses to control and coordinate the operations of processor - By using control bus. [2]

**(ii)** The processor runs the Fetch-Execute (F-E) cycle.

Write the stages of the F-E cycle using register transfer notation.

MAR ← [PC]
MDR ← [[MAR]]
IR ← MDR
PC ← PC + 1

[4]

**(b)** The computer has cache memory.

Describe **one** benefit of the computer using cache memory.

By using the cache memory it improves the system performance because cache is fast access memory close to CPU. [2]

**(c)** The computer connects to a monitor using a High Definition Multimedia Interface (HDMI) cable that connects into an HDMI port.

Explain how HDMI provides connection to peripheral devices.

HDMI transfers both audio and video using a single cable, it has a high bandwidth. The data is transmitted in a stream. [2]

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3 A programmer is writing a program in a high-level language.

**(a)** Complete the description of compilers and interpreters by writing the missing words.

A compiler checks all the code before attempting to translate the program. If any errors are found, they are all reported at the same time and the program does not translate or run. If there are no errors found, the compiler produces ..an executable file.. which can run without access to the ..source code.. .

An interpreter translates one line of code and then runs it, before moving to the next line of code. If the line of code has an error, the interpreter ..stops.. and displays the error. The programmer can correct the error ..in real time.. and then the interpreter continues translating from that point.

[4]

**(b)** The programmer needs to keep the program files secure on their computer and during electronic data transmission over the internet. The files are protected by a password.

Complete the table by identifying **one** other method of keeping the files secure during electronic data transmission **and one** other method of keeping the files secure on the computer.

State how each method protects the data.

The methods must be different.

| | Method | How the method protects the data |
|---|---|---|
| **during transmission** | Encryption | Encode the data so that it cannot be decrypted. |
| **on the computer** | Proxy | Filter out the incoming transmission and stop any that could be attempting unauthorised acess. |

[4]


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**(c)** The computer program allows users to play a game in a virtual world. Users can play the game from any computer with internet access using a web browser. The game allows users to interact with other users.

Explain the reasons why the statement 'This computer game uses a client-server model' is correct.

The webserver stores all the data for each player and the player web browser is the client. Which sends the request over the internet to web server and that web server performs the required action in the game.

[4]

**(d)** Describe the possible consequences of the programmer **not** joining a professional ethical body.

There is no limited access to legal devie in case of action is taken. There are fewer networking opportunities so they could miss out the jobs.

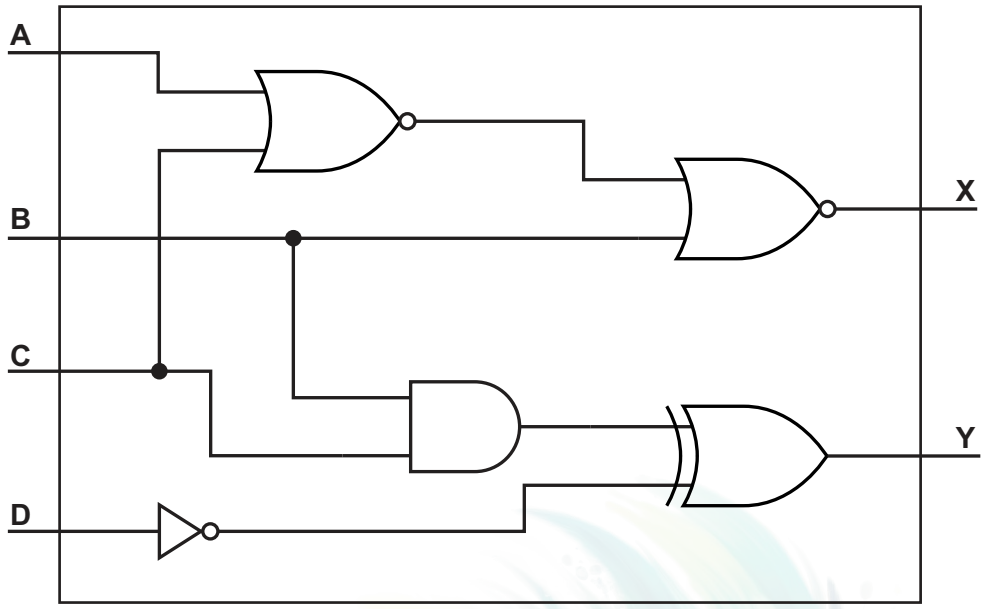
[3]

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4 **(a)** Write the logic expressions for the following logic circuit.




X = B NOR (A NOR C) .....

Y = (B AND C) XOR NOT D .....

[2]

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**(b)** Complete the truth table for the logic expression:

**X** = (**A** OR **B**) XOR (**B** OR **C**) XOR (NOT **A** NAND **C**)

| A | B | C | Working space: A OR B | Working space: B OR C | Working space: NOT A NAND C | X |
|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 |

[2]

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**5** 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 |
| STO | <address> | Store the contents of ACC at the given address |
| ADD | #n/Bn/&n | Add the number n to the ACC |
| ADD | <address> | Add the contents of the given address to the ACC |
| SUB | <address> | Subtract the contents of the given address from the ACC |
| SUB | #n/Bn/&n | Subtract the number n from 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> |
| CMP | #n | Compare the contents of ACC with number n |
| 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

**(a)** The current contents of memory are:

| Address | Instruction |
|---|---|
| 50 | 47 |
| 51 | 48 |
| 52 | 49 |
| 53 | 50 |
| ... | |
| 500 | LDM #50 |
| 501 | DEC ACC |
| 502 | CMP 51 |
| 503 | JPE 505 |
| 504 | JMP 501 |
| 505 | STO 50 |
| 506 | SUB #10 |
| 507 | STO 51 |
| 508 | END |

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**(i)** Trace the program currently in memory using the following trace table.

| Instruction address | ACC | Memory address | | | |
|---|---|---|---|---|---|
| | | 50 | 51 | 52 | 53 |
| | | 47 | 48 | 49 | 50 |
| 500 | 50 | | | | |
| 501 | 49 | | | | |
| 502 | | | | | |
| 504 | | | | | |
| 501 | 48 | | | | |
| 502 | | | | | |
| 503 | | | | | |
| 505 | | 48 | | | |
| 506 | 38 | | | | |
| 507 | | | 38 | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

[3]

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**(ii)** Complete the table by identifying **and** describing **two** modes of addressing that are **not** used in the program in part **(a)**.

| Mode of addressing | Description |
|---|---|
| Direct | The operand is the address of the data. |
| Indirect | The operand points to the memory location which is the address of data. |

[4]

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**(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> |
| <address> can be an absolute or a symbolic address<br># denotes a denary number, e.g. #123<br>B denotes a binary number, e.g. B01001010<br>& denotes a hexadecimal number, e.g. &4A | | |

Write the bit manipulation instructions that can be used to set only the most significant bit to 1 in an 8-bit register.

The instructions need to work on a register that contains any 8-bit binary number.

# 128

..... [2]

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6 A shop sells pens to customers. Customers place an order with the shop and collect the items the next day. The shop uses a database to store the information about the orders.

The database contains the following tables:

CUSTOMER(CustomerID, CustomerName, Email)

ORDER(OrderID, CustomerID, Date, Collected)

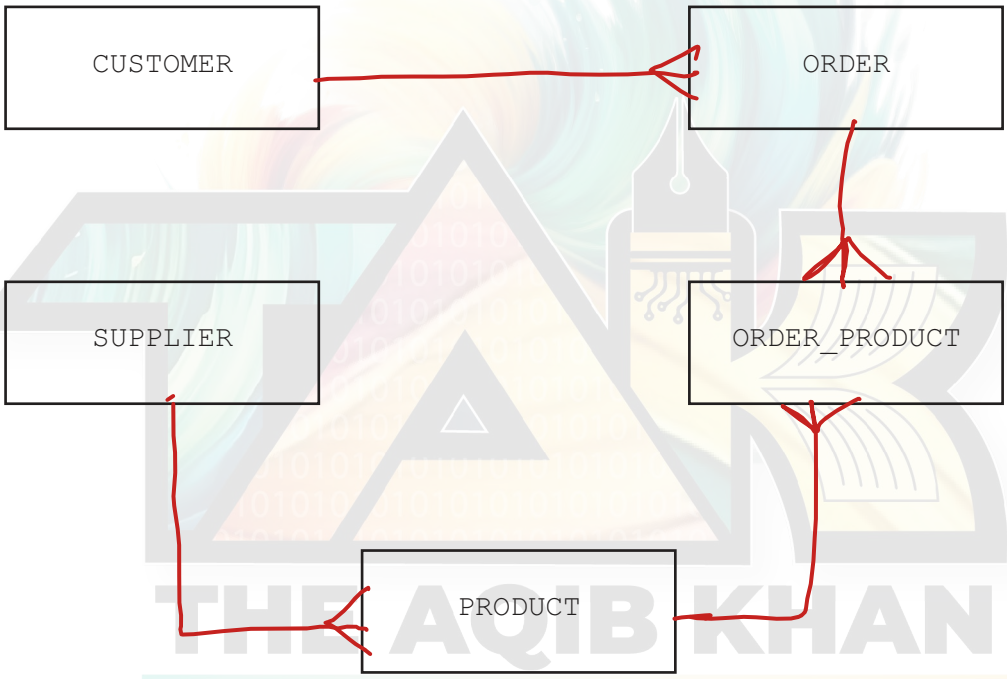
ORDER_PRODUCT(OrderID, ProductID, Quantity)

PRODUCT(ProductID, ProductName, QuantityInBox, Cost, SupplierID)

SUPPLIER(SupplierID, SupplierName, SupplierEmail)

The primary keys are underlined.

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




[4]

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**(b)** A new product needs to be entered into the database. The product has the ID 002323, the product name 'Blue ball point 2mm', there are 50 in a box, the product costs $5.00 and the supplier has the ID SFX223.

Write a Structured Query Language (SQL) script to enter the new product into the table `PRODUCT`.

```
INSERT INTO PRODUCT
VALUES ("002323","Blue ball point 2mm",50,5.00,
"SFX223")
```

[4]

**(c)** The attribute `Collected` in the table `ORDER` stores the Boolean value `TRUE` if the order has been collected and `FALSE` if the order has not been collected.

Write an SQL script to return the customer name for each customer that has orders they have not collected. Include the number of orders each customer has not collected with an appropriate title.

An example output might be:

| CustomerName | NotCollected |
|---|---|
| Jack Wright | 2 |
| Lin Cho | 1 |
| Santaya Yui | 1 |

```
SELECT CustomerName, COUNT(OrderID) AS NotCollected
FROM ORDER, CUSTOMER
WHERE ORDER.CustomerID = CUSTOMER.CustomerID
AND COLLECTED = FALSE
GROUP BY CUSTOMER.CustomerID
```

[4]

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**(d)** The shop uses a Database Management System (DBMS).

**(i)** One feature provided by a DBMS is a data dictionary.

The data dictionary stores the attribute names, table names, foreign keys and primary keys in the database.

Identify **three** other items stored in a data dictionary.

1 Relationships

2 Views

3 Data types

[3]

**(ii)** The DBMS provides a developer interface.

Explain how a database designer can make use of the developer interface.

It modify the database and create a form for data input. Add tools for eg drop down. It runs different queries.

[3]

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7 **(a)** A computer can perform logical and arithmetic shifts.

**(i)** Show the result of a logical left shift of 2 places on the two's complement binary integer 11001010

0010 1000

[1]

**(ii)** Show the result of an arithmetic right shift of 3 places on the two's complement binary integer 10011110

1110011

[1]

**(b)** Complete the following binary addition. Show your working. Include any overflow bit(s).

(1) 1 1 1 1 1 0 1 0 1
+ 1 0 1 1 0 0 0 1
(1) 1 0 1 0 0 1 1 0

[1]

**(c)** Subtract the binary number 00011110 from the binary number 01100100 using binary subtraction. Show your working.

Two's complement
11100010

01100100
+11100010
(1)01000110

over flow error

[2]


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