Cambridge Assessment International Education

Done

Cambridge International AS & A Level

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COMPUTER SCIENCE **9618/13**

Paper 1 Theory Fundamentals **October/November 2024**

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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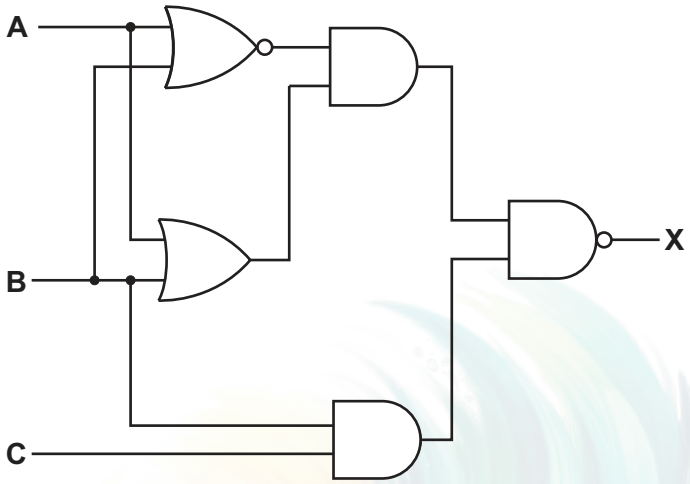
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1 **(a)** Describe the operation of a 2-input XOR gate.

.....

..... [1]

(b) Write the logic expression for the following logic circuit.



X = ...

..... [2]

(c) Draw the logic circuit for the logic expression:

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



[2]

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2 A memory buffer uses Dynamic RAM (DRAM).

(a) Identify **two** differences between DRAM and Static RAM (SRAM).

Difference 1 DRAM requires constant refreshing but SRAM does not need constant refreshing

Difference 2 DRAM has slower access times than SRAM

[2]

(b) Explain how a memory buffer is used when a computer is transferring data to its magnetic hard disk drive.

The computer transfers data faster than the HDD can receive. Buffer is used for temporary storage so that the computer can transfer data to the buffer at higher speed and so that data is transfered to hard drive from the buffer at slower rate.

[4]

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3 A car has an automatic braking system.

A sensor is used to measure the distance to objects that are in front of the car.

The car automatically brakes if an object is too close to the front of the car or the distance between the car and the object is decreasing too quickly. The closer the object is to the front of the car, the harder the car brakes so that the car slows down more quickly.

Explain the reasons why the automatic braking system of the car is a control system.

Breaking system is a kontrol system because it continously takes a input from distance sensor that measures how close the objects are. Based on this input the system automatically decides whether breaking is needed or not, how to apply break. After breaking the new distance is used to determine how hard the car needs the break. [3]

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4 A company makes ice cream and sells it to shops.

The ice cream is made in batches: a large quantity of one type and flavour of ice cream that is then split into smaller quantities for sale.

The company's owner has designed a relational database, `ICECREAM`, to store data about their ice cream and customers.

Some of the tables in the database are given. The database is not normalised.

`BATCH(BatchID, Type, Flavour, Size, SellingPrice, EndDate)` PK

`CUSTOMER(CustomerID, CompanyName, EmailAddress, TelephoneNumber)` PK

`SALE(SaleID, BatchID, CustomerID, Quantity, Date)` PK FK FK

(a) Identify **two** foreign keys in the table `SALE` **and** the table that each foreign key references.

Foreign key 1 Batch ID

Table name 1 BATCH

Foreign key 2 Customer ID

Table name 2 CUSTOMER

[2]

(b) Write an SQL script to return the total quantity of ice cream sold to the customer with the ID of 0034E in the year 2023.

```
SELECT SUM (Quantity)
FROM SALE
WHERE CustomerID = "0034E"
AND Date >= "01/01/2023" AND Date <= "31/12/2023";
```

[3]

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(c) The table definition for BATCH is repeated here:

BATCH(BatchID, Type, Flavour, Size, SellingPrice, EndDate)

Sample data for the table BATCH is given:

BatchID	Type	Flavour	Size	SellingPrice	EndDate
KIV12	Plain	Vanilla	1	2.20	12/12/2024
RIC14	Plain	Chocolate	0.5	1.80	12/12/2024
TYL1	Non-dairy	Lemon	0.5	2.10	01/02/2025
FYV2	Non-dairy	Vanilla	0.25	1.50	02/02/2025
BIV13	Plain	Vanilla	1	2.20	02/02/2024

(i) Write an SQL script to define the table BATCH.

Include constraints (restrictions) on the data that can be entered into each field where appropriate.

```
CREATE TABLE BATCH (
BatchID VARCHAR(6) NOT NULL,
Type VARCHAR(20) NOT NULL,
Flavour VARCHAR(20) NOT NULL,
Size Real
SellingPrice CURRENCY,
EndDate DATE,
PRIMARY KEY (BatchID)
);
```

[5]

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(ii) The table `BATCH` is not normalised.

Normalise the database table `BATCH`.

Write the table definitions for your new tables.

Identify any primary and foreign keys in your tables.

Do **not** change or include the tables `CUSTOMER` and `SALE`.

```
CREATE TABLE ICECREAM (
IceCreamID VARCHAR(6),
Type VARCHAR(20),
Flavour VARCHAR(20),
Size REAL
SellingPrice REAL
PRIMARY KEY (IceCreamID)
);
```

[4]

(d) Complete the following table by defining each database term.

Database term	Definition
Entity	A real life object that is represented as a table
Attribute	An item of data about an entity.

[2]

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(e) A Database Management System (DBMS) supports data integrity.

Explain how a DBMS supports data integrity.

Refrential integrity is enforced such as cascade or delete. It also ensures each foreign key has a corresponding primary key.

[3]

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5 A computer programmer writes programs that are distributed with a software licence.

(a) Complete the table by writing the type of software licence each statement describes.

Statement	Software licence
A fee is charged for the software. The source code cannot be accessed. Users do **not** get a free trial.	Commercial
Users can try the software before buying it. Users may **not** be able to access all features during the trial.	Share ware
Software is usually free of charge. Users can access the source code and alter the program to their needs.	Open Source

[3]

(b) Explain the reasons why it is important for the computer programmer to join a professional ethical body.

So a proffessional ethical body provides a code of ethics giving the clear standards to follow when making decisions. Being a member boost the programmer's reputation making clients and employers more confident in their skills. Professional ethical body runs training courses to keep computer skills up to date. [3]

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6 A computer system stores text, images and sound.

(a) A character set is used to represent characters in a computer.

Identify **and** describe **one** character set.

Character set ASCII

Description It have 7 to 8 bits per character. Also represents all characters from Latin alphabet. [2]

(b) The colour of each pixel in a bitmapped image is represented by 8 bits.

(i) State the largest number of different colours that can be represented by 8 bits.

256 [1]

(ii) State **one** drawback of increasing the number of bits that represents each pixel in the bitmap image.

Increased file size

[1]

(iii) A bitmap image can be compressed using lossy compression.

Explain the reasons why lossy compression is often suitable for a bitmap image.

Lossy compression is suitable because the data which is removed is usually not noticed to human eye. It also reduce the file size making it easier to store [2]

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(c) **(i)** Explain how an analogue sound wave is converted into digital data.

The size of analogue sound wave is measured a set number of times each second time. Each sample is givin by a binary number. [2]

(ii) Describe **one** method of compressing a sound file using lossy compression.

By decreasing sample resolution there is fewer bits per sample. [2]

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7 The following table shows part of the instruction set for a processor. The processor has two registers, the Accumulator (ACC) and the 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
LDX	<address>	Indexed addressing. Form the address from <address> + the contents of the index register. Copy the contents of this calculated address to ACC
LDR	#n	Immediate addressing. Load the number n to IX
ADD	#n/Bn/&n	Add the number n to the ACC
ADD	<address>	Add the contents of the given address to the ACC
SUB	#n/Bn/&n	Subtract the number n from the ACC
SUB	<address>	Subtract the contents of the given address from the ACC
INC	<register>	Add 1 to the contents of the register (ACC or IX)
DEC	<register>	Subtract 1 from the contents of the register (ACC or IX)

<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

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(a) The current contents of memory are shown:

Address	Data
50	54
51	55
52	50
53	52
54	100
55	25
56	50

The current contents of the ACC and IX are shown:

ACC	50
IX	45

Complete the table by writing the content of the ACC after each program has run.

	Instructions	ACC content
1	LDD 50 ADD #4 ADD 54	158
2	LDI 53 DEC ACC ADD 56	99
3	LDM #55 SUB #5	50

[3]

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(b) The instruction set also includes these bit manipulation instructions:

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 # denotes a denary number, e.g. #123 B denotes a binary number, e.g. B01001010 & denotes a hexadecimal number, e.g. &4A		

Explain how bit manipulation can be used to clear the data in an 8-bit register.

Write the bit manipulation instruction that will be used.

Explanation A bit manipulation operation is required to set all the bits to zero. Compare the result of masking with 0 so the result comparison will be true.

Instruction #00

[3]

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8 (a) Convert the hexadecimal number 1FAB into denary.

Working 0001 1111 1010 1011 (4096 2048 1024 512 256 128 64 32 16 8 4 2 1)
1 F A B

Denary value (8107)10 [1]

(b) Explain how to convert the two's complement integer 10011111 into denary. Give the denary value after conversion.

Explanation Flip each bit then add 1, the method of converting new binary number into denary. Add positive corresponding denary value

Denary value -97 [3]

(c) Describe the difference between a right logical binary shift and a right arithmetic binary shift.

A logical shift moves all the bits to the right and insert zeros in the leftmost bit. An arithmetic binary shift moves all bits to the right but copies the sign bit into most significant figure. [2]

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9 A computer is connected to a Local Area Network (LAN) that connects to a Wide Area Network (WAN).

(a) Describe the characteristics of a WAN.

A WAN covers a large geographical area. It is a Non-Dedicated hardware.

[2]

(b) Copper cable can be used to transmit data in a network.

Complete the table by identifying **and** describing **two other** transmission media that can be used to transfer data in the WAN.

Transmission medium	Description
Fibre Optic	It transmits data as pulses of light
Microwaves	Transmits electro magnetic waves on different frequencies.

[4]

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(c) The computer on the LAN is used for real-time video conferences, where people connected to the internet communicate in real-time using video and audio.

Explain how bit streaming is used in a real-time video conference.

The data is compressed before transmitting, the video and audio are transmitted continuously as series of bits. On download the media server sends data to buffer, so the buffer stores data from server until receiving device can process it. The receiving device receives the bit stream from buffer. [4]

(d) The LAN has a router. The router has a public IP address and a private IP address.

(i) State the purpose of a public IP address and a private IP address.

Public IP address So that the router is visible to WAN.

Private IP address So that the router is identified to computers within the LAN. [2]

(ii) The LAN uses subnetting.

Describe the purpose of subnetting in a network.

It allows the network to be divided into smaller networks which reduces the traffic in some parts of traffic. [2]

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