



CANDIDATE
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9618/13

May/June 2023

1 hour 30 minutes

You must answer on the question paper.

No additional materials are needed.

- 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.

- 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 **16** pages. Any blank pages are indicated.

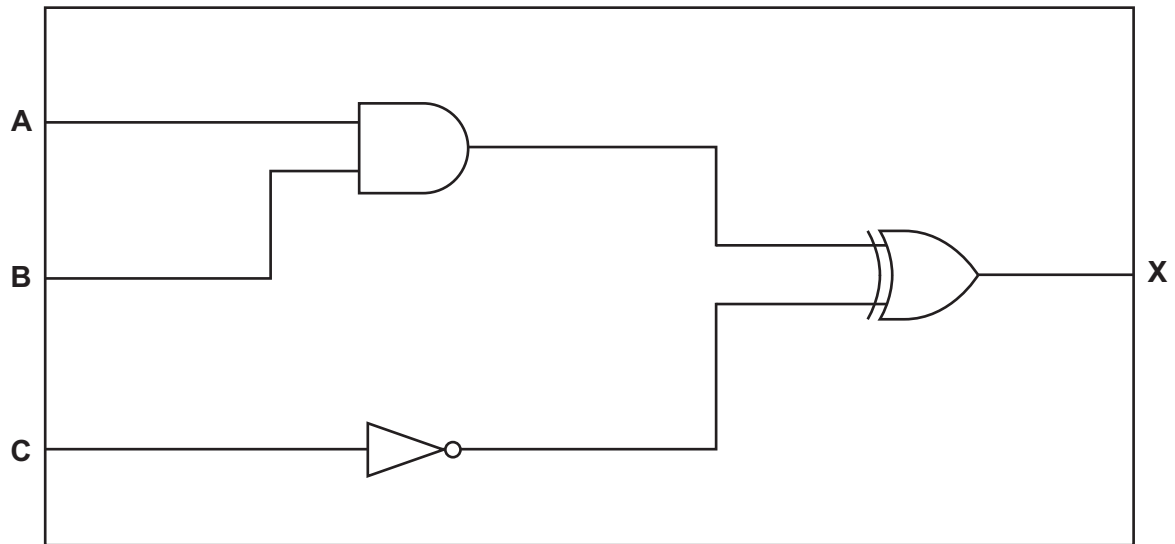
- 1 (a) Write the logic expression for this truth table:

A	B	C	X
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

NOT B

[1]

- (b) Complete the truth table for this logic circuit:



A	B	C	$A \times B$	Working space \bar{C}	X
0	0	0	0	1	1
0	0	1	0	0	0
0	1	0	0	1	1
0	1	1	0	0	0
1	0	0	0	1	1
1	0	1	1	0	0
1	1	0	0	1	0
1	1	1	1	0	1

[2]

- 2 A university has two sites. Each site has several computer rooms. The computers are all connected as a WAN (wide area network).

(a) Identify **two** differences between a WAN and a LAN (local area network).

- ~ WAN covers a large geographical area and LAN covers a small geographical area
- ~ LAN connections between devices are usually physical, whereas the WAN connections are often virtual
- ~ A LAN has a high data transfer rate, whereas a WAN has a low data transfer rate
- ~ The ownership of a LAN is private; the ownership of a WAN can be private or public
- ~ LAN is usually more secure than a WAN because protection is easier to implement

[2]

(b) The network uses different topologies in different areas of the sites. In one building there are five computers connected in a mesh topology.

(i) Describe what is meant by a mesh topology.

- ~ All computers are connected to at least one other device
- ~ There are multiple routes between devices
- ~ The computers can act as relays, passing packets on towards the final destination

[2]

(ii) Give **two** advantages of using a mesh topology instead of a bus topology.

- ~ If one line goes down there are more routes available
- ~ Improved security as not using one main line
- ~ No/fewer collisions
- ~ New nodes can be added without interruption or interfering with other nodes
- ~ More secure because data is sent over a dedicated connection

[2]

(c) The computers in one room are set up as thin-clients in a client-server model.

Describe the role of the different computers in this model.

- ~ Server performs all processes required by the task and/or data storage
- ~ Clients only sends requests to the server and displays the returned results

[2]

- (d) Students can connect their devices to the university network using cables or a wireless connection.

Explain the benefits to the students of allowing them to use **both** wired and wireless connections.

- ~ Some students might only have one sort of connection on their device
- ~ Wired provides better performance for the student's device
- ~ ... for example, enabling faster access to university databases
- ~ There will be less interference if students connect via a cable
- ~ Students can transmit private/confidential data/work securely
- ~ ... for example, their final dissertation
- ~ Wireless connection means that the students can use their devices in different rooms/sites/outside/anywhere more freely OR student devices can be portable
- ~ Wireless connection enables the students to bring multiple devices OR bring their own devices OR change devices

[4]

- (e) One site has split the network into several subnetworks.

An IP address in a subnetwork is divided into two parts.

Identify **and** describe the **two** parts of an IP address in a subnetwork.

IP address is made up of a network ID and a host ID

- ~ Each device in a subnetwork has the same network ID OR Each subnetwork has a different network ID
- ~ Every device in each subnetwork has a different host ID but the same network ID OR the host ID uniquely identifies the device within the subnetwork

[3]

3 A mobile telephone is used to record a video.

(a) The mobile telephone has a touchscreen. There are different types of touchscreen.

Complete the description of the principal operation of touchscreens.

A **resistive** touchscreen has two layers. When the user touches the screen, the layers touch and a **circuit** is completed.

A **capacitive** touchscreen has several layers. When the top layer is touched, there is a **change** in the electric current.

A microprocessor identifies the **coordinates** of the touch.

[5]

(b) The mobile telephone uses a built-in digital camera to record the video.

The digital camera automatically focuses on the faces of people.

Explain how Artificial Intelligence (AI) is used by the camera to automatically focus on the faces of people.

- ~ Scans the scene in real time
- ~ Identifies if there are faces in the image
- ~ Uses facial recognition
- ~ ... uses image recognition
- ~ ... takes each frame individually
- ~ ... analyses the pixels
- ~ ... stores pattern for a face
- ~ ... looks for patterns that match/come close to the pattern for a face
- ~ Camera focuses on the pattern identified

[3]

(c) The video includes a sound recording.

(i) Describe how sound is represented in a computer.

- ~ The amplitude is recorded a set number of times a second
- ~ Each (instance of an) amplitude is given a corresponding binary number
- ~ The binary number (of each amplitude) is saved in sequence

[3]

- (ii) A second video is recorded. The sound in the second video needs to be more precise.

Explain the reasons why increasing the sampling rate and the sampling resolution will improve the precision of the second recording.

Sampling rate

- ~ There are smaller 'gaps' in the sound wave // sound is recorded more often
- ~ Digital waveform is closer to the analogue waveform
- ~ The quantisation errors are smaller

Sampling resolution

- ~ There are more bits per sample OR a wider range of amplitudes can be stored
- ~ Each binary amplitude/note (in the digital recording) is closer to the analogue amplitude/note
- ~ Digital waveform is closer to the analogue waveform
- ~ The quantisation errors are smaller

[4]

- 4 A shop rents cars to customers. The shop uses a relational database to store information about the rentals.

(a) Describe **two** ways in which a relational database addresses the limitations of a file-based approach.

- ~ Reduces data redundancy
- ~ ... because linked tables mean that each data item is stored only once
- ~ Reduces program-data dependency
- ~ ... because the data is separate from the software so changes to the data do not require programs to be re-written
- ~ Reduces data inconsistency OR improves data integrity
- ~ ... because by only storing data once it only needs to be updated once OR changes in one table will automatically update in another OR linked data cannot be entered differently in two tables
- ~ Complex queries are easier to run
- ~ Can provide different views
- ~so users can only see specific aspects of the databas

[4]

(b) Complete the table by writing the missing term or description for each database feature.

Term	Description
Entity	An object that data is stored about.
Tuple	A row of data in a table about one instance of an object.
Secondary key	An additional/alternative key used as well as the primary key to locate specific data OR a candidate key that has not been chosen as a primary key.
Foreign key	A field in one table that is linked to a primary key in another table.

[4]

- (c) The car rental database is not normalised. The current database design is:

```
BOOKING(CarRegistration, StartDate, EndDate,
        CarModel, CarColour, CustomerFirstName)
```

```
CUSTOMER(CustomerFirstName, CustomerLastName, EmailAddress,
          TelephoneNumber)
```

Write a normalised database design for this database.

All tables must be in Third Normal Form (3NF).

Use the field names given **and** underline the primary key fields.

```
BOOKING(BookingID, CarRegistration, CustomerID,
        StartDate, EndDate)
CAR(CarRegistration, CarModel, CarColour)
CUSTOMER(CustomerID, CustomerFirstName,
        CustomerLastName, EmailAddress, TelephoneNumber)
```

[4]

- (d) The data is validated and verified when it is entered into the database.

- (i) The car registration number must be: 1 letter, followed by 3 numbers, followed by 2 letters.

For example, A123AA is valid but A12AA is invalid.

One way that a registration number can be validated is by using a presence check to make sure the registration number has been entered.

Describe **two other** ways that the car registration number can be validated.

- ~ Length check: the registration number must be 6 characters long
- ~ Format check: the registration number must be in the format letter-digit-digit-digit-letter-letter
- ~ Type check: the registration number must be alphanumeric

[2]

- (ii) Describe **two** ways that the car registration number can be verified when it is entered into the database.

- ~ Visual check: Manually compare the registration number entered with the source document
- ~ Double entry: Enter the registration number twice and the computer compares to check they are the same

[2]

- (iii) State why the car registration number might be incorrect even after it has been validated and verified.

The registration number on the original document might be in the correct format but may be the incorrect registration number for that car.

[1]

5 A programmer is developing a computer game in a high-level language to sell to the public.

(a) The programmer uses both an interpreter and a compiler at different stages of the development of the program.

(i) Explain the reasons why the programmer uses an interpreter while writing the program code.

- ~ Programmer can test sections of the code without every part working / being written
- ~ Programmer can debug in real time
- ~ ... so that errors can be fixed and the program continued from that point
- ~ The effect of any changes made by the programmer can be seen immediately
- ~ To avoid dependent errors

[2]

(ii) Explain the reasons why the programmer uses a compiler when the program has been written.

- ~ The compiler produces an executable file
- ~ ... so the user cannot access / edit / sell the code
- ~ ... and users do not need the translator to run the game
- ~ The game can be compiled for different hardware specifications
- ~ ... and then used to generate more income for the programmer
- ~ The program can be tested multiple times without having to retranslate each time

[3]

(b) The programmer needs to publish the game under a software licence so that it can be sold to the public.

Identify the **most appropriate** type of software licence for the game **and** justify your choice.

- ~ Commercial software licence
- ~ User has to pay for the product so the programmer can gain an income
- ~ Enables the program to be copyrighted
- ~ ... so the user cannot legally edit the program // the programmer retains control over product
- ~ ... and can take legal action against people who attempt to illegally copy it /sell it on
- ~ Shareware licence
- ~ Enables the program to be copyrighted
- ~ The user cannot legally edit the program so the developer retains control over product
- ~ User can try the program for free and then pay for the full game which allows the programmer to gain an income
- ~ so more people can experience it and therefore be more likely to buy it

[4]

6 Data needs to be kept secure when stored on a computer and during transmission over a network.

(a) Explain how a digital signature is used to authenticate a digital document during transmission over a network.

- ~ The sender hashes the document
- ~ ... to produce a digest
- ~ The sender encrypts the digest to create the digital signature
- ~ The message and the signature are sent to the receiver
- ~ The receiver decrypts the signature to reproduce the digest
- ~ The receiver uses the same hashing algorithm on the document received to produce a second digest
- ~ The receiver compares this digest with the one from the digital signature
- ~ If both of the receiver's digests are the same the document is authentic

4 Antimalware

- ~ scans the computer for viruses and checks against a stored database of viruses, that needs to be updated regularly and then deletes / quarantines them
- ~ compares downloaded files to a database of known viruses and prevents the download continuing

[5]

(b) Complete the table by identifying **and** describing **two** types of software that can be installed on a computer to prevent threats over a network.

Type of software	Description
1 Antivirus	~ scans the computer for viruses and checks against a stored database of viruses, that needs to be updated regularly and then deletes / quarantines them ~ compares downloaded files to a database of known viruses and prevents the download continuing
2 Antispyware	~ scans the computer for spyware and checks against a stored database of viruses, that needs to be updated regularly and then deletes / quarantines them ~ compares downloaded files to a database of known spyware and prevents the download continuing

[2]

3 Firewall

- ~ monitors incoming and outgoing traffic and compares it to criteria that are set by the user such as through a whitelist/blacklist/identifying allowed / blocked IP addresses
- ~ compares incoming and outgoing traffic to criteria blocks those that do not match criteria

7 A computer stores data in binary form.

(a) Draw **one** line from each description to its matching denary value.

Description	Denary value
	-127
The smallest integer that can be represented in 8-bit two's complement.	127
	-255
The largest integer that can be represented in 8-bit two's complement.	-128
	-256
	256
The largest unsigned integer that can be represented in 8 bits.	128
	255

[3]

(b) The computer has a Control Unit (CU), system clock and control bus.

Explain how the CU, system clock and control bus operate to transfer data between the components of the computer system.

- ~ The system clock gives out timing signals
- ~ ... which are sent on the control bus
- ~ ...to synchronise the other system components
- ~ The Control Unit initiates data transfer
- ~ ...by generating signals that are sent on the control bus to other components

[4]

- (c) Complete the table by writing the register transfer notation for each stage of the Fetch-Execute (F-E) cycle given in the table.

Stage description	Register transfer notation
The Program Counter (PC) is incremented	PC $[PC] + 1$
The data in the address stored in the Memory Address Register (MAR) is copied to the Memory Data Register (MDR)	MDR $[[MAR]]$

[2]

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