



Cambridge International AS & A Level

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COMPUTER SCIENCE

9618/11

Paper 1 Theory Fundamentals

May/June 2023

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

- 1 Images are being created to advertise holidays.

Some of the images are bitmap images and some are vector graphics.

- (a) Complete the table by defining the image terms.

Term	Definition
Drawing list	All the drawing objects in an image or A list that stores the commands required to draw each object
Pixel	The smallest part of the image or one square/dot of one colour
Colour depth	Number of bits per pixel or determines the number of colours that can be represented in an image

[3]

- (b) The bitmap images are photographs of the holiday locations.

- (i) Colour depth and image resolution are both included in the file header of a bitmap image.

Identify **two other** items that could be included in the file header of each photograph.

- 1 Conformation that it is a bitmap (or file type)
- 2 Location/offset of the data within the file
- 3 Compression type
- 4 Dimension eg: 100 x 100 pixels

[2]

- (ii) One of the photographs has a bit depth of 8 bytes and an image resolution of 1500 pixels wide and 3000 pixels high.

Calculate the file size of the photograph in megabytes. Show your working.

Working

$$\frac{1500 \times 3000 \times 8}{1600 \times 1000} = 36 \text{ MB}$$

File size MB

[2]

- (c) The photographs are compressed before they are uploaded to a web server. Customers download the photographs from this web server.

- (i) Explain the reasons why compressing the photographs will benefit the customers.

- Customers will be able to download the photograph in less time.
- ... and they will take less of customer's bandwidth
- Photographs will take less space on the customer's storage medium.
- therefore customers can store more images
- ... and will have space for other files

[3]

- (ii) An image can be compressed using run-length encoding (RLE).

Explain the reasons why RLE may **not** reduce the file size of a bitmap image. Give **one** example in your answer.

- RLE stores a colour and the number of times it occurs consecutively.
- An image may not have many sequence of the same colour.
- It would need to store each colour and then the count/number 1 which adds data.

eg: Red - Green - Blue will become Red 1 Green 1 Blue 1 [3]

2 An organisation uses a database to store data about the types of bird that people have seen.

(a) The database is managed using a Database Management System (DBMS).

(i) State what is meant by a data dictionary **and** give **one** example of an item typically found in a data dictionary.

Definition Data about the data in the database or data about the structure of the database or metadata for the database

Example table names, data types, field names

[2]

(ii) State what is meant by data integrity **and** give **one** example of how this is implemented in a database.

Definition methods of making sure data is consistent

Example enforcing referential integrity, if data in one table is deleted/edited all the tables are updated or cascading update/delete, validation/verification rules

[2]

- (b) The database, Birds, stores information about the types of bird and the people who have seen them.

Data about each bird seen is stored with its location and data about the person who saw the bird.

Database Birds has the following tables:

BIRD_TYPE(BirdID, Name, Size)

BIRD_SEEN(SeenID, BirdID, Date, Location, PersonID)

PERSON(PersonID, FirstName, LastName, EmailAddress)

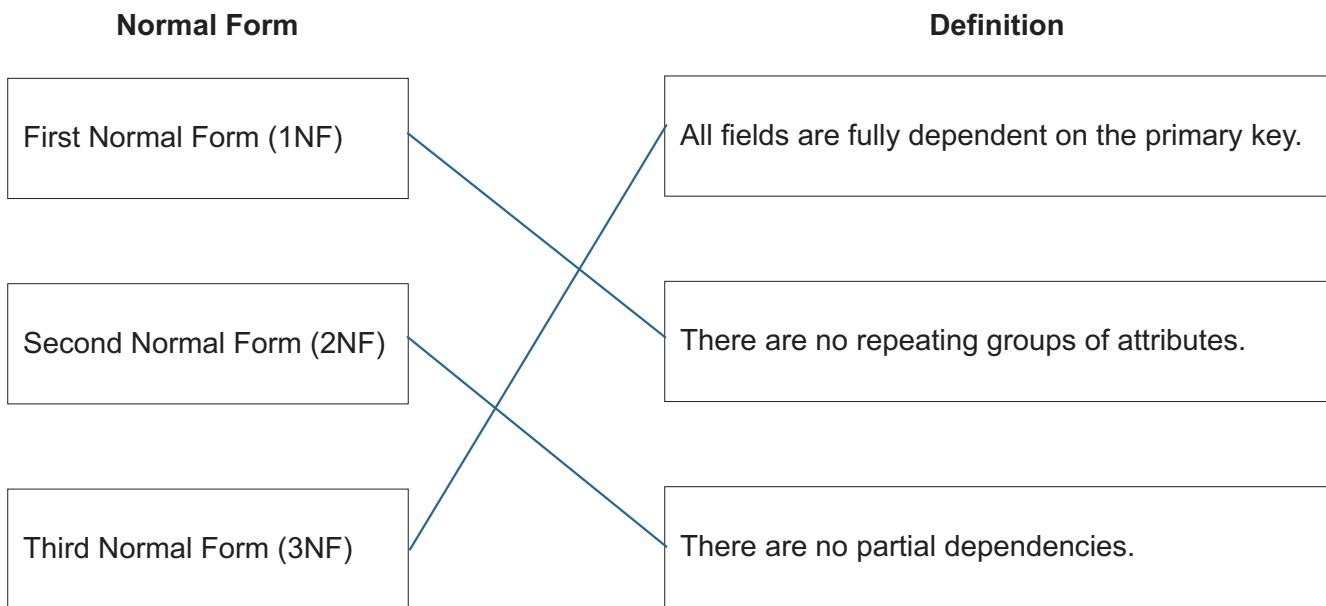
- (i) Complete the table by identifying **two** foreign keys and the database table where each is found.

Foreign key	Database table
BirdID	BIRD_SEEN
PersonID	BIRD_SEEN

[2]

- (ii) The database Birds has been normalised.

Draw **one** line from each Normal Form to the most appropriate definition.



[1]

(iii) Part of the database table BIRD_TYPE is shown:

BirdID	Name	Size
0123	Blackbird	Medium
0035	Jay	Large
0004	Raven	Large
0085	Robin	Small

The database only supports these data types:

- character
- varchar
- Boolean
- integer
- real
- date
- time

Write a Structured Query Language (SQL) script to define the table Bird_Type.

```
CREATE TABLE BIRD_IDC
    Bird-ID  CHAR(4) NOT NULL,
    Name  VARCHAR(9),
    Size  VARCHAR(6),
    PRIMARY KEY (Bird-ID)
);
```

[4]

- (iv) The database tables are repeated here for reference:

```
BIRD_TYPE(BirdID, Name, Size)  
BIRD_SEEN(SeenID, BirdID, Date, Location, PersonID)  
PERSON(PersonID, FirstName, LastName, EmailAddress)
```

Complete the SQL script to return the number of birds of each size seen by the person with the ID of J_123.

```
SELECT BIRD_TYPE.Size, .....COUNT..... (BIRD_TYPE.BirdID)  
AS NumberOfBirds  
FROM BIRD_TYPE, .....BIRD_SEEN.....  
WHERE .....BIRD_SEEN.PersonID..... = "J_123"  
AND BIRD_TYPE.BirdID = .....BIRD_SEEN.Bird-ID.....  
.....GROUP BY..... BIRD_TYPE.Size;
```

[5]

3 A computer has an Operating System (OS).

(a) Describe how the Operating System manages the peripheral hardware devices of the computer.

- Installs device drivers
 - to allow communication between peripherals and computer
 - Sends data and receives data to and from peripherals
 - ... such as an output device and from an input device / by example
 - Handles buffers for transfer of data
 - ... to ensure smooth transfer between devices that transmit and receive at different speeds
 - Manages interrupts / signals from the device
- [4]

(b) Hardware management is one key management task carried out by the Operating System.

Identify **two other** key management tasks carried out by the Operating System.

- 1 Memory management or file management or security management
 - 2 Process management or error checking and recovery
- [2]

(c) The Operating System has utility software including defragmentation software.

Explain how defragmentation can improve the performance of the computer.

- ~ Rearranges blocks of individual files (on the HDD) so they are contiguous OR moves the free space together
- ~ Accessing each file is faster
- ~ ...because there is no need to search for the next fragment / block of the file
- ~ ...so less head movement is needed

[3]

(d) The computer stores data in binary form.

(i) State the difference between a kibibyte and a kilobyte.

Kibibyte is 1024 bytes and kilobyte is 1000 bytes
 Kibibyte is binary prefix and kilobyte is denary prefix

[1]

- (ii) Convert the denary number 964 into Binary Coded Decimal (BCD).

1001 0110 0100

[1]

- (iii) Convert the positive binary integer 11110010 into hexadecimal.

F2

[1]

- (iv) Give the smallest **and** largest two's complement binary number that can be represented using 8 bits.

Smallest 10000000

Largest 01111111

[2]

- (v) Add the following two binary integers using binary addition. Show your working.

$$\begin{array}{r}
 1011000 \\
 + 00011011 \\
 \hline
 11001011 \\
 \hline
 11
 \end{array}$$

[2]

- (vi) Show the result of a 3-place right logical shift on the binary number:

11001100

00011001

[1]

- 4 A networked closed-circuit television (CCTV) system in a house uses sensors and cameras to detect the presence of a person. It then tracks the person and records a video of their movements.

Data from the CCTV cameras is transmitted to a central computer.

- (a) This computer has both Read Only Memory (ROM) and Random Access Memory (RAM).

- (i) Describe the contents of the ROM in the central computer.
- ~ Stores the bootstrap program // start-up instructions for the central computer // BIOS
 - ~ Stores the start-up instructions for the CCTV system/cameras // firmware for CCTV
 - ~ Stores the kernel of the Operating System // stores parts of the Operating System

[2]

- (ii) The central computer has Dynamic RAM (DRAM).

Identify **two** advantages of using DRAM instead of Static RAM (SRAM).

- ~ Costs less per unit
- ~ Higher storage density
- ~ Simple design – uses fewer transistors

[2]

- (b) The central computer stores the video files on secondary storage.

Describe **two** reasons why magnetic storage is more appropriate than solid state storage for this computer.

- ~ The computer will have a large number of read/write operations because it is working all the time
- ~ .. magnetic storage has more longevity
- ~ Magnetic storage costs less per storage unit
- ~ ... videos are large files and therefore very large storage capacity is required

[4]

- (c) The CCTV system uses Artificial Intelligence (AI) to identify the presence of a person in the house and to track their movements.

Describe how AI is used in this system.

- ~ Uses image recognition
- ~ Monitors every image taken to identify matching images/shapes/features to a 'person' ...
- ~ ... starts recording to secondary storage/permanently when a person is identified
- ~ System identifies direction of movement of person and uses this to decide where/how to move the camera/record
- ~ System identifies other cameras to start recording based on direction of movement

[3]

- (d) The CCTV cameras are connected to a network and transfer their data wirelessly to the central computer.

- (i) Each device on the network has an IP address.

Complete the description of IP addresses.

An IPv4 address contains 4 groups of digits. Each group is represented in 8 bits and the groups are separated by full stops.

An IPv6 address contains 8 groups of digits. Each group is represented in 16 bits. Multiple groups that only contain zeros can be replaced with a double colon

[5]

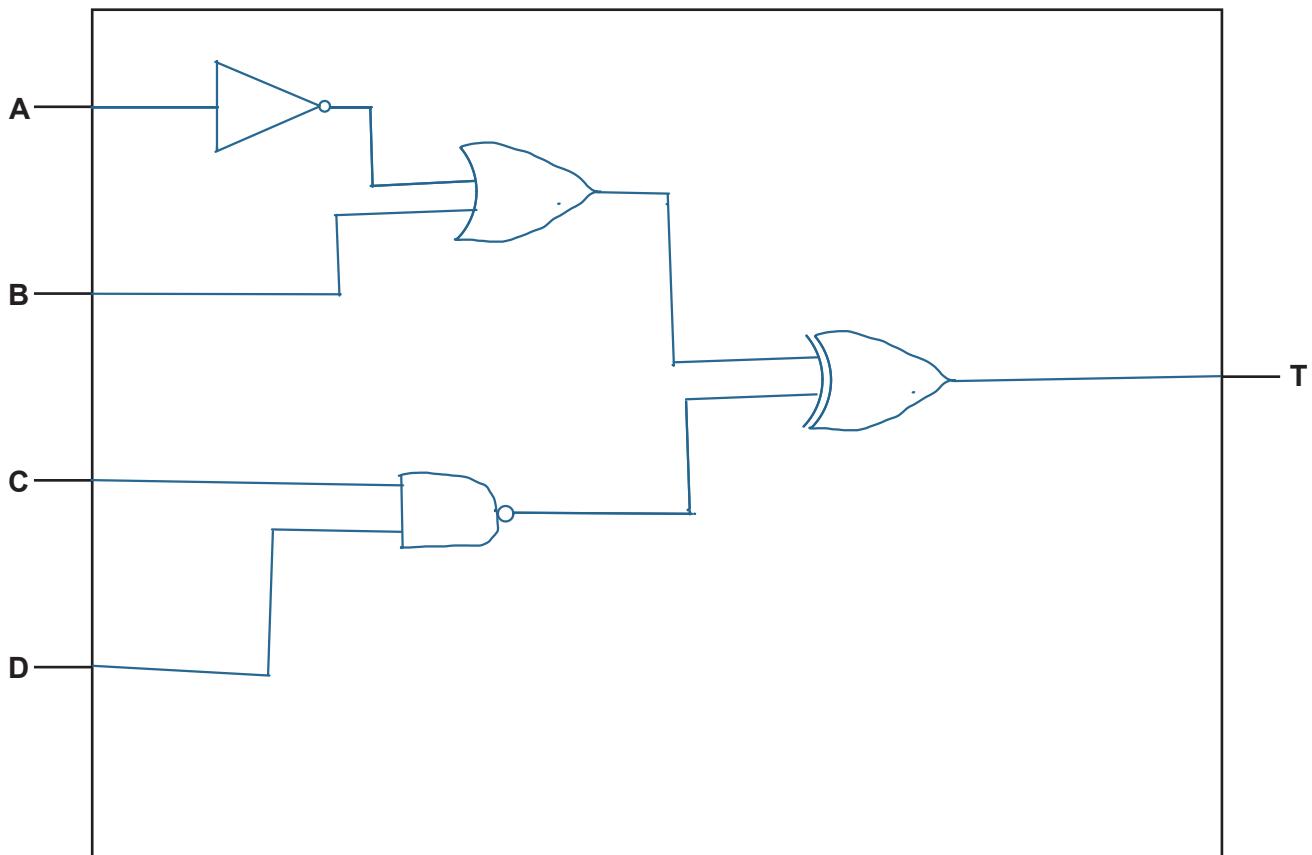
- (ii) The network makes use of subnetting.

Describe **two** benefits of subnetting a network.

[4]

- 5 (a) Draw the logic circuit for this logic expression:

$$T = (\text{NOT } A \text{ OR } B) \text{ XOR } (C \text{ NAND } D)$$



[2]

- (b) Describe the function of the NAND and NOR logic gates.

NAND 0 is only output when both inputs are 1 // 1 is only output when none, or (either) one of the inputs is 1

NOR 1 is only output when both inputs are 0 // 0 is only output when (either) one or both inputs are 1

[2]

- 6 An interrupt is generated when a key is pressed on a computer keyboard.

Explain how the computer handles this interrupt.

- ~ An interrupt flag is raised in the (interrupt) register
- ~ At the end of the current FE cycle // at the start of the next FE cycle
- ~ The system checks the interrupt register for higher priority interrupts than current process
- ~ If true, it stores the current contents of the registers on the stack
- ~ The appropriate interrupt service routine (ISR) for the key press is called
- ~ The input data from the keyboard is processed
- ~ The contents of the registers are restored from the stack
- ~ ... and control is passed back to previous process

[5]

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