Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5440440993

COMPUTER SCIENCE **9618/12**

Paper 1 Theory Fundamentals **October/November 2021**

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

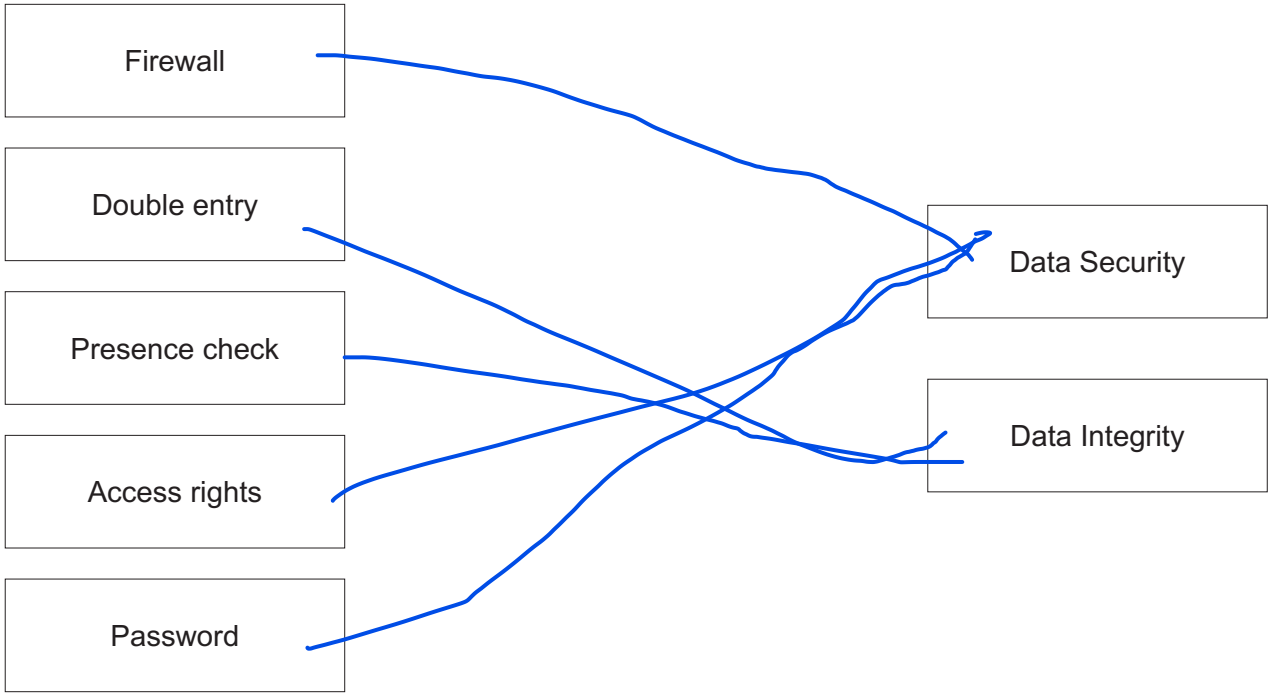
- The total mark for this paper is 75.
- The number of marks for each question or part question is shown in brackets [ ].
- No marks will be awarded for using brand names of software packages or hardware.

This document has **16** pages. Any blank pages are indicated.

1 When designing computer systems, it is important to consider the security, integrity and privacy of the data.

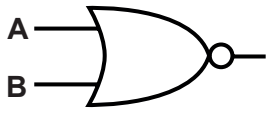
Draw **one** line from each measure to indicate whether it keeps data secure or protects the integrity of data.

Measure

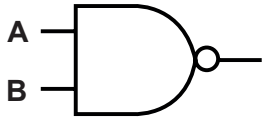


[2]

2 **(a)** Complete the truth table for each of the following two logic gates.



A	B	Output
0	0	1
0	1	0
1	0	0
1	1	0

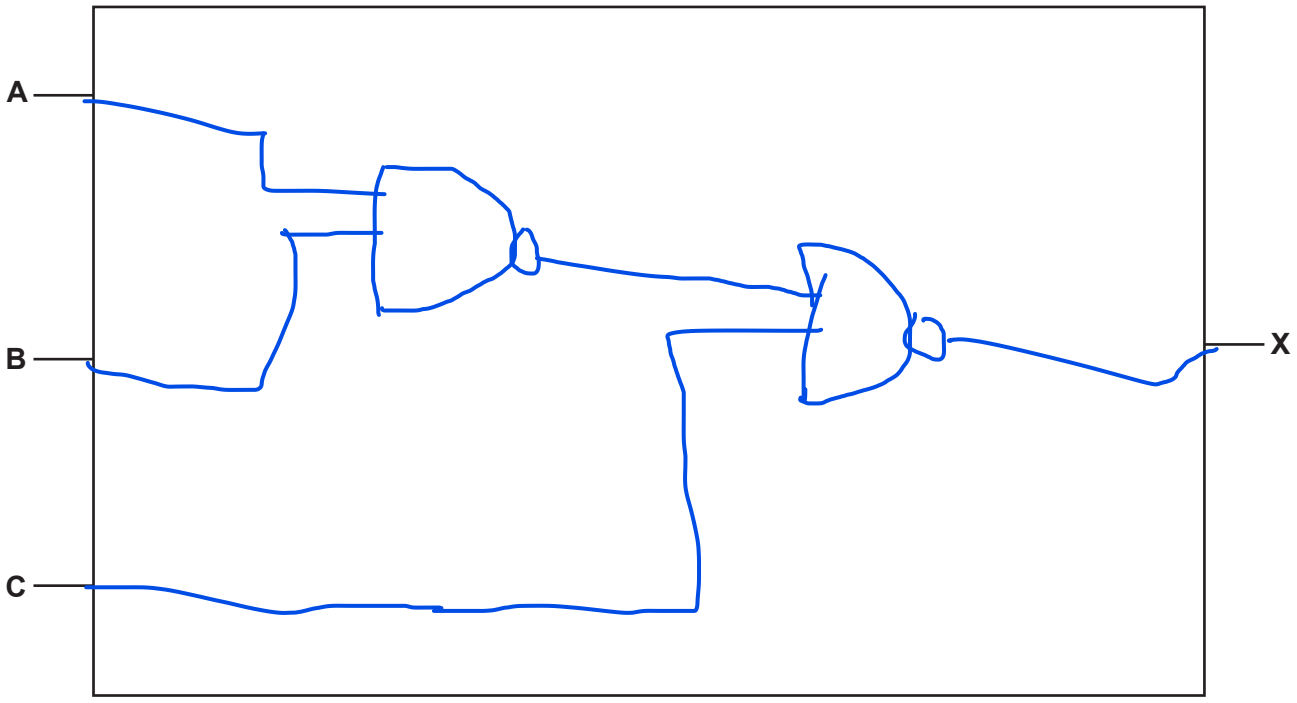


A	B	Output
0	0	1
0	1	1
1	0	1
1	1	0

[2]

(b) Draw a logic circuit for the following logic expression.

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



[2]

3 Andy likes to play computer games.

(a) Andy uses several input devices to play the games. These include a keyboard and a microphone.

Describe the principal operation of a microphone.

- The microphone has a diaphragm / ribbon
- The incoming sound waves cause vibrations of the diaphragm
- … causing a coil to move past a magnet // causing a magnet to move past a coil (dynamic microphone) // changing the capacitance (condenser microphone) // deforms the crystal (crystal microphone)
- An electrical signal is produced

[3]

(b) Andy plays some of the computer games over the internet. He has several devices that connect wirelessly to the router in his house.

(i) Identify the topology of Andy's home network. Justify your choice.

Topology star topology

Justification Devices are connected directly to the router independently // all devices are only connected to the router

[2]

(ii) The router has a wireless access point (WAP) to allow the devices to connect wirelessly.

Identify **three** functions of the router in Andy's network.

- To receive packets from devices or the Internet
- To forward / route packets to the destination
- To find the destination of the packet
- To assign / allocate private IP addresses to devices on LAN
- To store / update / maintain a routing table
- To find the most efficient path to the destination
- To maintain a table of MAC and IP addresses

[3]

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4 A register stores the following binary number:

1	1	0	0	1	1	0	1

(a) The binary value in the register represents an unsigned binary integer.

Convert the unsigned binary integer into denary.

205 ..... [1]

(b) The binary value in the register represents a two's complement binary integer.

Convert the two's complement binary integer into denary.

-51 ..... [1]

(c) The binary value in the register represents a hexadecimal number.

Convert the binary number into hexadecimal.

CD ..... [1]

(d) State why the value in the register cannot be interpreted as a Binary Coded Decimal (BCD).

The denary value in each group of 4 bits is greater than 9
// the denary value in each nibble is greater than 9 [1]

(e) The binary contents of **two** registers are:

Register 1	0	0	1	1	1	1	0	1
Register 2	0	0	1	0	1	1	0	1

(i) Add the contents of **Register 1** and **Register 2**. Show your working.

```
 0011 1101
+0010 1101
----------
 0110 1010
```

Answer 0110 1010 ..... [2]

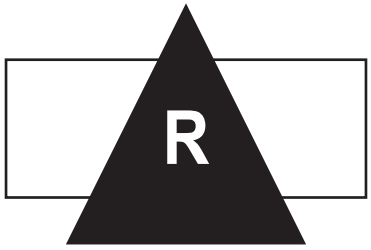
(ii) Subtract the contents of **Register 2** from the contents of **Register 1**. Show your working.

```
  0011 1101
+ 1101 0011
-----------
  0001 0000
```

Answer ..... 0001 0000 .....

[2]

5 Riya has created the following logo as a vector graphic.



(a) Complete the table by writing a description of each vector graphic term **and** give an example for this logo.

Term	Description	Example from logo
Property	data about the shapes // defines one aspect of the appearance of the drawing object	e.g. black line // white fill // black fill //solid (line) // font of letter // colour of triangle
Drawing list	the list of shapes involved in an image // a list that stores the command/description required to draw each object	e.g. triangle // capital letter R // rectangle // line

[4]

(b) Riya takes a photograph using a digital camera. The photograph is stored as a bitmap image.

(i) Describe **two** differences between a vector graphic and a bitmap image.

- Bitmap made up of pixels // bitmap is made of colours stored for individual pixels
- Vector graphic store a set of instructions about how to draw the shape
- When bitmap is enlarged the pixels get bigger and it pixelates
- When vector is enlarged it is recalculated and does not pixelate
- Bitmap files are usually bigger than vector graphics files because of the need to store data about each pixel
- Vector graphics have smaller file size because they contain just the instructions to create the shapes
- Bitmap images can be compressed with significant reduction in file size
- Vector graphic images do not compress well because of little redundant data

[4]

(ii) Riya needs to email the photograph. She compresses the photograph before sending it using an email.

Describe **two** lossy methods that Riya can use to compress the image.

• Reduce bit depth
• ... reduces the number of bits per colour / pixel which means each pixel
has fewer bits
• Reduce colour palette // reduce number of colours
• ... fewer colours mean fewer bits needed to store each colour
• Reduce image resolution
• ... fewer pixels per unit measurement means less binary to store

[4]

6 A shop sells plants to customers. The shop manager has a relational database to keep track of the sales.

The database, PLANTSALES, has the following structure:

PLANT(PlantName, QuantityInStock, Cost)

CUSTOMER(CustomerID, FirstName, LastName, Address, Email)

PURCHASE(PurchaseID, CustomerID)

PURCHASE_ITEM(PurchaseID, PlantName, Quantity)

(a) The database is normalised.

(i) The table lists the following three stages of normalisation:

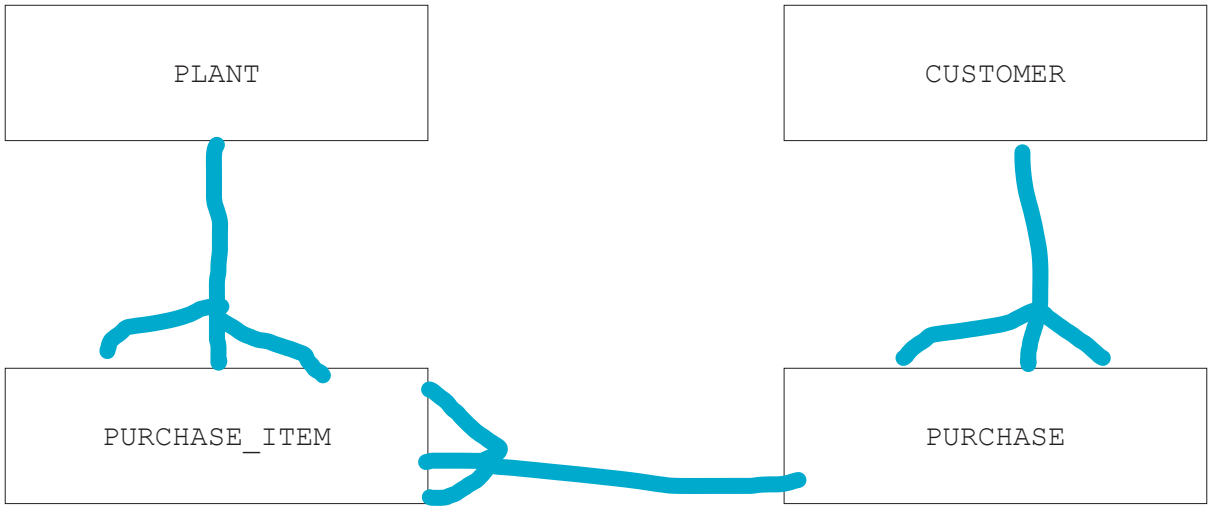
- The first stage is from a database that is not normalised (0NF) to First Normal Form (1NF).
- The second stage is from 1NF to Second Normal Form (2NF).
- The third stage is from 2NF to Third Normal Form (3NF).

Tick (✓) **one** box in each row to identify the appropriate stage for each task.

Task	Normalisation stage		
	0NF to 1NF	1NF to 2NF	2NF to 3NF
Remove any partial key dependencies		•	
Remove any repeating groups of attributes	•		
Remove any non-key dependencies			•

[2]

(ii) Draw an entity-relationship (E-R) diagram for the database PLANTSALES.



[3]

(b) The shop manager uses a Database Management System (DBMS).

Describe the purpose **and** contents of the data dictionary in the DBMS.

1 mark for description of purpose :

- Stores metadata about the database

1 mark for each example of contents to max 2:

- field / attribute names
- table name
- validation rules
- data types
- primary keys // foreign keys
- relationships

[3]

(c) The shop manager uses both Data Definition Language (DDL) and Data Manipulation Language (DML) statements to create and search the database.

(i) Complete the DML statements to return the total number of items purchased with the purchase ID of 3011A.

```
SELECT SUM(Quantity)
FROM PURCHASE_ITEM
WHERE PurchaseID = "3011A";
```

[4]

(ii) Write DDL statements to include a field in the table `PURCHASE` to store the date of the order.

- ALTER TABLE PURCHASE
- ADD OrderDate
- Suitable data type, e.g. DATE

```
ALTER TABLE PURCHASE
ADD OrderDate DATE;
```

[3]

7 A computer has system software.

(a) The Operating System handles interrupts.

Tick (✓) **one** box in each row to identify whether each event is an example of a hardware interrupt or a software interrupt.

Event	Hardware interrupt	Software interrupt
Buffer full		•
Printer is out of paper	•	
User has pressed a key on the keyboard	•	
Division by zero		•
Power failure	•	
Stack overflow		•

[3]

(b) Describe the file management tasks that an Operating System performs.

- Storage space is divided into file allocation units
- Space is allocated to particular files
- Maintains / creates directory structures
- Specifies the logical method of file storage (e.g. FAT or NTFS)
- Provides file naming conventions
- Controls access // implements access rights // implements password protection // Makes file sharing possible
- Specifies tasks that can be performed on a file (e.g. open, close, delete, copy, create, move etc.)

[4]

(c) Identify **two** utility programs that can be used to improve the performance of a computer **and** state how they improve the performance.

- Defragmentation
- Less time is taken to access files because each one is contiguous so there is less head movement

- Virus checker
- makes more RAM available for programs to run
- ... because it removes software that might be taking up memory / replicating

- Disk repair / Disk contents analysis
- preventing bad sectors being used because it identifies / marks them
- reduces access times by optimising storage

- Disk/system clean up
- releases storage by removing unwanted / temporary files

[4]

8 The Von Neumann model for a computer system uses registers.

(a) Describe the role of the following special purpose registers in the fetch-execute (F-E) cycle.

(i) Memory Address Register (MAR)

- Stores the next address to be fetched
- ... held in the Program Counter (PC)
- The data at this address is then fetched

Memory Data Register (MDR)

- Stores the data from the address pointed to by the MAR
- The data in it is copied to the Current Instruction Register (CIR)

[4]

(ii) Another special purpose register is the Index Register.

Identify **one other** special purpose register used in the Von Neumann model for a computer system.

Program Counter (PC)
Current Instruction Register (CIR)
Status register
Interrupt register

[1]

(b) The following table shows part of the instruction set for a processor. The processor has one general purpose register, 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
STO	<address>	Store the contents of ACC at the given address
INC	<register>	Add 1 to the contents of the register (ACC or IX)
CMP	<address>	Compare the contents of ACC with the contents of <address>
JPN	<address>	Following a compare instruction, jump to <address> if the compare was False
JMP	<address>	Jump to the given address
IN		Key in a character and store its ASCII value in ACC
OUT		Output to the screen the character whose ASCII value is stored in ACC
END		Return control to the operating system
XOR	#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	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>
AND	#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>
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		

The current contents of main memory are shown:

Address	Data
100	01010101
101	11110000
102	00001111
103	00000000
104	11111111

(i) In the following table, each row shows the current contents of the ACC in binary and the instruction that will be performed on those contents.

Complete the table by writing the new contents of the ACC after the execution of each instruction.

Current contents of the ACC	Instruction	New contents of the ACC
01010101	XOR 101	1010 0101
11110000	AND 104	1111 0000
00001111	LSL #4	1111 0000
11111111	OR 102	1111 1111

[4]

(ii) The following table contains five assembly language instruction groups.

Write an appropriate assembly language instruction for each instruction group, using the given instruction set. The first one has been completed for you.

Instruction Group	Instruction
Data movement	LDM #2
Input and output of data	IN / OUT
Arithmetic operations	INC ACC / INC IX
Unconditional and conditional instructions	JPN 100 / JMP 100
Compare instructions	CMP 100

[4]

(iii) The opcode `LDM` uses immediate addressing. The opcode `LDD` uses direct addressing.

Identify **and** describe **one additional** mode of addressing.

• Indirect addressing
  • the address to be used is at the given address

• Relative addressing
  • the address to be used is an offset number of locations away, relative to the address of the current instruction

• Indexed addressing
  • form the address from the given address plus the

[2]