1 **(a)** Complete the following description.

A kibibyte has a ..... prefix. Three kibibytes is the same as ..... bytes.

A megabyte has a ..... prefix. Two terabytes is the same as ..... gigabytes.

[4]

(b) Convert the denary number 241 to hexadecimal.

.....

..... [1]

(c) State what is meant by an **overflow in binary addition**.

.....

..... [1]

(d) Computers use character sets when representing characters in binary.

(i) Complete the table by identifying the number of bits each of the character sets allocates to each character.

Character set	Number of bits
ASCII	
extended ASCII	
Unicode	

[1]

(ii) Explain how the word 'Clock' is represented by a character set.

.....

.....

.....

..... [2]

2 A photograph is stored as a bitmap image.

(a) The photograph has a resolution of 4000 pixels wide by 3000 pixels high. The bit depth is 4 bytes.

Calculate an estimate for the file size of the photograph in megabytes.

Show your working.

Working .....

.....

.....

Answer ..... megabytes

[2]

(b) The photograph is compressed before being uploaded to a web server.

(i) Give **three** benefits of this photograph being compressed using lossy compression instead of lossless compression.

1 .....

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2 .....

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3 .....

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[3]

(ii) Explain how run-length encoding (RLE) will compress the photograph.

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..... [2]

(c) Identify **two** elements of a bitmap image that can be changed to reduce its file size.

1 .....

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2 .....

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[2]

3 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
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
DEC	<register>	Subtract 1 from the contents of the register (ACC or IX)
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)
<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 shown:

Address	Data
48	51
49	6
50	48
51	50
52	49
53	50
54	6

The current contents of the ACC and IX are shown:

ACC	2
IX	50

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

Program number	Code	ACC content

1	`LDM #50`
	`INC ACC`
	`SUB #1`	

2	`LDI 51` `ADD 52`	

3	`LDR #2`
	`LDX 50`
	`DEC ACC`	

4	`LDD 52`
	`SUB 54`
	`INC ACC`	

[4]

(b) The processor 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>
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 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		

The current contents of memory are shown:

Address	Data
100	00001101
101	10111110
102	11110011
103	00110111
104	00000000

The current content of the ACC is shown:

1	1	1	1	1	1	1	1

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

The binary number 11111111 is reloaded into the ACC before each instruction is run.

Instruction number	Instruction	ACC content
1	`LSL #2`	
2	`XOR 100`	
3	`AND 103`	

[3]

4 A theatre wants to use a database to store data about the shows that are scheduled, their customers and the seats that the customers have booked.

In the theatre:

- Each show can take place on multiple dates.
- Some dates can have more than one performance.
- There are multiple rows of seats.
- Each seat can be individually booked by its row letter and seat number, for example row E seat 2.

Part of the database design includes these tables:

SHOW(ShowID, Title, Duration)

SEAT(SeatID, RowLetter, SeatNumber)

PERFORMANCE(PerformanceID, ShowID, ShowDate, StartTime)

(a) Identify the relationship between the tables PERFORMANCE and SHOW.

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..... [1]

(b) Sample data for the table PERFORMANCE is shown:

PerformanceID	ShowID	ShowDate	StartTime
0001	MK12	5/5/2025	13:00
0002	MK12	5/5/2025	19:30
0003	MK12	6/5/2025	19:00
0004	OP3	7/5/2025	18:30
0005	OP3	8/5/2025	18:30
0006	OP3	9/5/2025	13:00

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

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..... [4]

(c) Write an SQL script to return the number of times each show is scheduled. For example, in the sample data in part **(b)**, the show MK12 is scheduled three times.

The result needs to include the show name and a suitable field name for the number of times it is scheduled.

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..... [4]

(d) Customers give their first name, last name and email address when they are making a booking. One booking can include multiple seats.

Describe the additional tables that will need to be included in the database **and** explain how these tables will be linked within the database.

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..... [5]

5 A multimedia design company has an office with a LAN (local area network). The LAN can have up to 20 devices connected with cables and other devices connected using wireless access.

(a) The company has private cloud storage for its employees to store their work.

(i) Define the term **private cloud**.

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..... [1]

(ii) Describe the benefits to the company of using private cloud storage instead of public cloud storage.

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..... [3]

(b) Part of the internal structure of the wired LAN is a star topology.

Explain how packets are transmitted between two devices in a star topology.

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..... [2]

(c) A different part of the network uses the Ethernet protocol.

(i) A collision is detected.

Describe how the collision is managed using Carrier Sense Multiple Access/Collision Detection (CSMA/CD).

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..... [2]

(ii) Identify **two** drawbacks of using CSMA/CD.

1 .....

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2 .....

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[2]

(d) The devices in the office have static private IP addresses.

State what is meant by a **static private IP address**.

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..... [1]

6 Each of the following truth tables has three inputs (**A**, **B** and **C**) and one output (**X**).

Draw **one** line to match each truth table with its logic expression.

Truth table

A	B	C	X
0	0	0	0
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

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

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

Logic expression

NOT (**A** XOR **B**) AND **C**

(**A** OR **C**) AND NOT **B**

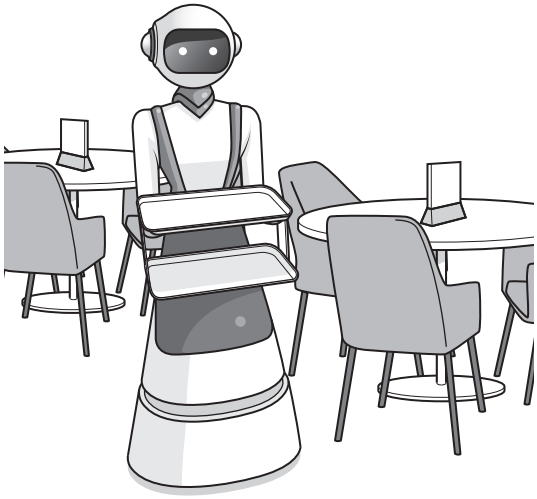
A NAND **B** NAND **C**

(**A** NAND **B**) OR **C**

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

[3]

7 Robots are used to serve food and drink to customers at a restaurant.



(a) A robot navigates through the restaurant to the table it is serving.

Complete the table by identifying **two** sensors that can be included in the robot **and** the purpose of each sensor in the navigation system.

Sensor	Purpose of sensor in navigation system
.....	.....
.....	.....
.....	.....
.....	.....

[2]

(b) The robot uses Artificial Intelligence (AI) to communicate with the customers. The customers speak to the robot to order their food and drinks.

Explain how AI will be used in this part of the robot.

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..... [3]

(c) The navigation system can be considered an example of a control system.

Describe how feedback is used in a control system.

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..... [2]

(d) The robot includes a touchscreen for the customer to make their payment.

Describe the principal operation of a touchscreen.

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..... [4]

(e) Program libraries were used when writing the robot's software.

(i) State what is meant by a **program library**.

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..... [1]

(ii) Some program libraries include Dynamic Link Library (DLL) files.

Describe the benefits of a programmer using a library with DLL files instead of using a library that does not include DLL files.

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..... [4]

(f) The data from the robots is transmitted to a central computer using a wireless connection.

(i) Complete the table by identifying **and** describing **two** methods of data verification that can be used during data transfer.

	Method	Description
1	.....	.....
	.....	.....
	.....	.....
		.....
		.....
		.....
2	.....	.....
	.....	.....
	.....	.....
		.....
		.....
		.....

[4]

(ii) Explain how encryption can protect the security of data during transmission.

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..... [2]