Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4877195459

COMPUTER SCIENCE **9618/11**

Paper 1 Theory Fundamentals **October/November 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.

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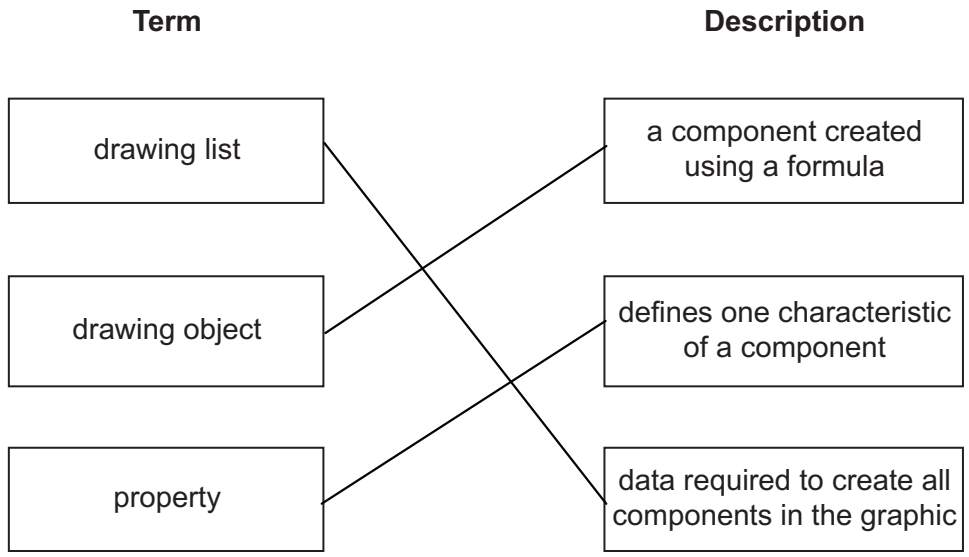
1 **(a)** Draw **one** line from each vector graphic term to its most appropriate description.



[2]

(b) State what is meant by the **bit depth** of a bitmap image **and** explain how changing the bit depth affects the image.

- The number of bits used to represent each colour
- Increase in bit depth means the image has a greater range of colours // Decrease in bit depth means the image has a smaller range of colours
- Increase in bit depth makes the image closer to the original / more realistic // Decrease in

[3]

(c) Explain why a bitmap image is often compressed before it is attached to an email.

- Reduced bandwidth usage when transmitting the message
- Reduced transmission time from email client to email server
- Reduced storage space on the email
- Email accounts often have a maximum size for an attachment

[2]

2 A school has a Local Area Network (LAN).

(a) The LAN connects to the internet using a router.

Describe the function of a router in a network.

- Receives packets from internet / external network
- Implements a firewall
- Analyses the destination IP address of each packet
- Forwards the packet towards its destination // send packets onto local network or external network
- ...using the routing table
- Maintains / updates the routing
- Allocates private IP addresses
- Finds the most efficient route to the destination
- Changes the packet format for transmission over the next network //
- Network Address Translation (NAT):NAT is a technique used by routers to allow multiple devices in a private local area network (LAN) to share a single public IP address.

[3]

(b) Complete the following table by writing the purpose of each of these other hardware devices used to support the LAN.

Hardware device	Purpose
switch	• To allow two or more devices to communicate with one another • To connect individual devices to each other • To receive transmissions and forward them to their destination
Wireless Access Point (WAP)	• To allow connection of devices (to the central device) using radio signals / Wi-Fi • To allow the central device to send / receive radio signals / Wi-Fi signals • To allow wireless enabled devices to connect to a wired network
bridge	• To connect two LANs / segments with the same protocol • To transmit data between two networks with the same protocol

[3]

(c) The students can save their school files on a public cloud.

Identify **two** drawbacks of the students storing their files on the public cloud.

- The students cannot access their files without a reliable internet connection
- The amount of space for no payment may be limited so students will have to purchase more space if needed
- The students do not have control over the backup (or security) of their work OR the students are dependent on a third party for the (security and) backing up of their work

[2]

(d) A new classroom is being set up with 20 computers and a switch.

Explain **one** advantage of implementing a star topology instead of a bus topology in the new classroom.

- Star topology is more resilient to faults
- …because there is no single cable and leads to less disruption to teaching

- Higher performance as fewer collisions
- ...because each device in the classroom is only connected to the switch

[2]

- Easier to add new nodes
- …because each device in the classroom connects directly to the switch

- Easier to fault find compared to bus topology

3 A shop manager has designed a relational database to store customer orders.

The database will have the following tables:

CUSTOMER(CustomerID, FirstName, LastName, Town)

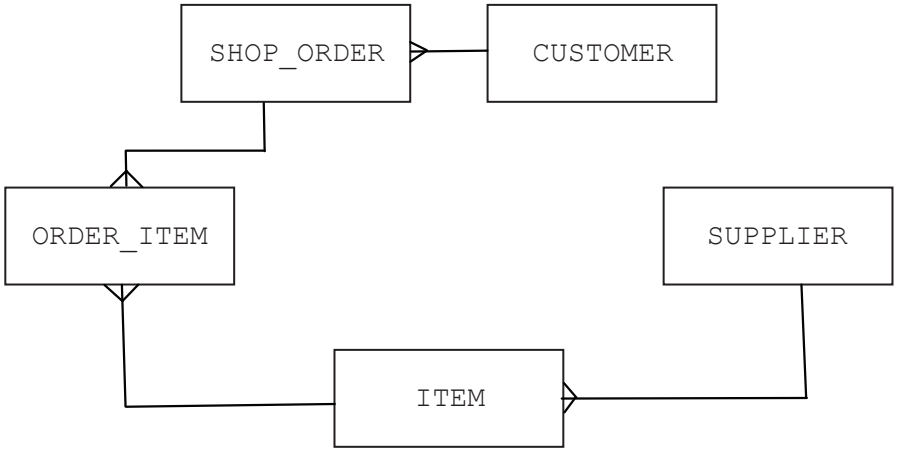
SHOP_ORDER(OrderNo, CustomerID, OrderDate)

SUPPLIER(SupplierID, EmailAddress, TelephoneNumber)

ITEM(ItemNumber, SupplierID, Description, Price)

ORDER_ITEM(ItemNumber, OrderNo, Quantity)

(a) Complete the entity-relationship (E-R) diagram for the relational database.



[3]

(b) Identify **three** advantages of a relational database compared to a file-based approach.

1 ....

- Reduced data redundancy
- Improved data integrity / consistency / referential integrity
- Allows for views / improved privacy
- Allows for program-data independence
- Complex queries can be executed

3 ....

....

[3]

(c) (i) Write a Structured Query Language (SQL) script to define the database called `SHOP`.

```
CREATE DATABASE SHOP;
```

[1]

(ii) Write the SQL script to return the total quantity of items that the customer with the ID of HJ231 has ordered.

```
SELECT SUM(Quantity)
FROM ORDER_ITEM, SHOP_ORDER
WHERE ORDER_ITEM.OrderNo = SHOP_ORDER.OrderNo
AND SHOP_ORDER.CustomerID = 'HJ231';

OR

SELECT SUM(Quantity)
FROM ORDER_ITEM (INNER) JOIN SHOP_ORDER
ON ORDER_ITEM.OrderNo = SHOP_ORDER.OrderNo
WHERE SHOP_ORDER.CustomerID = 'HJ231';
```

[4]

[Turn over

4 **(a)** Complete the truth table for the logic expression:

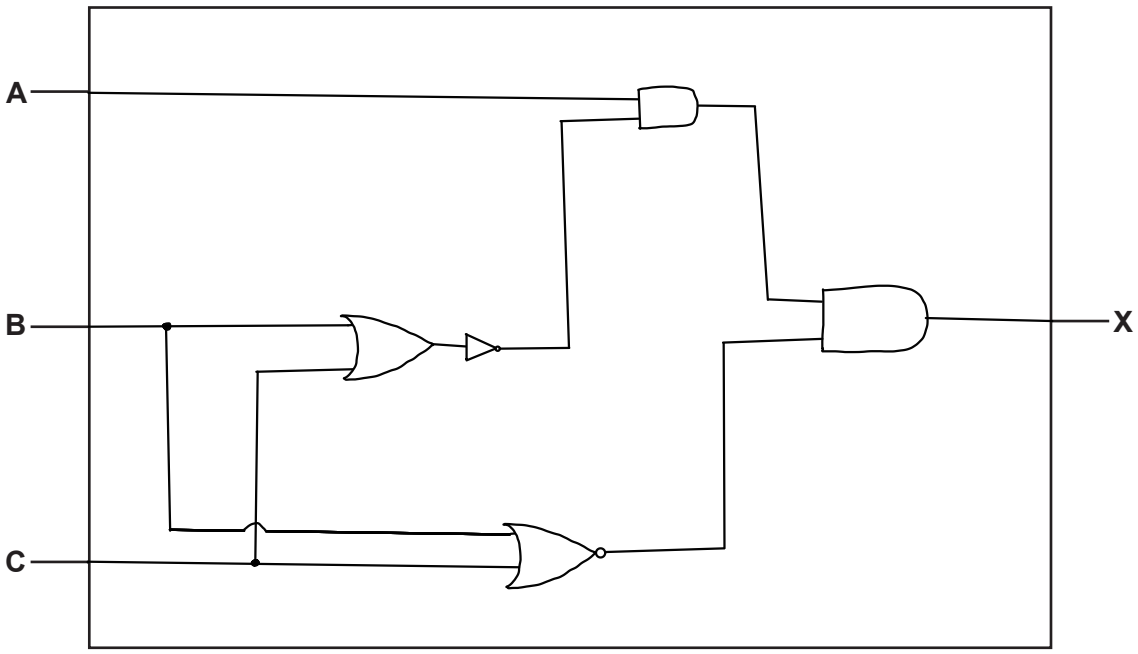
X = NOT (**A** NAND **B**) XOR (NOT **B** AND (**B** NOR **C**))

A	B	C	Working space	X
0	0	0		1
0	0	1		0
0	1	0		0
0	1	1		0
1	0	0		1
1	0	1		0
1	1	0		1
1	1	1		1

[2]

(b) Draw a logic circuit for the logic expression:

X = (**A** AND NOT (**B** OR **C**)) AND (**B** NOR **C**)



[2]

5 The Central Processing Unit (CPU) of the basic Von Neumann model for a computer system contains several special purpose registers.

(a) The Memory Data Register (MDR), Index Register (IX) and the Accumulator (ACC) are examples of special purpose registers.

Identify **two other** special purpose registers **and** state their role in the CPU.

- Program Counter (PC)
- stores the address where the next instruction is to be read from

Role

- Memory Address Register (MAR)
- stores the address of the memory location (or an I/O component) currently being read from or written to

- Current Instruction Register (CIR)
- holds the instruction currently being decoded and/or executed

Role

- Status Register
- Contains bits which can be referenced individually and set or cleared depending on the operation e.g. overflow, underflow

[4]

(b) Describe what is meant by the **Immediate Access Store (IAS)** in a computer system.

- Immediate Access Store holds all the data / instructions / programs currently in use
- Immediate Access Store is volatile memory
- Immediate Access Store has fast access times

[2]

(c) A computer has a single 2.1 GHz CPU.

(i) Describe how increasing the clock speed to 4 GHz can increase the performance of the computer.

- The CPU can now perform nearly twice as many F-E cycles per second
- Instead of 2.1 billion F-E cycles per second, the CPU can now perform 4 billion FE cycles per second

[1]

(ii) A second computer has a CPU with two 2.1 GHz cores.

Explain why the second computer does not always run twice as fast as the computer with one 2.1 GHz CPU.

- Multiple cores introduce additional overheads
- …because of the need for communication between cores
- Software may not be designed for multiple cores…
- …so one of the cores will be left idle
- Memory access speed may not match speed of cores…
- …so causing delay
- The two computers may have more differences than just the cores
- …one may have more RAM which allows faster multitasking
- ...one may have a GPU
- ...etc.

[5]

6 A programmer uses both a compiler and an interpreter to translate a program written in a high-level language.

(a) Describe the advantages of using the interpreter compared to the compiler to translate the program.

- easier to debug the program
- … because it translates line-by-line and stops when an error is found whereas the compiler translates all the program at the same time
- … only reporting one error at a time
- … which allows the error to be corrected in real time whereas the program would need to be corrected and recompiled
- ... and the program can restart at same point when error occurred with a compiler the program needs to be re-run
- The effect of any changes made by the programmer can be seen immediately with a compiler the effects can only be seen after re-running
- A partially completed program can be translated / tested on its own a compiler cannot translate a partial program

[4]

(b) State **one** reason why some high-level languages are partially compiled and partially interpreted.

- Partially compiled programs can be used on different platforms as they are interpreted when run
- Code is optimised for the CPU as machine code is generated at run time
- Source code does not need recompiling so more efficient to run

[1]

(c) **(i)** Identify **two** features that support the visual presentation of the code in a typical Integrated Development Environment (IDE).

1 • Prettyprint
• Expand/collapse code blocks
• Auto indentation / formatting

2

[2]

(ii) Identify **two** features that support the debugging of the code in a typical IDE.

1 • Single stepping
• Breakpoints
• Report window
• Variable expressions

2

[2]

7 **(a)** Describe the principal operations of a 3D printer.

- Additive manufacturing
- Uses a digital 3D model or a Computer Aided Design (CAD) (file)
- Builds up the model one layer at a time
- ...starting from the bottom
- ...using x, y and z co-ordinates
- The material is fused / cured together layer by layer

~Fused Deposition Modelling (FDM)
- Material is heated and pushed through nozzle / extruder

~Stereolithography (SLA)
- Photosensitive liquid resin is exposed to a UV-laser beam

~Digital Light Processing (DLP)
- Uses liquid plastic resin melted with arc lamps

~Selective Laser Sintering (SLS)
- Uses a laser to form objects from powdered material

[3]

(b) Describe the purpose of a temperature sensor within the 3D printer.

- To prevent overheating OR ensure material is hot enough
- ...by identifying the temperature of the object (being printed)
- ...by identifying the temperature of the material being used

[2]

(c) A 3D printer contains 1 GB of Dynamic RAM (DRAM) to store print data.

State **two** advantages of the printer having Dynamic RAM instead of Static RAM (SRAM).

1 - Dynamic RAM has lower cost per unit
- A fast access speed is not needed

2 - Higher bit density OR more data can be stored per chip

[2]

8 **(a)** Identify the purpose of the first pass of a two-pass assembler.

To create a symbol table

[1]

(b) 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**	
`LDR`	`#n`	Immediate addressing. Load the number n to IX
`STO`	`<address>`	Store contents of ACC at the given address
`ADD`	`<address>`	Add the contents of the given address to the ACC
`INC`	`<register>`	Add 1 to the contents of the register (ACC or IX)
`CMP`	`#n`	Compare the contents of ACC with number n
`JPE`	`<address>`	Following a compare instruction, jump to <address> if the compare was True
`OUT`		Output to the screen the character whose ASCII value is stored in ACC
<address> can be an absolute or symbolic address # denotes a denary number, e.g. #123		

(i) Give **one** example of an instruction that belongs to **each** of the following instruction groups.

Only use the instructions given in the table. Each instruction must have a suitable operand.

Data movement LDR #50 OR STO 201

Arithmetic operation ADD 100 OR INC IX

Conditional instruction JPE 96

[3]

(ii) The instruction `LDR #2` uses immediate addressing.

Give **one** similarity and **one** difference between direct addressing and indexed addressing.

Similarity

- both load the contents of an address into the Accumulator

Difference

- direct accesses the address given by the operand whereas indexed adds the contents of IX to the operand and accesses the data at that calculated address

[2]

(iii) Identify **one other** mode of addressing.

• Indirect (addressing)
• Relative (addressing

[1]

(c) The following table shows another part of the instruction set for the same processor.

Instruction		Explanation
Opcode	**Operand**	
AND	Bn	Bitwise AND operation of the contents of ACC with the operand
XOR	Bn	Bitwise XOR operation of the contents of ACC with the operand
LSR	#n	Bits in ACC are shifted logically n places to the right. Zeros are introduced on the left hand end
# denotes a denary number, e.g. #123 B denotes a binary number, e.g. B01001101		

(i) The current contents of the ACC are:

0	1	0	0	1	1	1	1

Show the contents of the ACC after the execution of the following instruction.

```
AND B10100101
```

0	0	0	0	0	1	0	1

[1]

(ii) The current contents of the ACC are:

0	0	0	1	0	1	1	1

Show the contents of the ACC after the execution of the following instruction.

```
LSR #3
```

0	0	0	0	0	0	1	0

[1]

(iii) The current contents of the ACC are:

1	1	1	1	0	1	1	1

Show the contents of the ACC after the execution of the following instruction.

```
XOR B00100101
```

1	1	0	1	0	0	1	0

[1]

9 **(a)** Explain the importance of feedback in a control system.

- Feedback ensures that a system operates within set criteria / constraints
- ...by enabling system output to affect (subsequent) system input
- ...thus allowing conditions to be automatically adjusted

[2]

(b) Give **one** example of an embedded system **and** explain why it is an example of an embedded system.

Example

- Dedicated to one task applied to example
- Does not require much processing power applied to example
- Built into a larger system applied to example
- Contains firmware that cannot be easily updated applied to example
- The system does not have its own operating system
- An embedded system must contain a processor, memory and an I/O capability OR Dedicated hardware

[3]