



Cambridge International AS & A Level

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COMPUTER SCIENCE

9618/11

Paper 1 Theory Fundamentals

May/June 2021

50/25
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.

- 1 Anya scans an image into her computer for a school project.

(a) The scanned image is a bitmapped image.

- (i) Complete the following table to describe the two terms about graphics.

Term	Description
Pixel	<i>smallest element in a picture, an image addressable</i> [3]
File header	<i>stores information about the file. store data about the bitmap image.</i> X [2]

- (ii) The image is scanned with an image resolution of 1024×512 pixels, and a colour depth of 8 bits per pixel.

Calculate an estimate for the file size, giving your answer in mebibytes. Show your working.

Working $\frac{1024 \times 512 \times 8}{8 \times 1024 \times 1024} = \frac{512}{1024} = 0.5$

Answer *0.5* mebibytes [3]

(b) The image is compressed using lossless compression.

Identify **one** method of lossless compression that can be used to compress the image **and** describe how the method will reduce the file size.

Lossless compression method *run-length encoding* ✓

Description *group continuous same color together and indicate how many there are to reduce the number of data needed to be stored*

Replace sequences of the same color pixel with color code and number of identical pixels.

- (c) One of the colours used in the image has the hexadecimal colour code:

#FC238A

FC is the amount of red, 23 is the amount of green and 8A is the amount of blue in the colour.

- (i) Convert the hexadecimal code FC into denary.

$$\begin{array}{r} 16^3 \quad 16^0 \\ F \quad C \\ \hline 15 & 12 \\ & 15 \\ & \cancel{8} \\ & 9 \end{array} \quad 15 \times 16 + 12 = 240 + 12 = 252$$

[1]

- (ii) The amount of green in binary is 00100011. This has the denary number 15 added to it to create a second colour.

$$\begin{array}{r} 15 \\ + 9 \\ \hline 24 \end{array}$$

Add the denary number 15 to the binary number 00100011 and give your answer in binary.

Perform the addition in binary. Show your working.

$$\text{Working } 15 = \begin{array}{r} 8 \ 4 \ 2 \ 1 \\ + 0 \ 0 \ 0 \ 0 \ 1 \ 1 \ 1 \\ \hline 0 \ 0 \ 1 \ 1 \ 0 \ 0 \ 1 \ 0 \end{array} = 0000111$$

$$\begin{array}{r} 00100011 \\ + 00001111 \\ \hline 00110010 \end{array}$$

Answer (in binary) 00110010

[3]

- (iii) Hexadecimal 23 in two's complement representation is 00100011. The denary number 10 needs to be subtracted from this value.

Subtract the denary number 10 from the two's complement representation 00100011.

Give your answer in binary. Show your working.

$$\text{Working } 10 = \begin{array}{r} 128 \ 64 \ 32 \ 16 \ 8 \ 4 \ 2 \ 1 \\ + 0 \ 0 \ 0 \ 0 \ 1 \ 0 \ 1 \ 0 \\ \hline 0 \ 0 \ 0 \ 1 \ 0 \ 1 \ 0 \end{array}$$

$$-10 = \begin{array}{r} 1 \ 1 \ 1 \ 1 \ 0 \ 1 \ 0 \ 1 \\ + 1 \ 1 \ 1 \ 1 \ 0 \ 1 \ 1 \ 0 \\ \hline 1 \ 0 \ 0 \ 0 \ 1 \ 1 \ 0 \ 1 \end{array} = 1110110$$

$$\begin{array}{r} 00100011 \\ + 1110110 \\ \hline 100011001 \end{array}$$

Answer (in binary) 100011001

[3]

- (d) Anya made sure that the image was not subject to any copyright before scanning it.

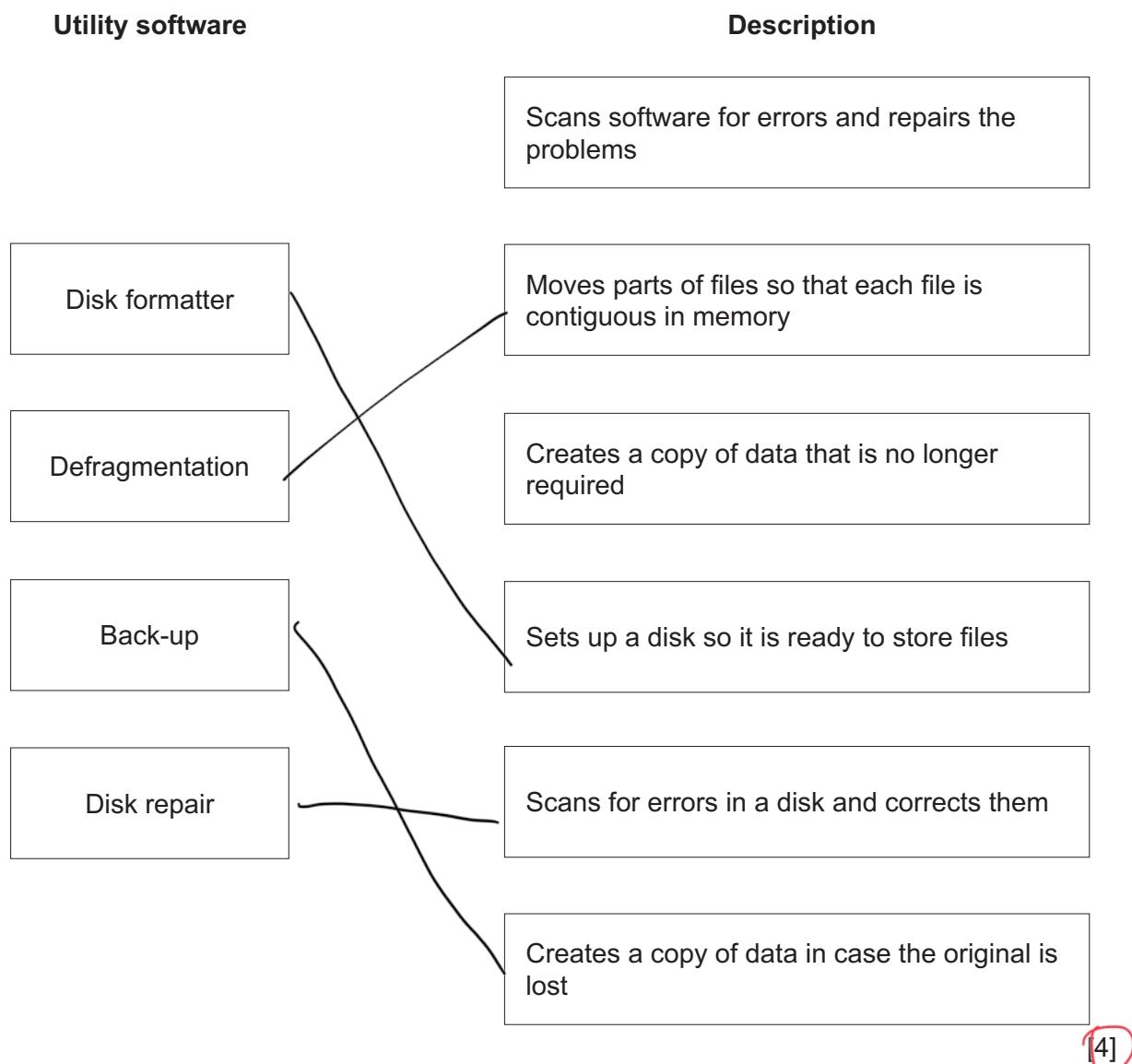
Describe what is meant by **copyright**.

The right to protect one's work.

The formal and legal rights to intellectual property rights... protects against unauthorised reproduction of work. Provides for legal right of redress. [2]

- 2 Bingwen's computer comes with an Operating System and utility software.

- (a) Draw **one** line from each utility software to its correct description.



[4]

- (b) Identify **four** key management tasks that the Operating System will perform.

- 1 *file management*
 - 2 *security management*
 - 3 *hardware management*
 - 4 *User interface* *memory management*
provide *process management.*
- BOD*

[4]

- 3 A processor has one general purpose register, the Accumulator (ACC), and several special purpose registers.

- (a) Complete the following description of the role of the registers in the fetch-execute cycle by writing the missing registers.

The program counter holds the address of the next instruction to be loaded. This address is sent to the Memory address register

The Memory data register holds the data fetched from this address. This data is sent to the Current instruction register and the Control Unit decodes the instruction's opcode.

The program counter is incremented.

[5]

- (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
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
MOV	<register>	Move the contents of the accumulator to the given register (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	<address>	Compare the contents of ACC with the contents of <address>
JPE	<address>	Following a compare instruction, jump to <address> if the compare was True
JPN	<address>	Following a compare instruction, jump to <address> if the compare was False
JMP	<address>	Jump to the given address
OUT		Output to the screen the character whose ASCII value is stored in ACC
END		Return control to the operating system
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 address or a symbolic address # denotes a denary number, e.g. #123		

The current contents of the main memory and selected values from the ASCII character set are shown.

Address	Instruction
200	LDD 365
201	CMP 366
202	JPE 209
203	INC ACC
204	STO 365
205	MOV IX
206	LDX 365
207	OUT
208	JMP 200
209	END
...	
365	1
366	3
367	65
368	66
IX	0

ASCII code table (selected codes only)

ASCII code	Character
65	A
66	B
67	C
68	D

Complete the trace table for the program currently in main memory.

Instruction address	ACC	Memory address				IX	Output
		365	366	367	368		
200	1	1	3	65	66	0	
201							
202							
203	2						
204		2					
205						2	
206	65						
207							A
208							
200	2						
201							
202							
203	3						
204		3					
205						3	
206	66						
207							B
208							
206	3						
201							
202							
209							

(6)

- (c) (i) The Accumulator currently contains the binary number:

0	0	1	1	0	1	0	1
---	---	---	---	---	---	---	---

Write the contents of the Accumulator after the processor has executed the following instruction:

LSL #2

[0		0		0	0
---	--	---	--	---	--	---	---

([1])

- (ii) The Accumulator currently contains the binary number:

0	0	1	1	0	1	0	1
---	---	---	---	---	---	---	---

Identify the mathematical operation that the following instruction will perform on the contents of the accumulator.

LSR #3

divide the number by 2^3 (8).

([1])

4

Melinda and her friends set up a peer-to-peer network between their computers to share data.

(a) Describe the key features of a peer-to-peer network.

~~Each device is connected to every other device.~~ Each computer is responsible for its own security.

~~Mesh network. Each computer provide access to data~~

~~One broke won't effect every one.~~

All computers are of equal status.

Computers can communicate and share resources.

(b) Describe two drawbacks to Melinda and her friends of using a peer-to-peer network.

1 Have a maximum of 10 devices connecting.

Melinda may have more than 10 friends.

No central management of back up, if the data from one computer is not backed up, it is lost to all of them.

2 Hard to set up as each computer need to

connect to every other computer.

Individual computer respond slower as they are being accessed by other computers.

(c) Melinda connects her laptop to the internet through her router.

(i) Tick (✓) one box in each row to identify whether the task is performed by the router or not.

Task	Performed by router	Not performed by router
Receives packets from devices	✓	
Finds the IP address of a Uniform Resource Locator (URL)		✓
Directs each packet to all devices attached to it		✓
Stores the IP and/or MAC address of all devices attached to it	✓	

[2]

- (ii) Melinda mainly uses the internet to watch films and play computer games.

Tick () **one** box to identify whether Melinda should connect to the router using a wired or wireless network **and** justify your choice.

Wired	<input checked="" type="checkbox"/>
Wireless	

Justification while playing games, the stability is important and connecting with wire is more stable than using wireless method.
Less packet loss

Higher band width \Rightarrow less latency

More secure

[3]

①

- (d) Melinda sends emails from her webmail account (email account accessed through a website).

Explain whether Melinda is using the internet, or the World Wide Web (WWW), or both.

Melinda is using ~~both~~. She use ~~WWW~~ by using the website page provided by ~~world wide web~~. She used internet by sending and receiving data packets through ~~internet~~, the infrastructure.

[3]

②

- 5 Kiara has a washing machine and a refrigerator.

- (a) She has an embedded system in her washing machine.

Describe what is meant by an **embedded system**, using the washing machine as an example.

A ~~system designed for a specific purpose~~
 washing machine is specifically designed to wash
 cloths. Microprocessor that performs one specific
 task. Embedded system in washing machine only
 control the program of washing cycle. [2]

- (b) The washing machine's embedded system makes use of both Random Access Memory (RAM) and Read Only Memory (ROM).

State the purpose of RAM and ROM within the washing machine's embedded system.

RAM store current instructions and data to be used

ROM ~~store the system program~~

~~Store the start-up instructions~~

[2]

①

- (c) The temperature in her refrigerator must be kept between 4 and 6 degrees Celsius.

The microprocessor in the refrigerator turns on the cooling if the temperature is too high, and turns off the cooling if the temperature is too low.

Explain why the system in the refrigerator is a control and not a monitoring system.

~~It automatically alter the temperature based on sensor feed backs without warning the user.~~

[2]

- 6 Each of the following algorithms performs data validation.

State the type of validation check that each of the algorithms performs.

(a)

```
INPUT x
IF x < 0 OR x > 10 THEN
    OUTPUT "Invalid"
ENDIF
```

Range check

[1]

(b)

```
INPUT x
IF x = "" THEN
    OUTPUT "Invalid"
ENDIF
```

empty check

presence check

[1]

(c)

```
INPUT x
IF NOT(x = "Red" OR x = "Yellow" OR x = "Blue") THEN
    OUTPUT "Invalid"
ENDIF
```

Type check.

Existence check

[1]

①

Bobby and Kim are discussing databases.

- (a) Bobby tells Kim that a file-based approach is usually better than a relational database.

Explain why Bobby is incorrect.

data updates

*In file-based approach, when one record changes, the other has to be manually changed as well. X
using same record*

everyone can access all the data, no privacy. ✓

No check for invalid input. X

[3]

①

- (b) Bobby has a shop that sells products to customers. His database will store data about his customers, their payment details, orders and the products he sells. Customers will have login details to access their accounts. The database will update customers' payment and login details without keeping any historical records.

- (i) Give **one** example of each of the following relationships from Bobby's database.

one-to-one

Customer and login details. ✓

one-to-many

Customer and orders. ✓

many-to-many

order and product. ✓

[3]

- (ii) Tick (✓) **one** box to identify the relationship that cannot be directly implemented in a normalised relational database.

Relationship	Tick (✓)
one-to-one	
one-to-many	
many-to-many	✓

[1]

- (iii) Bobby wants to name his database SHOPORDERS.

Write a Data Definition Language (DDL) statement to define a new database with the name SHOPORDERS.

~~TABLE SHOPORDERS () ;~~

~~CREATE DATABASE SHOPORDERS ;~~

[1]

- (c) A database has a data dictionary.

Give **three** items that are stored in a data dictionary.

1 ~~produce table name , data type~~

2 ~~Order field name, primary key, Foreign key~~

3 ~~Customer. relationships , type of validation.~~

[3]

- 8 Tick (\checkmark) **one** box in each row to identify the logic gate that each statement describes.

Statement	AND	NAND	NOR	XOR	OR
The output is 1 only when both inputs are 1	\checkmark				
The output is 1 only when both inputs are different				\checkmark	
The output is 1 only when both inputs are 0			\checkmark		

[3]

3

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