Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

2211393414

COMPUTER SCIENCE **9618/11**

Paper 1 Theory Fundamentals **May/June 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.

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	• A single square of one colour • The smallest addressable element in an image
File header	Data about the bitmap image (e.g. number of colours)

[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

1024 × 512 = 524 288 pixels/bytes
524288 / 1024 / 1024

Answer 0.50 mebibytes 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 Replace sequences of the same colour pixel with colour code and number of identical pixels

[3]

(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.

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.

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

Perform the addition in binary. Show your working.

Working ..... Converting 15 to binary 0000 1111
Method for addition
Final answer
0010 0011
0000 1111
0011 0010
1 111

Answer (in binary) .....

[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.

Working ..... Converting 10 to two's complement binary 1111 0110
• Adding values
• Final answer 0001 1001
10 = 0000 1010
–10 = 1111 0110
0010 0011
+ 1111 0110
0001 1001
11 11

Answer (in binary) .....

[3]

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

Describe what is meant by **copyright**.

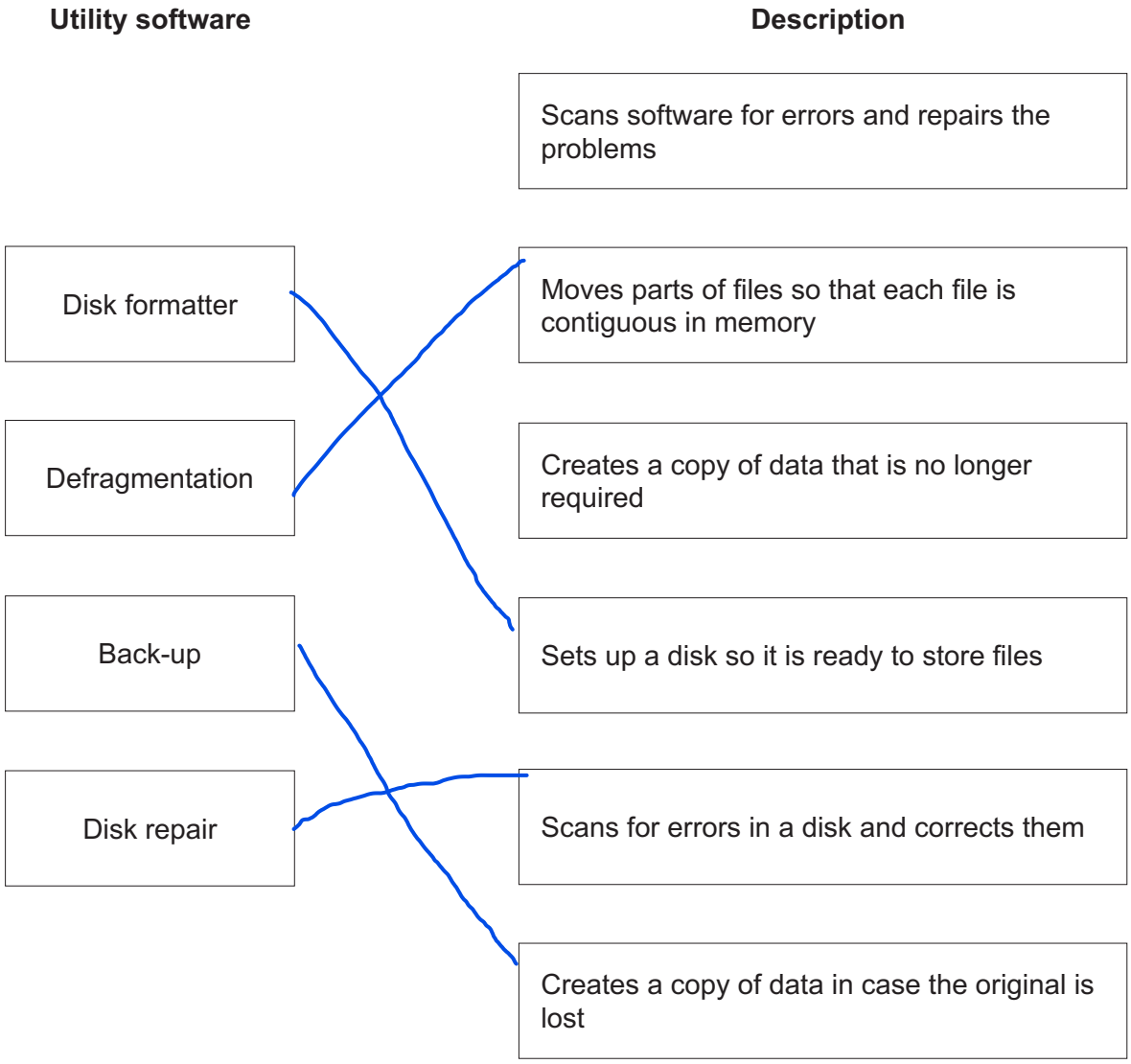
The formal and legal rights to ownership // intellectual property rights

- 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 memory management

2 • file management

3 • security management

4 • hardware / device / peripheral / resources management

[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		
		1	3	65	66	0	
200	1						
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							
200	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
```

1	1	0	1	0	1	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
```

The number is divided by 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.

• All computers are of equal status

• Each computer provides access to resources and data // data is distributed

• Computers can communicate and share resources

• Each computer is responsible for its own security [2]

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

• Reduced security // no central management of security
… only as secure as the weakest computer on the network
… each computer is at risk from viruses from other computers
• No central management of backup
... if the data from one computer is not backed up it is lost to all of them
• No central management of files/software
… consistency may be difficult to maintain
… each computer may have different software from the others
• Individual computers may respond slower
… because they are being accessed by other computers
• In order to share files etc. all the computers involved need to be switched on
... so the files etc. may not be always available

(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
- Faster connection // higher bandwidth
  …. needed as she is downloading/streaming large files
  … less time waiting / less latency / fewer delays
- More reliable / stable connection
  … is less susceptible to issues with distance/walls/interference
- More secure

Wireless
- Freedom of movement
  … can move between different rooms with a mobile device and still receive/transmit data
  … no need of a physical connection
- Easily expanded if friends want to access the same network
- Less cabling / expertise is needed
  ... making the initial setup less expensive

3

(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.

- using internet because sending data on the infrastructure
- using WWW because accessing a website (that is stored on a web server operated by the webmail) that is part of the WWW

3

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.

- Definition: Microprocessor/microcontroller within a larger system // microprocessor/microcontroller that performs one specific task
- Example: e.g. Embedded system in washing machine only controls the programs for the washing cycle // it is part of the washing machine but does not perform any other function within it

[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 the choices/wash program the user has entered // stores the data read from the sensors // stores the time left in the program // by example

ROM • Store the start-up instructions

[2]

(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.

- The system uses feedback
- The system causes the temperature to change // produces an action

[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
```

Presence Check ..... [1]

(c)

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

Existence Check ..... [1]

7 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.

• Flat-file has more data redundancy
• … because the same data is stored many times // data is stored in different tables which are linked
• There is program-data dependence with flat-files because any changes to the structure of the data means the programs that access that data have to be re-written
• Flat-file has more data inconsistency // worse data integrity because duplicated data might be stored differently //…because when data is updated in one place, it is not updated everywhere
• It is not easy to perform complex searches /queries because a new program has to be written each time
• Flat files could have a lack of privacy as user views cannot easily be implemented

[3]

(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

• e.g. customer to payment details // customer to login details

one-to-many

• e.g. customer to order

many-to-many

• e.g. order to product // customer to 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`.

CREATE DATABASE SHOPORDERS ;

..... [1]

(c) A database has a data dictionary.

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

1 • table name • field name // attribute • data type

2 • type of validation • Primary Key

3 • Foreign Key • relationships

[3]

8 Tick (✓) **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	•				
The output is 1 only when both inputs are different				•	
The output is 1 only when both inputs are 0			•		

[3]