Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

AS
COMPUTER SCIENCE

Paper 2

Monday 22 May 2023 Afternoon Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a calculator.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

Advice
- In some questions you are required to indicate your answer by completely shading a lozenge alongside the appropriate answer as shown. ⬬
- If you want to change your answer you must cross out your original answer as shown. ⊠
- If you wish to return to an answer previously crossed out, ring the answer you now wish to select as shown. ⊗

For Examiner's Use	
Question	Mark
1	
2	
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4	
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8	
9	
10	
11	
12	
13	
14	
TOTAL	

Answer **all** questions in the spaces provided.

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0 1 . 1 Shade in **one** lozenge to indicate which of the following values is an irrational number.

[1 mark]

A $\frac{3}{4}$ ⬭

B $\sqrt{2}$ ⬭

C 73 ⬭

D –19 ⬭

0 1 . 2 Shade in **one** lozenge to indicate which of the following values is a natural number.

[1 mark]

A $\frac{3}{4}$ ⬭

B $\sqrt{2}$ ⬭

C 73 ⬭

D –19 ⬭

0 1 . 3 Define the set of real numbers.

[1 mark]

Do not write outside the box

0 1 . 4 Shade in **one** lozenge to indicate which of the following symbols represents the set of numbers most suitable for counting the number of people in a room.

[1 mark]

A $\mathbb{N}$ ⬭

B $\mathbb{Q}$ ⬭

C $\mathbb{R}$ ⬭

D $\mathbb{Z}$ ⬭

0 1 . 5 What is meant by the term **ordinal number**?

[1 mark]

_____

_____

_____

5

Turn over for the next question

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0 2 . 1 Assembly language programmers can use hexadecimal to represent bit patterns instead of binary.

Explain why assembly language programmers will often choose to use hexadecimal in preference to binary.

[1 mark]

0 2 . 2 How many different values can be represented using 10 bits?

[1 mark]

2

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0 3 . 1 Shade in **one** lozenge to indicate which of the following prefixes represents 10^6

[1 mark]

A kibi ⬭

B mebi ⬭

C gibi ⬭

D kilo ⬭

E mega ⬭

F giga ⬭

Question 3 continues on the next page

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0 3 . 2 **Table 1** shows two unsigned binary integers, **Number 1** and **Number 2**.

Complete the table to show the result in binary of adding the two numbers.

You **must** complete the carry row to show the carry from the previous column where there is one.

Table 1

Number 1	0	0	0	1	1	0	1	1
Number 2	0	0	0	0	0	1	1	1
Result								
Carry								

[1 mark]

0 3 . 3 What is the result of subtracting the two's complement binary number `00100100` from the two's complement binary number `00011011`?

You should give your answer in two's complement binary.

You **must** show all your working in binary.

[2 marks]

0 3 . 4 In **decimal**, what are the lowest and highest values that can be represented by an **8-bit two's complement** binary integer?

[1 mark]

Lowest: _____ Highest: _____

Do not write outside the box

0 3 . 5 What is the **decimal** equivalent of the bit pattern shown in **Figure 1** if it represents an **unsigned fixed-point binary** value with two bits before the binary point and six bits after the binary point?

Figure 1

1	1	0	1	1	1	0	1

[2 marks]

7

Turn over for the next question

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0 4 Majority voting and the use of parity bits are two different systems that can be used to detect errors in the transmission of data.

0 4 . 1 Explain why it is better for a majority voting system to send each bit five times instead of four.

[1 mark]

0 4 . 2 Give **two** reasons why using a parity bit system might be preferred to using majority voting when transmitting data.

[2 marks]

0 4 . 3 **Figure 2** shows a bit pattern that a computer has received. Each byte contains a 7-bit ASCII code with a parity bit. The method used when transmitting data was odd parity, with the parity bit being transmitted in the leftmost bit of each byte.

Clearly circle the byte of data which the system calculates has been received **incorrectly.** Spaces have been inserted between each byte for clarity.

Figure 2

0	1	0	1	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	1	1	0	1

[1 mark]

4

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0 5 . 1 Describe how to calculate the minimum storage requirements, excluding metadata, of a bitmapped image.

[1 mark]

One way of representing sound digitally is by using sampling.

0 5 . 2 What is meant by the term **sampling rate**?

[1 mark]

0 5 . 3 What is meant by the term **sample resolution**?

[1 mark]

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0 5 . 4 A sampled sound could be compressed using lossy compression.

Describe a problem that may occur if lossy compression is used and how the compression method has caused this.

[2 marks]

0 5 . 5 An alternative to using sampled sound is MIDI.

State **two** advantages of using MIDI instead of sampled sound.

[2 marks]

7

Turn over for the next question

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0 6 . 1 Libraries are a type of system software.

Describe what libraries are **and** why programmers use them.

[2 marks]

Do not write outside the box

0 6 . 2 Discuss the **advantages and disadvantages** of high-level languages compared to low-level languages.

[6 marks]

8

Turn over for the next question

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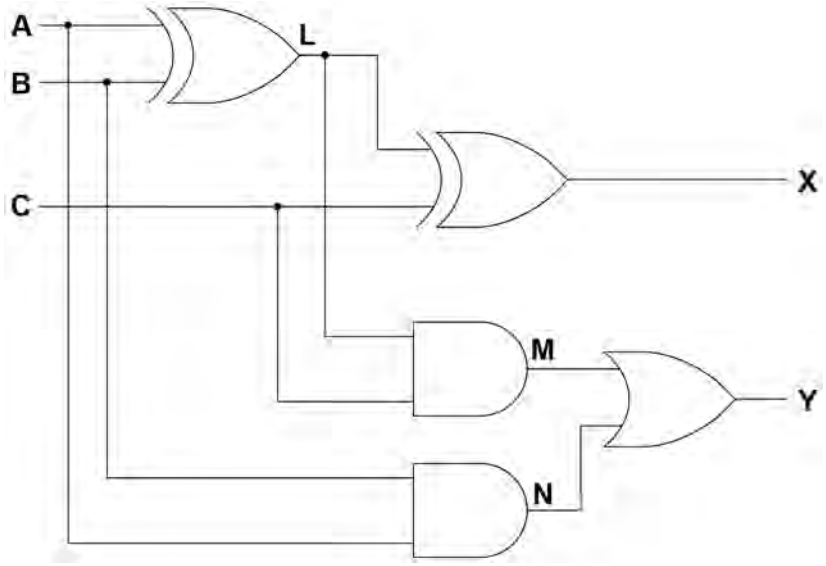
0 7 . 1 **Figure 3** shows a circuit diagram.

Figure 3



Complete the truth table below for the circuit shown in **Figure 3**.

[3 marks]

A	B	C	L	M	N	X	Y
0	0	0		0		0	
0	0	1		0		1	
0	1	0		0		1	
0	1	1		1		0	
1	0	0		0		1	
1	0	1		1		0	
1	1	0		0		0	
1	1	1		0		1	

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0 7 . 2 Using **Figure 3**, write a Boolean expression for output **Y** in terms of inputs **A**, **B** and **C**.
[2 marks]

Y = _____

0 7 . 3 Using the rules of Boolean algebra, simplify the following expression.

$$\overline{\overline{A} + \overline{B}} + B \cdot \overline{A} \cdot \left(\overline{C} + C\right)$$

You **must** show your working.

[4 marks]

9

Turn over for the next question

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0 8 . 1 Explain the role of the status register in a processor **and** describe a circumstance that would result in its contents being updated.

[2 marks]

0 8 . 2 One physical resource that the operating system manages is the processor.

Name another physical resource that the operating system is responsible for managing.

[1 mark]

0 8 . 3 Alice compiles a program on her computer to produce an executable file. Alice can run the executable file on her computer.

Bob's computer has a different processor to Alice's computer.

Explain why having a different processor might make it impossible for Alice's executable file to run on Bob's computer.

[2 marks]

5

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Table 2 shows the standard AQA assembly language instruction set that should be used to answer question **0 9**

Table 2 – standard AQA assembly language instruction set

`LDR Rd, <memory ref>`	Load the value stored in the memory location specified by `<memory ref>` into register `d`.
`STR Rd, <memory ref>`	Store the value that is in register `d` into the memory location specified by `<memory ref>`.
`ADD Rd, Rn, <operand2>`	Add the value specified in `<operand2>` to the value in register `n` and store the result in register `d`.
`SUB Rd, Rn, <operand2>`	Subtract the value specified by `<operand2>` from the value in register `n` and store the result in register `d`.
`MOV Rd, <operand2>`	Copy the value specified by `<operand2>` into register `d`.
`CMP Rn, <operand2>`	Compare the value stored in register `n` with the value specified by `<operand2>`.
`B <label>`	Always branch to the instruction at position `<label>` in the program.
`B<condition> <label>`	Branch to the instruction at position `<label>` if the last comparison met the criterion specified by `<condition>`. Possible values for `<condition>` and their meanings are: `EQ`: equal to `NE`: not equal to `GT`: greater than `LT`: less than
`AND Rd, Rn, <operand2>`	Perform a bitwise logical AND operation between the value in register `n` and the value specified by `<operand2>` and store the result in register `d`.
`ORR Rd, Rn, <operand2>`	Perform a bitwise logical OR operation between the value in register `n` and the value specified by `<operand2>` and store the result in register `d`.
`EOR Rd, Rn, <operand2>`	Perform a bitwise logical XOR (exclusive or) operation between the value in register `n` and the value specified by `<operand2>` and store the result in register `d`.
`MVN Rd, <operand2>`	Perform a bitwise logical NOT operation on the value specified by `<operand2>` and store the result in register `d`.
`LSL Rd, Rn, <operand2>`	Logically shift left the value stored in register `n` by the number of bits specified by `<operand2>` and store the result in register `d`.
`LSR Rd, Rn, <operand2>`	Logically shift right the value stored in register `n` by the number of bits specified by `<operand2>` and store the result in register `d`.
`HALT`	Stops the execution of the program.

Labels: A label is placed in the code by writing an identifier followed by a colon (:). To refer to a label the identifier of the label is placed after the branch instruction.

Interpretation of `<operand2>`

`<operand2>` can be interpreted in two different ways, depending on whether the first character is a # or an R:

- # – use the decimal value specified after the #, eg `#25` means use the decimal value 25
- `Rm` – use the value stored in register `m`, eg `R6` means use the value stored in register 6

The available general purpose registers that the programmer can use are numbered 0–12

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0 9 **Figure 4** shows an algorithm written in pseudo-code. It is used to calculate the value of the contents of variable A multiplied by the contents of variable B.

Line numbers are included in the pseudo-code but are not part of the algorithm.

Figure 4

```
1       A ← 4
2       B ← 3
3       C ← 0
4       WHILE B > 0
5           C ← C + A
6           B ← B – 1
7       ENDWHILE
```

Write a sequence of assembly language instructions that would perform the same function as the pseudo-code in **Figure 4**.

Registers R1, R2 and R3 are used to hold the values of A, B and C respectively. The assembly language code equivalent to line numbers 1 to 3 in **Figure 4** have been completed for you.

[4 marks]

```
MOV R1, #4
MOV R2, #3
MOV R3, #0
```

4

Turn over ►

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1 0 A company is redesigning the processor used in a smartwatch it sells. The redesign will allow the company to increase the clock speed of the processor.

The processor executes all software and controls all hardware on the smartwatch. The smartwatch uses a wide range of sensors to continuously collect data about its wearer and environment. To improve accuracy each sensor takes many readings every second and sends them to the processor for averaging. The smartwatch has different software applications to play music, display images and provide a summary of all the sensor data it has stored.

Customer feedback shows that the smartwatch provides all customers with reliable and accurate data. However, some customers mentioned that performance can worsen when loading a large image and listening to music at the same time.

Describe **two** features of the situation that suggest increasing the clock speed would improve the performance of the smartwatch.

[2 marks]

2

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1 1 A clothing company has developed an application that allows a user to take a photograph of themself on their mobile phone and upload it to their account on the company servers. The application will then use artificial intelligence to recommend new clothes that it computes will suit the user based on their preferences and the application's own interpretation of the way they look. It will then generate images of the user wearing the recommended clothes.

The user can preview the images and either buy the clothes from the company or use the generated images by linking to them from social media accounts.

Describe how a digital camera would work when capturing a photograph of the user for the application **and** discuss the moral, ethical, legal and cultural issues that developers of the application may have had to consider while developing it.

[9 marks]

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9

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1 2 . 1 Explain the purpose of a Service Set Identifier (SSID) in wireless networking **and** how disabling SSID broadcasting can make a network more secure.

[2 marks]

1 2 . 2 Explain the role of the security protocol WPA2 in wireless networking.

[2 marks]

1 2 . 3 MAC (Media Access Control) address filtering is another method that can be used to make a wireless network more secure by only allowing devices with a MAC address that is on a list of allowed addresses to use the network.

Describe **two** reasons why using this method would be an inappropriate choice for a coffee shop that is providing Internet access to its customers.

[2 marks]

6

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1 3 . 1 Explain the operation of a physical star network topology.

[2 marks]

1 3 . 2 Explain how client-server networking operates.

[2 marks]

4

Turn over for the next question

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1 4 A company needs to keep a file server in a secure room. The file server will need to be accessible for routine maintenance and in emergencies. All company staff carry an ID card but not all staff should be allowed into the secure room.

The company has replaced the keypad controlling an electronic door lock on the room with an RFID reader and replaced all staff ID cards with ones containing an RFID tag to control access.

State **three** characteristics of RFID technology **and** explain why each of these makes it a suitable choice in this scenario.

[3 marks]

3

END OF QUESTIONS

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