A

AQA

AS

COMPUTER SCIENCE

Paper 2

7516/2

Monday 22 May 2023   **Afternoon**

Time allowed: 1 hour 30 minutes

At the top of the page, write your surname and forename(s), your centre number, your candidate number and add your signature.

[Turn over]

MATERIALS

For this paper you must have:

- **a calculator**

- **an insert.**

INSTRUCTIONS

- **Use black ink or black ball-point pen.**

- **Answer ALL questions.**

- **You must answer the questions in the spaces provided. Do not write 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.**
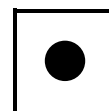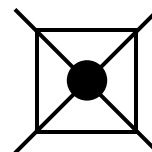
INFORMATION

- **The marks for questions are shown in brackets.**

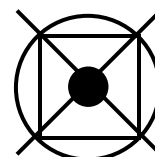- **The maximum mark for this paper is 75.**

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.**

DO NOT TURN OVER UNTIL TOLD TO DO SO

Answer ALL questions in the spaces provided.

| 0 | 1 | . | 1 |

Shade in ONE lozenge to indicate which of the following values is an irrational number. [1 mark]

| ○ | **A** $\dfrac{3}{4}$ |

| ○ | **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** $\dfrac{3}{4}$

○ **B** $\sqrt{2}$

○ **C** 73

○ **D** –19

0 1 . 3

Define the set of real numbers. [1 mark]

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[Turn over]

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]

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5

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]

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0 2 . 2

How many different values can be represented using 10 bits? [1 mark]

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[Turn over]

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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**

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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. [1 mark]

TABLE 1

NUMBER 1	0	0	0	1	1	0	1	1
NUMBER 2	0	0	0	0	0	1	1	1
RESULT	0	0	1	0	0	0	1	0
CARRY			1	1	1	1	1	

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]

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[Turn over]

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 _____

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?
[2 marks]

FIGURE 1

| 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 |

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[Turn over]

7

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

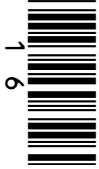**Explain why it is better for a majority voting system to send each bit five times instead of four. [1 mark]**

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0 4 . **2**

Give TWO reasons why using a parity bit system might be preferred to using majority voting when transmitting data. [2 marks]

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[Turn over]

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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.
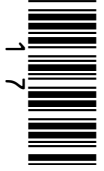**[1 mark]**

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

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0 5 . 1

Describe how to calculate the minimum storage requirements, excluding metadata, of a bitmapped image. [1 mark]

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One way of representing sound digitally is by using sampling.

0 5 . 2

What is meant by the term SAMPLING RATE? [1 mark]

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0 5 . 3

**What is meant by the term SAMPLE RESOLUTION?
[1 mark]**

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[Turn over]

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]

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0 5 . **5**

An alternative to using sampled sound is MIDI.

State TWO advantages of using MIDI instead of sampled sound. [2 marks]

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[Turn over]

7

0 6 . 1

Libraries are a type of system software.

Describe what libraries are AND why programmers use them. [2 marks]

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0 6 . 2

Discuss the ADVANTAGES AND DISADVANTAGES of high-level languages compared to low-level languages. [6 marks]

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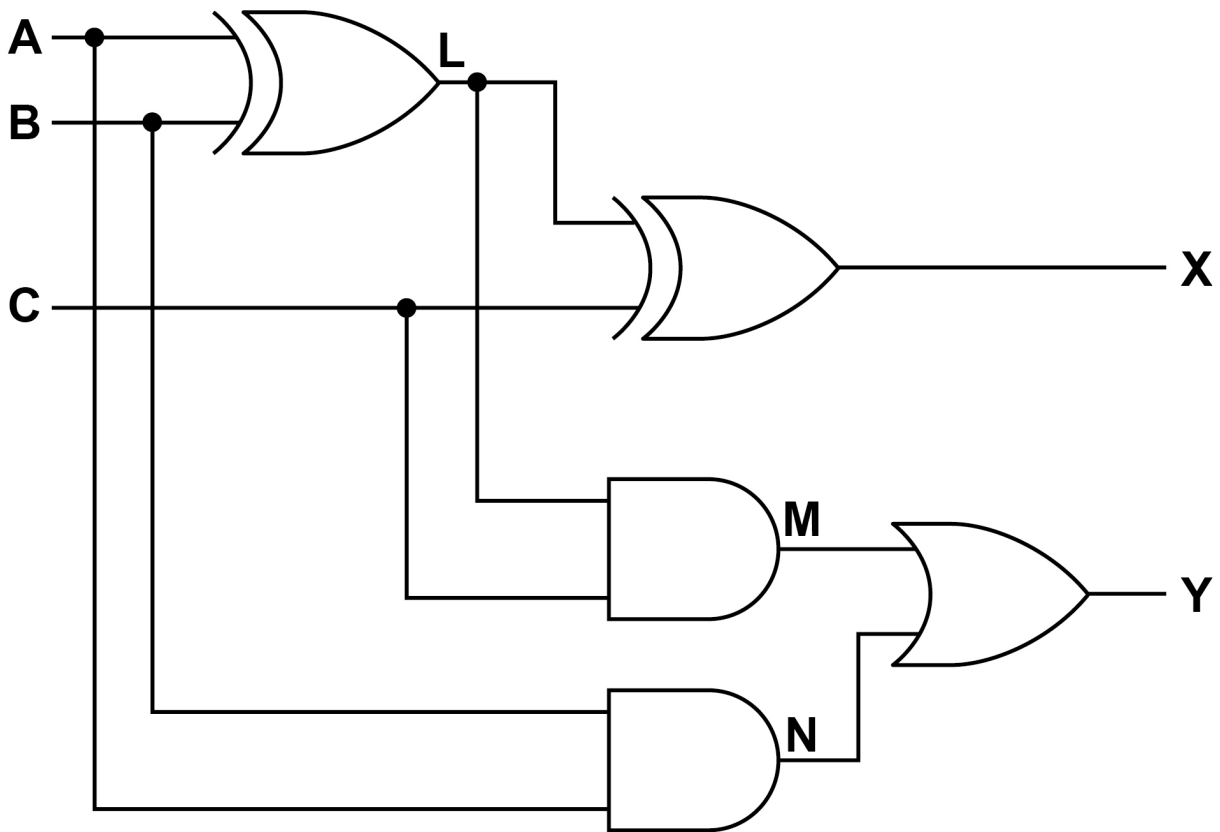_____

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[Turn over]

8

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	

0 7 . 2

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

Y =

[Turn over]

2 7

| 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]

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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]

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08 . 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]

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[Turn over]

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]

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[Turn over]

TABLE 2, provided in the separate insert, shows the standard AQA assembly language instruction set that should be used to answer question 09.

| 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
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[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]

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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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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]

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[Turn over]

12 . 2

Explain the role of the security protocol WPA2 in wireless networking. [2 marks]

12.**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]

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13 . 1

Explain the operation of a physical star network topology. [2 marks]

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1 3 . 2

Explain how client-server networking operates.
[2 marks]

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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]

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END OF QUESTIONS

3

Additional page, if required.

Write the question numbers in the left-hand margin.

Additional page, if required.

Write the question numbers in the left-hand margin.

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5 2

2 3 6 A 7 5 1 6 / 2