AQA

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

Tuesday 21 May 2024 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	
5	
6	
7	
8	
9	
10	
11	
TOTAL	

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

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0 1 . 1 Describe the set of real numbers.

[1 mark]

0 1 . 2 The number 5 can be written as $\frac{15}{3}$

Shade **two** lozenges to indicate which of the following statements are true.

[2 marks]

A	15 and 3 are **not** integers	⬭
B	15 and 3 are irrational numbers	⬭
C	5 is an irrational number	⬭
D	5 is a natural number	⬭
E	5 is a rational number	⬭

0 1 . 3 Shade **one** lozenge to indicate which of the symbols below represents the set of rational numbers.

[1 mark]

A	$\mathbb{C}$	⬭
B	$\mathbb{N}$	⬭
C	$\mathbb{Q}$	⬭
D	$\mathbb{R}$	⬭
E	$\mathbb{Z}$	⬭

4

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0 2 . 1 Convert the bit pattern `10001010` to hexadecimal.

[1 mark]

0 2 . 2 Represent the decimal number 139 as an **8-bit unsigned binary integer**.

[1 mark]

0 2 . 3 Show how the **unsigned binary number** `00100011` can be added to the **unsigned binary number** `00101011` without converting the numbers into decimal.

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

[2 marks]

```
  0 0 1 0 0 0 1 1
+ 0 0 1 0 1 0 1 1
```

Question 2 continues on the next page

Do not write outside the box

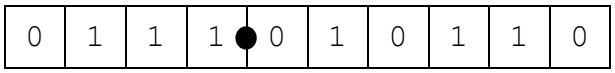
0 2 . 4 Show how the **8-bit two's complement binary integer** `00011100` can be subtracted from the **8-bit two's complement binary integer** `00111011` without converting the numbers to decimal.

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

[2 marks]

0 2 . 5 The bit pattern in **Figure 1** represents a **10-bit unsigned fixed point binary number** with four bits before and six bits after the binary point.

Figure 1



Convert the bit pattern in **Figure 1** to decimal.

[2 marks]

8

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0 3 . 1 State the name of the component on a sound card that transforms the continuous signal received from a microphone to a form that can be stored by a computer.

[1 mark]

0 3 . 2 A bitmap image is 52 pixels in height and 26 pixels in width. The bitmap representation of the image requires 845 bytes.

Calculate the maximum number of colours that could be used in the bitmap image.

You should show all your working.

[2 marks]

0 3 . 3 When a bitmap image is stored in a file, additional information is stored as well as the colours of the pixels. For example, the bitmap file might contain information on the date of creation, image width and height.

State the name given to this additional information when storing a bitmap image.

[1 mark]

Question 3 continues on the next page

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0 3 . 4 A sound is recorded with a sample rate of 96 000 Hz and a sample resolution of 24 bits. The file size of the recording is 12 096 kilobytes.

A sample rate of 1 Hz means that one sample has been taken every second.

Calculate the duration of the sound recording.

You should show all your working.

[3 marks]

0 3 . 5 A sample resolution of 16 bits is commonly used in audio recordings.

Explain why increasing the sample resolution from 16 bits to 24 bits can improve the quality of an audio recording.

[1 mark]

Do not write outside the box

0 3 . 6 MIDI does not use sampling to represent music.

Describe how music is represented using MIDI.

[2 marks]

0 3 . 7 Explain **one** advantage of using MIDI instead of sampled sound to represent music.

[1 mark]

11

Turn over for the next question

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0 4 . 1 A message is encrypted using a Caesar cipher that operates with a shift value of four. For example, the letter `A` in plaintext would be represented by `E` in ciphertext.

The ciphertext for the message is `WSSDI`.

What is the plaintext for the message?

[1 mark]

0 4 . 2 Explain **two** reasons why Caesar ciphers are vulnerable to being cracked.

[2 marks]

3

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0 5 . 1 Shade **one** lozenge to indicate which of the following is an example of system software.

[1 mark]

A	Computer game	⬭
B	Image editor	⬭
C	Programming language translator	⬭
D	Video conferencing software	⬭
E	Word processor	⬭

0 5 . 2 An operating system manages hardware resources, for example the I/O devices associated with a computer system.

State **two** other examples of hardware resources that an operating system is responsible for managing.

[2 marks]

3

Turn over for the next question

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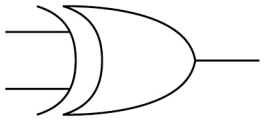
0 6 . 1 **Figure 2** shows the symbol for a logic gate.

Figure 2



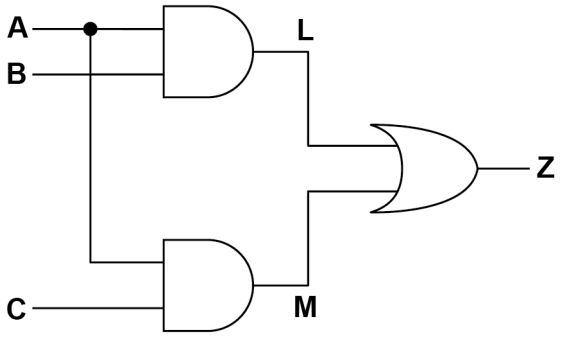
State the name of the logic gate shown in **Figure 2**.

[1 mark]

---

0 6 . 2 **Figure 3** shows a logic circuit.

Figure 3



Complete the truth table for the logic circuit in **Figure 3**.

[2 marks]

A	B	C	L	M	Z
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

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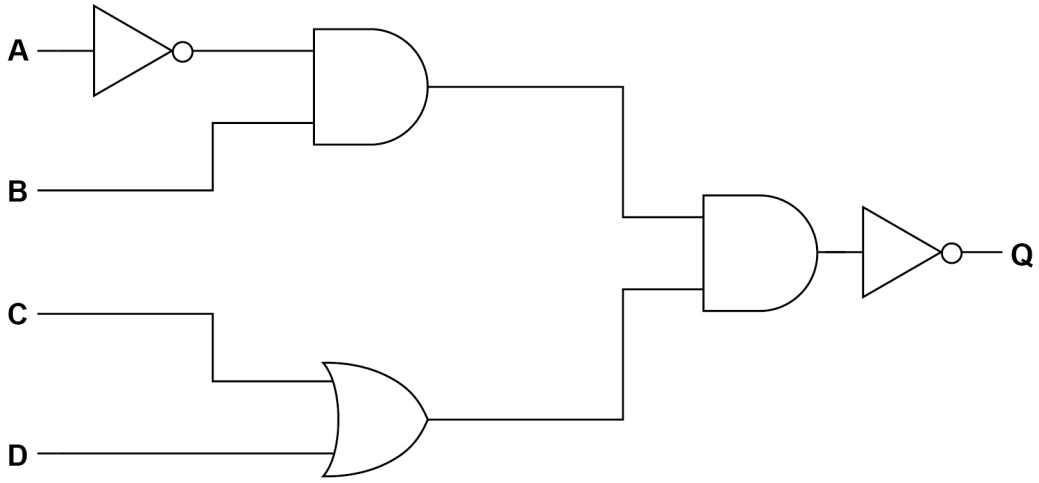
0 6 . 3 **Figure 4** shows a logic circuit.

Figure 4



Write a Boolean expression for **Q**.

[3 marks]

Question 6 continues on the next page

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0 6 . 4 Using the rules of Boolean algebra, simplify the following expression.

$$\overline{W} \cdot X \cdot Z + W \cdot Z + X \cdot Y \cdot \overline{Z} + \overline{W} \cdot X \cdot Y \cdot 1$$

You **must** show your working.

[4 marks]

Final answer _____

10

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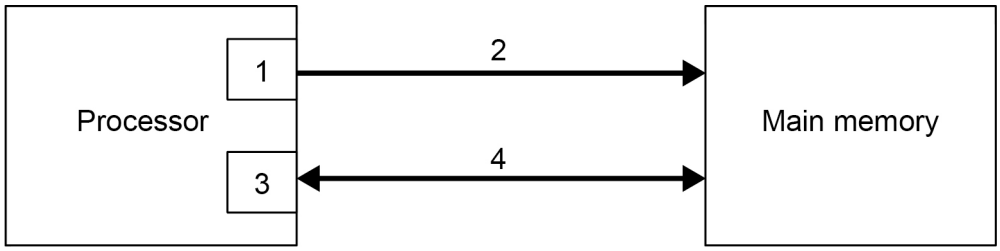
0 7 . 1 **Figure 5** shows some of the processor registers and buses that are used during the fetch stage of the fetch-execute cycle, together with the main memory.

Figure 5



State the name of the components that are labelled in **Figure 5** with the numbers **1** to **4**. In the case of register names, the full names **must** be stated.

[2 marks]

1	
2	
3	
4	

0 7 . 2 Describe the stored program concept.

[2 marks]

Question 7 continues on the next page

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0 7 . 3 In a particular processor instruction set, each instruction consists of an opcode and an operand. An operand could be an immediate value to be used by a program.

State **two** other types of value that can be stored in an operand.

[2 marks]

0 7 . 4 Computer A and Computer B both have a processor with a clock speed of 2.8 GHz but Computer A performs tasks much faster than Computer B. Computer A has a larger cache and greater word length than Computer B.

Explain why the larger cache and greater word length are possible factors for the performance difference between Computer A and Computer B.

[2 marks]

Larger cache

Greater word length

8

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Table 1 shows the standard AQA assembly language instruction set that should be used to answer question **0 8**

Table 1 – 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`:

1. `#` – use the decimal value specified after the `#`, eg `#25` means use the decimal value 25
2. `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 8 Registers `R1` and `R3` each store a different positive number.

Write a program using the standard AQA assembly language in **Table 1** that will:

- store the greater of these two numbers in `R1`
- store `1` in `R2` if the value originally in `R1` is greater than the value in `R3`, storing `3` in `R2` otherwise.

[4 marks]

4

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0 9 . 1 RFID tags can be read by an RFID reader.

Describe how data is read from an RFID tag.

[3 marks]

0 9 . 2 An RFID tag can be active or passive. A passive tag must be moved within a few centimetres of an RFID reader to be read. An active tag will have its own power source, which allows it to be read from a greater distance.

It is decided that RFID tags will be used in passports to store personal information.

Explain why passive tags are likely to be a more appropriate choice than active tags for use in passports.

[2 marks]

5

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1 0 A smartphone company has designed a device that can be put into items such as luggage to help locate these items if they are lost. The device works by sending an encrypted signal containing its current location to nearby smartphones. The smartphones relay the signal to the company's servers via the Internet, allowing a user to see the device's exact location using a mobile phone app.

The company expects to sell hundreds of millions of devices. The data collected from each device will be permanently kept in secondary storage on the company's servers. The company is planning to use solid-state drives in the servers that will hold device location data but is unsure whether using solid-state drives is a good idea.

Discuss a range of moral, ethical, legal and cultural issues raised by the new device **and** explain the properties of solid-state drives that the company should consider when deciding on a secondary storage technology.

In your answer you will be assessed on your ability to follow a line of reasoning to produce a coherent, relevant and structured response.

[12 marks]

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12

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1 1 . 1 Describe the difference between baud rate and bit rate.

[2 marks]

1 1 . 2 A photographer wants to create a large file sharing network to allow thousands of photographers to share their photos with each other for free.

State **two** reasons why the photographer may choose to use a peer-to-peer network rather than a client-server network.

[2 marks]

1 1 . 3 Explain the purpose of a Service Set Identifier (SSID).

[1 mark]

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1 1 . 4 Explain how disabling SSID broadcasting can increase the security of a wireless network.

[2 marks]

7

END OF QUESTIONS

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