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 19 May 2025 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	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
TOTAL	

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

Do not write outside the box

0 1 . 1 Which **two** of the numbers below belong to the set of numbers represented by $\mathbb{Z}$?

Shade **two** lozenges.

[2 marks]

A 0 ⬭

B $\sqrt{2}$ ⬭

C π ⬭

D $\frac{3}{4}$ ⬭

E 998 ⬭

0 1 . 2 Describe what is meant by the term **'ordinal number'**.

[1 mark]

0 1 . 3 Explain why **real numbers** are better suited to representing measurements of some quantities than **natural numbers**.

[1 mark]

4

Do not write outside the box

0 2 . 1 How many different values can be represented using one byte?

[1 mark]

0 2 . 2 The bit pattern in **Figure 1** represents an **8-bit unsigned binary integer**.

Figure 1

0	1	0	0	0	0	1	1

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

[1 mark]

0 2 . 3 Show how the **8-bit unsigned binary** number `01001111` can be added to the **8-bit unsigned binary** number `00001011` without converting the numbers into decimal.

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

[2 marks]

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

Turn over ►

Do not write outside the box

0 2 . 4 What are the lowest and highest values that can be represented by a **4-bit two's complement binary integer**?

Give your answers in **decimal**.

[2 marks]

Lowest _____

Highest _____

0 2 . 5 Using **8-bit two's complement binary**, what is the result of subtracting `00110100` from `01101101`?

Give your answer in **8-bit two's complement binary**.

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

[3 marks]

0 2 . 6 Represent 5.75 as an **8-bit unsigned fixed point binary** number with four bits before and four bits after the binary point**.**

[2 marks]

11

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0 3 . 1 The character Q has the binary representation 1010001 in ASCII.

What is the binary representation of the character T in ASCII?

[1 mark]

0 3 . 2 Unicode was introduced to overcome some of the limitations of ASCII.

State **one** limitation of ASCII that Unicode overcomes.

[1 mark]

2

Turn over for the next question

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0 4 . 1 Each time a sample of an analogue sound is taken a bit pattern is stored.

Describe what each bit pattern represents.

[1 mark]

0 4 . 2 A sound file is being played on a laptop computer. The laptop contains a digital to analogue converter (DAC).

Explain the role of the DAC and why it is necessary.

[2 marks]

0 4 . 3 A particular analogue sound must be sampled at a rate of at least 2200 Hz to be accurately represented.

State the highest frequency present in the analogue sound.

[1 mark]

4

Do not write outside the box

0 5 . 1 Explain why digital files are often stored in compressed format.

[1 mark]

0 5 . 2 Run length encoding (RLE) can be used to compress data. **Figure 2** shows some of the data from a file.

Figure 2

BBGGGRRRRW

State the RLE for the data shown in **Figure 2**.

[1 mark]

2

Turn over for the next question

Do not write outside the box

0 6 . 1 Describe what is meant by the terms computer hardware and computer software.

[2 marks]

Computer hardware _____

Computer software _____

0 6 . 2 Describe the difference between system software and application software.

[2 marks]

0 6 . 3 State **two** advantages of using a low-level language to write software.

[2 marks]

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0 6 . 4 State a type of **low-level** language other than assembly language.

[1 mark]

0 6 . 5 Describe the role of an assembler and explain why an assembler is needed.

[2 marks]

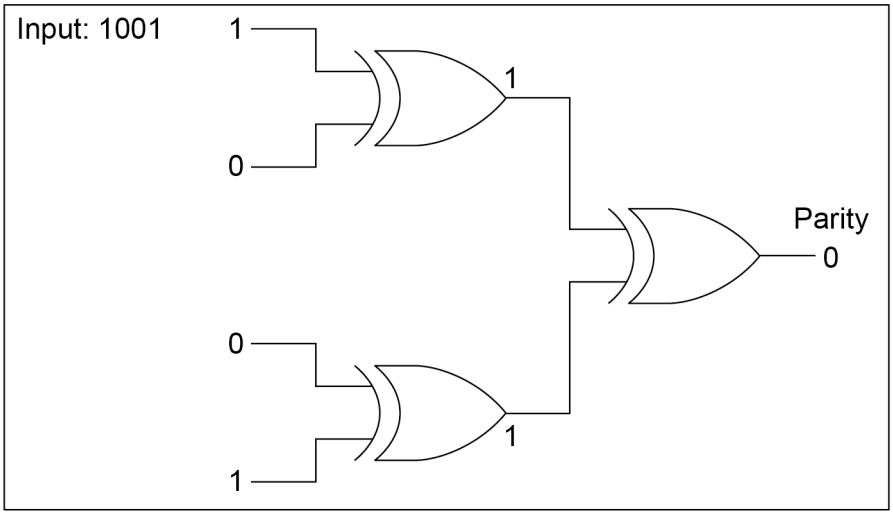
9

Turn over for the next question

Do not write outside the box

0 7 **Figure 3** shows a logic circuit that can be used to compute a parity bit for a 4-bit message. In **Figure 3** the message 1001 is shown as the input message and the circuit outputs 0 as the resulting parity bit.

Figure 3



0 7 . 1 The logic circuit in **Figure 3** uses three logic gates, all of the same type.

State the name of the type of logic gate used in **Figure 3** and explain the operation of this type of logic gate.

[2 marks]

Name _____

Operation _____

_____

_____

_____

_____

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0 7 . 2 State the type of parity that is computed by the logic circuit in **Figure 3** and give a reason for your answer.

[2 marks]

Type of parity _____

Reason _____

0 7 . 3 Alice wants to send a 4-bit message to Bob but is worried about errors. Alice decides to use a parity bit to allow some error checking.

Describe how Alice can send the message using a parity bit to allow for error detection and how Bob can determine if an error has occurred.

As part of your answer you must state when Alice and Bob can make use of a copy of the logic circuit in **Figure 3**.

[3 marks]

0 7 . 4 Describe **one** limitation of using a parity bit for error detection.

[1 mark]

8

Do not write outside the box

0 8 . 1 Apply De Morgan's law to the Boolean expression shown below.

[1 mark]

$$\overline{A \cdot B} = \_\_\_\_\_$$

0 8 . 2 Draw a logic circuit for the Boolean expression below using only AND, OR and NOT gates.

[3 marks]

$$Q = \overline{X + Y} + \overline{(Z \cdot Y) + X}$$

4

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0 9 . 1 Describe the roles of the memory address register (MAR) and memory buffer register (MBR) in the **fetch stage** of the Fetch-Execute cycle.

[2 marks]

MAR _____

MBR _____

0 9 . 2 Describe what happens during the **decode stage** of the Fetch-Execute cycle, including the role of any dedicated registers**.**

[3 marks]

5

Turn over for the next question

Do not write outside the box

Table 1 shows the standard AQA assembly language instruction set that should be used to answer question **1 0 . 1** and question **1 0 . 2**

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`:

- `#` – 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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1 0 . 1 An assembly language program contains an instruction that loads the integer value 13 into register `R1`.

Complete the missing part of the instruction.

[1 mark]

```
MOV R1, _____
```

Question 10 continues on the next page

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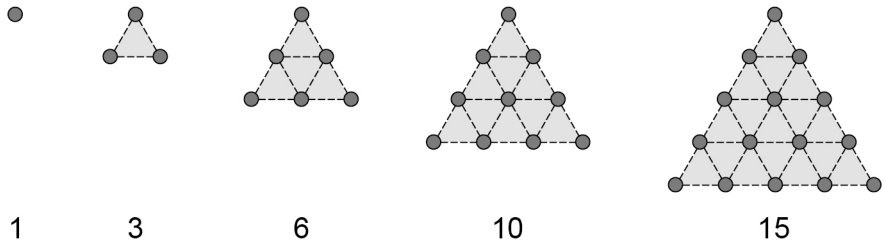
1 0 . 2 Triangular numbers are numbers that count the number of objects that would appear when arranged in an equilateral triangle.

The sequence of triangular numbers starts with 1 and proceeds in order. The first five triangular numbers are 1, 3, 6, 10, and 15. The diagram in **Figure 4** shows the first five triangular numbers.

Figure 4



Complete the assembly language program below to calculate the nth triangular number. The value of n has already been stored in register `R0`. The program should store the nth triangular number in register `R1`.

Write one instruction per line. You may not need to use all lines for your solution.

[4 marks]

5

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1 1 . 1 A photographer uses a digital camera to take pictures. To take a picture, the shutter opens allowing light to enter. The light is then focused on an array of light-sensitive cells that are arranged in rows and columns.

Describe the principles of operation of a digital camera **after** light has been focused on the light-sensitive cells**.**

[3 marks]

1 1 . 2 The digital pictures are transferred to a solid-state disk (SSD).

Explain how solid-state disks store binary data**.**

[3 marks]

6

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1 2 A UK company is launching an online image editing platform. Customers will upload their images to a dedicated website. The website will allow customers to edit uploaded images using a powerful set of editing tools. A customer can subscribe to the website for an annual fee or use the service for free as a non-subscriber.

Only subscribers will retain ownership of the images they upload. If a non-subscriber uploads an image, they agree to transfer ownership of the uploaded image to the company. The company intends to sell the images it then owns to third parties to enable it to keep offering the service for free.

Discuss a range of moral, ethical, legal and cultural issues raised by the plans that the company has for its online image editing platform.

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

[9 marks]

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9

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1 3 . 1 State what is meant by the serial transmission of data.

[1 mark]

1 3 . 2 Explain how it is possible for the **bit rate** along a serial cable to be greater than the **baud rate**.

[1 mark]

1 3 . 3 A network that is physically wired in a star topology can behave logically as a bus network.

Explain how this is possible.

[2 marks]

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1 3 . 4 A wireless network has its Service Set Identifier (SSID) broadcast disabled.

Explain how disabling the SSID broadcast offers protection to the network.

[2 marks]

6

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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