A

Surname ______________________________

Other Names ______________________________

Centre Number ______________________________

Candidate Number ______________________________

Candidate Signature ______________________________

I declare this is my own work.

AS

COMPUTER SCIENCE

Paper 2

7516/2

Time allowed: 1 hour 30 minutes

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]

J U N 2 2 7 5 1 6 2 0 1

For this paper you must have:
- **a calculator**
- **an insert.**

INSTRUCTIONS

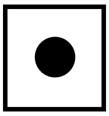
- **Use black ink or black ball-point pen.**
- **Answer ALL questions.**
- **You must answer the questions in the spaces provided. Do not write on blank pages.**
- **If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).**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

INFORMATION

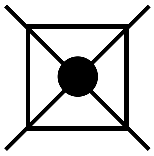
- **The marks for questions are shown in brackets.**
- **The maximum mark for this paper is 75.**

ADVICE

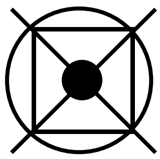
- **In some questions you are required to indicate your answer by completely shading a circle alongside the appropriate answer as shown.**



- **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

Describe the difference between natural numbers and integers.

In your answer, give ONE example of a number that is an integer but not a natural number. [2 marks]

01.2

Describe what it means for a number to be irrational.

In your answer, give ONE example of an irrational number. [2 marks]

[Turn over]

0 1 . 3

Shade ONE lozenge in the COUNTING column to indicate which set of numbers is most suitable for counting and ONE lozenge in the MEASURING column to indicate which set of numbers is most suitable for measuring real-world quantities. [2 marks]

		COUNTING	MEASURING
A	Integer	○	○
B	Natural	○	○
C	Rational	○	○
D	Real	○	○

6

0 2 . 1

Convert the decimal number 177 to unsigned binary using 8 bits. [1 mark]

0 2 . 2

Convert the decimal number 193 to hexadecimal. [1 mark]

[Turn over]

2

0 3 . 1

State, IN DECIMAL, the lowest and highest values that could be represented in unsigned binary when using 16 bits. [2 marks]

Lowest ______________________________

____

____

____

Highest ______________________________

____

____

____

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[Turn over]

0 3 . 2

FIGURE 1 and FIGURE 2 show the bit patterns of two UNSIGNED BINARY INTEGERS.

FIGURE 1

0	0	0	1	0	1	0	1

FIGURE 2

0	0	0	0	0	1	1	1

Calculate the result of multiplying these two numbers together using BINARY MULTIPLICATION.

You MUST show your working in binary. [2 marks]

Answer

[Turn over]

4

0 4 . 1

ASCII is one character coding system.

Explain the term 'character code'. [1 mark]

0 4 . 2

Explain why Unicode was introduced as an alternative to ASCII. [2 marks]

[Turn over]

FIGURE 3 shows a 7-bit ASCII character code. The character code is to be sent across a network using a parity system.

FIGURE 3

0	0	1	0	1	1	1

0 4 . 3

Describe how the parity bit would be generated for the character code in FIGURE 3 using even parity.
[2 marks]

0 4 . 4

Write the parity bit below to complete the byte that will be sent using even parity. [1 mark]

	0	0	1	0	1	1	1

[Turn over]

0 4 . 5

The bit pattern 1000001 represents the character 'A' in 7-bit ASCII. Other characters follow on from this in sequence. For example, the bit pattern 1000100 represents the character 'D'.

The bit pattern 1000100 1000001 1000010 represents 'DAB' in 7-bit ASCII.

What bit pattern results from encrypting the string 'DAB' using a Vernam cipher with the key 'EGG'?

You MUST show your working. [3 marks]

[Turn over]

9

0 5 . 1

Describe the difference between analogue and digital data. [2 marks]

0 5 . 2

Describe the steps that an analogue to digital converter (ADC) carries out when converting a sound signal.
[3 marks]

[Turn over]

5

0 6 . 1

Define the term ‘software’. [1 mark]

0 6 . 2

Translators are one type of system software.

Give TWO other types of system software. [2 marks]

Type 1 ____

____

____

____

Type 2 ____

____

____

____

[Turn over]

0 6 . 3

Some compilers translate source code into an intermediate language rather than producing an executable file. Bytecode is one example of an intermediate language.

Explain how intermediate language code is used after it has been generated. [2 marks]

0 6 . 4

Give ONE reason why some compilers produce their final output in an intermediate language instead of machine code. [1 mark]

[Turn over]

6

0 7 . 1

State which logic gate has the truth table shown in FIGURE 4. [1 mark]

FIGURE 4

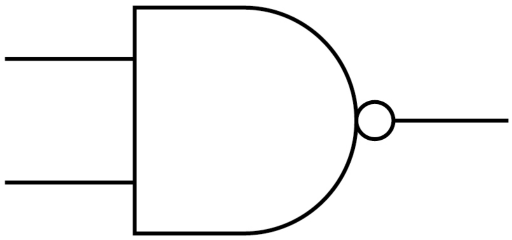
A	B	Q
0	0	1
0	1	0
1	0	0
1	1	0

Answer ____

0 7 . 2

State the logic gate that is represented by the symbol shown in FIGURE 5. [1 mark]

FIGURE 5



Answer ______________________________

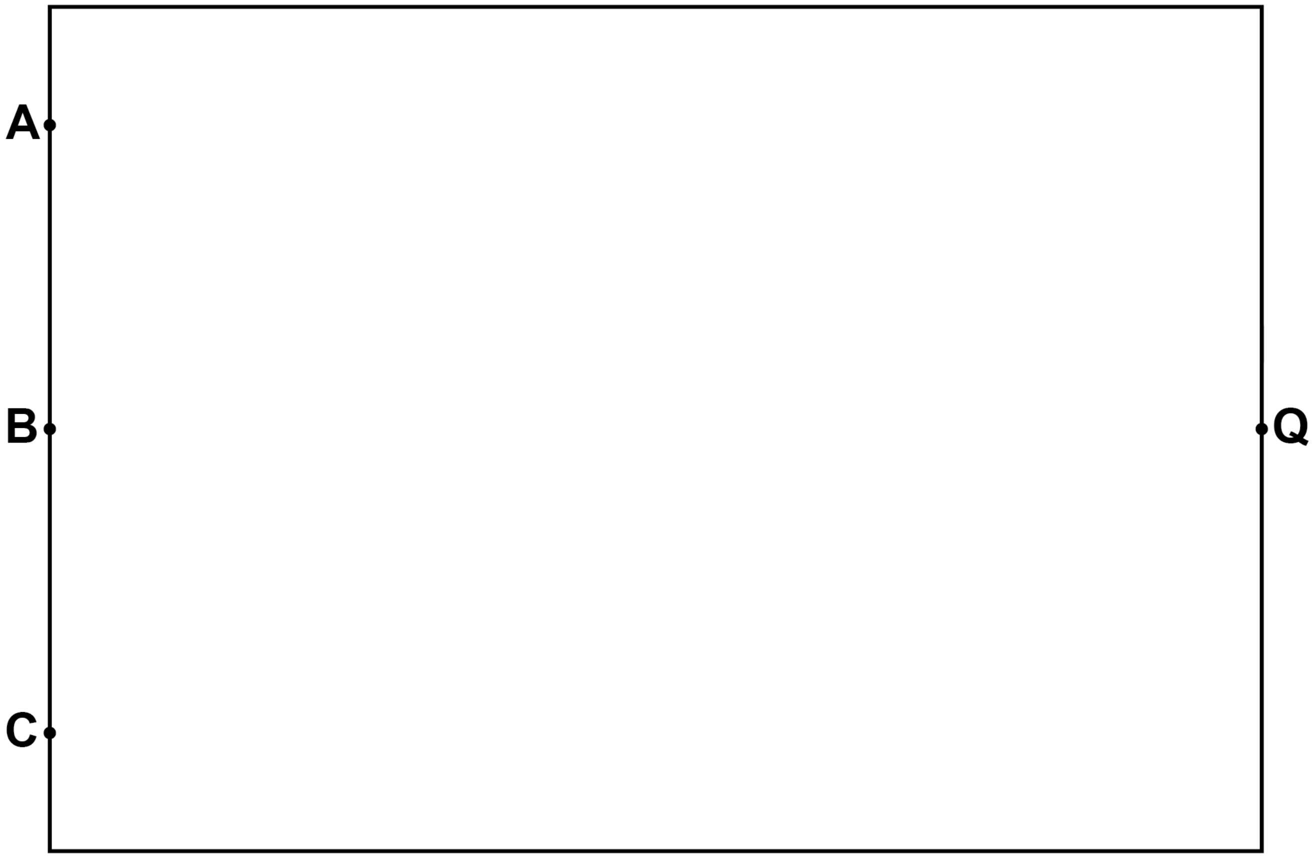
[Turn over]

0 7 . 3

Draw the logic circuit for the following Boolean expression.

$$Q = \overline{\overline{A \cdot B} + C}$$

[2 marks]



0 7 . 4

Complete the truth table below.

A	B	$\overline{B}$	$\left(A+\overline{B}\right)$	$\left(A+\overline{B}\right)\cdot B$
0	0			
0	1			
1	0			
1	1			

Using the final column, give a simplified Boolean expression for

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

[3 marks]

Answer ______________________________

0 7 . 5

Using the rules and identities of Boolean algebra, simplify the following Boolean expression.

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

[4 marks]

Answer

[Turn over]

11

0 8 . 1

The fetch-execute cycle involves the Current Instruction Register (CIR), Control Unit, Memory Address Register (MAR), Memory Buffer Register (MBR) and Program Counter (PC).

FIGURE 6, on the opposite page, lists four events that can take place during one cycle of the fetch-execute cycle. The events are labelled A to D.

Some events that take place during the fetch-execute cycle are not listed.

Put these events in the order they would occur in the fetch-execute cycle when an ADD instruction is executed.

Write the numbers 1 to 4 beside each description in FIGURE 6 to indicate the order in which the events occur. The number 1 should be used to indicate the event that would happen first. [3 marks]

FIGURE 6

	DESCRIPTION	ORDER (1 TO 4)
A	The contents of the MBR are copied to the CIR.	
B	The contents of the PC are copied to the MAR.	
C	The Control Unit decodes the contents of the CIR.	
D	The result of the calculation is stored.	

[Turn over]

0 8 . 2

Describe the role of main memory in the execution of computer programs. [2 marks]

0 8 . 3

State the name of the processor component that is responsible for performing mathematical operations such as addition and multiplication. [1 mark]

[Turn over]

0 8 . 4

Explain why increasing the data bus width can lead to improvements in processor performance. [1 mark]

____

____

____

____

0 8 . 5

Identify the bus that would need to be changed AND state the change needed so that the maximum amount of memory addressable by the processor would be doubled. [2 marks]

Bus to change ______________________________

Change needed ______________________________

____

____

____

9

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[Turn over]

TABLE 1, provided in the insert, shows the standard AQA assembly language instruction set that should be used to answer question 0 9 . 1 and question 0 9 . 2

0 9 . 1

Shade ONE circle to show which of the assembly instructions in FIGURE 7 uses immediate addressing.
[1 mark]

FIGURE 7

	INSTRUCTION	IMMEDIATE ADDRESSING
A	`LDR R3, 42`	○
B	`MOV R3, #42`	○
C	`STR R3, 101`	○
D	`SUB R3, R2, R1`	○

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[Turn over]

0 9 . 2

A computer program is required that will multiply the value stored in `X` by 2 if it is less than 50 and leave it unchanged if it is 50 or more.

The algorithm for this task can be written in pseudocode as:

```
IF X < 50 THEN
  X ← X * 2
ENDIF
```

Write an assembly language program using the AQA assembly language instruction set shown in TABLE 1, provided in the insert, to carry out this task.

At the start, the value of `X` is stored in memory location 101 [4 marks]

[Turn over]

5

10.1

Describe the purpose of start and stop bits in asynchronous data transfer. [2 marks]

Purpose of start bit ______________________________

____

____

____

Purpose of stop bit ______________________________

____

____

____

1 0 . 2

Protocols are used in computer networking.

Define the term 'protocol'. [1 mark]

1 0 . 3

Users of a computer network will experience latency.

Define the term 'latency'. [1 mark]

[Turn over]

1 0 . 4

Explain how a physical star topology can behave logically as a bus network. [2 marks]

6

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[Turn over]

1 1

An international technology company produces a smart speaker for use in homes. The smart speaker can be controlled by a user providing voice commands, which means the device must always be listening for audio input. The company stores audio recordings of each user to analyse when improving its voice recognition algorithms. The audio recordings are compressed using lossy compression and then sent over the Internet to be stored at the company's headquarters.

Discuss a range of ethical, legal and cultural issues that are raised by the company storing the audio captured by its smart speakers AND justify why the company might use lossy compression.

You will be assessed on your ability to follow a line of reasoning to produce a coherent, relevant and structured response. [12 marks]

[Turn over]

[Turn over]

END OF QUESTIONS

12

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.

Additional page, if required.

Write the question numbers in the left-hand margin.

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For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
TOTAL	

IB/M/CD/Jun22/7516/2/E4