A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

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I declare this is my own work.

AS
COMPUTER SCIENCE

Paper 2

7516/2

Friday 22 May 2020 Morning

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]

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

INSTRUCTIONS

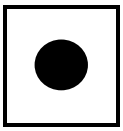
- **Use black ink or black ball-point pen.**
- **Answer ALL questions.**
- **You must answer the questions in the spaces provided. Do not write on blank pages.**
- **If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).**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

INFORMATION

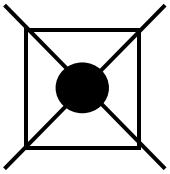
- **The marks for questions are shown in brackets.**
- **The maximum mark for this paper is 75.**

ADVICE

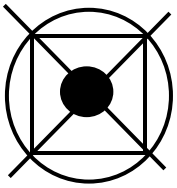
- **In some questions you are required to indicate your answer by completely shading a lozenge alongside the appropriate answer as shown.**



- **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

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Answer ALL questions in the spaces provided.

0 1 . 1 **State the DECIMAL equivalent of the hexadecimal number C57 [1 mark]**

0 1 . 2 **How many different values can be represented using two bytes? [1 mark]**

[Turn over]

0 1 . 3 **A data transmission system transmits one byte of data, using the majority voting system for error correction.**

FIGURE 1 shows the bit pattern that was received.

FIGURE 1

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

Shade ONE lozenge to indicate the byte of data that the receiver will assume was sent. [1 mark]

- ○ 10010011
- ○ 10011011
- ○ 10010111
- ○ 10011110

0 1 . 4 **A check digit can be used to detect errors when data are entered or transmitted.**

Explain what a check digit is and outline how the check digit is generated. [2 marks]

[Turn over]

5

0 2 . 1 **FIGURE 2 shows two unsigned binary integers.**

FIGURE 2

0	0	1	0	1	1	0	1

0	0	0	0	0	1	0	1

What is the result in BINARY of multiplying the two numbers shown in FIGURE 2?

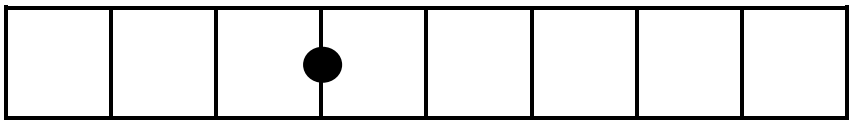
You MUST show all your working in binary.
[2 marks]

Answer _____

0 2 . 2 **Convert the decimal number 6.34375 into an unsigned fixed point binary number using 8 bits with 5 bits after the binary point.**

You may use the space below for working.
[2 marks]

Answer



0 3 . 1 **A sound is being recorded from an analogue source using a sound card in a computer. The sound card contains an analogue to digital converter (ADC).**

Describe the steps the ADC performs in this process. [3 marks]

[Turn over]

A sound has been recorded and takes up 34.56 megabytes (MB) of storage space. The sound lasts 360 seconds and was recorded with a sample resolution of 16 bits.

0 3 . 2 **Calculate the sample rate used for the recording.**

State your answer in samples per second (Hertz).

You should show your working. [2 marks]

Answer _____

0 3 . 3 **State Nyquist's theorem. [2 marks]**

7

0 4 A student has attempted to calculate the minimum file size, in bytes, of a bitmapped image.

The bitmapped image is 10 pixels wide by 16 pixels high with 4 possible colours for each pixel.

The student calculates the answer to be 80 bytes by using the following method:

$$\frac{\text{number of pixels wide} \times \text{number of pixels high} \times \text{number of colours}}{\text{number of bits in a byte}}$$

Explain what the student has done wrong AND state the correct minimum file size in bytes. [2 marks]

What the student has done wrong _____

_____

_____

_____

Correct minimum file size _____

_____

[Turn over]

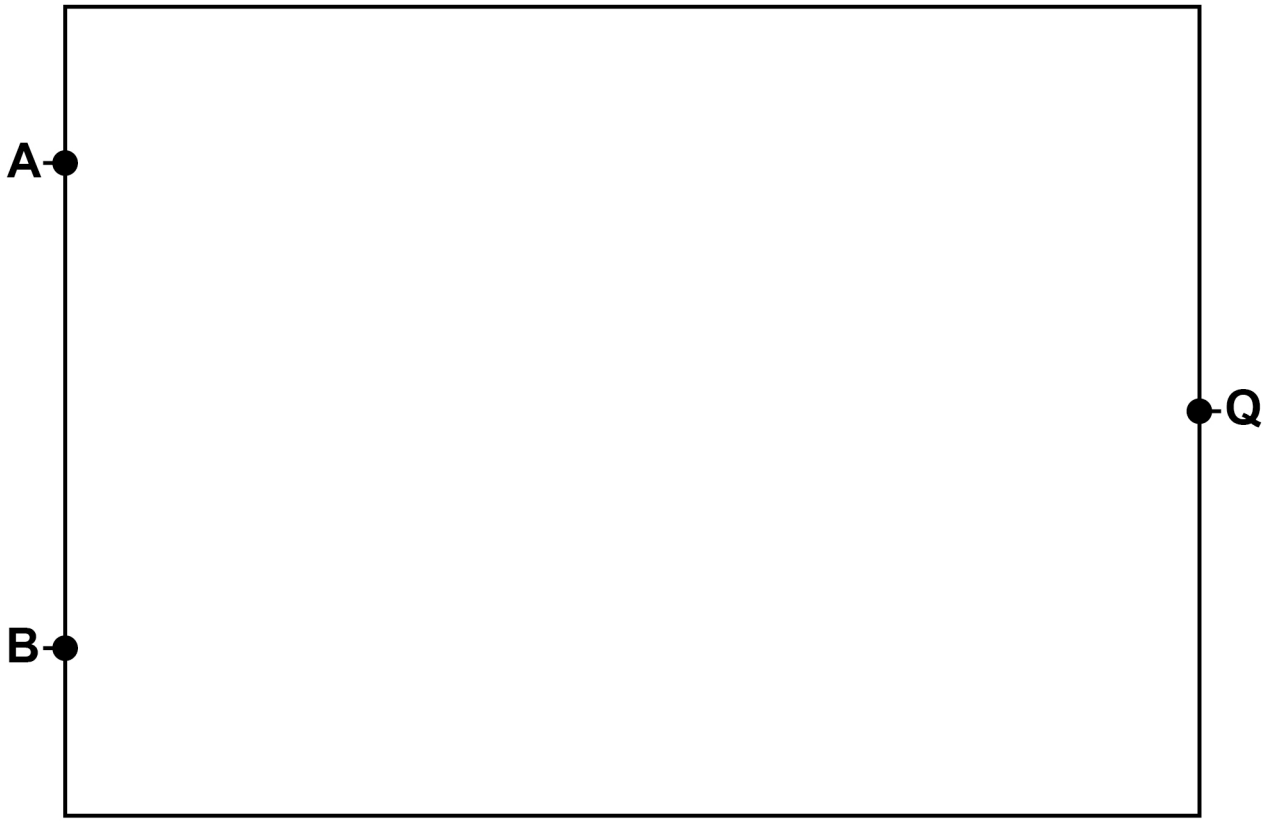
2

0 5 . 1 **Complete the truth table for A NAND B.**
[1 mark]

A	B	A NAND B
0	0	
0	1	
1	0	
1	1	

0 5 . 2 **A XOR B can be implemented as a logic circuit without using an XOR gate.**

Using ONLY AND, OR and NOT gates draw a circuit that will produce an output Q which is logically equivalent to A XOR B. [3 marks]



[Turn over]

0 5 . 3 **Using the rules and identities of Boolean algebra, simplify the following Boolean expression.**

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

You MUST show your working. [4 marks]

Answer _____

[Turn over]

8

0 6 . 1 **The memory buffer register and the program counter are examples of registers.**

What is a register? [1 mark]

0 6 . 2 **Describe the stored program concept. [2 marks]**

0 6 . 3 **Some buses in a computer system have to be bidirectional, meaning data or instructions can travel both ways.**

Explain why the data bus in a computer system must be bidirectional. [2 marks]

[Turn over]

0 6 . 4 **State TWO differences between how the Harvard and von Neumann architectures operate. [2 marks]**

Difference 1 _____

_____

_____

_____

Difference 2 _____

_____

_____

_____

0 6 . 5 **Describe FOUR steps that a processor goes through during the fetch stage of the Fetch-Execute cycle.**

You MUST explain the purpose of each step. [8 marks]

_____

_____

[Turn over]

15

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[Turn over]

TABLE 1, in the separate insert, shows the standard AQA assembly language instruction set that should be used to answer question part 0 7 . 1

0 7 . 1 **Write an assembly language program to encrypt a single character using the Caesar cipher. The character to be encrypted is represented using a character set consisting of 26 characters with character codes 0–25. The output of the process should be the character code of the encrypted character.**

The assembly language instruction set that you should use to write the program is listed in TABLE 1, in the separate insert.

TABLE 2, on the opposite page, shows the character codes and the characters they represent.

TABLE 2

Code	Character
0	A
1	B
2	C
3	D
4	E
5	F
6	G
7	H
8	I

Code	Character
9	J
10	K
11	L
12	M
13	N
14	O
15	P
16	Q
17	R

Code	Character
18	S
19	T
20	U
21	V
22	W
23	X
24	Y
25	Z

[Turn over]

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- **Memory location 100 contains the character code to be encrypted, which is in the range 0–25**
- **Memory location 101 contains an integer key to be used for encryption, which is in the range 0–25**
- **The program should store the character code of the encrypted character in memory location 102**

[4 marks]

0 7 . 2 **An instruction uses immediate addressing.**

What is immediate addressing? [1 mark]

0 7 . 3 **Another method of encryption is the Vernam cipher.**

Explain why, under the correct conditions, the Vernam cipher is perfectly secure. [1 mark]

6

0 8 **The managers of a care home expect all of their residents to wear a Personal Emergency Response System (PERS) device. This is a device which residents wear around their neck and has a button that can be used to summon help should they feel unwell or require assistance.**

A company has developed a life-blogging device. Like the PERS device it is worn around the neck. The life-blogging device monitors bodily signs such as blood pressure and heart rate as well as recording audio and video. The data collected are sent to a server and all of the data collected on the server can be accessed via a website.

The care home managers are considering using the life-blogging system instead of PERS so that the staff can monitor the residents' data. The life-blogging system will allow the care home to respond more quickly to an emergency situation and deal with situations where the resident is not capable of pushing a button. The managers are considering not telling the residents about the new device as they think it may confuse them.

0 8 . 1 **Discuss any moral, ethical, legal and cultural issues that the care home managers should consider before introducing the new life-blogging devices. [9 marks]**

0 8 . 2 **The life-blogging device contains a solid-state disk (SSD). It stores its data on this in addition to uploading the data to a server.**

Explain TWO reasons why an SSD is a better choice than a magnetic hard disk for this application. [4 marks]

Reason 1 _____

Reason 2 _____

[Turn over]

13

0 9 . 1 **State ONE reason why a user might choose to compress an image file. [1 mark]**

0 9 . 2 **Describe ONE advantage of lossless compression over lossy compression. [1 mark]**

0 9 . 3 **Explain how data can be compressed using dictionary-based compression. [3 marks]**

5

1 0 . 1 **Explain the operation of a logical bus network topology. [3 marks]**

1 0 . 2 **Explain how it is possible for the bit rate of a communications channel to be higher than its baud rate. [1 mark]**

1 0 . 3 **A data transmission system uses even parity. Data are transmitted in bytes, with each byte containing seven data bits and one parity bit.**

Explain how the receiver will perform error detection on a received byte. [2 marks]

1 0 . 4 **State TWO advantages of serial data transmission over parallel data transmission and explain how these are achieved. [4 marks]**

Advantage 1 _____

_____

_____

How achieved _____

_____

_____

_____

Advantage 2 _____

_____

_____

How achieved _____

_____

_____

_____

END OF QUESTIONS

10

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	
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