AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

AS
COMPUTER SCIENCE

Paper 2

Friday 24 May 2019 Morning 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.
- 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 Explain the difference between the set of natural numbers and the set of integer numbers.

[1 mark]

0 1 . 2 Explain the difference between rational and irrational numbers.

[1 mark]

2

0 2 . 1 Convert the bit pattern shown below into hexadecimal.

1	0	1	1	0	1	1	1

[1 mark]

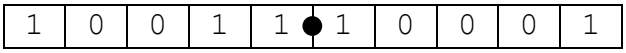
0 2 . 2 Explain why programmers often use hexadecimal to represent bit patterns instead of binary.

[1 mark]

Do not write outside the box

0 2 . 3 The bit pattern below represents an **unsigned fixed-point binary** number with five bits before and five bits after the binary point.

Convert the binary number into decimal.



[2 marks]

0 2 . 4 Explain how the **two's complement binary integer** `00100111` can be subtracted from the **two's complement binary integer** `01001001` without converting the numbers into decimal.

[2 marks]

6

Turn over for the next question

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0 3 . 1 The bit pattern `00111000` is the character code for the numeric character '`8`'

The bit pattern `00001000` represents the decimal number 8

Explain how a computer could convert the character code for '`8`' to the bit pattern for its corresponding decimal value.

[1 mark]

0 3 . 2 ASCII and Unicode are two common information coding systems.

Explain why Unicode was introduced as an alternative to ASCII.

[2 marks]

3

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0 4 . 1 Sampling with an 8-bit sample resolution means that each sample can be approximated to one of 256 different levels.

If the sample resolution is increased to 10 bits, how many **more** levels are available for approximating samples?

[1 mark]

0 4 . 2 A sound lasts 3 minutes and 20 seconds. It is sampled at a 44.1kHz sample rate with a 16-bit sample resolution.

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

Calculate the minimum amount of storage space, in megabytes (MB), needed to store the sampled sound.

You should show your working.

[3 marks]

Answer:

4

Turn over for the next question

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0 5 A computer system can be defined as hardware and software working together.

0 5 . 1 What is meant by the term hardware?

[1 mark]

0 5 . 2 What is meant by the term software?

[1 mark]

0 5 . 3 Explain the key difference between system software and application software.

[2 marks]

0 5 . 4 Some of the following types of software are examples of system software.

Shade in **two** lozenges to indicate which types of software are system software.

[2 marks]

Compiler	⬭	Photo editor	⬭	Spreadsheet	⬭
Computer game	⬭	Operating system	⬭	Word processor	⬭

6

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0 6 . 1 State the name of the logic gate represented by the truth table shown in **Figure 1**.

[1 mark]

Figure 1

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

Answer: _____

0 6 . 2 A factory has a machine for filling bottles on a conveyor belt.

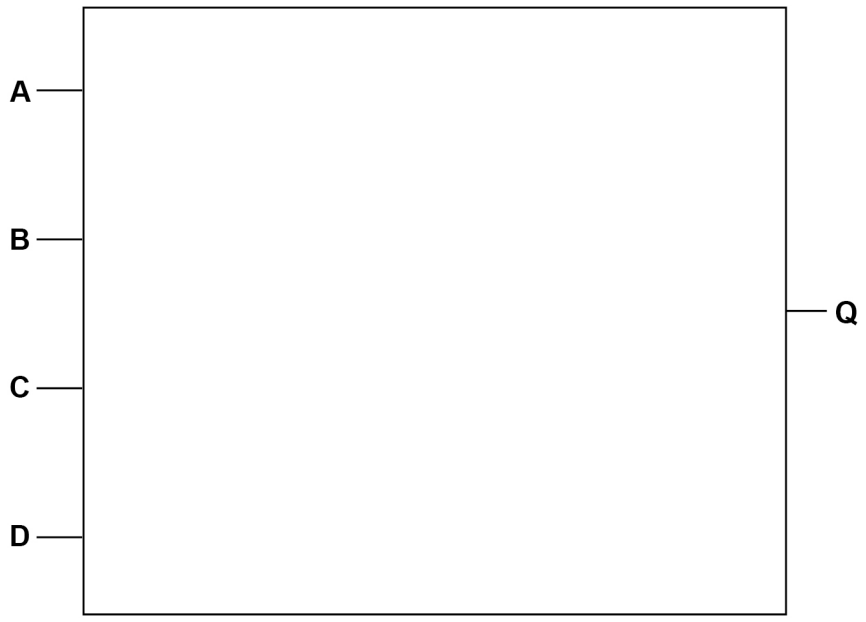
- Q represents the signal to move the conveyor belt on. When Q is set to true the belt will move on.
- A is a sensor which outputs true if a bottle is present.
- B is a sensor which outputs true if a bottle is full.
- C is a sensor which outputs true if a bottle is correctly positioned.
- D is a sensor which outputs true if the next section has a bottle in it.

The conveyor belt is able to move if both of these conditions are true:

- a bottle is full and correctly positioned or there is no bottle present
- there is no bottle in the next section.

In the box below, draw a logic circuit for the machine.

[3 marks]



Turn over ►

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0 6 . 3 De Morgan's laws can be applied to enable a combination of logic gates to be replaced by a single gate that produces the same output.

What single gate could replace the combination of gates in the expression $\overline{\overline{A} \cdot \overline{B}}$?

[1 mark]

0 6 . 4 Using the rules and identities of Boolean Algebra, simplify the following Boolean expression.

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

[4 marks]

9

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0 7 When the processor writes data to the main memory it will make use of the address, control and data buses.

Explain how **each** of these buses will be used during this **write** process.

[4 marks]

4

Turn over for the next question

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0 8 Modern computers often come with hard disks and solid-state disks (SSD) but no optical disk drives.

0 8 . 1 Explain why computers often have both of these types of storage rather than just having a hard disk or just having an SSD.

[2 marks]

0 8 . 2 Explain why it is faster to access data from solid state storage than from an optical disk.

[2 marks]

4

0 9 Three students share a house when they go to university and have set up a peer-to-peer network between their computers for sharing files and playing multi-user games.

0 9 . 1 Explain why a peer-to-peer network might be a better choice for the students than a client-server network.

[2 marks]

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0 9 . 2 Define the term 'protocol'.

[1 mark]

0 9 . 3 Define the term 'baud rate'.

[1 mark]

0 9 . 4 Define the term 'bandwidth'.

[1 mark]

0 9 . 5 Discuss how encrypting data with WPA/WPA2, disabling SSID broadcasting and MAC address whitelisting could enhance the security of a WiFi network.

[3 marks]

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0 9 . 6 When transmitting data, the wireless network uses the following systems:

- Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) with Request to Send/Clear to Send (RTS/CTS)
- Majority Voting.

Explain the process the transmitting device will go through to transmit data and what the receiving device would then do when it receives data.

[8 marks]

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0 9 . 7 Explain an advantage that majority voting has over using parity bits when transmitting data.

[1 mark]

17

Turn over for the next question

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

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 to 12

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1 0 **Figure 2** shows an algorithm, written in pseudo-code, that is used to multiply two variables W and X together. The resulting answer is stored in variable Y. It can be assumed that both W and X are positive integers. Z is a temporary variable. The operation DIV performs integer division.

Line numbers are included but are not part of the algorithm.

Figure 2

```
1  W ← 9
2  X ← 12
3  Y ← 0
4  REPEAT
5    Z ← W LOGICAL BITWISE AND 1
6    IF Z = 1 THEN
7      Y ← Y + X
8    END IF
9    W ← W DIV 2
10   X ← X * 2
11 UNTIL W = 0
```

1 0 . 1 Write a sequence of assembly language instructions that perform multiplication using the same method shown in **Figure 2**.

Assume that registers 0, 1, 2 and 3 are used to store the values represented by variables W, X, Y and Z accordingly.

Some lines, including those equivalent to line numbers 1 to 5 in **Figure 2**, have been completed for you.

[7 marks]

```
                MOV R0, #9
                MOV R1, #12
                MOV R2, #0
startloop:      AND R3, R0, #1
```

_____

_____

_____

```
jump:
```

_____

_____

_____

_____

```
                B startloop
endloop:
```

Turn over ►

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1 0 . 2 Describe **two** differences between machine code and assembly language.

[2 marks]

1 0 . 3 Assemblers and compilers are two different types of translator.

Describe **one** similarity and **one** difference between the role of an assembler and the role of a compiler.

[2 marks]

11

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1 1 There have been some cases where law enforcement officers have requested a phone manufacturer to bypass access restrictions on a phone that they believe contains evidence of criminal activity. The manufacturers frequently refuse to do so.

Discuss a range of ethical and legal issues raised by the manufacturer agreeing or refusing to bypass access restrictions to the contents of the phone.

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

END OF QUESTIONS

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