A

Surname ____________________

Other Names ____________________

Centre Number ____________________

Candidate Number ____________________

Candidate Signature ____________________

AS
COMPUTER SCIENCE

Paper 2

7516/2

Friday 8 June 2018 Morning

Time allowed: 1 hour 30 minutes

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

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

[Turn over]

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INSTRUCTIONS

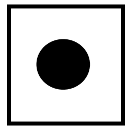
- Use black ink or black ball-point pen.
- Answer ALL questions.
- You must answer the questions in the spaces provided. Do not write on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

INFORMATION

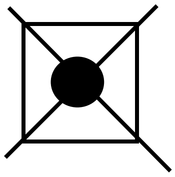
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

ADVICE

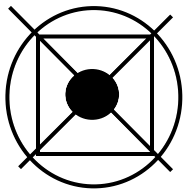
- In some questions you are required to indicate your answer by completely shading a lozenge alongside the appropriate answer as shown.



- 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

Answer ALL questions in the spaces provided.

0 1 **TABLE 1 describes some sets of numbers.**

TABLE 1

A	**A set of numbers that represent all possible real world quantities.**
B	**A set of numbers that can be written as fractions (ratios of integers).**
C	**A set of numbers that cannot be written as fractions (ratios of integers).**

0 1 . 1 **Shade in ONE lozenge to indicate which of the descriptions in TABLE 1 describes the set of real numbers. [1 mark]**

A	○	**B**	○	**C**	○

0 1 . 2 **Shade in ONE lozenge to indicate which of the descriptions in TABLE 1 describes the set of irrational numbers. [1 mark]**

A	○	**B**	○	**C**	○

2

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[Turn over]

0 2 . 1 TABLE 2 lists five different quantities of memory, each measured using different units.

Place the quantities of memory into order by writing the numbers 1 to 5 in the POSITION column of TABLE 2, with 1 representing the smallest quantity and 5 representing the largest quantity. [2 marks]

TABLE 2

QUANTITY	POSITION
3 kilobytes	
2 mebibytes	
2 bytes	
2 megabytes	
20 bits	

0 2 . 2 **Convert the hexadecimal numbers 27 and C9 into binary. Then, in binary, add them together to work out the total. Finally, convert the total back into hexadecimal to give the answer.**

You MUST show your working. [2 marks]

Answer in hexadecimal ____________________

0 2 . 3 **In decimal, what is the most negative number that can be represented using a 12-bit two's complement binary integer? [1 mark]**

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[Turn over]

5

0 3 . 1 **Describe the difference between analogue and digital data. [2 marks]**

Two methods of representing music digitally are as sampled sound and using MIDI.

0 3 . 2 **State TWO advantages of representing music using MIDI instead of as sampled sound.**
[2 marks]

4

0 4 . 1 **What is encryption? [1 mark]**

0 4 . 2 **A sensitive message could be encrypted using either the Vernam cipher or the Caesar cipher.**

Explain why the Vernam cipher is a better choice. [2 marks]

The bit pattern 1010011 1001111 1001110 represents the string 'SON' in 7-bit ASCII.

The bit pattern 1000001 represents the character 'A' in 7-bit ASCII and other characters follow on from this in sequence. For example, the bit pattern 1001000 represents the character 'H'.

0 4 . 3 **What bit pattern results from encrypting the string 'SON' using a Vernam cipher with the key 'HOG'?**

You MUST show your working. [3 marks]

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0 5 **An operating system is a type of software.**

0 5 . 1 **Shade ONE lozenge to indicate which category of software an operating system belongs to.**
[1 mark]

System software	○
Application software	○
Translation software	○

0 5 . 2 **State ONE resource that the operating system manages. [1 mark]**

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0 5 . 3 **State ONE role of the operating system, other than resource management. [1 mark]**

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3

[Turn over]

0 6 . 1 What is the stored program concept?
[2 marks]

Ella writes a program on her home computer and compiles it into an executable file.

0 6 . 2 **Ella's executable file will not run on Josephine's computer because the two computers have different processors.**

Explain why having different processors may have caused this problem. [2 marks]

The processor in Ella's computer has four cores running at 2.8 GHz and the processor in Josephine's computer has one core running at 3.2 GHz.

0 6 . 3 **Considering these differences, explain why Josephine's computer might be able to complete a particular task more quickly than Ella's. [2 marks]**

6

0 7 **A company employs a team of programmers to develop software to control a fleet of driverless cars, providing a taxi service for clients in a large city.**

0 7 . 1 **Discuss a range of moral, ethical, legal and cultural issues that the programmers may need to consider whilst developing the service and that may arise during the use of the service by the public.**

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]

9

0 7 . 2 **Cameras within the taxi take still images once every second for security purposes. The images are compressed using run-length encoding and stored on a flash memory card within the camera.**

Describe how a digital image could be captured by a digital camera and compressed using run-length encoding. [6 marks]

6

0 8 **A network with a physical star topology can have a logical bus topology.**

0 8 . 1 **Describe the difference between a physical and a logical topology. [2 marks]**

0 8 . 2 **Explain the operation of a physical star topology. [2 marks]**

[Turn over]

A new bank is setting up an internal network.

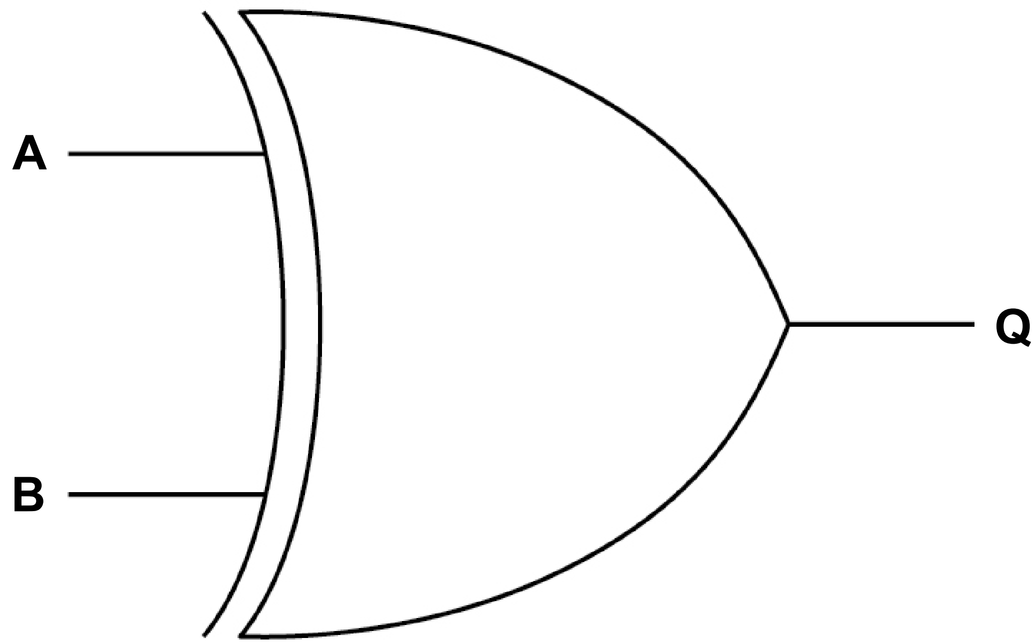
0 8 . 3 **Two types of networking are client-server and peer-to-peer. With reference to the needs of the bank and the properties of the two types of networking, explain why the bank should implement a client-server rather than a peer-to-peer network. [6 marks]**

10

0 9 . 1 **FIGURE 1 shows a logic gate symbol.**

Write the name of the logic gate underneath the figure. [1 mark]

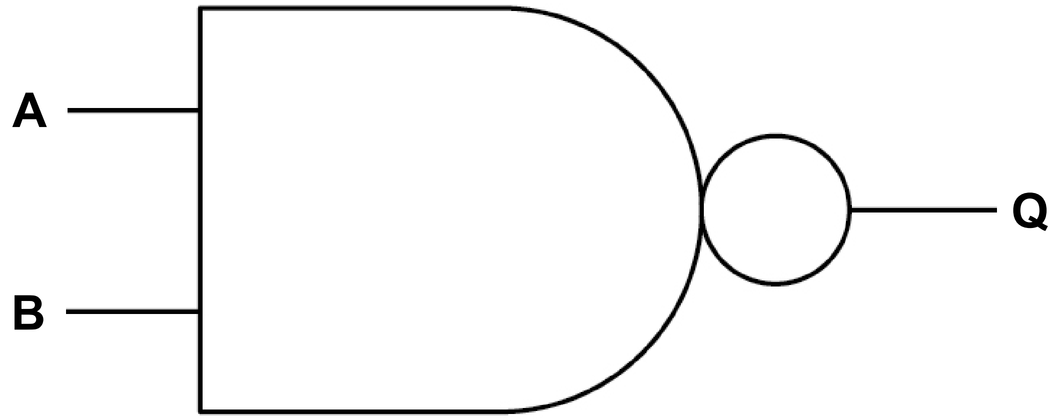
FIGURE 1



Answer = ______________________

0 9 . 2 FIGURE 2 shows a logic gate symbol.

FIGURE 2

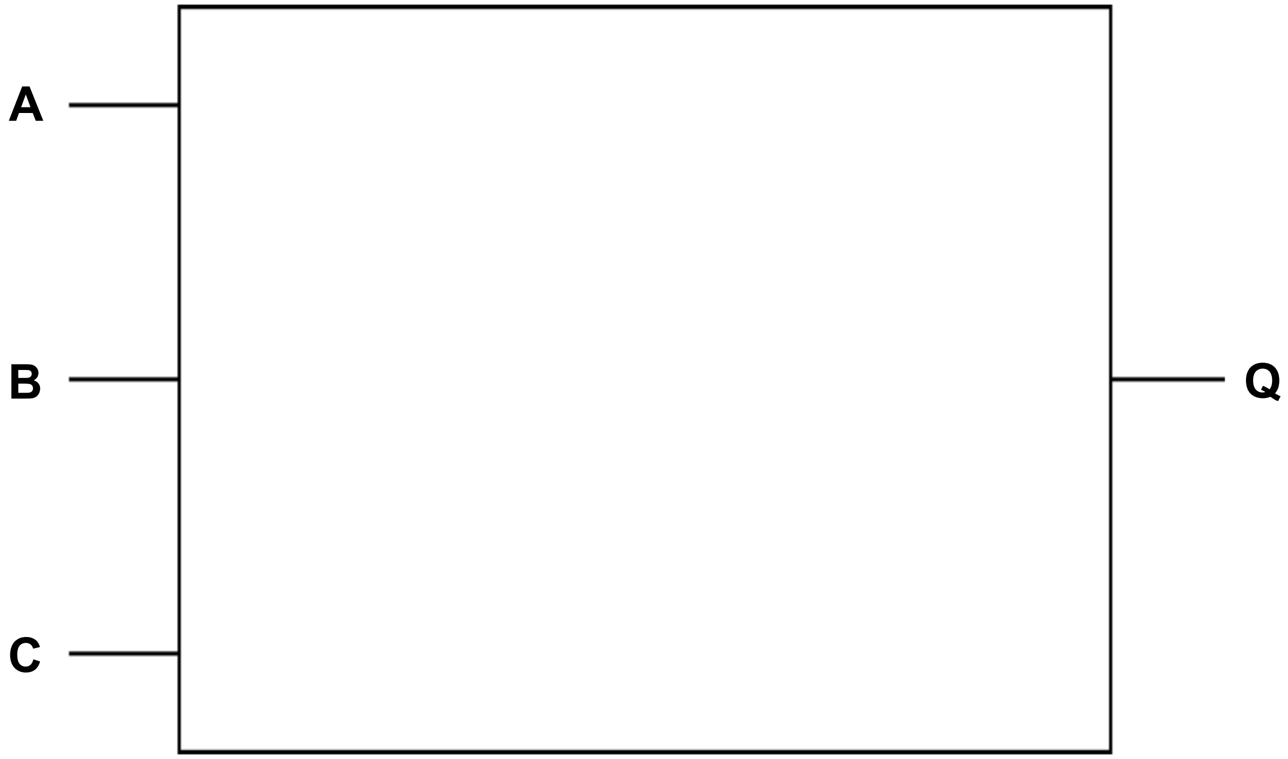


Complete the truth table below for the logic gate shown in FIGURE 2. [1 mark]

A	B	Q
0	0	
0	1	
1	0	
1	1	

[Turn over]

0 9 . 3 **Represent the Boolean equation $\overline{A} + \overline{B} \cdot C$ as a logic circuit by drawing a diagram of it in the space below. [3 marks]**



0 9 . 4 **Using the rules of Boolean algebra, simplify the following expression.**

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

You MUST show your working. [4 marks]

Answer =

[Turn over]

9

1 0 **TABLE 3 – standard AQA assembly language instruction set. This should be used to answer question part 1 0 . 1**

`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`.

[Turn over]

`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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FIGURE 3 shows an incomplete assembly language program, intended to perform integer division by 10.

The program decrements the value in R1 in steps of 10 until the value stored in R1 is less than 10. Each time that the value in R1 is decreased by 10 the value in R3 is increased by 1. For example, if R1 started at 43 the sequence of numbers stored in R1 would be 43, 33, 23, 13, 3 and the final value in R3 would be 4.

10.1 Complete the program in FIGURE 3.

You should assume that R1 has already been assigned a value to divide.

You may not need to use all four lines for your solution and you should not write more than one instruction per line. [4 marks]

FIGURE 3

```
            MOV R3, #0

loopstart:  CMP R1, #10

            ____________________

            ____________________

            ____________________

            ____________________

end:        HALT
```

[Turn over]

A processor supports 32 different basic machine code operations, and two addressing modes represented by a single bit, as shown in FIGURE 4 below.

FIGURE 4

Opcode						Operand									
Basic machine operation					Addressing mode										
0	0	0	0	1	1	0	0	1	1	1	0	1	1	0	1

1 0 . 2 How many different opcodes is the machine potentially capable of supporting? [1 mark]

____

10.3 In direct addressing, the value stored in the operand is the address of the memory location which contains the data to process.

In direct addressing mode, how many memory locations could a processor that used the instruction format described in FIGURE 4 potentially make use of? [1 mark]

____

6

1 1 Some compilers produce intermediate code such as bytecode as their final output whilst others produce executable code.

1 1 . 1 Explain why some compilers produce bytecode as the final output instead of executable code. [1 mark]

11.2 **Describe how bytecode programs are executed after the bytecode has been produced. [2 marks]**

[Turn over]

1 1 . 3 **Explain what is meant by the term imperative high-level language. [2 marks]**

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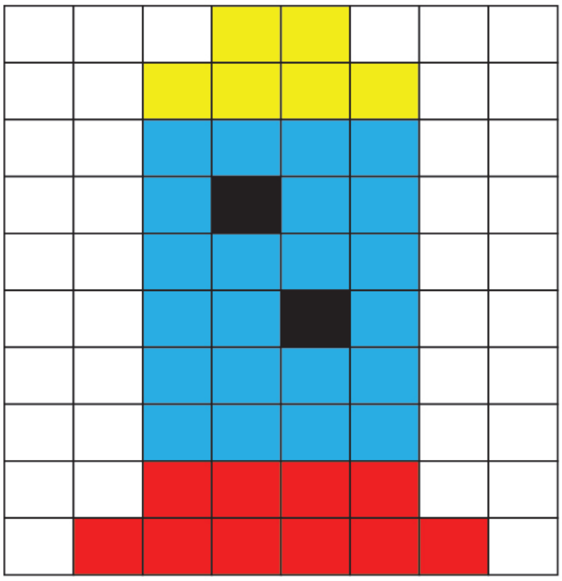
[Turn over]

12 FIGURE 5 shows a bitmap representation of an image consisting of white, red, blue, black and yellow pixels only.

FIGURE 5



12.1 Calculate the minimum size of file (excluding metadata) that could be used to store the bitmap image in FIGURE 5. Express your answer in bytes.

You MUST show your working. [3 marks]

12.2 Shade in ONE lozenge to indicate the minimum colour depth in bits required for an image with 18 colours. [1 mark]

3	○

4	○

5	○

4

END OF QUESTIONS

There are no questions printed on this page

For Examiner's Use	
Question	Mark
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