A

AQA

Surname _____

Other Names _____

Centre Number _____

Candidate Number _____

Candidate Signature _____

A-level

COMPUTER SCIENCE

Paper 2

7517/2

Friday 15 June 2018 **Morning**

Time allowed: 2 hours 30 minutes

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

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

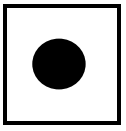
- **Use black ink or black ball-point pen.**
- **Answer ALL questions.**
- **You must answer the questions in the spaces provided. Do not write on blank pages.**
- **Do all rough work in this book. Cross through any work you do not want to be marked.**

INFORMATION

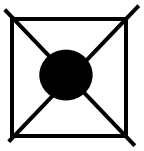
- **The marks for questions are shown in brackets.**
- **The maximum mark for this paper is 100.**

ADVICE

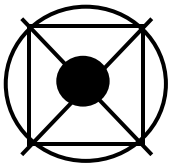
- **In some questions you are required to indicate your answer by completely shading a circle alongside the appropriate answer as shown.**



- **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.

0 1 . 1 **Shade ONE circle to indicate which of the unsigned numbers listed in TABLE 1 has the largest value. [1 mark]**

TABLE 1

Number base	Number	Largest value (shade one)
Binary	101101001	◯
Hexadecimal	30A	◯
Decimal	396	◯

Questions 01.2 and 01.3 use a NORMALISED floating point representation with a 7-bit mantissa and a 5-bit exponent, both stored using two's complement.

The following is a floating point representation of a number:

Mantissa

0 ●	1	0	1	1	0	0

Exponent

1	1	1	0	1

0 1 . 2 **Calculate the decimal equivalent of the number. You MUST show your working. [2 marks]**

Answer _____

[Turn over]

0 1 . 3 **Write the normalised floating point representation of the decimal value -608 in the boxes on page 7. You MUST show your working. [3 marks]**

ANSWER

Mantissa

Exponent

6

[Turn over]

0 2 **FIGURE 1 shows an image composed of four objects, represented digitally as a vector graphic. FIGURE 2 shows the same image, represented digitally as a bitmap graphic.**

The bitmap graphic has an image size of 50 x 50 pixels.

Each image uses four colours: white, black, yellow and blue.

FIGURE 1

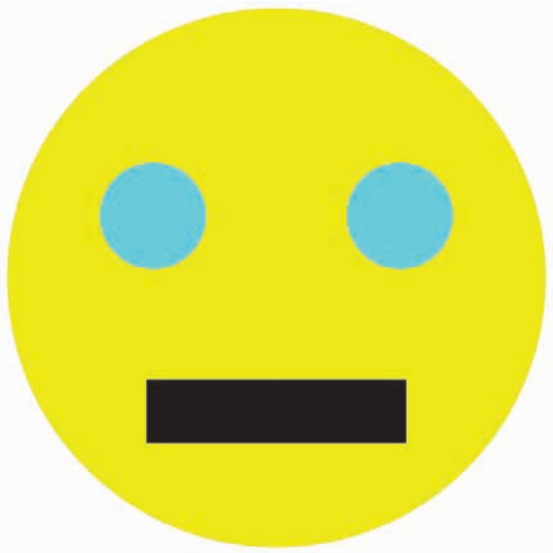


FIGURE 2

0 2 . 1 Describe how a vector graphic is represented.

Include an explanation of how the black rectangle in FIGURE 1 would be represented in your description. [3 marks]

0 2 . 2 **Calculate the minimum amount of storage space that is required to store the bitmap image in FIGURE 2, on page 8, excluding metadata. Express your answer in bytes.**

You MUST show your working. [2 marks]

Answer _____

FIGURE 3 shows an enlarged view of part of one row of pixels from the image in FIGURE 2.

FIGURE 3

0 2 . 3 Describe how a row of pixels, such as that shown in FIGURE 3, could be represented in compressed form by using run length encoding. [2 marks]

FIGURE 4 shows an image of a woodland scene.

FIGURE 4

0 2 . 4 The image in FIGURE 2, on page 8, is compressed using run length encoding. The compressed file is 80% smaller than the original file.

The image in FIGURE 4 is compressed using the same technique and the compressed file is approximately the same size as the original file.

Explain why the run length encoding method was not able to compress the image in FIGURE 4 as much as it could compress the image in FIGURE 2. [2 marks]

[Turn over]

9

0 3 **FIGURE 5, on page 2 of the insert, shows a logic circuit.**

0 3 . 1 **Complete the part of the truth table, shown below, for the circuit in FIGURE 5. [3 marks]**

Inputs						Outputs	
A	B	C	D	E	F	G	H
0	0	0					
0	0	1					
0	1	1					
1	1	1					

0 3 . 2 **Using FIGURE 5, on page 2 of the insert, write a Boolean expression to show how the output G is calculated from the inputs A, B and C.**
[3 marks]

G = _____

0 3 . 3 **Explain the purpose of the circuit. [1 mark]**

_____

_____

_____

7

0 4 **Employees at a bank use client computers to access data that is stored on a database server.**

The database server uses software to query and modify data stored in a database on hard disk drives. It returns the results of these queries to the clients over the bank's computer network.

The performance of the system is unsatisfactory: the time-delay between a client sending a query to the server and the client receiving the results is unacceptably long.

Explain how the performance of the system might be improved. You should consider the following factors that might be affecting the performance:

- **the hardware of the server**
- **the design of the computer network**
- **the database and software running on the server.**

In your answer 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]

12

0 5 **FIGURE 6, on page 3 of the insert, shows the physical topology of a local area network (LAN) used by a company, and its connection to the Internet. The LAN uses the IPv4 protocol.**

Internally, the network has been divided into subnets: 27 bits have been allocated to the network/subnet identifier.

0 5 . 1 **In binary, write out the subnet mask that has been programmed into the devices on the network. [1 mark]**

20

0 5 . 2 **SUBNET Z consists of all of the devices that are directly connected to Switch B.**

What is the maximum number of devices that could be connected to SUBNET Z at the same time? [1 mark]

0 5 . 3 When a device wishes to join SUBNET Z it communicates with the DHCP server.

Explain:

- **the purpose of the DHCP system**
- **why the DHCP system is used**
- **what will happen during this communication.**

[4 marks]

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[Turn over]

0 5 . 4 **The web server, which has the IP address 192.168.16.12, must be accessible from computers that are connected to the Internet but outside the company's own network.**

As the web server has a non-routable IP address, it cannot be accessed directly from outside the network. Therefore, access to the web server will be facilitated by the External Router, which supports Network Address Translation (NAT) and port forwarding.

Explain how the External Router will have been configured so that the web server can be accessed by computers outside the network. [2 marks]

8

[Turn over]

0 6 . 1 **Describe the principles of operation of an optical disk drive that is used to read data from an optical disk such as a CD-ROM or DVD-ROM. [6 marks]**

0 6 . 2 **USB Flash Drives (a type of SSD) are a more popular choice for transferring files such as images and word processed documents from one computer to another than CD-Rs (a type of optical disk).**

Explain why this is the case. [1 mark]

7

[Turn over]

0 7 **Athletes, who are members of teams, compete in running events, which are held at fixtures throughout the year.**

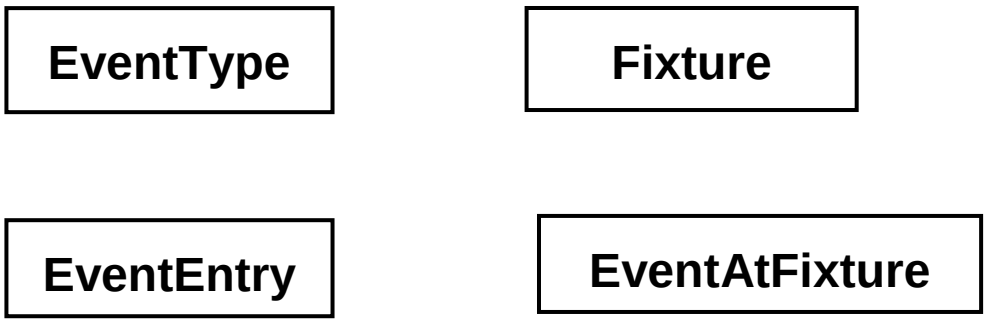
For example, athlete 15 might compete in the Girls' 1500m Under 18 race in the fixture at Marsten on 12 September 2018.

A relational database is used to store the details of which athletes enter each event at each fixture. The relations used in the database are shown in FIGURE 7, on page 4 of the insert.

0 7 . 1 **FIGURE 8 shows an incomplete entity-relationship diagram for part of the database.**

Draw lines on FIGURE 8 to show the degree of any THREE relationships that exist between the four entities shown. [2 marks]

FIGURE 8



0 7 . 2 **FIGURE 9 shows an SQL statement that is intended to make a table to represent the Athlete relation. The statement contains some errors.**

FIGURE 9

```
CREATE TABLE Athlete (
   PRIMARY KEY AthleteID,
   VARCHAR(50) Surname,
   VARCHAR(30) Forename,
   DATE DateOfBirth,
   VARCHAR(6) Gender,
   VARCHAR(30) TeamName
)
```

You may assume that all of the data types used in FIGURE 9 are valid and the field lengths are appropriate.

State TWO errors that have been made.
[2 marks]

Error 1: _____

_____

_____

_____

_____

Error 2: _____

_____

_____

_____

_____

0 7 . 3 **State TWO reasons why database designs, such as this one, are usually normalised.**
[2 marks]

Reason 1: _____

_____

_____

_____

Reason 2: _____

_____

_____

_____

A list is to be produced of the names of all athletes who are competing in the fixture that is taking place on 17/09/18. The list must include the Surname, Forename and DateOfBirth of these athletes and no other details. The list should be presented in alphabetical order by Surname.

0 7 . 4 Write an SQL query to produce the list.
[5 marks]

0 8 **Explain some of the challenges that face legislators in the digital age. [3 marks]**

3

0 9 . 1 **Three numbers are listed in the first column of TABLE 2.**

For each row in TABLE 2, shade one or more circles, in the appropriate column(s), to indicate which set(s) of numbers contain(s) the number on the row.

As an example, the first row has been completed for you, to indicate that π is a member of the set of irrational numbers and the set of real numbers, but is not a member of the sets of natural, integer or rational numbers.
[2 marks]

TABLE 2

	Natural	Integer	Rational	Irrational	Real
π	○	○	○	●	●
15/23	○	○	○	○	○
108	○	○	○	○	○

0 9 . 2 **FIGURE 10 shows a list of eight numbers, stored in an array.**

FIGURE 10

Index	[0]	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Contents	48	9	201	62	82	92	30	72

Describe what an ordinal number is AND what an ordinal number would be used for in the context of this array. [2 marks]

4

1 0 **Using the laws of Boolean algebra, show that:**

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

You MUST show your working. [4 marks]

4

1 1 **FIGURE 11, on page 5 of the insert, shows an analogue signal represented as a waveform. The analogue signal is being converted to a digital signal by an analogue to digital convertor (ADC).**

Points A and B in FIGURE 11 indicate the amplitude of the waveform (A), at a point in time, and the value that was recorded for this measurement when the waveform was sampled (B).

1 1 . 1 **The waveform's amplitude is measured and recorded using a scale with 16 divisions, which are shown on the Y axis in FIGURE 11.**

The recorded digital data indicates which division on the Y axis each measurement is closest to. For example, the closest division to measurement A is 13.

What sample resolution has been used?
[1 mark]

1 1 . 2 **The graph covers a time period of 0.01 seconds. During this time period, 10 samples have been recorded at the times indicated by the divisions on the X axis in FIGURE 11.**

What sample rate has been used? [1 mark]

1 1 . 3 **Explain the impact of the difference between A and B and how this difference could be reduced by redesigning the sampling system. [2 marks]**

[Turn over]

1 1 . 4 **A different analogue signal is being sampled. The highest frequency present in the signal's waveform is 1200 Hz.**

What is the minimum sample rate that must be used during sampling in order to preserve all of the frequencies in the waveform? [1 mark]

_____

_____

_____

_____

5

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[Turn over]

1 2 **The pseudo-code in FIGURE 12, on page 6 of the insert, shows one method for carrying out encryption of a single character using the Caesar Cipher.**

If the character to be encrypted is a capital letter, then the encrypted character will be shifted along the alphabet by the number of positions specified by the key. If the character is not a capital letter, then the encrypted character is set to be equal to the original character.

The pseudo-code assumes that the letter to encrypt is stored using the Unicode UTF-8 encoding method, for which the values of capital letters (in decimal) are shown in TABLE 3, on page 7 of the insert.

FIGURE 13, on the opposite page, shows an incomplete assembly language program that has been written to implement the pseudo-code algorithm shown in FIGURE 12, on page 6 of the insert. The assembly language instruction set that has been used to write the program is listed in TABLE 4 on pages 8–11 of the insert.

The symbols ❶ and ❷ indicate the positions of missing lines of code.

FIGURE 13

```
   CMP R1, #65
   BLT doNotEncrypt
   CMP R1, #90
   BGT doNotEncrypt
   ADD R3, R1, R2
❷
doNotEncrypt:
❶
finished:
   HALT
```

1 2 . 1 By analysing the assembly language program in FIGURE 13, explain the purpose for which the registers R1, R2 and R3 have been used. [2 marks]

Register	Purpose
R1	
R2	
R3	

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1 2 . 2 **On FIGURE 13, on page 41, write the assembly language instruction that is missing from position ❶. [1 mark]**

1 2 . 3 **On FIGURE 13, on page 41, write the assembly language instructions that are missing from position ❷. [3 marks]**

6

[Turn over]

1 3 **A family uses a wireless computer network at home.**

1 3 . 1 **Describe TWO security measures that the family should put in place to ensure that the wireless access point is secure AND explain how these security measures will make wireless connections to the access point more secure. [2 marks]**

Measure 1: _____

_____

_____

_____

_____

_____

Measure 2: _____

_____

_____

_____

_____

_____

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[Turn over]

1 3 . 2 **The network uses the CSMA/CA access method with Request to Send/Clear to Send (RTS/CTS).**

A computer on the network has data to send to another computer. Explain how the CSMA/CA access method with RTS/CTS will be used during this transmission. [6 marks]

8

1 4 . 1 **One characteristic of a data set that might result in it being classified as Big Data is that it contains a variety of different forms of information.**

Describe TWO OTHER characteristics that might result in a data set being classified as Big Data. [2 marks]

Characteristic 1: _____

_____

_____

_____

_____

_____

Characteristic 2: _____

_____

_____

_____

_____

_____

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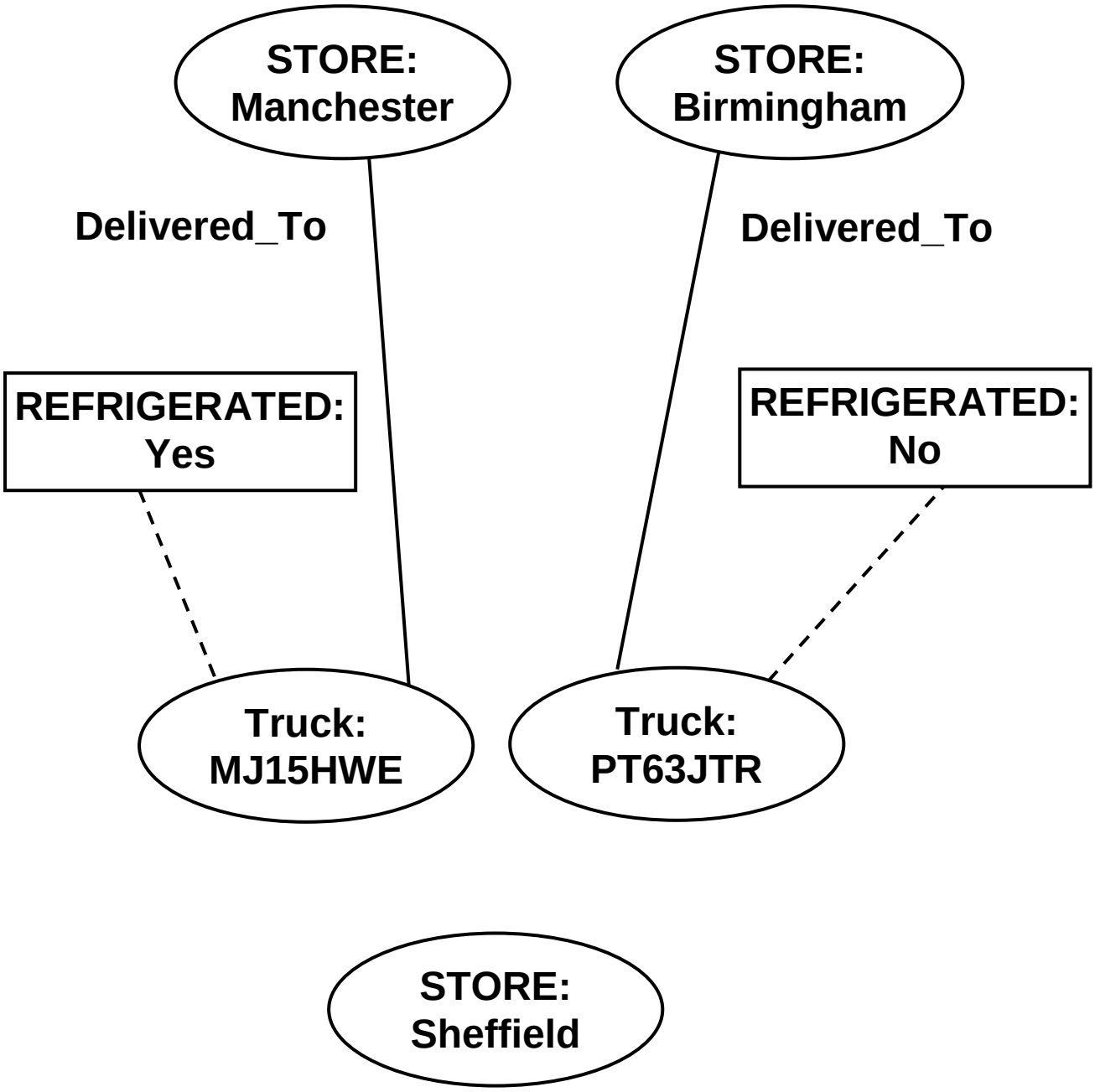
[Turn over]

1 4 . 2 **In a fact-based model, data is represented as atomic facts, which are immutable (ie will never change). Fact-based models can be represented visually using a graph schema.**

FIGURE 14 shows part of a graph schema for a data set about deliveries made to stores by trucks.

FIGURE 14



Complete the graph schema in FIGURE 14 to represent the following additional facts.

- **Truck MJ15HWE has made a delivery to the Sheffield store.**

- **Truck PT63JTR was last serviced on 10 May 2018 and truck MJ15HWE was last serviced on 18 March 2018.**

- **Both of the trucks are owned by a haulage company called Ferguson's which has 15 employees and has a head office in Bolton.**
  [3 marks]

5

1 5 **In a functional programming language, four functions named `fw`, `fx`, `fy` and `fz` and a list named `sales` are defined as shown in FIGURE 15.**

FIGURE 15

```
fw [a,b] = a * b
fx c = map fw c
fy d = fold (+) 0 d
fz e = fy (fx e)

sales = [[10,2], [2,25], [4,8]]
```

The `sales` list represents all of the sales made in a shop in 1 day. It is composed of sublists.

The values in each sublist indicate the price of a product and the quantity of the product that was sold. For example, `[10,2]` indicates that 10 units of a product priced at £2 were sold.

1 5 . 1 **Shade ONE circle to indicate how many of the four functions (`fw`, `fx`, `fy`, `fz`) in FIGURE 15 use a higher-order function. [1 mark]**

1 ○	2 ○	3 ○	4 ○

1 5 . 2 Calculate the results of making the function calls listed in TABLE 5, using the functions and lists in FIGURE 15 as appropriate. [3 marks]

TABLE 5

Function call	Result
`fw [4,3]`	
`fx sales`	
`fz sales`	

1 5 . 3 In the context of the shop, explain what the result of the function call `fz sales` represents. [1 mark]

END OF QUESTIONS

5

There are no questions printed on this page

For Examiner's Use	
Question	Mark
1	
2	
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11	
12	
13	
14	
15	
TOTAL	