**Q1.**

The table describes some sets of numbers.

|  |  |
| --- | --- |
| **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). |

(a)  Shade in **one** lozenge to indicate which of the descriptions in the table describes the set of real numbers.



**(1)**

(b)  Shade in **one** lozenge to indicate which of the descriptions in the table describes the set of irrational numbers.



**(1)**

**(Total 2 marks)**

**Q2.**

(a)     Shade in **one** lozenge to indicate which of the symbols represents the set of rational numbers.



**(1)**

(b)     Shade in **one** lozenge to indicate which of the symbols represents the set of numbers that does **not** include **all** of the numbers −3, 4 and 9.



**(1)**

(c)     Shade in **one** lozenge to indicate which of the symbols represents the set of numbers that is most suitable for measuring the circumference of a ball.



**(1)**

**(Total 3 marks)**

**Q3.**

The figure shows a bit pattern.



(a)     What is the hexadecimal equivalent of the bit pattern shown in the figure?

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**(1)**

(b)     Why do programmers often use hexadecimal instead of binary to represent bit patterns?

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**(1)**

(c)     What is the decimal equivalent of the bit pattern shown in the figure if it represents an **unsigned fixed-point binary** value with four bits before the binary point and four bits after the binary point?

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**(2)**

(d)     What is the decimal equivalent of the bit pattern shown in the figure if it represents a **two’s complement binary integer**?

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**(1)**

(e)     The ASCII code for the numeric character "0" is 4810; other numeric characters follow on from this in sequence.

What character is represented by the bit pattern in the figure if it is an ASCII code?

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**(1)**

(f)      Parity bits are often used to detect errors during data transmission. If the most significant bit in the bit pattern in the figure (the leftmost bit) is a parity bit, explain how the value of this was calculated by the sending device before the byte was transmitted. You should assume that the even parity system is being used.

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**(2)**

(g)     Majority voting is an alternative to using parity bits. Explain how the majority voting system works in the context of data transmission.

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**(2)**

**(Total 10 marks)**

**Q4.**

(a)  The table 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 the table, with 1 representing the smallest quantity and 5 representing the largest quantity.

|  |  |
| --- | --- |
| **Quantity** | **Position** |
| 3 kilobytes |  |
| 2 mebibytes |  |
| 2 bytes |  |
| 2 megabytes |  |
| 20 bits |  |

**(2)**

(b)  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.

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Answer in hexadecimal \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

**(Total 4 marks)**

**Q5.**

Indicate clearly below where the binary point must be placed so that the value 19.375 is represented.



**(Total 1 mark)**

**Q6.**

Bit patterns can be interpreted in a number of different ways.  A computer word contains the bit pattern 0011 0110.

(a)     What is its decimal value if it represents a pure binary integer

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**(1)**

(b)     (i)      The ASCII value for the character ‘2’ is 50.  What is the character stored in the computer word 0011 0100?

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**(2)**

(ii)     Name **one** other standard coding system for coding information expressed in character or text-based form.

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**(1)**

(c)     One method of storing graphics in a computer system is as vector graphics.

(i)      Name **one** other method.

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**(1)**

(ii)     Describe how a black-and-white image would be stored using your method.

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**(2)**

**(Total 7 marks)**

**Q7.**

(a)     What is the denary equivalent of the hexadecimal number A7?

*You may use the space below for rough working. You may get some marks for your working, even if your answer is incorrect.*

Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(b)     Represent the denary value 7.625 as an **unsigned binary fixed point** number, with 4 bits before and 4 bits after the binary point.

*Use the space below for rough working.*

Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(c)     Represent the denary value -18 as an **8-bit two's complement binary integer**.

*Use the space below for rough working.*

Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(d)     What is the **largest positive denary value** that can be represented using **8-bit two's complement binary**?

*Use the space below for rough working*.

Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(e)     Describe how **8-bit two's complement binary** can be used to subtract one number from another number. In your answer you must show how the calculation 23 – 48 would be completed using the method that you have described.

*You may use the space below for rough working*.

Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(4)**

**(Total 11 marks)**

**Q8.**

Images are often represented in a computer’s memory using bitmapped graphics.

(a)     What is meant by the **resolution** of a bitmapped graphic image?

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**(2)**

(b)     How many colours can a bitmapped graphic image with a colour depth of 4 bits contain?

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**(1)**

(c)     A bitmapped image has 16 × 16 pixels. It is stored in an image format that is limited to 65536 colours. Calculate the minimum image size in bytes.

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**(3)**

(d)     Instead of using bitmapped graphics, images may be represented in a computer’s main memory using vector graphics.

State **two** advantages of vector graphics compared to bitmapped graphics.

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**(2)**

**(Total 8 marks)**

**Q9.**

A performance by a music band is to be recorded and distributed on CD.

**Figure 1** shows three samples stored in a computer's memory that have been taken from an analogue signal as part of the recording process. A sampling rate of 44,000Hz (Hertz) has been used.

1Hz is one sample per second.

**Figure 1**

|  |
| --- |
| 0000  0001  1000  1110 |
| 0000  0001  1000  1110 |
| 0000  0001  1000  0011 |

(a)     What sampling resolution has been used?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(1)**

(b)     If the original analogue signal lasts 100 seconds, how many bytes of storage will be required to store all the samples taken in the recording process?

*You may use the space below for rough working. You may get some marks for your working, even if your answer is incorrect.*

Answer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(3)**

(c)     The average human can hear frequencies up to 20,000Hz (Hertz).

Explain why a sampling rate of 44,000Hz has been chosen for the recording.

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**(2)**

(d)     The CD recording is processed to create a version of the performance that can be downloaded from the band’s website.

The sound quality of the version of the recording stored on the web server is not as good as the sound quality of the CD version.

State **one** possible cause of this reduction in sound quality.

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**(1)**

**(Total 7 marks)**

**Q10.**

MIDI is a system that can be used to enable musical devices to communicate and to represent music on a computer.

Explain how MIDI represents music **and** the advantages of using MIDI for representing music instead of using sampled sound.

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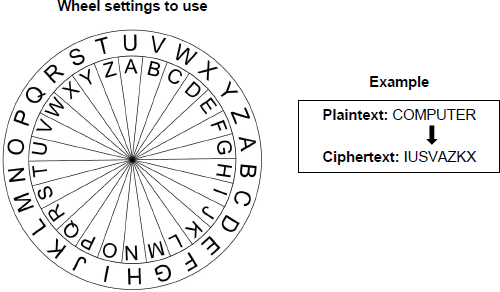
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**(Total 4 marks)**

**Q11.**

**Figure 1** shows a message being encrypted using a Caesar cipher.

**Figure 1**

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Decrypt the ciphertext "QGOZRKT" using the Caesar cipher with the settings shown in **Figure 1**.

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**(Total 1 mark)**

**Q12.**

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’.

What bit pattern results from encrypting the string ‘SON’ using a Vernam cipher with the key ‘HOG’?

You **must** show your working.

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**(Total 3 marks)**