**Q1.**

The figure shows a bit pattern.



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

**(1)**

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

**(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?

**(2)**

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

**(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?

**(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.

**(2)**

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

**(2)**

**(Total 10 marks)**

**Q2.**

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

**(Total 1 mark)**

**Q3.**

(a)     How many bytes are 1 Kilobyte?

**(1)**

(b)     A computer system uses 2 bytes to store a number.

(i)      What is the largest pure binary integer it can store?

**(1)**

What is the bit pattern if the number 37 is to be stored as

(ii)     a pure binary integer?



**(1)**

(c)     The ASCII coding system uses seven bits to code a character.

The character digits 0 to 9 are assigned the decimal number codes 48 to 57.

An extra bit is used as a parity bit.

A computer system uses the most significant bit (MSB) as a parity bit for each byte and works with **even** parity.

(i)      What is the bit pattern if the digits 37 are to be stored as characters?



**(3)**

(ii)     Explain how the parity bit is used by this computer system.

**(2)**

**(Total 8 marks)**

**Q4.**

The code below shows a 7-bit ASCII character code. The character code is to be sent across a network using a parity system.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 1 | 0 | 1 | 1 | 1 |

Describe how the parity bit would be generated for the character on the code above using even parity.

**(Total 2 marks)**

**Q5.**

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.

**(Total 3 marks)**

**Q6.**

The bit pattern 1000001 represents the character ‘A’ in 7-bit ASCII. Other characters follow on from this in sequence. For example, the bit pattern 1000100 represents the character ‘D’.

The bit pattern 1000100 1000001 1000010 represents ‘DAB’ in 7-bit ASCII.

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

You **must** show your working.

**(Total 3 marks)**

**Q7.**

A band is recording and digitising a song to make available as a download from their website.

(a)     The song lasts 3 minutes. The sample resolution is 16 bits and a sample rate of 44 kHz has been used.

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

Calculate the minimum amount of storage space, in megabytes (MB), needed to store the song in an uncompressed format.

You **must** show your working.

**(3)**

(b)     The song is being recorded using a microphone plugged into the sound card of the computer. The sound card contains an analogue to digital converter (ADC).

Describe the steps the ADC goes through in this process.

**(3)**

(c)     The band have been advised to save their song using lossless compression.

Explain why it might be appropriate for the band to save the song using lossless compression rather than using lossy compression.

**(2)**

**(Total 8 marks)**