**Q1.**

Shade **one** lozenge that states why Unicode is now commonly used in preference to ASCII.

|  |  |  |
| --- | --- | --- |
| **A** | Unicode can be represented in hexadecimal. |  |
| **B** | Unicode includes characters from many different alphabets. |  |
| **C** | Unicode is a sequential character set. |  |
| **D** | Unicode is easier to remember than ASCII. |  |
| **E** | Unicode takes up less space in memory than ASCII. |  |

**(Total 1 mark)**

**Q2.**

A student has written the following statements about representing images. Two are correct and two are incorrect:

**Statement 1**

“Bitmap images are made up of pixels.”

**Statement 2**

“A 2 pixel by 4 pixel bitmap image contains 16 pixels.”

**Statement 3**

“A pixel is a single point in a graphical image.”

**Statement 4**

“Black and white images have a minimum colour depth of two.”

Write the correct versions of the **two** incorrect statements that the student has made.

First corrected statement  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Second corrected statement  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(Total 2 marks)**

**Q3.**

Calculate the minimum file size in **bits** of a 10 pixel by 10 pixel image with a colour depth of 3 bits.

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**(Total 1 mark)**

**Q4.**

Calculate the minimum file size in **bytes** of a 10 pixel by 10 pixel image with 12 different colours.

You should show your working.

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**(Total 3 marks)**

**Q5.**

Convert the decimal number 220 into binary.

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**(Total 1 mark)**

**Q6.**

Convert the hexadecimal number AD into binary.

You should show your working.

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

**(Total 2 marks)**

**Q7.**

Convert the hexadecimal number 1A into decimal.

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**(Total 1 mark)**

**Q8.**

What is the largest hexadecimal number that can be represented in binary using 8 bits?

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**(Total 1 mark)**

**Q9.**

The code below shows a value represented as a bit pattern.

1  0  1  1  0  0  0  0

A binary shift can be used to divide the value in the code above by 4.

What is the result of this shift?

Your answer **must** be in binary.

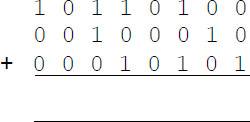
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(Total 1 mark)**

**Q10.**

Add the following binary numbers and give your answer in binary.



**(Total 2 marks)**

**Q11.**

Eight minutes of sound has been digitally recorded. The sampling rate used was 25 000 Hertz and the sample resolution used was 4 bits.

(a)  Calculate the minimum file size for the recording. Give your answer in **megabytes**.

You should show your working.

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

**(4)**

(b)  Explain what effects increasing the sampling rate would have on the recording.

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**(2)**

**(Total 6 marks)**

**Q12.**

**Figure 1** shows a black and white image.

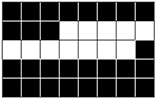
**Figure 1**

****

The image shown in **Figure 1** could be compressed using Run Length Encoding (RLE). The RLE for the image in **Figure 1** is B15 W9.

(a)  **Figure 2** shows another black and white image.

**Figure 2**

****

Give the RLE for the image shown in **Figure 2**.

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

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**(1)**

(b)  The RLE will be represented using binary, with one bit representing the colour (W = 1, B = 0) followed by seven bits representing the frequency.

Give the binary representation of the RLE: B15 W9

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

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**(2)**

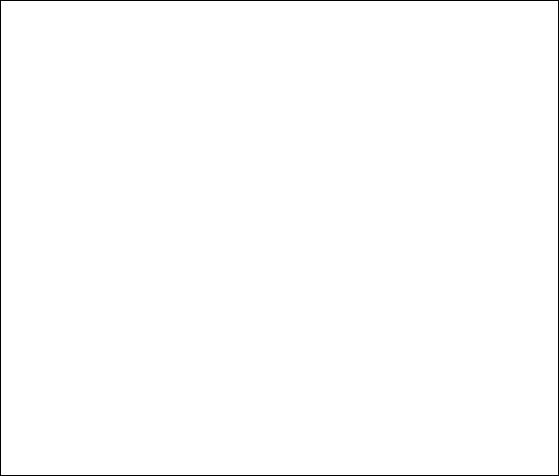
**(Total 3 marks)**

**Q13.**

The table below is a frequency table that contains the frequency of characters in a string.

|  |  |
| --- | --- |
| A | 6 |
| B | 2 |
| C | 3 |

Use the frequencies given in the table above to draw a Huffman tree that represents the string.



**(Total 3 marks)**

**Q14.**

The table below shows the Huffman codes for the characters used in the string PIEDPIPER

|  |  |  |
| --- | --- | --- |
| **Character** | **Character frequency** | **Huffman code** |
| P | 3 | 10 |
| I | 2 | 11 |
| E | 2 | 01 |
| D | 1 | 000 |
| R | 1 | 001 |

Calculate how many bits would be saved if the phrase PIEDPIPER was encoded using the Huffman codes shown in above table, rather than using ASCII.

You should show your working.

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

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Number of bits saved \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(Total 3 marks)**

**Q15.**

A bitmap image is represented as a grid of pixels.

State what is meant by the term pixel.

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**(Total 1 mark)**

**Q16.**

State the maximum number of different colours that can be used if a bitmap image has a colour depth of six bits.

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**(Total 1 mark)**

**Q17.**

State the **hexadecimal** representation of the binary number 10010100

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

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**(Total 1 mark)**

**Q18.**

State the **hexadecimal** representation of the decimal number 143

You should show your working.

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

**(Total 2 marks)**

**Q19.**

State the **binary** representation of the hexadecimal number BE

You should show your working.

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

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

**(Total 2 marks)**

**Q20.**

What is the largest decimal number that can be represented using 6 bits?

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

**(Total 1 mark)**

**Q21.**

Shade **one** lozenge to show which statement best describes data compression.

|  |  |  |
| --- | --- | --- |
| **A** | The process of calculating the file size of a saved file. |  |
| **B** | The process of encoding characters into more than one language. |  |
| **C** | The process of encoding information to try and use fewer bits than the original. |  |
| **D** | The process of removing necessary data from a file. |  |

**(Total 1 mark)**

**Q22.**

Give **two** reasons why data compression is often used.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

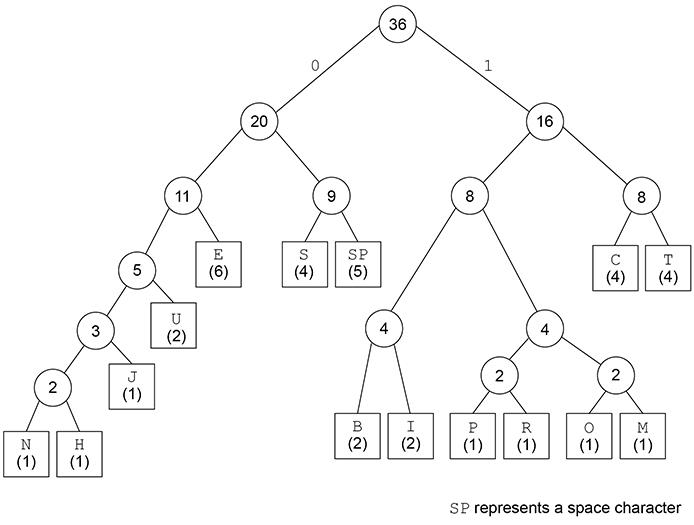
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(Total 2 marks)**

**Q23.**

**Figure 1** shows a Huffman tree that has been created to represent the string shown in **Figure 2**.

**Figure 1**

****

**Figure 2**

COMPUTER  SCIENCE  IS  THE  BEST  SUBJECT

(a)  Use the Huffman tree in **Figure 1** to state the Huffman encoding for the string MOST

|  |  |  |  |
| --- | --- | --- | --- |
| **M** | **O** | **S** | **T** |
|  |  |  |  |

**(3)**

(b)  A student was asked to describe how a Huffman tree could be created for the string in **Figure 2**. Her response was:

“I would count the number of times each character appears in the string and create a frequency table sorted alphabetically. For example, the letter S has the highest frequency in **Figure 2**. Next I would take the two characters with the highest frequencies and combine them into a new node. The new node would be added to the end of the frequency table. The two characters with the lowest remaining frequencies are now combined into a new node and the process is repeated until all the characters have been added to nodes and the tree created.”

State **four** mistakes the student has made in her response.

1.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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2.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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3.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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

4.  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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

**(4)**

(c)  When the Huffman tree in **Figure 1** is used, the string in **Figure 2** can be represented using 130 bits.

The 36-character string shown in **Figure 2** could also be encoded using ASCII.

How many bits are **saved** when Huffman coding is used rather than ASCII to represent the string shown in **Figure 2**?

You **must** show your working.

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

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

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

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

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

**(2)**

**(Total 9 marks)**

**Q24.**

Convert the decimal number 197 into binary.

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

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

**(Total 1 mark)**

**Q25.**

Convert the hexadecimal number A4 into decimal.

Show your working.

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

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

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

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

**(Total 2 marks)**

**Q26.**

What is the largest decimal number that can be represented using 5 bits?

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

**(Total 1 mark)**

**Q27.**

How many bits are there in 3 MB?

Show your working.

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

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

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

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

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

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

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

**(Total 2 marks)**

**Q28.**

State **one** advantage of using Unicode instead of using ASCII.

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

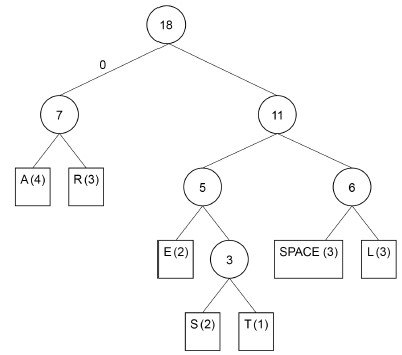
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(Total 1 mark)**

**Q29.**

The Huffman tree in **Figure 1** was generated for the string ARE ALL STARS REAL

**Figure 1**

****

(a)  Part of the string ARE ALL STARS REAL was incorrectly encoded as in **Figure 2** below.

**Figure 2**

1111000010101011

What string does this encoding represent?

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

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

**(1)**

(b)  What would be the correct binary encoding for the substring STAR?

Write the correct encoding below the letters in the table.

|  |  |  |  |
| --- | --- | --- | --- |
| S | T | A | R |
|  |  |  |  |

**(2)**

**(Total 3 marks)**

**Q30.**

A bit pattern is shown below.

01001110

(a)  Convert the bit pattern into decimal.

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

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

**(1)**

(b)  Convert the bit pattern into hexadecimal.

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

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

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

Answer: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

**(Total 3 marks)**

**Q31.**

A student’s answer to the question “Why is hexadecimal often used instead of binary?” is shown below.

|  |
| --- |
| Because it uses fewer digits it will take up less space in a computer’s memory. |

Explain why the student’s answer is incorrect.

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

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

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

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

**(Total 2 marks)**

**Q32.**

A sound engineer is using a sampling rate of 2000 Hz and a sample resolution of 4 bits. What is the minimum file size of a 5-second recording? Your answer should be given in **bytes**.

You should show your working.

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

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

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

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

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

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

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

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

**(Total 4 marks)**

**Q33.**

A bit pattern is shown below.

10011100

(a)  Convert the bit pattern shown above into decimal.

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

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

**(1)**

(b)  Convert the bit pattern shown above into hexadecimal.

You should show your working.

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

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

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

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

**(2)**

**(Total 3 marks)**

**Q34.**

State the **denary** representation of the binary number 10010011.

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

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

**(Total 1 mark)**

**Q35.**

What is the largest **hexadecimal** number that can be represented using two hexadecimal digits?

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

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

**(Total 1 mark)**

**Q36.**

Tick **one** box to indicate the statement that is true about hexadecimal and binary numbers:

|  |  |
| --- | --- |
| **Statement** | **Tick one box** |
| Hexadecimal generally uses more digits to represent a decimal number than binary does. |  |
| Binary numbers take up more space in a computer’s memory than hexadecimal numbers. |  |
| Any binary number can also be represented in hexadecimal. |  |

**(Total 1 mark)**

**Q37.**

Every ASCII character is stored in a computer system as a bit pattern.

(a)  State the **minimum** number of bits required to represent any of the 128 different characters used in ASCII.

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

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

**(1)**

(b)  State how many **extra** bits will be required to represent a character in ASCII if the number of possible characters was extended from 128 characters to 256 characters.

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

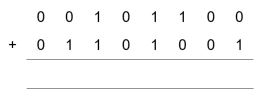
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

**(Total 2 marks)**

**Q38.**

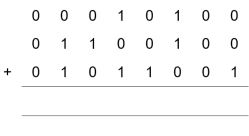
Complete the binary addition calculation.



**(Total 2 marks)**

**Q39.**

Complete the binary addition calculation of three numbers.



**(Total 2 marks)**

**Q40.**

Shade in **one** lozenge to indicate which of the statements below is the true statement.

|  |  |  |
| --- | --- | --- |
| **A** | Performing a right binary shift by 1 place always exactly halves a whole decimal number stored in a byte. |  |
| **B** | Performing a right binary shift by 1 place sometimes exactly halves a whole decimal number stored in a byte. |  |
| **C** | Performing a right binary shift by 1 place never exactly halves a whole decimal number stored in a byte. |  |

**(Total 1 mark)**

Mark schemes

**Q1.**

**Mark is for AO1 (understanding)**

**B** Unicode includes characters from many different alphabets.;

**R.** if more than one lozenge is shaded.

**[1]**

**Q2.**

**2 marks for AO2**

1 mark for each correction:

(Statement 2)

A 2 pixel by 4 pixel bitmap image contains 8 pixels //

A *n* pixel by *m* pixel bitmap image contains 16 pixels *[where n\*m=16]*;

(Statement 4)

Black and white images have a minimum colour depth of one //

Three/Four-colour images have a minimum colour depth of two;

**A.** Explanation of error that makes it clear what should have been written instead of the corrected statement.

**[2]**

**Q3.**

**Mark is for AO2**

300 (b // bits);

**[1]**

**Q4.**

**3 marks for AO2**

50 (B // bytes);;;

If incorrect answer then award a **max of two** marks for the following working:

identifying the colour depth is 4;

correctly multiplying 10 x 10 x (possibly incorrect) colour depth;

attempt at dividing the calculated size in bits by 8;

**[3]**

**Q5.**

**Mark is for AO2 (apply)**

11011100;

**[1]**

**Q6.**

**2 marks for AO2 (apply)**

10101101;;

If the binary answer given is incorrect then award a maximum of **one** working mark as follows:

•   A converted to 1010

•   D converted to 1101

•   both hexadecimal digits converted correctly to decimal, ie A=10, D=13

**[2]**

**Q7.**

**Mark is for AO2 (apply)**

26;

**[1]**

**Q8.**

**Mark is for AO2 (apply)**

FF;

**[1]**

**Q9.**

**Mark is for AO2 (apply)**

00101100;

**A.** Any number of leading zeros including none, eg 101100.

**[1]**

**Q10.**

**2 marks for AO2 (apply)**

1110 1011;;

If the binary answer given is incorrect then award a maximum of **one** working mark as follows:

•   left-hand side 4 bits are correct, ie 1110

•   right-hand side 4 bits are correct, ie 1011

**[2]**

**Q11.**

(a)  **4 marks for AO2 (apply)**

6;;;;

If the answer given is incorrect then award a maximum of **three** working marks as follows:

•   converting 8 minutes to 480 (seconds);

•   100 000 // 25 000 x 4;

•   divide by 8;

•   divide by 1 million;

**4**

(b)  **2 marks for AO1 (understanding)**

One mark for each of the following points:

•   the file size would increase;

•   (the more samples per second) the more accurate / (the higher the sampling rate) the truer (higher quality) the (recorded) sound;

**2**

**[6]**

**Q12.**

(a)  **Mark is for AO2 (apply)**

B11 W12 B17;

**1**

(b)  **2 marks is for AO2 (apply)**

00001111 10001001;;

If answer is not correct, **one** working mark may be given as follows:

•   the first bit values (for colour) are both correct (0 and 1);

•   the frequency values are both correct (0001111 and 0001001);

**2**

**[3]**

**Q13.**

**3 marks for AO2 (apply)**

3 marks if solution is fully correct;;;

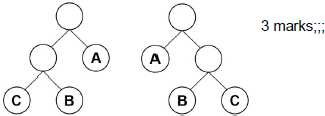
If solution is not fully correct then mark as follows:

•   If all three letters shown then award 1 mark for each letter in correct relative location (to a maximum of **two** marks)

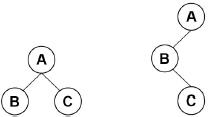
•   Award 1 mark if only two letters shown but they are in the correct relative locations

**I.** Frequency totals written inside nodes.

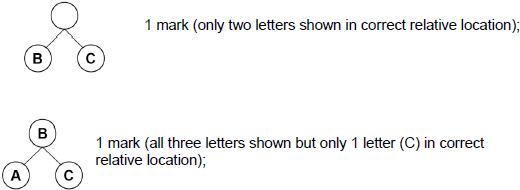
**Correct solutions**

****

**Partially correct solutions**

****

2 marks (all three letters shown with two letters in correct relative location);;



**[3]**

**Q14.**

**3 marks for AO2 (apply)**

43;;;

If incorrect answer then a maximum of **two** working out marks may be awarded as follows:

•   calculate ASCII bits:

  9 characters x 7 bits // 63 (bits);

•   Huffman bits:

  (3 x 2) + (2 x 2) + (2 x 2) + (1 x 3) + (1 x 3) /

  (7 x 2) + (2 x 3) //

  20 (bits);

•   correctly subtracting Huffman bit total from ASCII bit total;

•   Huffman code written in full (10 11 01 000 10 11 10 01 001);

**[3]**

**Q15.**

**Mark is for AO1 (recall)**

(A pixel is a) single point (of colour) in an image/smallest (addressable) part of an image;

**A.** picture element

**A.** alternatives to the word point eg dot, element 1

**[1]**

**Q16.**

**Mark is for AO2 (apply)**

64 // 26;

**[1]**

**Q17.**

**Mark is for AO2 (apply)**

94;

**[1]**

**Q18.**

**2 marks for AO2 (apply)**

8F;;

If the answer given is not 8F then award a **maximum of 1 working mark** for any of the following:

•   converted 143 to 10001111;

•   converted 143 to an incorrect 8-bit binary number but converted this correctly to hexadecimal;

•   attempted division of 143 by 16 to get a quotient of 8 and a remainder of 15 but incorrectly represented this in hexadecimal;

•   either the 8 or the F are present anywhere within the answer;

**[2]**

**Q19.**

**2 marks for AO2 (apply)**

10111110;;

If the answer given is not 10111110 then award a **maximum of 1 working mark** for any of the following:

•   converted B to 1011;

•   converted E to 1110;

•   converted BE to 190 and then incorrectly converted this value to binary;

**[2]**

**Q20.**

**Mark is for AO2 (apply)**

63 // 26 -1;

**[1]**

**Q21.**

**Mark is for AO1 (recall)**

**C** The process of encoding information to try and use fewer bits than the original;

**R.** if more than one lozenge shaded.

**[1]**

**Q22.**

**2 marks for AO1 (understanding)**

A **maximum of 2 marks** can be awarded.

Example mark points include:

•   To speed up file transfer;

•   To use less storage (capacity);

•   (It could) save money if you use less bandwidth;

•   To use less memory;

•   (It could) save money if you use less storage capacity;

**[2]**

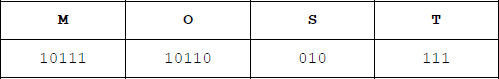
**Q23.**

(a)  **3 marks for AO2 (apply)**

1 mark for any one character correctly encoded

2 marks for any three characters correctly encoded

3 marks for all characters correctly encoded



**3**

(b)  **4 marks for AO1 (understanding)**

**1 mark** for each of the following:

•   the characters with the highest frequencies should not be combined // the characters with the lowest frequencies should be combined;

•   the frequency table should not be sorted alphabetically // the frequency table should be sorted in order of frequency;

•   the letter S does not have the highest frequency in Figure 2 // E has the highest frequency;

•   the new node should not be added to the end of the frequency table // the new node should be inserted in the correct place based on the combined frequencies;

**4**

(c)  **2 marks for AO2 (apply)**

122 (bits);;

If the answer given is not 122 bits, a **maximum of 1 working out mark** should be awarded as follows:

**ASCII Calculation**

36 characters \* 7 bits // 252 (bits);

**Calculate Saving**

Subtracting 130 from any other value;

**2**

**[9]**

**Q24.**

**1 mark for AO2 (apply)**

1100 0101;

**[1]**

**Q25.**

**2 marks for AO2 (apply)**

164;

If incorrect answer is given then maximum of 1 mark for working.

•   determining that A is worth 10 irrespective of it being in the correct column (place value);

•   multiplying an incorrect conversion of A by 16;

•   converting to binary to give 1010 0100;

**[2]**

**Q26.**

**1 mark for AO2 (apply)**

31 // 25-1;

**[1]**

**Q27.**

**2 marks for AO2 (apply)**

24 000 000;

If incorrect answer is given then maximum of 1 mark for working.

•   3 000 000//3\*1000\*1000 to calculate the correct number of bytes;

•   Multiplying an incorrect number of bytes by 8;

•   3 000 000 \* 8 with incorrect result;

**[2]**

**Q28.**

**1 mark for AO1 (understanding)**

•   To be able to represent additional / more characters / more languages (and symbols not available in the ASCII character set);

•   ASCII only allows 128 characters whereas Unicode can represent more;

•   To represent characters from other alphabets;

**A.** A response that says a specific single character can be shown i.e. “a playing card character can be shown”;

**A.** To represent non-English languages;

**[1]**

**Q29.**

(a)  **1 mark for AO2 (apply)**

LEAST;

**A.** Any text sentence such as ‘the string represents the word LEAST’;

**I.** Upper / lower case.

**1**

(b)  **2 marks for AO2 (apply)**

|  |  |  |  |
| --- | --- | --- | --- |
| S | T | A | R |
| 1010 | 1011 | 00 | 01 |

1010 1011 00 01;

2 marks for **all four** codes correct ;

1 mark for **any two** codes correct ;

**A.** Clearly written codes that are correct as shown above, even if they are not written in the table.

**2**

**[3]**

**Q30.**

(a)  **Mark is for AO2 (apply)**

78;

**1**

(b)  **All marks AO2 (apply)**

4; (This must be the left hand digit to gain the mark)

E; (This must be the right hand digit to gain the mark)

**Maximum 1 mark**: if final answer not correct.

**2**

**[3]**

**Q31.**

**All marks AO1 (understanding)**

(The answer is incorrect because) the number will (still) be represented using binary in a computer’s memory;

so it will take up the same amount of memory space;

**[2]**

**Q32.**

**4 marks for AO2 (apply)**

4 marks if answer is correct

5,000 bytes/5,000B;;;;

**A.** 5,000

If answer given is not 5,000 bytes then award working marks as follows:

Mark A for multiplying any two of 2,000, 4 and 5 even if the result is incorrect;

Mark B for multiplying all of 2,000, 4 and 5 even if the result is incorrect;

Mark C for attempting to divide the result of a multiplication by 8;

Partially correct examples:

Example 1

2,000 \* 4 = 8,000; (Mark A)

8,000 / 8 = 1,000; (Mark C)

Example 2

2,000 \* 4 \* 5 = 20,000;; (Mark A and Mark B, note result is incorrect)

20,000 / 8 = 2,000; (Mark C, note result is incorrect)

**[4]**

**Q33.**

(a)  **Mark is for AO2 (apply)**

156;

**1**

(b)  **2 marks for AO2 (apply)**

9C;;

If the answer given is not 9C then award as follows:

1001 converted to 9;

1100 converted to C;

**Max 1 mark** if final answer is not correct.

**2**

**[3]**

**Q34.**

147;

**[1]**

**Q35.**

FF;

**R.**  255 or 11111111

**[1]**

**Q36.**

Third box only;

(Any binary number can also be represented in hexadecimal.)

**[1]**

**Q37.**

(a)  7;

**R.**  8

**1**

(b)  1;

**A.**  it would go up from 7 to 8;

allow follow-through from part (a), e.g. ‘it would go up from 5 to 6’, but 6 by itself would be rejected

**R.**  8

**1**

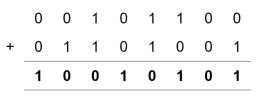
**[2]**

**Q38.**

**2 marks for AO2 (apply)**

**1 mark:** First four bits of answer are 1001

**1 mark:** Last four bits of answer are 0101



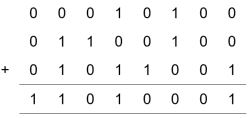
**[2]**

**Q39.**

**2 marks for AO2 (apply)**

**1 mark:** First four bits of answer are 1101

**1 mark:** Last four bits of answer are 0001



**[2]**

**Q40.**

**Mark is for AO1 (knowledge and understanding)**

**1 mark: B** Performing a right binary shift by 1 place sometimes exactly halves a whole decimal number stored in a byte.

**Award 0 marks if more than one lozenge shaded in**

**[1]**