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| 1(a) | <p><b>1 mark</b> for each correctly connected change box, <b>max 3</b> marks</p>                                                                                                                                                                                     |
| 1(b) | <p><b>1 mark</b> per bullet point, <b>max 2</b> marks</p> <ul style="list-style-type: none"> <li>Each character has a <b>unique</b> code</li> <li>Each character in the text is replaced <b>sequentially / in order</b> by its code</li> </ul>                       |
| 1(c) | <p><b>1 mark</b> per bullet point, <b>max 2</b> marks</p> <ul style="list-style-type: none"> <li>ASCII uses 7 / 8 bits Unicode can use many more / up to 32 bits</li> <li>Unicode can represent a wider range of characters including different languages</li> </ul> |

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| 7(a) | <p><b>1 mark</b> per point, <b>max 2</b> marks</p> <p>e.g.</p> <ul style="list-style-type: none"> <li>The learning experience could be improved</li> <li>... by identifying students who are struggling</li> <li>.... and employing more personalised learning</li> <li>There could be early Intervention</li> <li>... to determine which students require extra support</li> <li>Teachers and students could understand the challenges better</li> <li>....and identify optimal times for learning</li> <li>There could be privacy concerns</li> <li>.... students / teachers could be uncomfortable with constant surveillance</li> <li>... students might not want their data / actions passed to third parties</li> <li>There could be Mental Health concerns</li> <li>.... due to constant monitoring and pressure</li> <li>.... contributing to student stress and anxiety</li> </ul> |
| 7(b) | <p><b>1 mark</b> for the working<br/><b>1 mark</b> for the correct answer</p> <p>Working:<br/> <math display="block">(4000 \times 3000 \times 30 \times 16) / (8 \times 1000 \times 1000 \times 1000)</math> <math display="block">/(4000 \times 3000 \times 30 \times 2) / (1000 \times 1000 \times 1000)</math> </p> <p>Answer: 0.72 gigabytes</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 7(c) | <p><b>1 mark</b> for the name <b>2 marks</b> for the matching description, <b>max 3</b> marks</p> <ul style="list-style-type: none"> <li>Parity Byte Check</li> <li>a parity bit is added to each byte to make the number of 1s match the parity, odd or even</li> <li>each byte can be checked on receipt and request to be resent if the byte does not match parity</li> <li>Parity Block Check</li> <li>a bit is added to each byte, but a parity byte is also set for each block</li> <li>the location of an error can be found using vertical and horizontal parity</li> <li>Checksum</li> <li>A calculation is made from the data and transmitted with the data</li> <li>The receiver performs the same calculation and compares with received checksum to see if they match</li> </ul>                                                                                               |

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| 7(d) | <b>1 mark</b> per reason, <b>1 mark</b> for corresponding justification <b>x2</b><br><b>max 4</b> marks <ul style="list-style-type: none"> <li>Lower cost per unit of storage</li> <li>... so the high capacity of storage required for large number of video files will be less costly</li> <li>A large number of read/write operations are being performed continuously</li> <li>... and magnetic storage is likely to have a longer life span compared with solid state</li> </ul> |
| 7(e) | <b>1 mark</b> for each validation check correctly identified, <b>max 3</b> marks<br><br>Range Check<br>Existence Check<br>Format Check                                                                                                                                                                                                                                                                                                                                                |

| 3(a)                                                                                        | <b>1 mark</b> for each correct answer <table border="1"> <thead> <tr> <th>Statement</th><th>Answer</th></tr> </thead> <tbody> <tr> <td>The term for the smallest element that makes up an image.</td><td><b>pixel</b></td></tr> <tr> <td>The largest number of different colours that can be represented with a bit depth of 8 bits.</td><td><b>256 // 2<sup>8</sup></b></td></tr> <tr> <td>The term for the dots per inch (dpi) when an image is displayed.</td><td><b>Screen resolution</b></td></tr> </tbody> </table> | Statement | Answer | The term for the smallest element that makes up an image. | <b>pixel</b> | The largest number of different colours that can be represented with a bit depth of 8 bits. | <b>256 // 2<sup>8</sup></b> | The term for the dots per inch (dpi) when an image is displayed. | <b>Screen resolution</b> |
|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--------|-----------------------------------------------------------|--------------|---------------------------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------------|--------------------------|
| Statement                                                                                   | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |        |                                                           |              |                                                                                             |                             |                                                                  |                          |
| The term for the smallest element that makes up an image.                                   | <b>pixel</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |        |                                                           |              |                                                                                             |                             |                                                                  |                          |
| The largest number of different colours that can be represented with a bit depth of 8 bits. | <b>256 // 2<sup>8</sup></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           |        |                                                           |              |                                                                                             |                             |                                                                  |                          |
| The term for the dots per inch (dpi) when an image is displayed.                            | <b>Screen resolution</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |           |        |                                                           |              |                                                                                             |                             |                                                                  |                          |
| 3(b)(i)                                                                                     | <b>1 mark</b> each to <b>max 2</b> <ul style="list-style-type: none"> <li>A wider range of characters can be represented</li> <li>so characters from more languages can be represented</li> <li>and symbols such as emojis can be used</li> </ul>                                                                                                                                                                                                                                                                         |           |        |                                                           |              |                                                                                             |                             |                                                                  |                          |
| 3(b)(ii)                                                                                    | <b>1 mark</b> for:<br>10,094                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |        |                                                           |              |                                                                                             |                             |                                                                  |                          |
| 3(b)(iii)                                                                                   | <b>1 mark</b> for:<br>8,512                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |           |        |                                                           |              |                                                                                             |                             |                                                                  |                          |

| 1(a)(i)                                                         | <p><b>1 mark</b> for correct working:</p> <p>e.g.<br/><math>2000000 * 16 / (8 * 1000 * 1000)</math></p> <p><b>1 mark</b> for answer:</p> <p>4MB</p>                                                                                                                                                                                                                                                                                           |                  |             |                                                                 |                      |                                                             |                            |                                                            |                 |   |           |           |    |   |     |           |           |
|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-------------|-----------------------------------------------------------------|----------------------|-------------------------------------------------------------|----------------------------|------------------------------------------------------------|-----------------|---|-----------|-----------|----|---|-----|-----------|-----------|
| 1(a)(ii)                                                        | <p><b>1 mark</b> each</p> <p>Image:</p> <ul style="list-style-type: none"><li>There will be fewer shades of colour available</li><li>so the image does not match the original as detail is lost</li></ul> <p>Image file:</p> <ul style="list-style-type: none"><li>Fewer bits are used to store each pixel</li><li>so less data is stored, therefore the file size is reduced</li></ul>                                                       |                  |             |                                                                 |                      |                                                             |                            |                                                            |                 |   |           |           |    |   |     |           |           |
| 1(b)                                                            | <p><b>1 mark</b> for each correct term:</p> <table><tr><th>Description</th><th>Sound term</th></tr><tr><td>the number of times the amplitude is measured per time interval</td><td><b>Sampling rate</b></td></tr><tr><td>the number of bits used to store each amplitude measurement</td><td><b>Sampling resolution</b></td></tr><tr><td>the type of sound wave before it is recorded by a computer</td><td><b>Analogue</b></td></tr></table> | Description      | Sound term  | the number of times the amplitude is measured per time interval | <b>Sampling rate</b> | the number of bits used to store each amplitude measurement | <b>Sampling resolution</b> | the type of sound wave before it is recorded by a computer | <b>Analogue</b> |   |           |           |    |   |     |           |           |
| Description                                                     | Sound term                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |             |                                                                 |                      |                                                             |                            |                                                            |                 |   |           |           |    |   |     |           |           |
| the number of times the amplitude is measured per time interval | <b>Sampling rate</b>                                                                                                                                                                                                                                                                                                                                                                                                                          |                  |             |                                                                 |                      |                                                             |                            |                                                            |                 |   |           |           |    |   |     |           |           |
| the number of bits used to store each amplitude measurement     | <b>Sampling resolution</b>                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |             |                                                                 |                      |                                                             |                            |                                                            |                 |   |           |           |    |   |     |           |           |
| the type of sound wave before it is recorded by a computer      | <b>Analogue</b>                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |             |                                                                 |                      |                                                             |                            |                                                            |                 |   |           |           |    |   |     |           |           |
| 1(c)(i)                                                         | <p><b>1 mark</b> each to <b>max 2</b></p> <ul style="list-style-type: none"><li>8 / 16 / 32 / bits per character</li><li>Represents <math>2^8 / 2^{16}</math> / etc. characters</li><li>Represents every language and other characters such as emojis</li></ul>                                                                                                                                                                               |                  |             |                                                                 |                      |                                                             |                            |                                                            |                 |   |           |           |    |   |     |           |           |
| 1(c)(ii)                                                        | <p><b>1 mark</b> for each correctly completed space</p> <table><tr><th>Character</th><th>Denary</th><th>8-bit Binary</th><th>Hexadecimal</th></tr><tr><td>!</td><td>33</td><td><b>0010 0001</b></td><td>21</td></tr><tr><td>L</td><td><b>76</b></td><td>0100 1100</td><td>4C</td></tr><tr><td>ü</td><td>252</td><td>1111 1100</td><td><b>FC</b></td></tr></table>                                                                             | Character        | Denary      | 8-bit Binary                                                    | Hexadecimal          | !                                                           | 33                         | <b>0010 0001</b>                                           | 21              | L | <b>76</b> | 0100 1100 | 4C | ü | 252 | 1111 1100 | <b>FC</b> |
| Character                                                       | Denary                                                                                                                                                                                                                                                                                                                                                                                                                                        | 8-bit Binary     | Hexadecimal |                                                                 |                      |                                                             |                            |                                                            |                 |   |           |           |    |   |     |           |           |
| !                                                               | 33                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>0010 0001</b> | 21          |                                                                 |                      |                                                             |                            |                                                            |                 |   |           |           |    |   |     |           |           |
| L                                                               | <b>76</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0100 1100        | 4C          |                                                                 |                      |                                                             |                            |                                                            |                 |   |           |           |    |   |     |           |           |
| ü                                                               | 252                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1111 1100        | <b>FC</b>   |                                                                 |                      |                                                             |                            |                                                            |                 |   |           |           |    |   |     |           |           |

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| 7(a)(i)   | <p><b>1 mark</b> for each correct definition</p> <p>Colour depth:</p> <ul style="list-style-type: none"> <li>the number of bits used to represent a colour // the number of colours that can be represented in an image</li> </ul> <p>File header:</p> <ul style="list-style-type: none"> <li>stores data about the image file / metadata</li> </ul>                                                                                                                                                                                                                                                   |
| 7(a)(ii)  | <p><b>1 mark</b> for each correct explanation</p> <p>Image quality:</p> <ul style="list-style-type: none"> <li>Decreasing resolution means details within the image are lost because there are fewer pixels // Increasing resolution means the image is more detailed because there are more pixels</li> </ul> <p>File size:</p> <ul style="list-style-type: none"> <li>Decreasing the resolution will decrease the file size because there are fewer pixels therefore less data // Increasing the resolution will increase the file size because there are more pixels therefore more data</li> </ul> |
| 7(a)(iii) | <p><b>1 mark</b> for correct method</p> <p>For example:</p> <ul style="list-style-type: none"> <li>Run-Length Encoding</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 7(b)      | <p><b>1 mark</b> for each correct definition</p> <p>Property:</p> <ul style="list-style-type: none"> <li>an attribute of a drawing object // data about a shape // defines one aspect of the appearance of a drawing object</li> </ul> <p>Drawing list:</p> <ul style="list-style-type: none"> <li>all the drawing objects/shapes in an image // stores the commands/descriptions / mathematical equations required to draw each object</li> </ul>                                                                                                                                                     |

|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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| 2(a)      | <p><b>1 mark</b> for each correctly completed statement:</p> <ul style="list-style-type: none"> <li>(LCD) displays/screens/lenses</li> <li>gyroscope/accelerometer</li> <li>direction/speed</li> <li>digital cameras</li> </ul> <p>A headset can have one or two <b>(LCD) displays/screens/lenses</b> that output the image to the user. The headset has speakers that output surround sound to give a realistic experience.<br/>The user's head movements are detected using a sensor.<br/>This sensor is a <b>gyroscope/accelerometer</b>. The data is transmitted to a microprocessor that analyses the data to identify the <b>direction/speed</b> of movement. Some headsets use <b>digital cameras</b> that record the user's eye movements for analysis.</p> |
| 2(b)      | <p><b>1 mark</b> each to <b>max 3</b>:</p> <ul style="list-style-type: none"> <li>The buffer is used as a <b>temporary</b> store for data going to the headset</li> <li>Data is <b>transferred</b> into the buffer by the computer</li> <li>Data is <b>retrieved</b> from the buffer by the headset</li> <li>When the buffer is empty/full an interrupt is sent to the computer requesting more data/stopping further data being sent</li> <li>When the headset has enough data/needs more data, an interrupt is sent by the headset to the computer to stop sending data from buffer</li> </ul>                                                                                                                                                                    |
| 2(c)      | <p><b>1 mark</b> each to <b>max 3</b>:</p> <ul style="list-style-type: none"> <li>EEPROM allows <b>frequent/multiple</b> read/write/erase operations</li> <li>... so the headset can take advantage of new features</li> <li>... without fully erasing the contents of the firmware in the headset first // can erase a particular byte or the whole EEPROM</li> <li>... without removing the chip(s)/firmware from the headset</li> <li>... the contents of the firmware in the headset can be changed by the user without technical expertise</li> <li>Cheaper to manufacture so headset will be cheaper to purchase</li> </ul>                                                                                                                                   |
| 2(d)(i)   | <p><b>1 mark</b> each:</p> <ul style="list-style-type: none"> <li>Image is made of pixels and each pixel has one colour</li> <li>Each colour has a <b>unique</b> binary code</li> <li><b>Code for the colour</b> of each pixel is stored in <b>sequence</b></li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 2(d)(ii)  | <p><b>1 mark</b> each to <b>max 2</b>:</p> <ul style="list-style-type: none"> <li>List of objects in the drawing</li> <li>A list that stores the command/description/equation required to draw each object</li> <li>Properties of each object e.g. the fill colour, line weight/colour</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 2(d)(iii) | <p><b>1 mark</b> each to <b>max 2</b>:</p> <ul style="list-style-type: none"> <li>Dedicated connection to the headset // not sharing bandwidth</li> <li>Already fast connection that can transmit the data without slowing</li> <li>Video may already be a small file size and does not need further reduction</li> <li>Video is not saved so storage is not an issue in the headset</li> </ul>                                                                                                                                                                                                                                                                                                                                                                     |