Mark scheme

Question			Answer/Indicative content	Mark	Guidance
1		i	1 mark each to max 2 • Start-up instructions / BIOS / bootstrap / where to find the OS • Firmware / Program/instruction to run the Follow Me system / Instructions for operation • Example of data being stored e.g. the maximum speed, the min distance • Operating System / OS	2	MP2 'programs' on its own is NE MP3, Allow two marks for examples of instructions or data. For example both marks can be given for: 1 – The maximum speed 'Follow Me' can operate 2 – The minimum distance the car in front can be **Examiner's Comments** Many candidates were able to identify that ROM stores the start-up instructions or gave an example of these instructions. Some candidates were also able to identify that an embedded system runs firmware, or gave a description of the program for this system being stored in the ROM.
		ii	1 mark each to max 3 e.g. • Current distance from car in front • Set distance from car in front • Current speed of vehicle • Current speed of vehicle in front • Reading from sensor • Driver actions (e.g. moving wheel/braking) • Direction the car (in front) is travelling (e.g. turning)	3	'speed' or 'distance' on its own is NE BOD reference to a camera taking images of what is in front **Examiner's Comments** Candidates were told that the system stores currently running data and instructions in RAM and required an application of that data to the given scenario.

					The most common responses related to the speed of the car and the distance between the cars. Some candidates identified that the speed of the car in front was stored as well as the current speed of that car. Some candidates identified other data that could be stored in the RAM, for example whether the driver has control, if the system is currently active as well as data that would be needed to identify which car is being followed.
		iii	1 mark each to max 2 • Only stores a small amount of data in **RAM** / only stores specific/few items in **RAM** • … unlikely to run out of **RAM** / there is enough space in **RAM** • No secondary storage to use/needed as VM • Few/one program/instructions running at a time / no memory intensive tasks • Dedicated hardware will be optimised for system / **RAM** is designed to meet the system's requirements	2	**Examiner's Comments** Many candidates were able to identify that VM is used when a system is short of RAM, they were then able to apply this to the given system, i.e. that the current system will not run out of RAM. Some candidates expanded this by also identifying that very few data items would be stored in RAM. Some of the stronger responses included an acknowledgement that the embedded system is unlikely to have secondary storage and therefore cannot create VM.
			Total	**7**	

<table>
<tr>
<td>2</td>
<td>a</td>
<td></td>
<td>1 mark each
<table><tr><th>8-bit Binary</th><th>Denary</th></tr><tr><td>11110000</td><td>240</td></tr><tr><td>01101001</td><td>105</td></tr><tr><td>00011110</td><td>30</td></tr></table></td>
<td>3</td>
<td>Binary must be 8-bits

<u>Examiner’s Comments</u>

Candidates were often able to correctly convert the numbers between the two forms. The conversion from binary to denary was most commonly accurate with more candidates inaccurately converting from denary to binary.</td>
</tr>
<tr>
<td></td>
<td>b</td>
<td></td>
<td>1 mark each
<table><tr><th>Statement</th><th>Answer</th></tr><tr><td>The smallest denary number that can be represented by a 4-bit binary number</td><td>0</td></tr><tr><td>The largest denary number that can be represented by a 6-bit binary number</td><td>63</td></tr><tr><td>The maximum number of different colours that can be represented with a colour depth of 7-bits</td><td>128</td></tr><tr><td>The minimum number of bits needed to represent 150 different characters in a character set</td><td>8</td></tr></table></td>
<td>4</td>
<td>Accept calculations that equate to the same answer.

Accept any number of 0s for the first answer.

<u>Examiner’s Comments</u>

This question required candidates to consider the storage of denary numbers in binary in ways other than converting them. Candidates commonly gave the correct smallest denary number, although a common error was giving 1 instead of 0. Some candidates used 7-bit or 8-bit binary numbers for the second response or gave the next value of 64. Candidates found the third response more challenging with many giving 256 for an 8-bit binary number or giving the largest value of 127. The final response had the greatest variance of answers ranging from 1, 2 up to 16 or even 32.</td>
</tr>
<tr>
<td></td>
<td>c</td>
<td></td>
<td>11110000</td>
<td>1</td>
<td>Ignore leading 0s

<u>Examiner’s Comments</u></td>
</tr>
</table>

					Candidates often gave the correct response by shifting the digits accurately. Some candidates did not shift the correct number of places, for example moving 3 places.
	d		1 mark for an example 2-digit hex number **correctly** converted into denary. 1 mark each to max 2 for describing/showing each stage. Either: Multiplying: • **Multiply the left/first digit by 16** • **Add** value of **second** digit (without additional calculation) Or: Converting: • Convert each digit into **4-bit binary** • Combine and convert the **8-bit binary** to denary	3	No marks for converting denary to hex. If the example has an inaccurate result, for example they have converted A to 11. They can still get the method marks. No requirement to show how letters are used. **Examiner's Comments** Candidates that did well on this question used the example to show how they converted a value from hexadecimal to denary. They included annotations to show what they were doing at each stage. Candidates often chose a hexadecimal value that included a letter. Some candidates chose hexadecimal values that were straightforward to convert, for example A0 where they multiplied 16 by 10 and then added 0. Some candidates chose a more complicated calculation and did not always calculate the correct result.
	e		1 mark for correct working (4 carries) 1 mark for answer 01111010 Working showing carries e.g.	2	Do not award working mark for conversion to denary and back.

			01101011 00001111 01111010 1111		Carries must be on the correct values, but could be above, below etc. **Examiner's Comments** Most candidates attempted to show their working, commonly by including the carries in an appropriate place. Where the working was correct the answer was also often accurate. Some candidates converted the binary numbers to denary, added them and then converted the result back into denary. This method allowed them to get the answer but did not gain the working marks.
			Total	**13**	
3	a	i	1 mark for The amplitude of the wave is measured at set intervals	1	2+ ticks = 0 marks **Examiner's Comments** Some candidates were able to correctly identify that it was the amplitude that is measured at set intervals. A common error was that the frequency of the wave is measured, the frequency is a technical sound term that relates to the pitch of the wave, or the number of times the wave changes.
		ii	1 mark each to max 2 • The number of bits per sample will change / by example e.g. there will be more/less bits per sample • The file size will change / by example e.g. the file size will increase/decrease • There will be a change in the accuracy of each	2	MP3 needs to be clearly a wider range of amplitudes can be recorded i.e. more different values. **Not** that there are more **amplitudes/samples per second**. MP3 – 'more amplitudes can be measured' is BOD,

			sample/amplitude/sound / by example e.g. more precise amplitudes / by example e.g. a wider/smaller range of amplitudes can be recorded • The quality will change / there will a different amount of distortion / by example e.g. the quality will improve/decline		but 'more amplitudes measured per second' is incorrect. BOD 'sound' for 'amplitude' e.g. for MP3 "a larger range of sounds can be recorded." **Examiner's Comments** This question was answered well by many candidates who were most commonly able to identify that the file size would change. Many candidates gave this through an example that when the bit depth increases the file size also increases. Candidates also often identified that the quality of the sound would increase, or that the sound would become more accurate when compared to the sound being recorded. Some candidates incorrectly identified that the bit depth would result in more samples being taken per second.
	b	i	No mark for type. Accept the type by example e.g. HDD for magnetic. 1 mark each for each point matching to type given to max 4 Magnetic e.g. • (Usually) cheaper cost to purchase per unit of data • Sufficient/good durability for what is needed • … computer unlikely to move (regularly) / by example • Sufficient/fast speed of access	4	MP1 needs to be cost per unit e.g. it costs less per GB than other storage types. Not just 'it is cheap to buy'. Allow reverse argument for each e.g. for magnetic, why they have not chosen solid state. For example: 'magnetic is not as robust but the computer will not be moved' gets 1 mark for the not moving, and 1 mark for solid state's

			• … no significant delays in storing/reading data • (Long-term) reliable / longevity • … unlikely to need to purchase another /unlikely to break from over-use • High capacity • … e.g. file size of sound files can be large / allows the musician to store files with higher bit depth Solid state e.g. • Cost often equates to magnetic per quantity / not expensive per unit of data • Durable / robust / no moving parts • … so computer can be moved without risk of losing data • Fast speed of access of data • … no significant delays in storing/reading data / musician does not have to wait for files to load/store • High capacity / (nearly the) same/higher capacity than magnetic • … file size of sound can be large • Small in physical size • … device is portable / can fit in a smaller type of computer • Produces less sound when running • … so the musician distracted • Requires little/less power (compared to others) • … so running costs are reduced • Drives do not get fragmented files • … drives do not need to be defragged / constant access time		robustness is not required. If there is no type give on line 1. Read the answer to look for a type and then award justification. If there is not type identified anywhere in the answer, 0 marks. **Examiner's Comments** This question required candidates to identify which of the two choices they would make and to justify their choice. Either choice was appropriate and candidates were given marks for explaining why they had made the choice they did. There was no common choice with both often being selected. Choices were often suitably justified. Common points included the amount of data that could be stored with some candidates also linking this to the need for sound files to have a high capacity. Candidates often identified that solid state has a faster access speed than magnetic, although some responses just stated that it was faster without identifying what it was faster at. When justifying solid state candidates often identified the robustness of the device and linked this to the musician possibly needing to move the

					device. Magnetic justifications often identified that although they had slower access speed than solid state this would still be sufficient. They also identified that it does have moving parts, but if the device is not being moved then the durability of solid state is also not required. **Misconception** A misconception is that solid state devices have more longevity than magnetic, that they have an unlimited life span and will outlast magnetic.
		ii	1 mark for Optical	1	BOD optic. Do not award an example of optical storage **Examiner's Comments** Some candidates found this question challenging and were not able to give a different type of secondary storage, often repeating magnetic or solid state from the question. Candidates quite often did not provide a response to this question.
		iii	1 mark for 200 000 KB	1	2+ ticks = 0 marks **Examiner's Comments** Some candidates were able to correctly identify the smallest capacity of 200 000KB. 300MB was

					often inaccurately selected.
		iv	1 mark for the answer 3 GB 1 for working e.g. • 3 * 1000 / 1000 • 3 * 1000 • 3000 / 1000 • 3 / 1000 • 0.003 * 1000	2	Allow 2.9296875 (or approximated) for division by 1024. Allow addition of metadata e.g. 10% added. This can be awarded for both working and answer. Not all of the working needs to be correct to get the working mark. Ignore mention of MB/GB in the working. **Examiner's Comments** Candidates were often able to gain a mark for partial working, for example by multiplying 3 and 1000 even if other parts of the working then performed incorrect calculations.
			Total	**11**	
4	a		1 mark for: • Binary is used because computers are made of switches that can only be on or off (box 3)	1	Accept cross or other indication as long as clear which one they intend.2+ ticks = 0 mark **Examiner's Comments** This question required candidates to identify the true statement. Many responses identified that the third statement was true. Statement 1 was incorrect because binary digits cannot include the value 2. Statement 2 was incorrect because the left-most bit is the largest value. Statement 4 was most commonly given as

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>an incorrect choice, the smallest whole number that can be stored in 8 bits is the number 0, not the number 1.</td></tr>
<tr><td></td><td>b</td><td></td><td>1 mark for each completed box

<table><tr><th>Denary</th><th>8-bit binary</th><th>Hexadecimal</th></tr><tr><td>7</td><td>00000111</td><td>7</td></tr><tr><td>49</td><td>00110001</td><td>31</td></tr><tr><td>102</td><td>01100110</td><td>66</td></tr><tr><td>244</td><td>11110100</td><td>F4</td></tr></table></td><td>4</td><td>Must be 8-bits.

Ignore case in hex.

Ignore calculations in answer box

<u>Examiner’s Comments</u>

This question required candidates to translate denary, binary and hexadecimal numbers into each of the other forms.

Many responses accurately converted the 8-bit binary to denary. The binary conversion was often correctly converted. However, some candidates did not include the required 0s at the start to make the answer an 8-bit binary number as required.

The conversion of the third binary number to denary was more challenging. A range of responses were often seen including 114, and conversion to hexadecimal.

The final conversion to hexadecimal was often given inaccurately, for example E4 or F2 being given instead.</td></tr>
<tr><td></td><td>c</td><td></td><td>1 mark for:

• 200MB (box 3)</td><td>1</td><td>Accept cross or other indication as long as clear which one they intend.
2+ ticks = 0 mark</td></tr>
</table>

					Examiner's Comments There were a range of responses given by candidates. Many candidates identified 200MB as the correct response. 2300 KB was commonly given as an incorrect response.
	d		1 mark for both boxes: • 4 500 000 bytes (box 1) 4.5 MB (box 3)	1	Accept cross or other indication as long as clear which one they intend. 1/3+ ticks = 0 mark **Examiner's Comments** This question required candidates to work out which of the two file sizes were the same. Candidates had to tick two boxes. Many candidates identified the two correct answers. Correct responses often had working at the side of the answer. There was a range of incorrect answers given where different combinations were selected.
	e		1 mark each: • Answer (1) 0 0 0 0 1 1 1 1 • Correct working e.g. carrying (might be above, below etc.) 01110001 10011110 00001111 carries: 1 1 1	2	Do not award marking for converting each number to denary and adding them together. If the carries are present, and converting to denary is present – award the carries (conversion can be used to check their answer). Marks are not dependent. **Examiner's Comments** Candidates were required to complete the addition in

					binary. Some responses converted each binary number to denary, added these, and then converted them back to binary. This allowed them to access the final answer mark, but **not** the mark for showing their working. The mark for showing working out required candidates to show how the data was carried. Some responses correctly identified the inclusion of an overflow. The overflow was not required for the mark this time but is good practice. Incorrect answers must be clearly crossed out. The new answer must be written clearly and separately. Some candidates overwrite a 1 with a 0, or vice-versa, making it impossible to identify the intended answer.
	f		1 mark each: • Left shift • 3 places	2	**Examiner's Comments** This question was often answered well. For full marks, candidates needed to accurately identify that it was a left 3-place shift. Some responses only gave the direction, i.e. left, and did not note the number of marks (2) that can identify the level of response required.
			Total	**11**	

5	a		1 mark for each completed space A character set stores **all** of the characters that the computer can represent. Each character is given a **unique/different** binary code. Lower-case and upper-case letters in a character set are given **unique/different/similar** binary codes. One example of a character set is ASCII. This character set uses **8** bits for each character. If the ASCII value for the character 'F' is 70 Then the ASCII value for the character "L" is **76**.	5	Award the same term used multiple times if used correctly **Examiner's Comments** This question required candidates to use the given terms to complete the description of character sets. Many responses accurately identified that a character set stores all the characters. Some candidates identified each character as being given an identical code or a repeated code. This is incorrect. The code for L was often given accurately. The number of bits for each character had a range of responses given, commonly 256 bits for each character. The specification for J277 states that in the exam ASCII will be described as having 8-bits to avoid confusion between ASCII and extended-ASCII, which are not differentiated in the specification.
	b	i	1 mark: • Data about the data/image/file	1	Question is for a definition, not an example. If the definition is not clear, for example details about the image, information about the image – this is NE, but read the example to see if it clarifies. For example: 'Information about the image, such as the number of pixels' give a BOD.

<table>
<tr>
<td></td><td></td><td></td><td></td><td></td>
<td>Data could be properties / characteristics.

<u>Examiner's Comments</u>

This question required a definition of the term metadata and many responses correctly defined it as the data about the image, or the data about the file.

Some candidates used information, for example the information about the file, which was not precise enough - but they often carried on with an example that supported their statement and demonstrated their understanding.

Misconception

A common misconception was that metadata identifies the colour of each pixel in the image.</td>
</tr>
<tr>
<td></td><td></td><td>ii</td>
<td>1 mark each:

• First row: red red purple
• Remainder correct and in correct order

<table>
<tr><td>red</td><td>red</td><td>purple</td></tr>
<tr><td>blue</td><td>green</td><td>blue</td></tr>
<tr><td>purple</td><td>purple</td><td>purple</td></tr>
<tr><td>red</td><td>green</td><td>blue</td></tr>
</table>
</td>
<td>2</td>
<td>Ignore case/spelling as long as legible.

If a candidate has completed the table in the incorrect layout e.g. right to left, or bottom to top, then award MP2 as a FT if they have done it all correctly.

<u>Examiner's Comments</u>

This question required candidates to consider the binary number and the binary value for each</td>
</tr>
</table>

					colour, divide the binary number into groups of 4 bits and match them to the appropriate colour. This was completed accurately by many candidates who were able to match the codes and colours. The instructions stated that the image starts in the top left, but some candidates started in the bottom right instead. Some responses did not use the colours provided in the question and created their own colour scheme for the image, commonly just using black and white.
		iii	16	1	Accept any calculation that equates to 16 i.e. 2^4 **Examiner's Comments** Candidates were required to calculate the number of different colours that can be represented in 4-bits. This was done by working out how many binary numbers can be created using 4-bits. A common error was giving four colours, or in some cases only one or two colours.
		iv	1 mark each to max 2: • The **quality** of the image can be improved • The **file** size will increase / takes up more **storage** space / image has/requires/takes up more data • The number of colours that can be represented/used will increase / BOD more colourful	2	Do not award higher resolution, image size increases, clearer image (NBOD) more detailed image (NBOD). Closer to original is NE on its own because there is not an original image in this context. Mark first answer in each

					answer space. **Examiner's Comments** This question was often answered well. Candidates commonly identified that the file size will increase with an increase in colour depth. Some responses also identified that this increase would allow the image to use more colours. **Misconception** A common misconception is that colour depth increases the resolution of the image. This would need to be an increase in the resolution (the number of pixels) as opposed to the number of bits per pixel.
	c	i	1 mark for lossless 1 mark each to max 2 for justification: e.g. • Lossless will not remove any **data** / No **data** is lost with lossless / **File/data** can be fully reconstructed back to the original • Text files require all data to open/be used/work / text files will not work if any data is lost / lossy cannot (usually) be used on text files / none of the required characters / words / spaces / case / formatting / information would be lost / the text will remain accurate / the text will not have changed	3	Do not award an example of lossless for 1st mark (e.g. RLE), but FT for justification. Do not FT for lossy. Accept reverse for answers e.g. Lossy will remove data. If compression type is missing, read justification and if clearly stated which type is used then award justification. MP1 requires reference to the data (or equivalent) not information. MP2 requires reference to the text file context and

			meaning / the text will still make sense		information is allowed. If not valid compression – 0 mark. **Examiner's Comments** Lossless compression was often correctly identified as the type of compression used for text. Some candidates justified this in context either by explaining why lossless is required for text files, or by explaining why lossy was not appropriate.
		ii	1 mark for lossy 1 mark each to max 2 for justification e.g.: • Will reduce the **file size more/significantly** (than lossless) • Image will only lose **quality** / changes may **not be noticed** by the user / remove **unnoticeable/unnecessary** detail/content	3	Do not award an example of lossy for 1st mark (e.g. reduce resolution), but FT justification. Do not award lossless but FT for justification for lossless: e.g. • Quality/detail of the image can be retained • No data will be lost (permanently) • File size may still be a substantial reduction If compression type is missing, read justification and if clearly stated which type is used then award justification. Do not award how the file can be compressed e.g. reduce number of colours – unless they also state that this change will not be noticed. MP1 it compresses the file more is NE – compression

					is in the question, the candidate needs to explain what this means. If not valid compression – 0 mark. **Examiner's Comments** Many candidates correctly identified that lossy is the most appropriate. Lossless could be used but is not as appropriate in this scenario. Candidates who stated lossy compression were often able to describe how the loss of data would not be noticed, and some responses also identified that the file size could be decreased more. Candidates that gave lossless were able to gain marks for the justification. However, often candidates could not justify it appropriately, for example by describing how it would be compressed instead of why this was appropriate.
			Total	**17**	
6		i	1 mark each Primary • to store (active) **data/instructions/software/OS** that the **processor** needs to **access** / without primary the computer won't be able to start up/work / (ROM) so the start-up instructions are not deleted when the computer turns off / (RAM) to store the **currently** running **data/software/instructions** / (Cache) to store **frequently** used **data/instructions**	2	Question is not what they store, but why they are needed. Secondary NBOD 'to backup data' without reference to the long-term/permanence **Examiner's Comments** Some candidates found this question challenging and often gave examples of each type of storage instead of answering why

			Secondary • to store **data/files long-term/permanently** / without secondary the user's files will not be stored when the power is turned off / store **data** not currently being used		both are required. Some candidates were able to accurately describe the purpose of primary storage as storing currently running data and software. **Misconception** A common misconception was that secondary storage is used when primary storage is full, or that it is only used as a backup.
		ii	1 mark for device, 1 mark for data • Hard drive / SSD / USB (memory) stick / Flash memory card / CD / DVD etc. • E.g. Images created / documents / software / files / data moved from RAM to virtual memory	2	Allow any secondary device. BOD 'optical disc' Question asks for device not type of device e.g. magnetic/optical/solid state is NE. Award example even if incorrect secondary storage. USB on its own is NE **Examiner's Comments** Candidates were required to identify a secondary storage device. Some responses identified a type of storage media (for example magnetic) instead of identifying a device (for example hard drive). Some responses gave RAM or ROM as a secondary storage device. These responses were incorrect. The example data varied but many responses were able to identify the storage

<table>
<tr><td></td><td></td><td></td><td></td><td></td><td>of files, the images or software.</td></tr>
<tr><td></td><td></td><td>iii</td><td>1 mark for each row.

<table><tr><th>Statement</th><th>True (✓)</th><th>False – rewrite the statement to make it true</th></tr><tr><td>A section of primary storage is partitioned to act as virtual memory</td><td></td><td>A section of secondary storage is partitioned to act as virtual memory</td></tr><tr><td>Data from ROM is transferred into VM</td><td></td><td>Data from RAM is transferred into VM</td></tr><tr><td>VM is needed when RAM is full, or nearly full</td><td>✓</td><td></td></tr><tr><td>Data from VM is transferred back to secondary storage when needed</td><td></td><td>Data from VM is transferred back to RAM when needed</td></tr></table></td><td>4</td><td>Allow a description of the error in column 2, e.g.
in row 1: 'primary should be secondary'

Accept HDD/SSD for secondary storage for the 1st row.

Do not accept primary for RAM (rows 2 and 4).

<u>Examiner’s Comments</u>

In this question candidates needed to consider each statement, identify whether it was true or false and if it was false re-write the statement about virtual memory to make it true.

Candidates commonly identified the third statement as being true.

The first statement was often correctly altered to identify that secondary storage was used. The second statement was sometimes changed correctly to RAM, but at other times was changed to secondary storage.

The final statement was often changed to primary storage, which was not enough because primary storage would include ROM and cache, therefore not being precise enough to describe how VM works.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>8</td><td></td></tr>
<tr><td>7</td><td>a</td><td></td><td>1 mark for each row</td><td>4</td><td></td></tr>
</table>

			<table><tr><th>File size</th><th>2 megabytes</th><th>2 petabytes</th><th>2 kilobytes</th><th>2 bytes</th><th>2 gigabytes</th></tr><tr><td>2000 bytes</td><td></td><td></td><td>✓</td><td></td><td></td></tr><tr><td>2000 terabytes</td><td></td><td>✓</td><td></td><td></td><td></td></tr><tr><td>16 bits</td><td></td><td></td><td></td><td>✓</td><td></td></tr><tr><td>4 nibbles</td><td></td><td></td><td></td><td>✓</td><td></td></tr></table>		**Examiner's Comments** Candidates needed to calculate each file size into a different binary unit to identify which is the equivalent. This question was often answered well by candidates who were able to accurately identify the equivalent binary units. Most commonly accurate were the 200 bytes into kilobytes and 16 bits into 2 bytes. Fewer candidates converted 2000 terabytes into 2 petabytes.
	b		1 mark for working e.g. dividing by 2, or writing the powers/values with the binary below, subtracting. 1 mark for answer 11011101	2	No FT for answer from working. Award the working mark if the binary is back-to-front i.e. 1 2 4 8 16 32 64 128 1 0 1 1 1 0 1 1 **Examiner's Comments** Candidates were required to convert 221 into binary and to include their working. Most candidates included. Candidates used a range of methods to calculate the 8 bit binary number. A common method was to write the binary header numbers and then use subtraction from 221. Some candidates put the binary header numbers the

					wrong way around, going from left to right, getting the binary number reversed. Some candidates did not accurately double the binary header numbers each time, including additional numbers such as 24.
	c		1 mark for working e.g. multiplying by 16 (2 * 16 + 15), or converting to binary first (0010 1111) 1 mark for answer 47	2	No FT for answers from working. **Examiner's Comments** Candidates needed to convert the hexadecimal number 2F into denary and to show their working. Candidates showed a range of methods, most commonly converting each digit into 4-bit binary and then adding the sum of the final binary number. Some candidates did not accurately convert F to binary, for example giving 1101 instead of 1111 which then left the final conversion incorrect.
	d		1 mark for B0	1	Correct answer only **Examiner's Comments** This required the conversion of a binary number into hexadecimal. Working was not required to be shown to gain the mark available. A common error was giving the final hexadecimal number as B, with the 0 missing. As 0 is

					the right most digit this will alter the value produced. When converting numbers between bases some candidates might find it beneficial to use their final answer to do the reverse calculation as a check. For example, if a candidate got the answer B, they then convert B back into binary which gives them 1011. 1011 does not equate to 10110000.
	e		16	1	Correct answer only **Examiner's Comments** There were a range of responses to this question, commonly 15, 8, 4 and 2 were given. Candidates who gave 15 often had calculations to identify the highest number that can be represented in 4 bits; missing the number 0 that can also be represented.
	f		00010001	1	**Examiner's Comments** This question was often answered well with many candidates correctly shifting the number. Some candidates attempted to include a binary point to show where the binary numbers moved to. This is not part of the specification and should not be included.
			Total	**11**	
8	a	i	1 mark per bullet to max 3	3	MP2 do not award frequency of the wave is

<table>
<tr>
<td></td><td></td><td></td>
<td>

(analogue) sound wave is sampled
… amplitude/height (of wave) is measured
… at set/regular time intervals / by example
Each sample/measurement is stored as a binary number
The binary number for each sample is stored sequentially

</td>
<td></td>
<td>measured

<u>Examiner's Comments</u>

This question required candidates to describe how an analogue sound wave is measured and converted into digital. Many candidates were able to identify that the sound wave is sampled, with some also identifying that it was the amplitude (or wave height) that is sampled.

Misconception

A common misunderstanding is that the wave frequency is used. The frequency in sound sampling is the number of samples taken each second or in sound waves is the number of times the wave has high and low amplitudes within a given time. It is not the number of changes in a second that is recording, it is the height of the wave.</td>
</tr>
<tr>
<td></td><td></td><td>ii</td>
<td>1 mark for each row

<table>
<tr><th>Change</th><th>File size increases</th><th>File size decreases</th><th>Accuracy increases</th><th>Accuracy decreases</th></tr>
<tr><td>Duration changes from 10 minutes to 20 minutes</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>Sample rate changes</td><td></td><td>✓</td><td></td><td>✓</td></tr>
</table>
</td>
<td>3</td>
<td><u>Examiner's Comments</u>

Many candidates were able to correctly identify that the increase in duration increases the file size.

The additional two changes were also often given accurately, but some candidates only gave one tick on each row for these, for example correctly</td>
</tr>
</table>

<table>
<tr>
<td></td><td></td><td></td>
<td>
<table>
<tr><td>from 44 kilohertz to 8 kilohertz</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Bit depth changes from 8 bits to 16 bits</td><td>✓</td><td></td><td>✓</td><td></td></tr>
</table>
</td>
<td></td>
<td>identifying the change in file size but not accuracy.</td>
</tr>
<tr>
<td></td><td>b</td><td>i</td>
<td>T</td>
<td>1</td>
<td>Case sensitive

Mark first letter

<u>Examiner’s Comments</u>

This question was answered by many candidates who correctly gave the capital letter T. Some candidates clearly gave a lowercase t which would have a different ASCII code and was therefore incorrect.</td>
</tr>
<tr>
<td></td><td></td><td>ii</td>
<td>Unicode</td>
<td>1</td>
<td>Accept any other valid

<u>Examiner’s Comments</u>

Unicode was the most commonly given second character set given.

Misconception

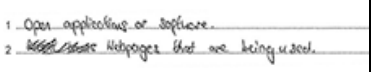
Some candidates gave an additional character, e.g. U and its associated ASCII code demonstrating a misunderstanding as to what a character set is.</td>
</tr>
<tr>
<td></td><td>c</td><td></td>
<td>1 mark each to max3
e.g.

• Height
• Width</td>
<td>3</td>
<td>Accept anything reasonable but not features of image e.g. names of people</td>
</tr>
</table>

			• Colour/bit depth • Date • Geolocation • File size • File type • Compression type • Author		Award resolution for height or width, but max 2 for resolution/dimensions/image size, height, width. 'Colour' on its own is NE. 'Size' on its own is NE. Needs to be what is stored, e.g. date is stored, age of image is not stored. **Examiner's Comments** This question was answered well with many candidates identifying examples of metadata for an image. There were a wide range of correct responses. The most common responses were the bit or colour depth, the resolution and the file size. Some candidates focused on the device that took the image originally, for example the type of camera, the GPS location or the time and date it was taken.
	d	i	1 mark each to max 2 • Reduces file **size** • Takes less time to transmit / faster to upload / faster to download • Requires less **storage** space (on the server/device) • May otherwise exceed **email** storage • Uses less bandwidth to transmit • Uses less data to send (e.g. mobile data)	2	Mark first answer in each section **Examiner's Comments** This question required candidates to consider the reasons why the data is compressed before emailing it. Many candidates answered this well with most identifying the reduction in file size and

					that this allows the email to be received faster. Some candidates were not precise enough in their response. For example, stating 'It is faster' without identifying what is faster, in the context of the question this would be the compression is faster and hence incorrect. Some candidates gave the same point multiple times i.e. the transmission of the email, by stating that it could also be downloaded faster. It can be downloaded faster because the transmission from the email server to the computer is faster, and hence the same reason. A second common response was that 'It takes up less space', space on its own is not enough because the candidate is not identifying what this 'space' is, for example it could be space on the screen. For this question candidates needed to identify that it was the storage or memory space.
		ii	1 mark each to max 2 • Data will be **permanently** lost / not all data is recoverable • **Text files** cannot be compressed with lossy • Teacher requires the original/high quality **image/video/sound** files	2	MP2 is for identifying that the files contain text and they cannot be compressed with lossy **Examiner's Comments** This question required application to the question to demonstrate candidate's understanding. The compression is used to compress all of the

					student's files in the question. This includes a sound file, text document and image. Lossy is usually appropriate for images and sound, but is not appropriate for text documents. Some candidates were able to identify this appropriately but some candidates inaccurately stated that the letters would be blurry, or some of the letters or words would not be displayed. Lossy compression would not change the display of the letters and would not select words to be removed, instead the file would be corrupted.
			Total	**15**	
9	a	i	1 mark for • ROM is non-volatile, RAM is volatile / by description • Content of ROM cannot (usually) be changed, content of RAM can be changed	1	Read whole answer **Examiner's Comments** This question was answered well with many candidates correctly identifying that RAM is volatile and ROM is not-volatile. When a difference is required candidates must make sure they are giving both sides of the difference. For example RAM is volatile is not enough on its own. Some candidates gave the purpose of RAM and ROM. This is a difference in the use and not a fundamental

					difference between the two.
		ii	1 mark each to max 2 e.g. • Web browser/application that is **running** • (Parts of the) operating system currently **running** • Current video/film/tv program being watched • Data being downloaded/buffered • Button pressed by the user • Current volume • Current channel being watched • Source being watched (e.g. HDMI1)	2	Allow anything reasonable but must be clearly RAM e.g. not just stores the software/OS (this is secondary storage). Do not award brand names without exemplification. **Examiner's Comments** Some candidates found this question challenging. Many responses were generic applications such as a streaming service, a tv programme, etc. A TV programme will not be stored in RAM, but the parts of it currently/about to be watched would be stored in RAM. Likewise, an application in its entirety will not be stored in RAM, but the parts that are being used will be. The most commonly correct responses were the recording currently being watched, the data received from the remote control and the websites being accessed. Exemplar 5  This candidate has identified two suitable examples of data and has given more than just identifying, e.g. applications. They have stated that it is the open

					applications, and webpages being used, which both demonstrate their understanding of when RAM is used.
	b	i	1 mark for example e.g. the OS, web browser software, recorded show, user preferences 1 mark for • To store data once the computer is turned off / permanently / for non-volatile storage	2	Allow 2 marks by example, e.g. “To install software that will not be lost when the TV is turned off” gets 1 mark for software and 1 mark for not being lost when turned off. Do not award brand names without exemplification. **Examiner’s Comments** This question was answered well by many candidates. Many candidates correctly identified an example, most commonly downloaded videos, the operating system, or applications. Fewer were able to expand this as to why, for example stating that it was needed for the computer to work. **Misconception** A common misunderstanding was that it is needed as a backup for when the television fails.
		ii	1 mark for choice either magnetic or solid state 1 mark per bullet to max 3 for justification e.g. Magnetic:	4	Do not award specific device, e.g. hard disk. Question asks for type. But then FT for justification to max 3. If device and type given award, e.g. solid

			• Large storage capacity • … for storing software/videos/HD • Television unlikely to be moved • … therefore durability/portability not required • Cost to **purchase** is low • … so the TV will be cheaper to **manufacture**/**purchase** • Device will fit in a tv / device is small • Longevity / reliable Solid state: • Large storage capacity • … for storing software/videos/HD • Television may be moved • … therefore durable/robust/portable • Fast **data access** • … television will be more responsive • Cost to **purchase** is low • … so the TV is not too expensive to **manufacture**/**purchase** • Run quieter • Produce less heat • Use less energy • Compact / lightweight • … so tv can be made smaller / lighter		state drive, SSD, magnetic hard disk drive. Mark first secondary storage type given. No secondary storage type, read justification for a type. Do not award this but mark justification (Max 3). Justification must match choice. If type is inappropriate e.g. optical, do not award. **Examiner's Comments** Many candidates were able to correctly justify their choice of secondary storage. A few candidates gave a type of storage, instead giving a specific device such as a hard drive. There were some good examples of application in responses. For example, expanding the feature of high capacity to the need to download high-definition movies which can take up large amounts of storage. Another application commonly given was the need for a responsive television which was provided by the fast data access speeds.
			Total	**9**	
10	a	i	1 mark for working, 1 mark for answer 1000*3 = 3000 images	2	
		ii	1 mark for suitable type i.e. solid state / magnetic	3	

<table>
<tr>
<td></td><td></td><td></td>
<td>1 mark per bullet to justification to max 2
solid state e.g.:

• Large enough capacity
• Can move computer without damaging storage
• Faster access speeds

magnetic e.g.:

• Largest capacity
• Do not need to move computer so moving parts do not matter
• More reliable long-term</td>
<td></td><td></td>
</tr>
<tr>
<td></td><td></td><td>iii</td>
<td>1 mark for 2 correct ticks
2 marks for all 3 or 4 correct ticks
3 marks for all correct

<table>
<tr><th></th><th>True</th><th>False</th></tr>
<tr><td>The sample rate is the number of times the amplitude is recorded per second</td><td>✓</td><td></td></tr>
<tr><td>The smaller the bit depth the smaller the range of sounds recorded</td><td>✓</td><td></td></tr>
<tr><td>The larger the sample rate the larger the bit depth</td><td></td><td>✓</td></tr>
<tr><td>The frequency and pitch of the sound wave are measured</td><td></td><td>✓</td></tr>
<tr><td>Sound is stored using pixels</td><td></td><td>✓</td></tr>
</table>
</td>
<td>3</td><td>2 ticks in 1 row is incorrect</td>
</tr>
<tr>
<td></td><td>b</td><td>i</td>
<td>1 mark per bullet to max 2

• Reduces the file size…
• …takes up less space on the server
• Faster upload to server
• Faster download for users</td>
<td>2</td><td></td>
</tr>
<tr>
<td></td><td></td><td>ii</td>
<td>1 mark for lossy
1 mark per bullet to max 2</td>
<td>3</td><td>Award FT marks for justifying lossless appropriately to max 2</td>
</tr>
</table>

<table>
<tr><td></td><td></td><td></td><td>• Lossy will most likely reduce the file size by a large amount than lossless
• Lossy will remove data that is not noticeable / the changes will allow for further reduction without the user noticing</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>13</td><td></td></tr>
<tr><td>11</td><td>a</td><td>i</td><td>1 mark e.g.
All the different characters a computer can represent</td><td>1</td><td>'The set of characters' is repeating the question and not enough</td></tr>
<tr><td></td><td></td><td>ii</td><td>256</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>iii</td><td>1 mark for working, 1 mark for answer
e.g.

2000 * 8 = 16000 bits
16000/8 = 2000 bytes
2000/1000 = 2 Kilobytes</td><td>2</td><td>Ignore any overheads e.g. adding 10%</td></tr>
<tr><td></td><td></td><td>iv</td><td>UNICODE</td><td>1</td><td></td></tr>
<tr><td></td><td>b</td><td></td><td>01001010</td><td>1</td><td>cao</td></tr>
<tr><td></td><td>c</td><td></td><td>1 mark for adding 1 to J: binary 01001011 / converting J to hexadecimal and adding 1
1 mark for answer 4B</td><td>2</td><td>Allow 1 mark for converting J into 4A without adding 1</td></tr>
<tr><td></td><td>d</td><td></td><td>1 mark for left
1 mark for 3 places</td><td>2</td><td>Ignore any reference to arithmetic/logical</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>10</td><td></td></tr>
<tr><td>12</td><td></td><td></td><td>1 mark for 2 correct ticks
2 marks for all 4 correct ticks

<table><tr><th></th><th>True</th><th>False</th></tr><tr><td>Each colour has a unique binary code</td><td>✓</td><td></td></tr><tr><td>Metadata stores the colour of each pixel in the image</td><td></td><td>✓</td></tr><tr><td>A bitmap is made of pixels</td><td>✓</td><td></td></tr><tr><td>The higher the colour depth, the smaller the</td><td></td><td>✓</td></tr></table></td><td>2</td><td>2 ticks in 1 row is incorrect</td></tr>
</table>

			number of different colours that can be displayed		
			Total	**2**	
13	a		203	1 (AO2 1b)	Correct Answer Only
	b		00110010	1 (AO2 1b)	Correct Answer Only
	c		• Divide the number by 4 • Loses precision	2 (AO2 1b)	
			Total	**4**	
14			1 mark per bullet • each character from MOP has its ASCII code stored in the order written • **77 79 80 (MOP)** • ASCII code converted to 8-bit binary number	2 (AO2 1a AO2 1b)	
			Total	**2**	
15	a		• Long term/non-volatile storage of data/files • External/auxiliary storage of data	1 (AO1 1a)	1 mark only to be awarded for a correct definition.
	b		• Optical • Magnetic • Solid state	3 (AO1 1a)	1 mark only to be awarded for each correct definition.
	c		Four characteristics from: • Capacity/size • Speed • Portability • Durability • Reliability • Cost	4 (AO1 1b)	1 mark to be awarded for each correct characteristic to a maximum of 4 marks.
			Total	**8**	

<table>
<tr><td>16</td><td>a</td><td></td><td>
<table>
<tr><th></th><th>RAM</th><th>ROM</th></tr>
<tr><td>Stores the boot up sequence of the Sat Nav.</td><td></td><td>✓</td></tr>
<tr><td>The contents are lost when the Sat Nav is turned off.</td><td>✓</td><td></td></tr>
<tr><td>Holds copies of open maps and routes.</td><td>✓</td><td></td></tr>
</table>
</td><td>3 (AO2 1a)</td><td>Award 1 mark for each correct tick.

No marks should be awarded if ticks are in both boxes in a given row.</td></tr>
<tr><td></td><td>b</td><td></td><td>• A computer system that is built into another device</td><td>1(AO 1 1a)</td><td></td></tr>
<tr><td></td><td>c</td><td></td><td>Three devices from:
e.g.

• Dishwasher
• MP3 player
• Washing machine
• Mobile phone
• Manufacturing equipment</td><td>3(AO 1 1a)</td><td>1 mark to be awarded for each correct example identified to a maximum of 3 marks.

There are many other examples of devices with embedded systems which may be acceptable.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>7</td><td></td></tr>
<tr><td>17</td><td>a</td><td></td><td>• The height of the wave is measured/sampled (at regular/set intervals)
• Turned into/stored as binary</td><td>2 (AO1 1b)</td><td>1 mark for each bullet, to a maximum of 2.</td></tr>
<tr><td></td><td>b</td><td></td><td>• The quality will improve
• The file size will increase</td><td>2 (AO1 1b)</td><td>1 mark for each bullet.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>4</td><td></td></tr>
</table>