

INFORMATION REPRESENTATION MS

1.

1 mark each: • Working – carried values clearly indicted • Correct answer 0001 1000 • Overflow clearly indicated as overflow Example: <pre> 1 0 0 1 1 1 1 0 0 1 1 0 0 0 0 1 + 0 0 0 1 1 0 0 1 ----- (1) 0 0 0 1 1 0 0 0 1 1 1 1 1 1 1.....(carries) </pre>	3
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2.

(a)	1 mark for: 3300 kibibytes	1
(b)	1 mark each: • Converting 100 to binary 0110 0100 and 10 to binary 0000 1010 • Subtraction method - converting 10 to – 10 and adding // direct subtraction ... • ... correct answer 0101 1010 Method 1: Converting to -10 and adding: Binary for +10 is 0000 1010 Binary for –10 is 1111 0110 Binary for 100 is 0110 0100 100 + (-10): <pre> 0 1 1 0 0 1 0 0 +1 1 1 1 0 1 1 0 (1) 0 1 0 1 1 0 1 0 Carries: 1 1 0 0 1 0 0 0 </pre> Method 2: Direct Subtraction Borrows: <pre> 0 0 0 1 1 0 1 0 0 1 1 0 0 1 0 0 - 0 0 0 0 1 0 1 0 0 1 0 1 1 0 1 0 </pre>	3
(c)	1 mark for working: 1100 0000 1111 // 2048 + 1024 + 8 + 4 + 2 + 1 // (12 * 16 ²) + 15 // (12 * 16 * 16) + 15 // 3072 + 15 1 mark for correct answer: 3087	2

3.

I(a)	1 mark for each correct answer: • binary • 3072 • denary/decimal • 2000 A kibibyte has a binary prefix. Three kibibytes is the same as 3072 bytes. A megabyte has a decimal/denary prefix. Two terabytes is the same as 2000 gigabytes.	4								
I(b)	1 mark for correct answer: F1	1								
I(c)	1 mark for a correct answer: The answer is too long to be represented in the same number of bits as the binary numbers being added	1								
d)(i)	1 mark for all 3 answers correct: <table><tr><th>Character set</th><th>Number of bits</th></tr><tr><td>ASCII</td><td>7</td></tr><tr><td>extended ASCII</td><td>8</td></tr><tr><td>Unicode</td><td>16/32</td></tr></table>	Character set	Number of bits	ASCII	7	extended ASCII	8	Unicode	16/32	1
Character set	Number of bits									
ASCII	7									
extended ASCII	8									
Unicode	16/32									
d)(ii)	1 mark each: • Each character has a unique binary code • The binary code for each character is stored in sequence	2								

4.

2(a)	1 mark for working: • $4000 * 3000 * 4$ 1 mark for correct answer: • 48MB	2
2(b)(i)	1 mark each to max 3 : • The file takes less storage space on the web server than if lossless compression was used • The file is faster to upload/download to/from the server than if lossless compression was used • The file uses less bandwidth to transmit than if lossless compression was used • The file consumes less data allowance than if lossless compression was used	3
2(b)(ii)	1 mark each: • Identifies consecutive repeating pixels of the same colour • Stores the colour /pattern and the number of times it repeats	2
2(c)	1 mark each to max 2 : • Colour/bit depth • Image resolution	2

5.

(a)	1 mark for: • A tebibyte = 1024 gibibytes / 1 048 576 kibibytes / 2^{40} bytes whereas a gigabyte = 1000 megabytes / 1 000 000 kilobytes / 10^9 bytes • Tebi is binary prefix giga is denary prefix	1
5(b)(i)	1 mark for: C67	1
5(b)(ii)	1 mark for: -1641	1
5(b)(iii)	1 mark for: 573	1

(c)	1 mark for working 1 mark for answer. Working Using the two's complement and adding: 23 in binary = 00010111 so minus 23 is 11101001 $\begin{array}{r} 0100\ 1010 \\ +\ 1110\ 1001 \\ \hline (1)0011\ 0011 \end{array}$ Direct subtraction: $\begin{array}{r} 0100\ 1010 \\ -\ 0001\ 0111 \\ \hline 0011\ 0011 \end{array}$ Answer: 0011 0011	2
(d)	1 mark from: • The answer cannot be represented in the number of bits available • The answer is larger than the maximum positive number that can be stored in the register • The answer is smaller than the most negative number that can be stored in the register	1

6.

(i)	1 mark for each bullet point (max 3) e.g. • Less of the teacher's storage space is used • ... so more student work can be stored • Transmission time is reduced • ... so the teacher does not have to wait as long for it to arrive • Bandwidth usage is reduced • ... so other transmissions are not adversely affected • Less data allowance is used on the teacher's email system	3
(ii)	1 mark for each bullet point (max 3) • Run-Length Encoding // RLE • Repeated sequences of the same characters are replaced by • ... a single copy of the character • ... and a count of the number of characters	3

7.

(a)	1 mark for: 3300 kibibytes	1
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8.

i(a)	1 mark for identification 1 mark for matching description e.g. • ASCII • 7/8 bits per character // represents 128/256 characters // represents all characters from Latin alphabet • UNICODE • 8/16/32 bits per character // represents 256/65536+ characters // represents all characters in all languages	2
b)(i)	1 mark for: 256 // 2^8	1
b)(ii)	1 mark for: Increased file size	1
b)(iii)	1 mark for each bullet point (max 2) e.g. • The change may not be noticeable // Data removed is usually not noticed by the human eye • ... for example, changes in shade/detail • It produces a larger decrease in file size compared to lossless // Lossy decreases file size considerably	2
i(c)(i)	1 mark for each bullet point (max 2) • Value/magnitude/size of the analogue sound wave is measured a set number of times each second/time / at set intervals • Each sample/reading/measurement is given the binary number and stored in sequence	2

(c)(ii)	1 mark for each correct point and 1 mark for matching expansion e.g. • Decrease sample rate • ... fewer samples/readings/measurements stored per second // fewer bits per second stored • Decrease sample resolution • ... fewer bits per sample/reading/measurement // each sample has fewer bits • Sound outside of set/human hearing range is removed • ... fewer measurements are stored / decreases the number of possible binary values so fewer bits are stored	2
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9.

(a)	1 mark for: Denary value: 8107	1
(b)	1 mark for each bullet point for the method (max 2) e.g. • Flip each bit then add 1 ... • ... method of converting the new binary number into denary • Most significant 1 bit is treated as the corresponding negative denary value ... • ... add the other positive corresponding denary values 1 mark for correct conversion Denary value: -97	3
(c)	1 mark each: • A logical shift moves all bits to the right and inserts zeros in the appropriate leftmost bits • An arithmetic shift moves all bits to the right but copies the sign bit into the Most Significant Bit (MSB)	2

10.

l(a)	2 marks for all 3 lines correct 1 mark for 1 line correct <table><thead><tr><th>Term</th><th>Description</th></tr></thead><tbody><tr><td>drawing list</td><td>a component created using a formula</td></tr><tr><td>drawing object</td><td>defines one characteristic of a component</td></tr><tr><td>property</td><td>data required to create all components in the graphic</td></tr></tbody></table>	Term	Description	drawing list	a component created using a formula	drawing object	defines one characteristic of a component	property	data required to create all components in the graphic	2
Term	Description									
drawing list	a component created using a formula									
drawing object	defines one characteristic of a component									
property	data required to create all components in the graphic									
l(b)	1 mark for the definition - The number of bits used to represent each colour 1 mark for each bullet point for the explanation - Increase in bit depth means the image has a greater range of colours // Decrease in bit depth means the image has a smaller range of colours - Increase in bit depth makes the image closer to the original / more realistic // Decrease in bit depth makes the image less like the original / less realistic	3								
l(c)	1 mark for each bullet point (max 2) - Reduced bandwidth usage when transmitting the message - Reduced transmission time from email client to email server - Reduced storage space on the email - Email accounts often have a maximum size for an attachment	2								

11.

(a)	1 mark for: Either - kibibyte = 1,024 bytes // 2^{10} bytes and megabyte = 1000 kilobytes // 1 000 000 bytes // 10^3 kilobytes // 10^6 bytes Or - kibi is binary prefix and mega is denary prefix	1
b)(i)	1111 0011 1100	1
b)(ii)	865	1
b)(iii)	470	1
(c)	1 mark for a correct application 1 mark for a corresponding justification - An application that performs financial / banking calculations ... because it is difficult to represent decimal values exactly in normal binary and financial transactions use only two decimal places and must be accurate, no accumulating errors Or - Electronic displays, e.g. calculators, digital clocks ... because visual displays only need to show individual digits ... because conversion between denary and BCD is easier Or - The storage of the date and time in the BIOS of a PC ... because conversion with denary is easier	2

12.

i(a)	1 mark for each bullet point (max 3) Lossy compression (ticked) • Loss of quality will not be noticed • Needs to be viewed in real time so less bandwidth needed if file size smaller • Smaller file sizes will reduce buffering so the video will play more smoothly • Viewers may watch on different devices, so may not need high quality resolution Lossless compression (ticked) • Original recording may not have been made in high resolution • Could be streaming to high bandwidth devices • The reduction in the file size is sufficient for the receiving device • Viewers do not want any loss of quality	3
(b)	1 mark for each bullet point (max 3) Increase sampling resolution • ... the number of bits used for each sample is increased • ... there will be more values available to represent each sample // more amplitudes can be represented • ... each binary amplitude/note in the digital recording is closer to the analogue amplitude/note • ... quantisation errors are reduced • ... the digital soundwave is closer to the original analogue soundwave Decrease sampling resolution • ... the number of bits used for each sample is decreased • ... there will be fewer values available to represent each sample // fewer amplitudes can be stored • ... each binary amplitude/note in the digital recording is further from the analogue amplitude/note • ... quantisation errors are increased • ... the digital soundwave is less like the original analogue soundwave	3
(c)	1 mark for answer, 1 mark for working Answer: 2.5 mebibytes Working: $(2048 \times 1024 \times 10) / (8 \times 1024 \times 1024)$	2

13.

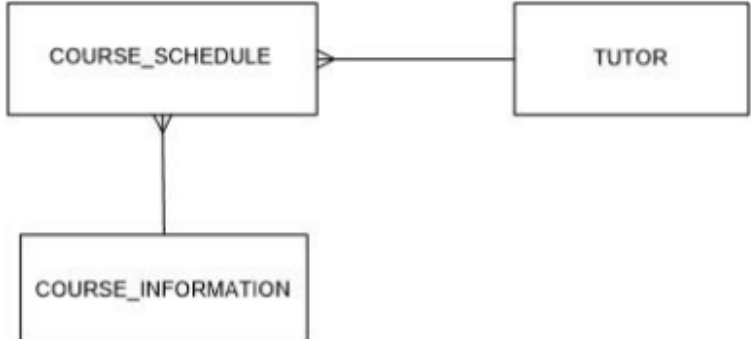
(a)	1 mark for: data values that are continuously changing // variable // any value	1								
(b)	1 mark for 1 correct line 2 marks for 3 correct lines <table><tr><th>Term</th><th>Description</th></tr><tr><td>sampling</td><td>the number of samples taken per second</td></tr><tr><td>sampling rate</td><td>taking measurements at regular intervals and storing the values</td></tr><tr><td>sampling resolution</td><td>the number of bits used to store each sample</td></tr></table>	Term	Description	sampling	the number of samples taken per second	sampling rate	taking measurements at regular intervals and storing the values	sampling resolution	the number of bits used to store each sample	2
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14.

(a)	1 mark for each bullet point: - more pixels can be stored / are available - the image is sharper / less pixelated	2
(b)	1 mark for answer. 1 mark for working Answer: 4096 kibibytes Working: File size = $(2048 \times 1024 \times 16) / (8 \times 1024)$	2

15.

(a)(i)	1 mark for each bullet point (max 2). - Courses must be available to anyone who wishes to follow them - Courses must be available on the internet - Company is willing to share infrastructure with other companies (public) ...which is more economic for the company	2
(a)(ii)	1 mark for each bullet point (max 2 for each disadvantage). - There could be a possible loss of control unlike the LAN ...because the data is stored on a remote infrastructure / someone else's infrastructure ...reliance on external agency to complete tasks, e.g. backups, security - Requires reliable internet connection ...to ensure access to the remote data, more likely with LAN - Increased recurring costs ...as cloud provider charges must be paid, costs for LAN once only.	4

(a)(iii)	1 mark each for firewall, encryption and passwords. Firewall: - Monitors incoming and outgoing traffic and rejects any traffic that does not meet the set rules Encryption: - Ensures that if data is intercepted / obtained it cannot be understood without the decryption key Passwords: - Ensures only users with the correct password can access the resources // prevents unauthorised access	3
(b)(i)	1 mark for both 1:M relationships as follows:  <pre> graph TD CS[COURSE_SCHEDULE] --> T[TUTOR] CS --> CI[COURSE_INFORMATION] </pre>	1

16.

(a)	1 mark for: - A tebibyte = 1024 gibibytes / 1 048 576 kibibytes / 2^{40} bytes whereas a gigabyte = 1000 megabytes / 1 000 000 kilobytes / 10^9 bytes - Tebi is binary prefix giga is denary prefix	1
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