1 Data representation

1 Convert the denary number 165 into:

a binary

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b hexadecimal

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2 a Convert the following binary number into denary:

0 1 1 1 0 1 1 0

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b Convert the following hexadecimal number into denary:

5F

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c Convert the following binary number into hexadecimal:

1 0 1 0 1 1 0 0 0 1 0 0

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d Convert the following hexadecimal number into binary:

3ED

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3 **a** How many mebibytes (MiB) of storage would be needed to store 800 photographs each of which are 16 MiB in size?

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b Write your answer from part **a** in gibibytes (GiB).

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4 The ASCII code for 'A' is 65 and for 'a' is 97.

a Write these denary values in 8-bit binary:

i 65

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ii 97

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b State the denary ASCII code for 'V' and 'v'.

i 'V'

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ii 'v'

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c Write the two denary values in part **b** in 8-bit binary format:

i 'V'

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ii 'v'

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d Using your answers to part **a** and part **b**, suggest an easy way of finding the ASCII binary code for a lower-case letter (for example, 'm') if the ASCII code for the upper-case letter (for example, 'M') is known.

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5 A computer system uses binary codes for letters of the alphabet as follows:

A = 10, B = 11, C = 12, ... , X = 33, Y = 34, Z = 35

a Write the denary value for 'X' in binary using an 8-bit register:

b To convert the binary code for 'X' to the binary code for 'x', all the bits in the 8-bit register in part **a** undergo a logic shift **two** places to the left.

i Write down the contents of the 8-bit register after the bits, representing 'X', have been moved two places to the left.

ii Convert the binary value in part **b i** into denary:

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c State the denary values for the following two letters using the method described in part **b**.

i r:

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ii m:

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6 a Convert the denary number 4 4 8 0 1 into hexadecimal.

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b Convert the hexadecimal number in part **a** into a 16-bit binary number.

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7 State **three** uses of the hexadecimal system.

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8 Six questions are shown on the left and eight numerical values are shown on the right.

Draw lines to connect each question to its correct numerical value (two of the numerical values are not used).

What is the denary value of this hexadecimal digit? E	10
What is the denary value of this binary number? 0 0 0 1 1 1 0 0	12
If the download speed for broadband is 8 mebibytes per second, how long would it take to download a 96 mebibyte file (in seconds)?	14
If $2x$ = 1 tebibyte (TiB), what is the value of x?	16
What is the hexadecimal value of this denary number? 50	22
How many bits are there in two bytes of data?	28
	32
	40

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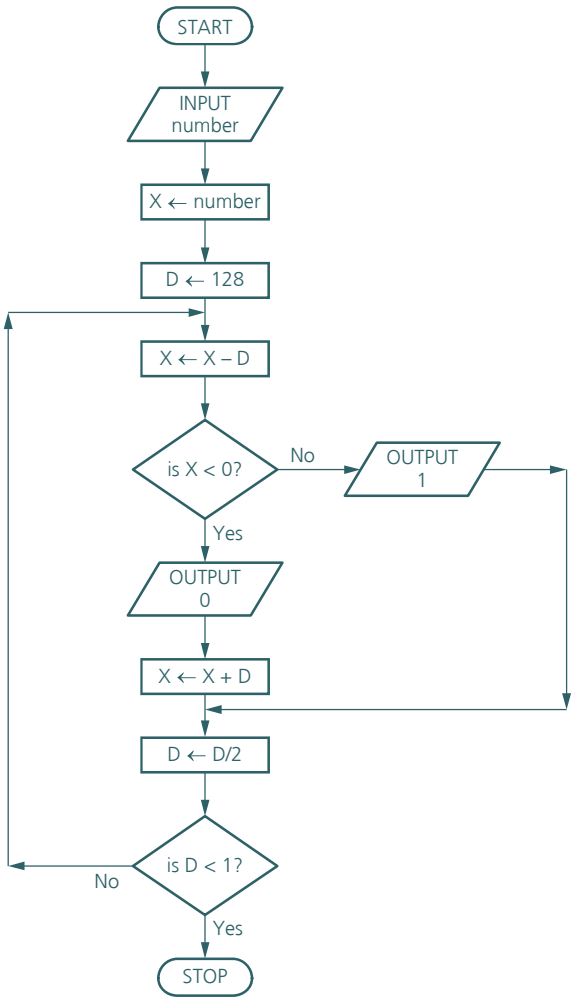

a Trace through the flowchart using the following two values as inputs:

i 220

Number	X	D	OUTPUT

ii 73

Number	X	D	OUTPUT

b Explain the function of the flowchart in part **a**.

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10 a i Convert 0 1 0 1 1 1 1 0 into denary.

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ii Convert 0 0 1 1 1 1 0 1 into denary.

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b i Add together 0 1 0 1 1 1 1 0 and 0 0 1 1 1 1 0 1, giving your answer in binary.

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ii Convert your answer in part **b i** to denary.

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11 a Write down the largest number that can be represented by the following binary register.

Give your answer in binary and denary form:

128	64	32	16	8	4	2	1

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b i Add together 0 1 1 1 0 1 1 1 and 1 0 0 1 1 1 0 1, giving your answer as an 8-bit binary number.

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ii Comment on your answer to part **b i**.

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12 An 8-bit binary register contains the following value:

0	0	1	1	1	1	0	0

a Write down the denary value of the register.

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b The contents of the register undergo a logical shift one place to the right.

i Show the result of this right shift:

ii Write down the denary value of your answer to part **b i**.

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iii The register in part **b i** now undergoes a further logical shift two places to the right. Comment on your result.

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c The content of the original register (shown in part **a**) now undergoes a logical shift **two** places to the left.

i Show the contents of the register after this left shift operation.

ii State, with reasons, the effect of this shift on the denary value shown in part **a**.

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13 a Convert the denary numbers, 37 and 19, into 8-bit binary numbers:

37: .....

19: .....

b Add together the two binary numbers in part **a**, and give your answer in binary.

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c Carry out a logical shift, **two** places to the left, on your result from part **b**.

Comment on your answer.

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d Carry out a logical shift, **four** places to the right, on your result from part **b**.

Comment on your answer.

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14 A computer system uses two's complement notation.

a Complete the headings for an 8-bit binary number which uses two's complement:

64 32 16 8 4 2 1

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b Write down **i** the **most negative** and **ii** the **most positive** numbers that can be stored in an 8-bit register which uses two's complement. Give your answers in both denary and binary format.

i most negative:

denary value:

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ii most positive:

denary value:

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c Convert the following two denary numbers into 8-bit binary numbers which use the two's complement format.

i +47

ii –59

d Convert the following two binary numbers, written in two's complement format, into denary.

i 1 1 0 0 1 1 1 0

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ii 1 1 1 1 1 1 1 0

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e i Convert the denary number, +45, into binary, using the two's complement format.

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ii Convert the denary number, –45, into binary, using the two's complement format.

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iii Add together the binary numbers found in parts **e i** and **e ii**, leaving your answer in binary. Comment on the result.

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15 a A camera detector has an array of 4096 by 2048 pixels and uses a colour depth of 16.

Calculate the size of an image taken by this camera; give your answer in MiB.

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b An audio CD uses 40960 samples per second, with 16 bits being used per sample.

The music being sampled uses two channels to allow for stereo recordings.

Calculate the file size for a 1024 second recording. Give your answer in MiB.

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16 a Give **three** reasons why it is often necessary to reduce the size of a file.

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b Explain the difference between lossy and lossless file compression.

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c i Give **one** example of the use of lossy file compression.

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ii Give **one** example of the use of lossless file compression.

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17 In terms of representing bitmap images, explain the following:

a colour depth: .....

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b image resolution: .....

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18 Explain the difference between ASCII code and Unicode.

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19 Seven statements are shown on the left and eleven computing terms are shown on the right in the diagram below.

Draw lines to connect each statement to the correct computer term.

In a binary number, this is the right-most binary digit	Overflow error
Method used by a computer to allow the representation of negative numbers as well as positive numbers	Resolution
Result of adding two binary numbers that exceeds the maximum size of a number which can be stored	Unicode
The moving of bits to the left or to the right in a register, which represents multiplication by 2^x or division by 2^x (where x represents the number of places the bits are moved left or right)	American standard code for information interchange
A 7-bit code used to represent letters, numbers and characters found on a standard keyboard plus 32 control codes	Pixel
Number of sound samples taken per second when representing sound digitally in a computer	Two's complement
The smallest element of a picture	Sampling rate
	Logical shift
	Least significant bit
	Error code
	Colour depth

20 a Which one of the following is not a correct hexadecimal number?

A CODE

B AX1S

C 1DEA

D FACE

b The number of bits used to represent a sound sample is known as:

A the sampling rate

B amplitude value

C loudness of a sound sample

D sampling resolution

c The MP3 format removes redundant sound from a file. Which one of the following best describes the type of file reduction being used by the MP3 format?

A lossy files compression

B sound file damping

C image file compression

D lossless file compression

d Temporary files produced by a camera where no compression has been applied, are called:

A jpeg files

B png files

C gif files

D raw bitmap files

e Lossless file compression, which reduces the size of a string of adjacent, identical data, is called:

A jpeg

B run-length encoding

C sampling resolution

D audio compression

21 a Explain what is meant by run-length encoding (RLE).

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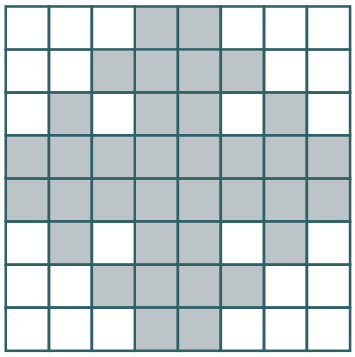
b



i The above monochrome image is being designed.

Each white square is represented by 'W' and each dark square is represented by 'D'. Show how run-length encoding (RLE) would be used to produce a condensed file for the above image. Using the grid below, write down the data you would expect to find in the RLE compressed format; the first two have been done for you.

3W	2D								

ii Assuming that each square in the 8 × 8 grid requires one byte of storage, and each character in the RLE code also requires one byte of storage (for example, '3' requires 1 byte, 'W' requires 1 byte), calculate the file size reduction when using RLE.

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22 a Explain the following terms used in the electronic storage of sound:

i sampling resolution:

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ii sampling rate:

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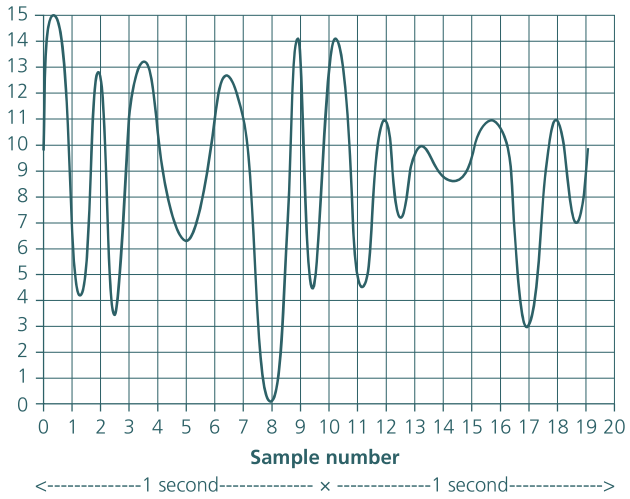
b Look at the sound wave below that has been sampled:



i From the graph, what is the sampling resolution?

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ii From the graph, what is the sampling rate?

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iii Using the *x*-axis, locate points 9 and 18 on the graph. Write down the 4-bit binary values corresponding to the *y*-axis values of these two points.

point 9:				
point 18:				

c Discuss the benefits and drawbacks of increasing the sampling rate and sampling resolution when representing sound in an electronic (binary) format.

23 Write down a series of steps that could be used to convert a denary number into a hexadecimal number. Your steps should allow somebody to follow them clearly to give the correct converted value.

24 a State what is meant by a bit.

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b Give two reasons why computers use binary numbers rather than decimal numbers.

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c Explain why the hexadecimal number system is used by computer technicians and programmers.

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