Convert the following denary numbers to 8-bit unsigned binary:
1a) 37
1b) 96
1c) 219

Convert the following unsigned binary numbers to denary:
2a) 01100110
2b) 10010010
2c) 11110000

Convert the following denary numbers to hex:
3a) 19
3b) 153
3c) 999

Convert the following hex numbers to denary:
4a) A7
4b) 9F
4c) D3D

Convert the following binary numbers to hex:
5a) 1100 0101
5b) 0111 1011 0011
5c) 1111 0000 0000 1101

Convert the following hex numbers to binary:
6a) 8E
6b) 6B
6C) CAB

7a) A person hosts a torrent file and is seeding (sending) the file at 3MB/s on average - how many bits would they transfer in 1 year - give your answer in a sensible unit?

7b) An image is taken with a resolution of 1280x720px and a bit depth of 32 - how many Mebibytes would this image be?

7c) By how much would the size of this image reduce if you reduced the bit depth to 8?

7d) A song is recorded with 2 channels at a sampling frequency of 44.1kHz and a sampling resolution of 24 bits - how many mebibits would 3 minutes of audio use?

7e) Each record in a database requires 200 bytes - a company knows there will never be more than 100 million records. They plan to buy a 32GB USB to store a backup of their database - will the USB have enough capacity to store a copy of a database if it reaches 100 million records?

8a) Add an appropriate base & power in the form $b^n = x$ as well as the regular number for how many bytes each represent
kilobytes = ……… = …………………………
megabytes = ……… = …………………………
gigabytes = ……… = …………………………
terabytes = ……… = …………………………

8b) Add an appropriate base & power in the form $b^n = x$, the correct multiple of 1024 the number represents, as well as the regular number for how many bytes each represent
kibibytes = ……… = ………………………… = …………………………
mebibytes = ……… = ………………………… = …………………………
gibibytes = ……… = ………………………… = …………………………
tebibytes = ……… = ………………………… = …………………………

Write the following denary numbers in 8-bit signed magnitude:
9a) 47
9b) -75

Write the following denary numbers in 8-bit one's complement:
10a) 142
10b) -53

Write the following denary numbers in 8-bit two's complement:
11a) 125
11b) -96

Write the following denary number in packed binary-coded decimal - how would it be different if using unpacked BCD?
12) 592

Write the following packed binary-coded decimal number in denary:
13) 1001 0111 0101 0011 0001

14) What are two problems with both signed magnitude & one's complement?

15) How does two's complement solve the issues mentioned in question 14?

16) Write the two's complement number for zero - then use a method (e.g. "flip the bits & add 1") to try and convert zero to negative - what happens?

17) Complete the table (assume numbers are stored using 1 byte):

Number	Denary value	Bit pattern
Smallest signed magnitude value		
Biggest signed magnitude		
Smallest one's complement		
Biggest one's complement		
Smallest two's complement		
Biggest two's complement		

Perform the following sums using 8-bit unsigned binary integers & comment on the correctness of the answer:
18a) 100 + 40
18b) 154 + 125

Perform the following sums using signed binary integers & comment on the correctness of the answer:
19a) 95 + 52
19b) -37 + 83

20) What is overflow when performing arithmetic?

Perform the following arithmetic operations using BCD:
21a) 7.8 + 4.5
21b) 12.7 + 3.4

Without performing the calculations in binary, write "y" or "n" for whether they would result in overflow (assume using 8-bit two's complement both operands & answer):

22a) 63 + 64

22b) 64 + 64

22c) -100 + -30

22d) -64 + -64

Extra (taken from the June 2022 AS exam):

Statement	Answer
The hexadecimal value 11 represented in denary	
The smallest denary number that can be represented by an unsigned 8-bit binary integer	
The denary number 87 represented in Binary Coded Decimal (BCD)	
The denary number 240 represented in hexadecimal	
The denary number -20 represented in 8-bit two's complement	

23) What are the two main character sets & how many bits do each use? Why was the second character set created?

24) Complete the table:

Character	ASCII Value in Denary
0	
A	
a	
5	
G	
z	

25) What are the first 32 (0-31) characters in ASCII called - what kind of things are they used for?

26) Why does saving "你好" use more bytes than saving "Hi"?

27) What are the two categories of images - can you list some file formats of each?

28) Define the following terms:
Pixel:

Resolution:

Colour/bit depth:

Bitmap:

Vector:

29) What is the formula for calculating the file size of an image?

30) Fill in the blank: colour codes are often written in _____ format to make it easy for humans to understand

31) What is a file header? And, more specifically, what data would be contained an image's file header (i.e. an image header)?

32) An image is 500x500px with a bit depth of 8 - how many different colours could this image contain and what would the file size be in MB?

33) A 1920x1080px image has a file size of 5.93MiB - what bit depth do you think was used?

34) Define the following terms when talking about vector images:
Element

Drawing list

Attribute/property

Value

35) Complete the table

	Advantages	Disadvantages	Use cases
Bitmaps			
Vectors			

36) Define the terms:
Sample:

Sampling resolution/bit depth:

Sampling rate/frequency:

Channels:

37) Briefly explain how sound is represented in a computer

38) What is quantisation?

39) What happens to the sound wave we can reproduce & file size when the sampling rate & sampling resolution are increased?

40) Suppose we want to store 1 million distinct amplitudes - what would be the minimum bit depth for each sample we'd need to use?

41) What does Nyquist's theorem state about the sampling rate and hence what is usually considered the lowest sampling frequency you should use for audio designed to be listened to by humans

42) What is the formula for calculating the file size of an audio file?

43) A singer records a 60 minute album with 2 channels, at a sampling rate of 44.1kHz and a sampling resolution of 24 - what would be the file size in Mebibytes?

44) A CD has a capacity of 700MB and will be used to store interviews - only 1 channel will be required, with a bit depth of 8 and a sampling frequency of 44,100Hz - how many minutes of audio will the CD be able to store?

45) _____ encoding displays the entire video frame at once, while _____ encoding alternates between displaying only the even rows, then only the odd rows

46) Define the terms lossy & lossless compression:


47) Complete the table:

	Lossy compression technique(s)	Lossless compression technique(s)
Images		
Audio		
Video		
Text		

48) What are 3 benefits of compression?

49) Briefly explain how run-length encoding works and calculate the run-length encoded representation of the following black and white 5x4px image (you can write your answer in denary):
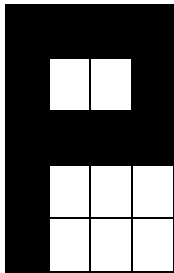
50) Can run-length encoding be used effectively on photos? Between the two photos, which would RLE before more effective for and why?
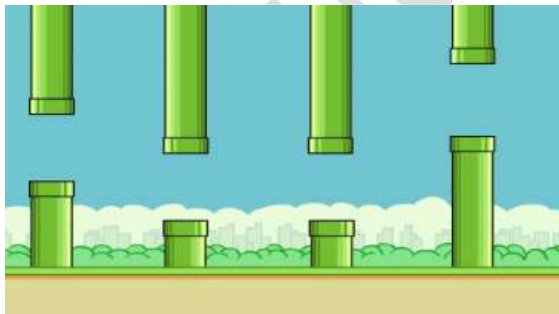
51) Briefly explain how Huffman Coding works

52) Suppose you have the following Huffman dictionary and encoded sequence of bits - what is the original string?

1110101111000001010110110011101100

o	101
p	000
r	001
e	010
s	110
i	011
n	100
C	1110
m	1111