Review Worksheet: Data Representation 1

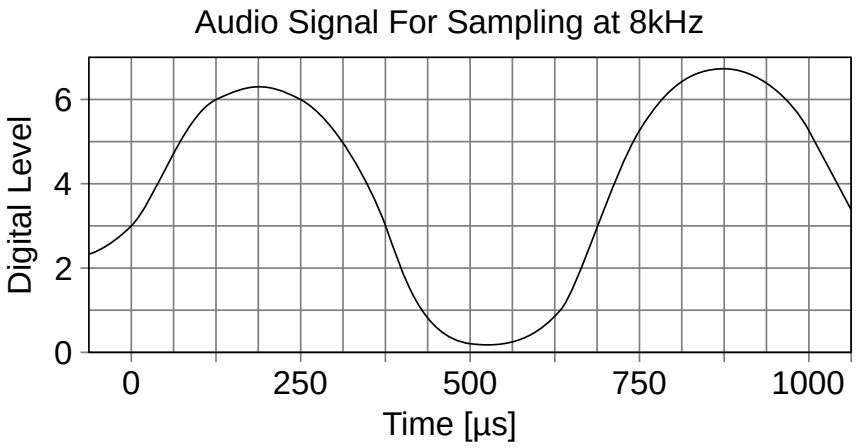
1. For a traditional telephone, audio is sampled at a frequency of 8kHz. This is a sample period of 125µs between each sample, as shown by the calculation:

$$\frac{1}{8000\,\text{Hz}} = 0.000125\,\text{s} = 125\,\mu\text{s}$$

The image below right shows a diagrammatic representation of an audio signal that is to be sampled with a digital amplitude with 8 gradations, and an 8kHz sample rate.

a) Complete the table below by writing the sample values for the given times – first in decimal, then converted to binary. Remember that digital samples must be whole numbers – no decimal values.

Time [µs]	Digital Level	
	decimal	binary
0		
125		
250		
375		
500		
625		
750		
875		



b) What is the bit depth of each sample?

c) Write the resulting bitstream by combining the binary values.

d) Convert the bitstream in part (c) to hexadecimal

e) Speech on a telephone is rather low fidelity and some say it sounds “tinny”. List two ways that the fidelity of a sampled signal can be increased.

i) .....

ii) .....

2. Compact disc (CD) audio is sampled at a frequency of 44.1kHz with the amplitude divided into 65,536 gradations, which is a bit depth of 16 bits ($2^{16} = 65536$). Write the formula that calculates the file size in megabytes (MB) of a single channel CD-quality audio clip that is 1.5 minutes in duration. Do *not* solve the equation.

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3. Examine the raster image below right. The image contains three colors, white, pink, and black.

a) What is the color depth of the image?

b) Suggest a binary encoding for each color

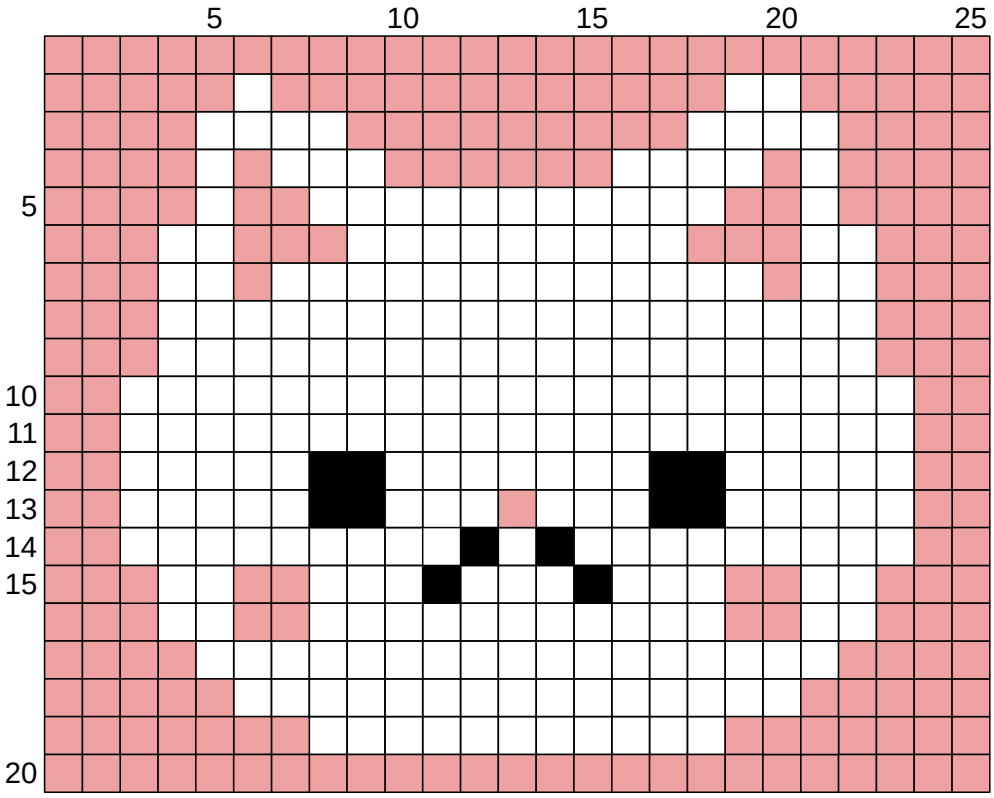
i) black

ii) pink

iii) white

c) What is the resolution of the image?

d) What is the aspect ratio of the image (simplify)?



e) A run-length encoding compression algorithm uses:

- K for black pixels
- P for pink pixels
- W for white pixels

Give the result of compressing lines 11 through 14 of the image above using the algorithm.

Line 11:	
Line 12:	
Line 13:	
Line 14:	

f) Explain whether this image would compress well using run-length encoding

g) Write an equation to calculate the number of bytes that would be required to store the above image as a bitmap with no compression.