fund 2017

4 A signal is being digitised by sampling at 12 kHz.
The total voltage is 5.0 V and the noise voltage is 4.9 mV.

Which statement is correct?

$b = \log_2\left(\dfrac{V_T}{V_n}\right)$

$b = 9.9 \approx$ so 10

A $\dfrac{V_{total}}{V_{noise}} \approx 10^3$ ✓

~~B~~ The highest frequency in the signal should not exceed 24.0 kHz.

~~C~~ The recommended number of bits per sample is 8.

~~D~~ The voltage resolution of the sampling should be about 1 mV. no - don't want noise

Your answer ☐   **[1]**

Turn over for the next question

32 A video file is downloaded at a rate of 24 Mbit s⁻¹.
The video file is 1.2 Gbytes in size.

(a) Show that the time taken for the file to download is greater than 6 minutes.

$$\frac{1.2 \times 10^9 \times 8}{24 \times 10^6} = 400 \Rightarrow 6.6 \, min$$

[2]

(b) The video file contains a soundtrack sampled at 16.0 kHz.
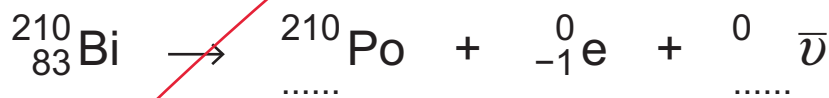State and explain the highest frequency of sound that can be recorded on the soundtrack.

highest frequency ......8 *k*...................... kHz

.....need a sample rate 2×.....
.....highest freq..... **[2]**

33 The radioactive isotope $^{210}_{83}$Bi decays by this beta decay.

(a) Complete the decay equation.

$$^{210}_{83}\text{Bi} \longrightarrow {}^{210}_{......}\text{Po} + {}^{0}_{-1}e + {}^{0}_{......}\overline{v}$$

[2]

(b) State why an antineutrino is emitted during beta decay.

....

.... **[1]**

41 This question is about sampling sounds. **Fig. 41.1** shows part of a waveform. This waveform has been sampled at the points shown by small circles.
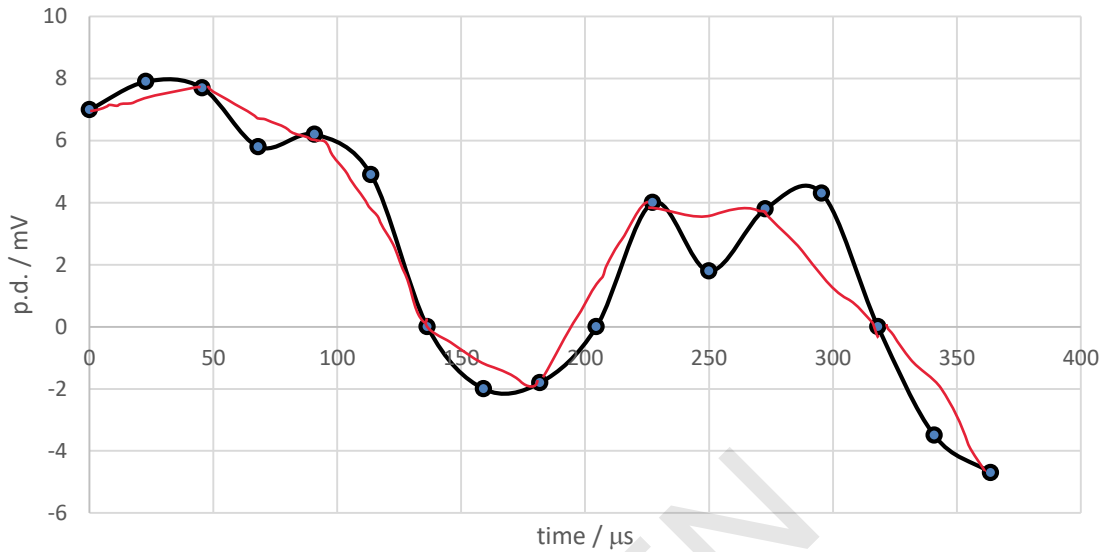

Fig.41.1

The sampling rate is 44 kHz.

(a) On **Fig. 41.1** sketch the waveform that would be reproduced if the sample rate is reduced to 22 kHz. Explain your reasoning and state how the reproduced waveform will differ from the original waveform.

Since sample rate is half what it was the detail in the wave is reduced meaning higher freq elements of the sound are lost [3]

(b) A student estimates that the system uses 50 000 voltage levels. Calculate how many bits are required to produce this number of levels and suggest a more likely value for the number of voltage levels.

$B = \log_2 (\text{levels})$ $\log_2(50000)$

15.6 bits. But this is

nearly 2 bytes so 2^{16} is

more likely $= 65536$

[3]

(c) This system is used for high quality sound. Explain why it is necessary to sample at a frequency of 44 kHz when the highest note that can be heard is about 20 000 Hz.

this is more than 2×
higher than the highest
freq. & you need to resolve
the high freq for good sound **[2]**

(d) Telephone systems are often designed to use 8 bit sampling at 8 kHz instead of the 16 bit sampling at 44 kHz used for music. Suggest and explain why this decision was made in designing those systems and explain why recorded music can sound distorted on a telephone.

The systems carry huge amounts of data
So reduce the number of bytes for phones
because you don't need the resolution to
understand the voice. This is because ther are less
higher frequency tones in the voice and in music, so
you can still understand voice with lower quality.
Music down a 8bit phone will sound very bad.

[3]

END OF QUESTION PAPER