1) $w = 16 \frac{bits}{sample}$

$r = 44100 \frac{samples}{s}$

$\Rightarrow \quad w \cdot r \cdot 2 = 16 \cdot 44100 \cdot 2 \frac{bits}{s} = 1411200 \frac{bits}{s}$

$\Rightarrow \quad 70\ min \cdot 60 \frac{s}{min} \cdot 1411200 \frac{bits}{s}$

$= 5927040000 \quad bits$

$= 706{,}56 \quad MByte$

2) $RMS = \frac{\text{magnitude}}{\sqrt{2}}$

$$\Rightarrow L = 20 \log_{10} \frac{\frac{0{,}1\ Pa}{\sqrt{2}}}{20\mu Pa} = 71{,}0\ dB\ SPL$$

$$L_{dB\,FS} = 10 \log_{10} \frac{P}{\frac{A^2}{2}}$$

$$P = \left(\frac{0{,}25}{\sqrt{2}}\right)^2$$

$$\Rightarrow L_{dB\,FS} = 10 \log_{10} \frac{\left(\frac{0{,}25}{\sqrt{2}}\right)^2}{\frac{1^2}{2}} = -12{,}0\ dB\,FS$$

$$a = L_{dB\,FS} - L_{dB\,SPL}$$

$$= -12{,}0 - 71 = -83$$

3) $-12\ dB\ FS = 10 \log_{10} \frac{P_{Signal}}{\frac{A^2}{2}}$

$$P_{Signal} = \frac{A^2}{2} 10^{\frac{-12}{10}}$$

$$= 0{,}0315$$

$$P_{Noise} = \frac{\Delta^2}{12} \qquad \Delta = \frac{2A}{2^{bit}}$$

$$= 77{,}61 \cdot 10^{-12}$$

$$SNR = 10 \log_{10} \frac{P_{Signal}}{P_{Noise}} = 10 \log_{10} \frac{0{,}0315}{77{,}61 \cdot 10^{-12}}$$

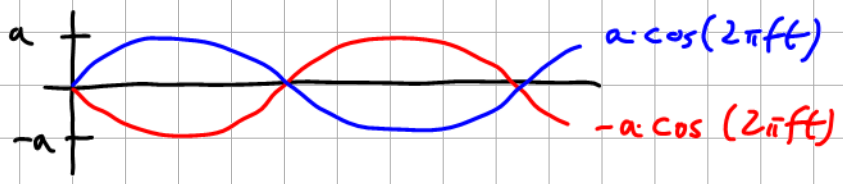
$$= 86{,}1\ dB$$

4) $RMS_x = \frac{a}{\sqrt{2}}$

$$75\,dB\,SPL = 20 \log_{10} \frac{RMS_x}{20\mu Pa} = 20 \log_{10} \frac{a}{\sqrt{2} \cdot 20\mu Pa}$$

$$\Rightarrow \quad a = \sqrt{2} \cdot 20\mu Pa \cdot 10^{\frac{75}{20}} = 0{,}159\ Pa$$

The sign of a is undetermined:



Both signals have same RMS and same L.

The level is independent of the frequency: L is the same
L = 75 dB SPL

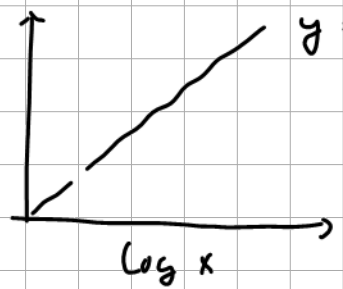
Exception: If the frequency is 0 Hz:

$$RMS = a$$

$$L = 20 \log_{10} \frac{a}{20\mu Pa}$$

$$\Rightarrow a = 20\mu Pa \cdot 10^{\frac{75}{20}} = 0{,}1125\ Pa$$

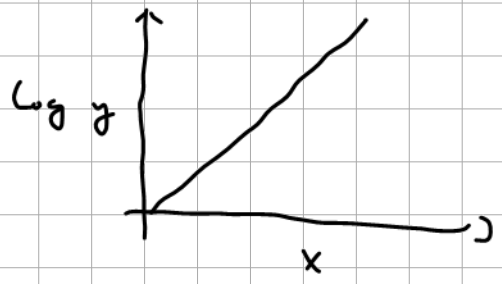
5) Log x-axis:



$y = f(\log x) = m \cdot \log x$

⇒ f is a logarithmic function.

Log y-axis:

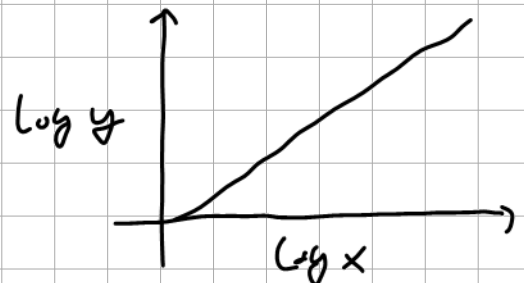


$\log y = \log f(x) = m \cdot x$

$y = e^{m \cdot x}$

⇒ f is an exponential function

Log-Log-plot



$\log y = \log f(\log x) = m \cdot \log x$

$y = e^{m \cdot x}$

⇒ f is a linear function.