The ratio of the power output from a circuit to the power input to a circuit is quoted in decibels or dB.

$$\text{Power ratio} \quad = 10 \log \left(\frac{P_{out}}{P_{in}} \right) = 20 \log \left(\frac{V_{out}}{V_{in}} \right)$$

This gives a compression of scale.

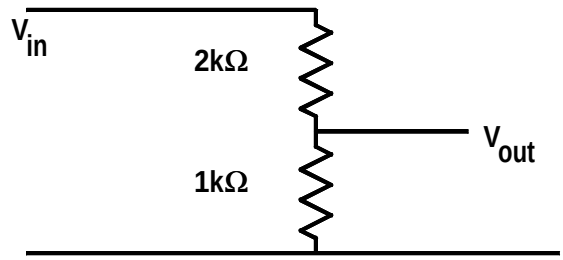
The bel is the logarithm to base 10 of the ratio of two quantities.

The response of the ear is logarithmic.

Equal increments of the log of the audio power give equal increments in sensation.

Threshold of hearing is 10^{-12} Watts m^{-2} and this is taken as the 0dB on the loudness scale.

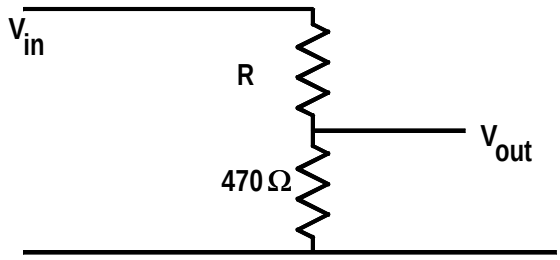
Example 1.
Calculate the ratio of the output to input for the potentiometer circuit in Figure 7.1.



$$\begin{aligned} \text{attenuation} &= 20\log\left(\frac{1k\Omega}{1k\Omega + 2k\Omega}\right) \\ &= -20 \times 0.477 \\ &= -9.54\text{dB} \end{aligned}$$

A reduction or attenuation gives a negative quantity when quoted in dB.
An amplifier gives a gain which is a positive quantity when quoted in dB.

Example 2
Calculate the value of resistor R which will give an attenuation of −35dB between the input and output signals.



$$\begin{aligned}
\text{We have} \quad -35 &= 20\log\left(\frac{V_{out}}{V_{in}}\right) \\
&= 20\log\left(\frac{470\Omega}{R+470\Omega}\right) \\
\frac{470\Omega}{R+470\Omega} &= 10^{(\frac{-35}{20})} \\
&= 0.01778 \\
\text{giving} \quad 470 &= 470 \times 0.01778 + R \times 0.01778 \\
\text{giving} \quad R &= 25.96k\Omega
\end{aligned}$$