EE 322 Advanced Electronics, Spring 2013
Quiz 4, February 25, 2013

1. **What is the RMS voltage noise from a 1 MΩ resistor in a 1 MHz bandwidth at a temperature of 300 K? Help: $k = 1.4 \times 10^{-23}\,\frac{\mathrm{J}}{\mathrm{K}}$**

$$v_{\mathrm{RMS}} = \sqrt{4kTRB} = \sqrt{4 \times 1.4 \times 10^{-23} \times 300 \times 10^6 \times 10^6} = 0.13\,\mathrm{mV}$$

2. **Consider an inverting amplifier with gain −100 and input resistance 1 MΩ. If $e_{na} = 100\,\frac{\mathrm{nV}}{\sqrt{\mathrm{Hz}}}$ and $T = 300\,\mathrm{K}$, what is the RMS noise at the output?**

Setting $A = 100$ we can write

$$\begin{aligned}
v_{\mathrm{RMS}} =& \sqrt{B}\sqrt{4kTR_1 \times A^2 + 4kTR_2 + e_{na}^2\,(A+1)^2} \\
=& \sqrt{B}\sqrt{4kTR_1\,(A + A^2) + e_{na}^2\,(A+1)^2} \\
=& \sqrt{10^6}\sqrt{4 \times 1.4 \times 10^{-23} \times 300 \times 10^6 \times (100 + 10^4) + (100 \times 10^{-9})^2 \times 101^2} \\
=& 16.5\,\mathrm{mV}
\end{aligned}$$