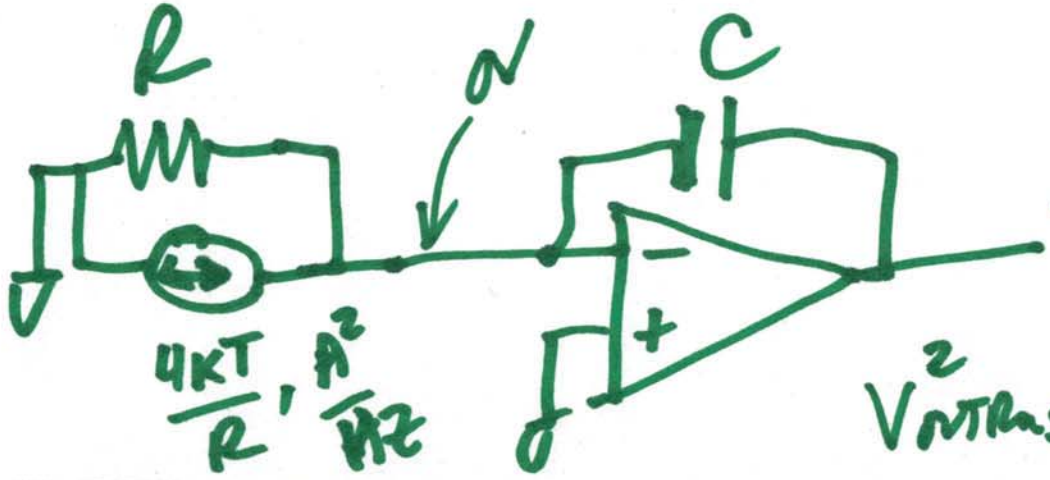
ECE 720

Feb. 11, 2016

Lecture 8 Spring 2016

Feb. 12, 2:30 → Make-up lecture

Feb. 19 → TBE-B

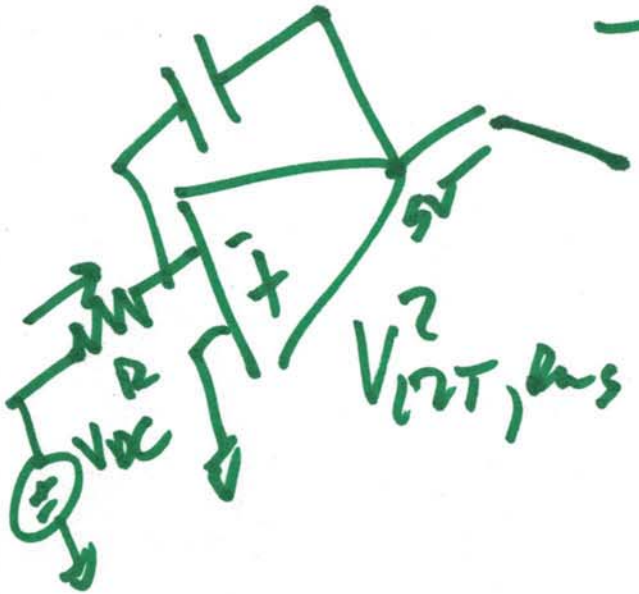


$$v_{out} = \left|\frac{1}{j\omega C}\right|^2 \cdot \frac{4KT}{R}$$

$$V_{out,rms}^2 = \frac{4KT}{R} \cdot \frac{1}{(2\pi C)^2} \int_{f_L}^{f_H} \frac{df}{f^2}$$

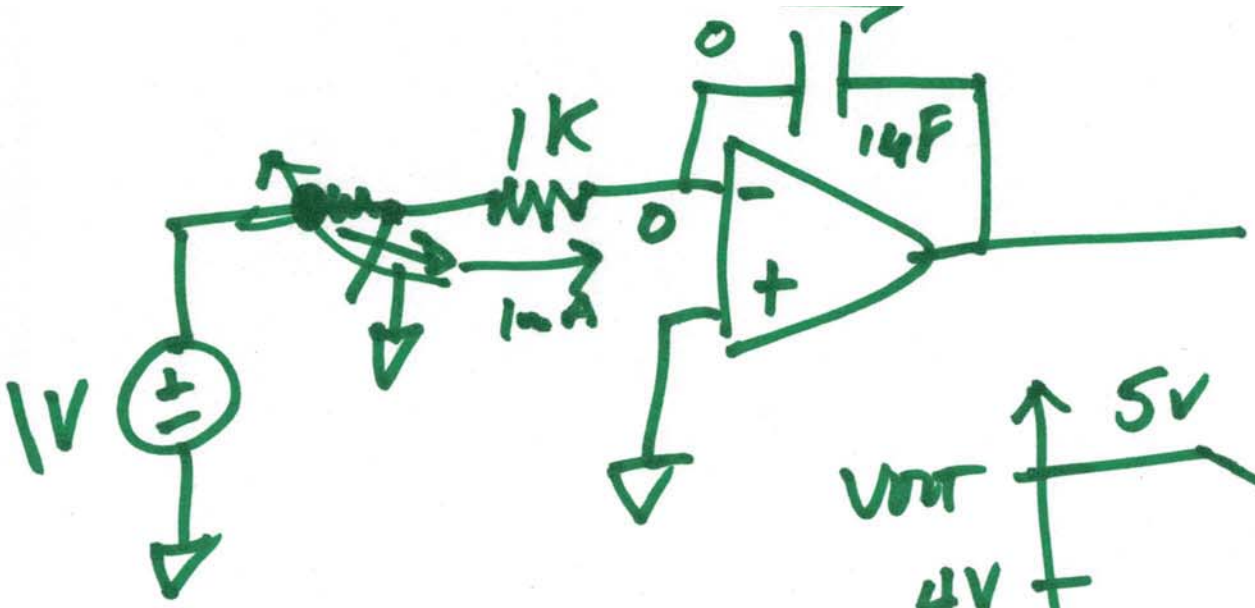
$$V_{out,rms}^2 = \frac{4kT}{R} \cdot \frac{1}{(2\pi C)^2} \left. \frac{-1}{f} \right|_{f_L}^{f_H}$$

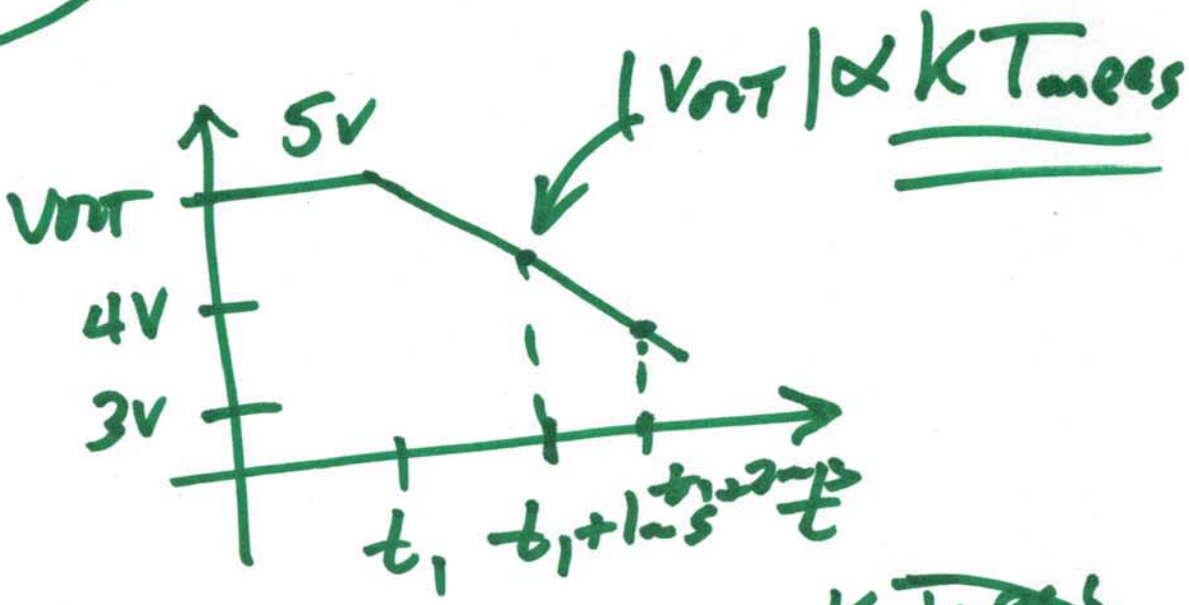
$$= \frac{4kT}{R} \cdot \frac{-1}{(2\pi C)^2} \left(\frac{1}{f_H} - \frac{1}{f_L} \right) \quad \begin{matrix} f_H \to \infty \\ f_L \to \frac{1}{T_{meas}} \end{matrix}$$

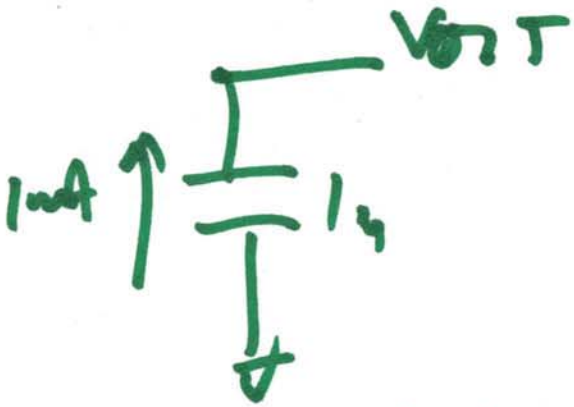


$$V_{out,rms}^2 = \frac{4kT}{R} \frac{1}{(2\pi C)^2} T_{meas}$$

$$\frac{}{C}$$



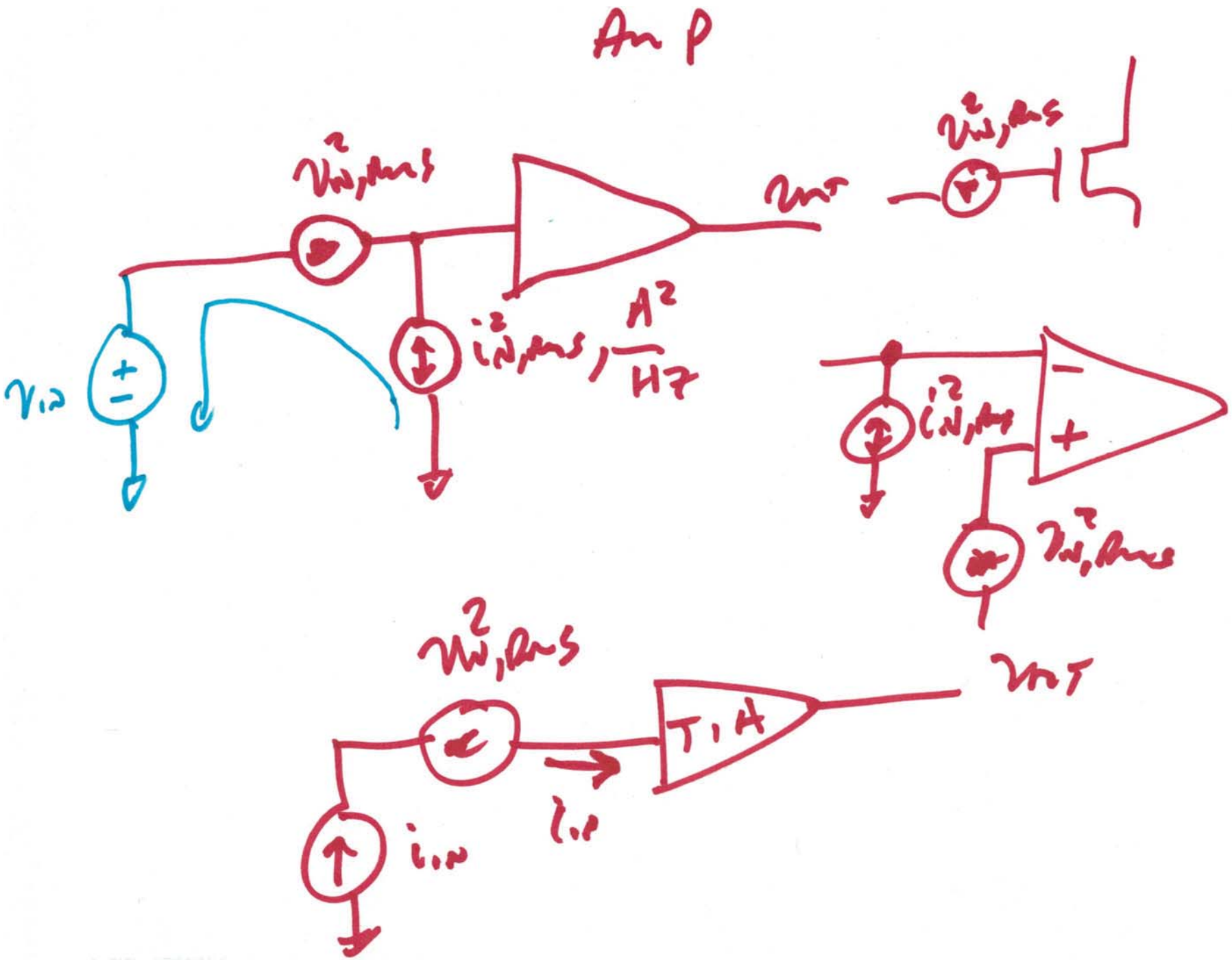


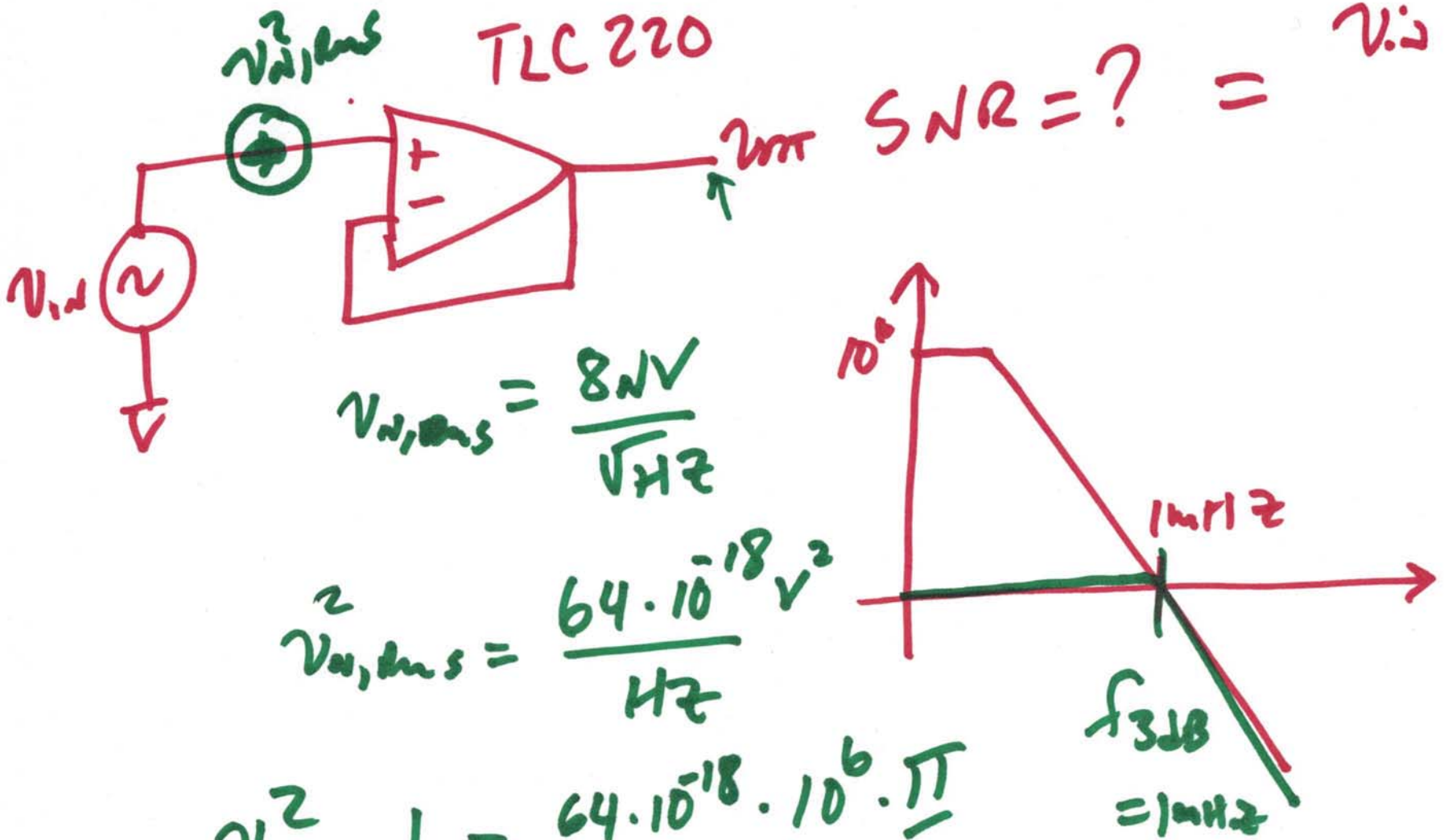


$$I = C\frac{dV}{dT} = \frac{1V}{1K \cdot 1\mu F} = \frac{dV}{dT}$$

$$\frac{1V}{ms} = \frac{1V}{ms}$$

$$SNR = \frac{kT}{C}$$


Amp
$v_{no,rms}^2$
v_{no}
v_{ni}
$i_{n,rms}^2$
A^2/Hz
$v_{ni,rms}^2$
$i_{n,rms}^2$
$v_{ni,rms}^2$
$v_{ni,rms}^2$
T.A
v_{no}
i_{in}
i_{in}


TLC220
SNR = ? =
$v_{n1,rms}^2$
$v_{n,rms} = \frac{8nV}{\sqrt{Hz}}$
$v_{n,rms}^2 = \frac{64 \cdot 10^{-18} V^2}{Hz}$
$v_{o,rms}^2 = \frac{64 \cdot 10^{-18} \cdot 10^6 \cdot \frac{\pi}{2}}{}$
Thermal noise
10^6
1mHz
f_{3dB}
=1mHz

$$\sqrt{V^2_{noise,rms}} = \sqrt{\frac{FNN}{f}} = \frac{60\ nV/\sqrt{Hz}}{1\ Hz}$$

$$\frac{FNN}{10} = \frac{3600 \cdot 10^{-18}}{10} = 360 \cdot 10^{-18}$$

$$\sqrt{360} \cdot \frac{nV}{\sqrt{Hz}} \qquad 18.97$$

$$V^2_{noise,1Hz} = \frac{3.6 \times 10^{-15}\ V^2/Hz}{f}$$

$$V^2_{noise,rms} = \int_{f_L}^{f_H} \frac{\overbrace{3.6 \times 10^{-15}\ V^2/Hz}^{FNN}}{f}\, df$$

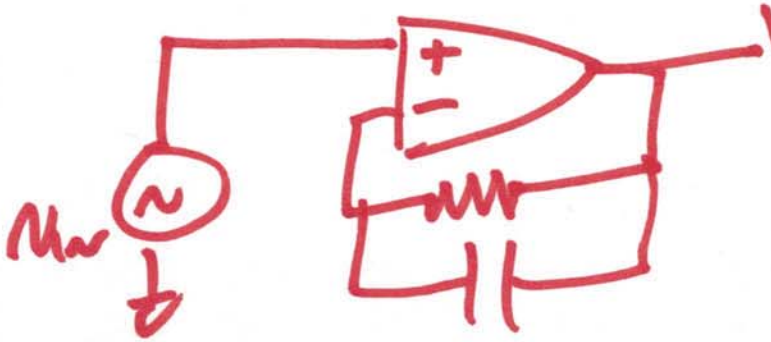
b)

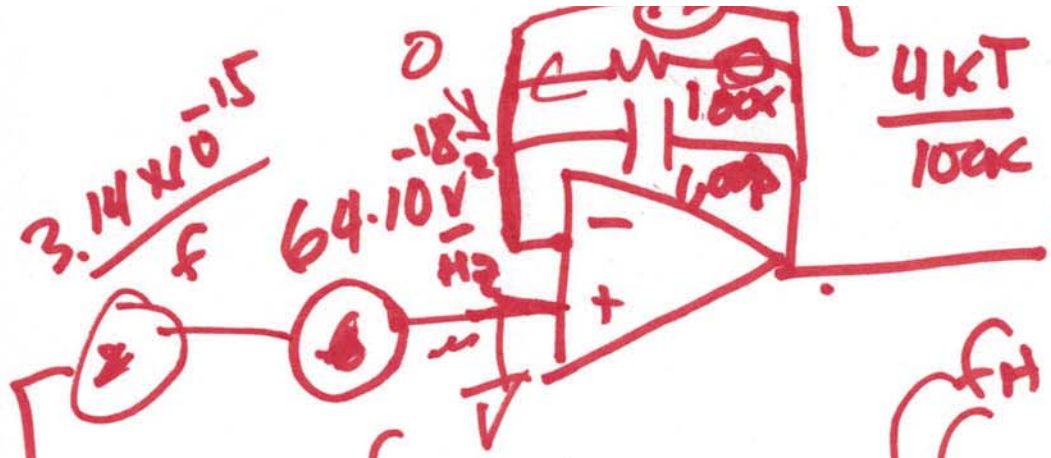
$$V_{OUT,NOISE,rms}^2 = 3.6 \times 10^{-15} \frac{V^2}{Hz} \cdot (\ln f_H - \ln f_L)$$

$$= 3.6 \times 10^{-15} \cdot \frac{V^2}{Hz} \cdot 49 = FNN \cdot 49$$

$$V_{OUT,NOISE,rms} = \sqrt{FNN} \cdot 7$$

$$V_{OUT} = \sqrt{3.6 \times 10^{-15}} \cdot 7$$





$$f_{3dB} = \frac{1}{2\pi \cdot 1{,}000pF \cdot 100K}$$

$$\overline{v_{rms}^2} = \int_{f_L}^{f_H} v_{n,noise}^2\,df = \int_{f_L}^{f_H} \left[\frac{3.14\times10^{-15}\,V^2}{f} + 64\times10^{-18}\,\frac{V^2}{Hz} + \frac{4KT}{100K}\cdot\left|\frac{100K}{1+j\omega 10^{-7}\cdot 10^{5}}\right|^2\right]$$

f_{UN}

$$= 3.14\times10^{-15}\cdot 49 + 64\times10^{-18}\cdot f_{3dB}\cdot\frac{\pi}{2} \qquad f_w$$

$$4KT\cdot 100K\cdot f_{3dB}\cdot\frac{\pi}{2}$$