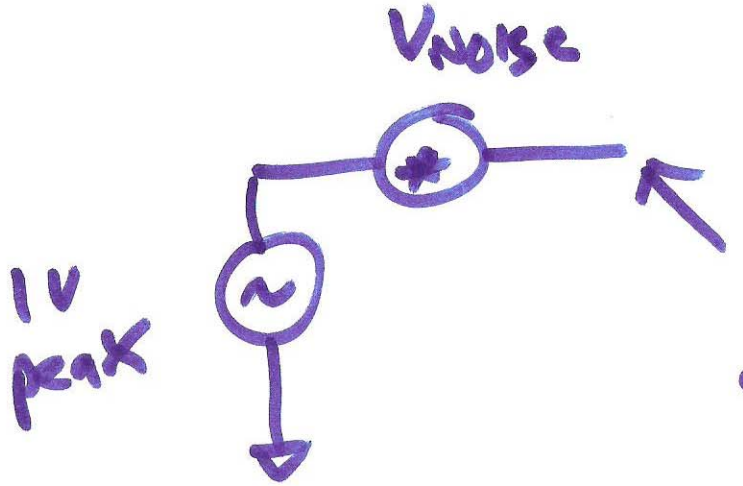
ECE 614 Advanced Analog IC Design

BOISE STATE UNIVERSITY

Lecture 13

OCT. 4, 2011



doesn't make sense

1V + INV rms noise

Signal

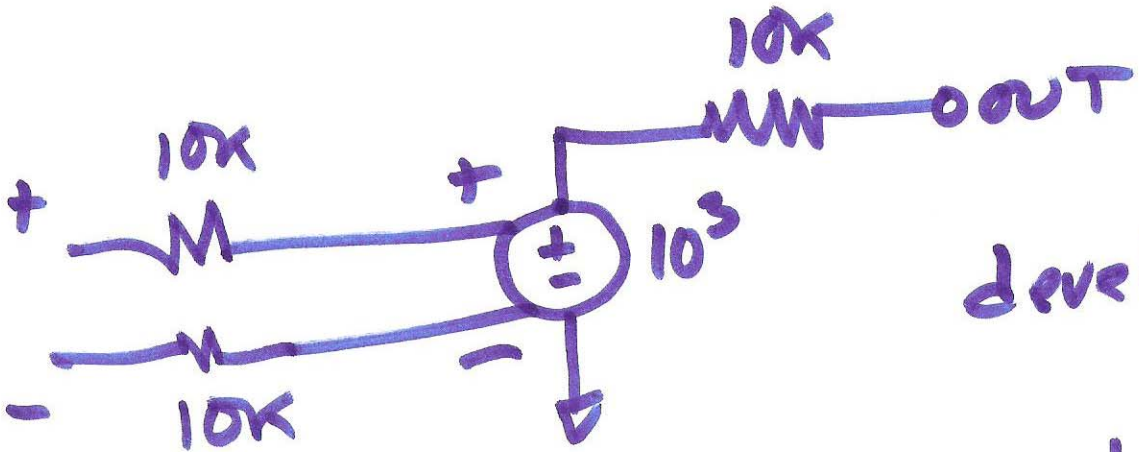
$= 1.000000001$

$SNR = \frac{1}{1N}$

$1 \sin 2\pi 100t + 2 \sin 2\pi 200t$

$= 3 \sin \ldots$

Op-Amp Noise model



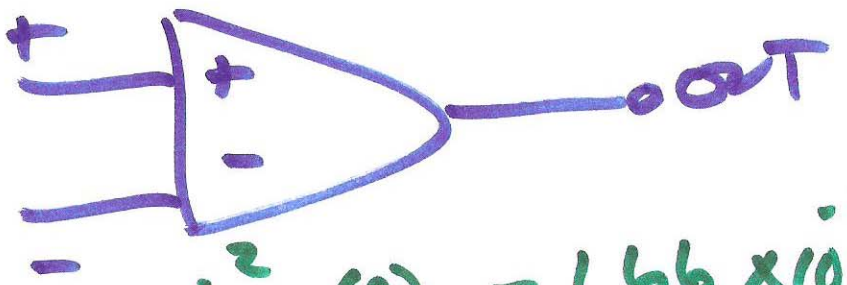
develope noise model

what are $i_{NOISE}(f)$

~~v_n~~ e_N & i_N

i_V = ?

Fig. 8.47

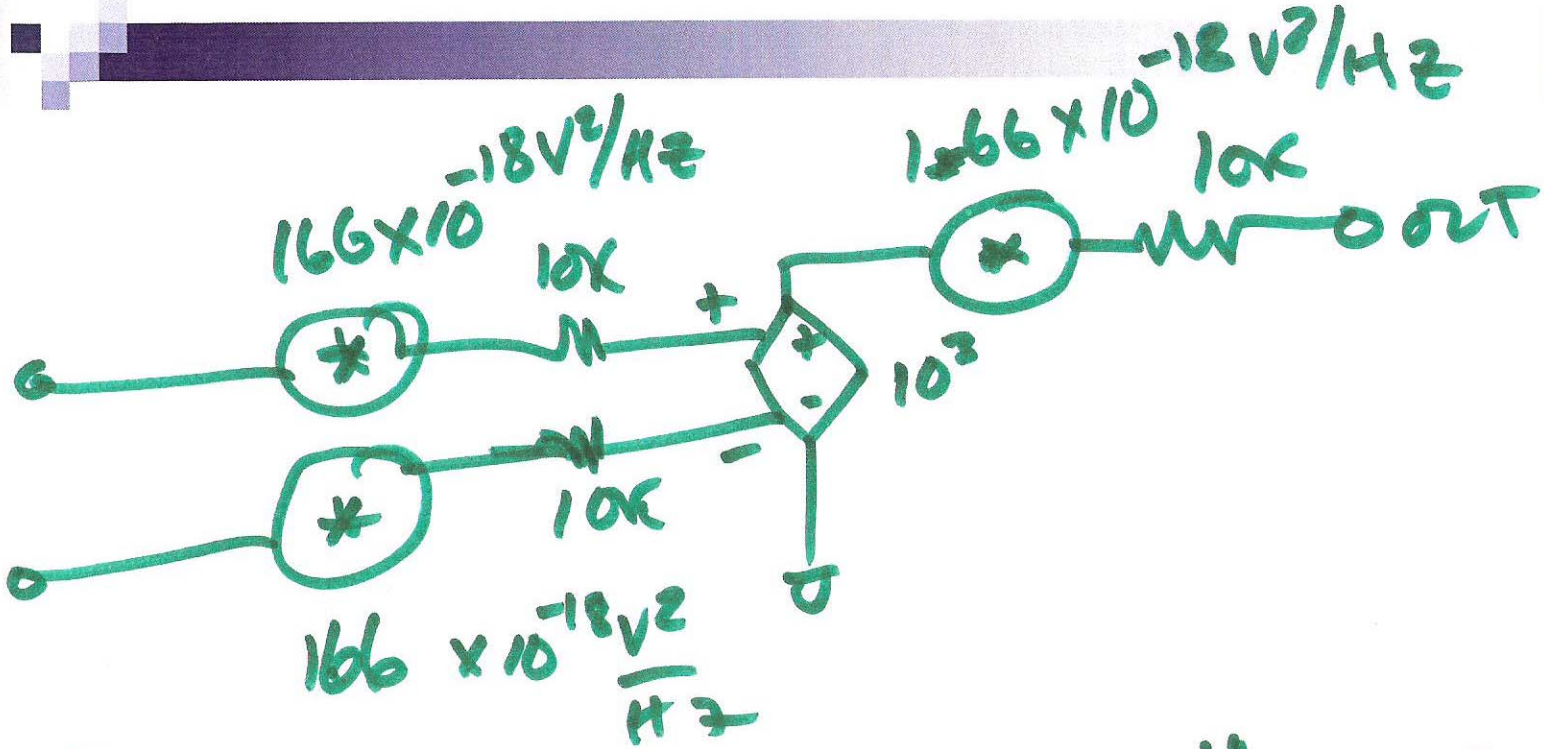


10^4 = 108

$i^2_{10K}(f) = 1.66 \times 10^{-24} \frac{A^2}{Hz}$

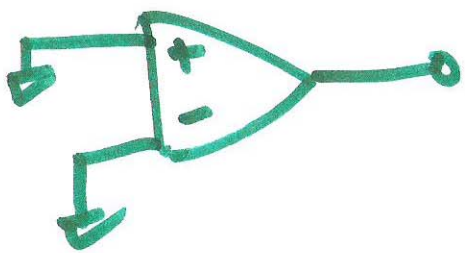
$v^2_{10K}(f) = 1.66 \times 10^{-16} \frac{V^2}{Hz}$

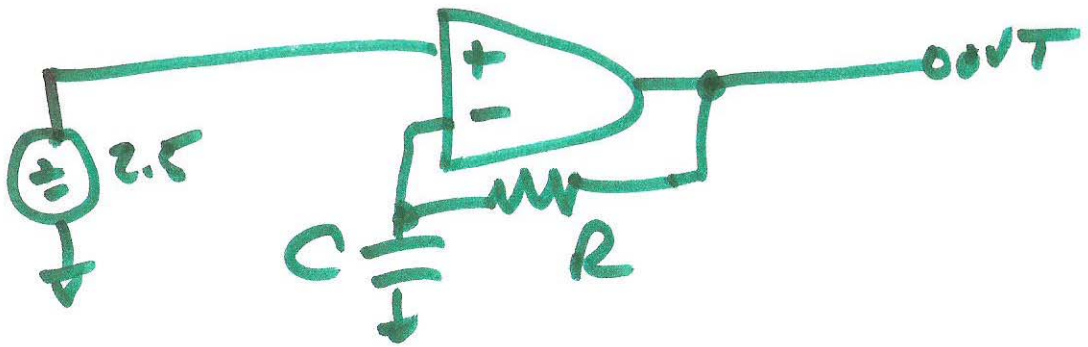
2)



$166\cdot10^{-18} + 166\times10^{-12}\cdot 2$

$= 332\times10^{-12}\frac{V^2}{Hz}$

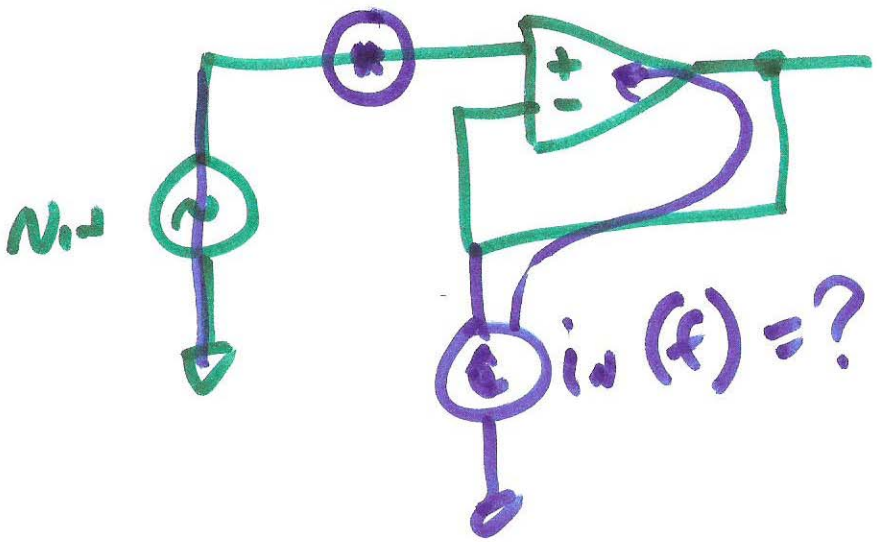




3)

input-referred noise

$e_N(f) = ?$

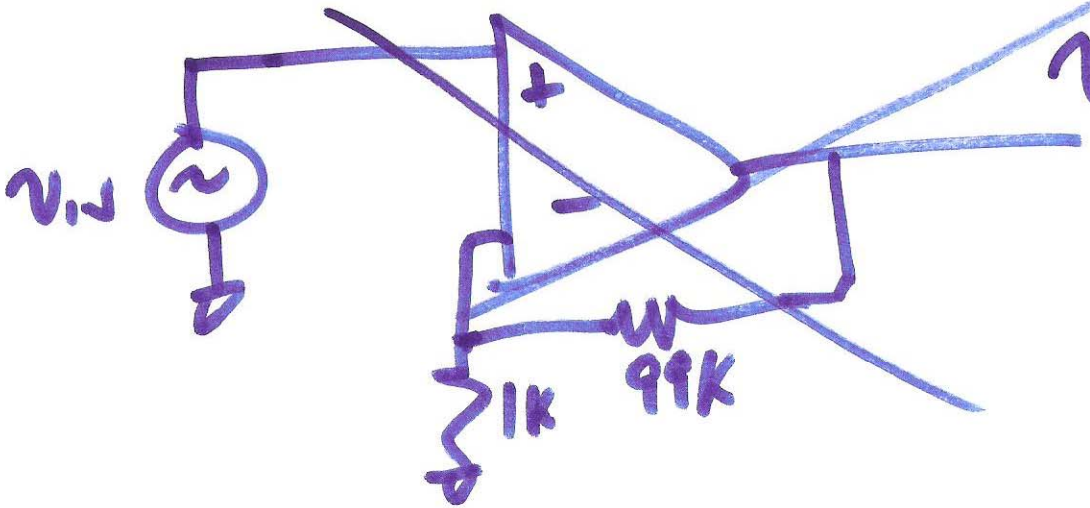


$V_{onoise}(f) = ?$

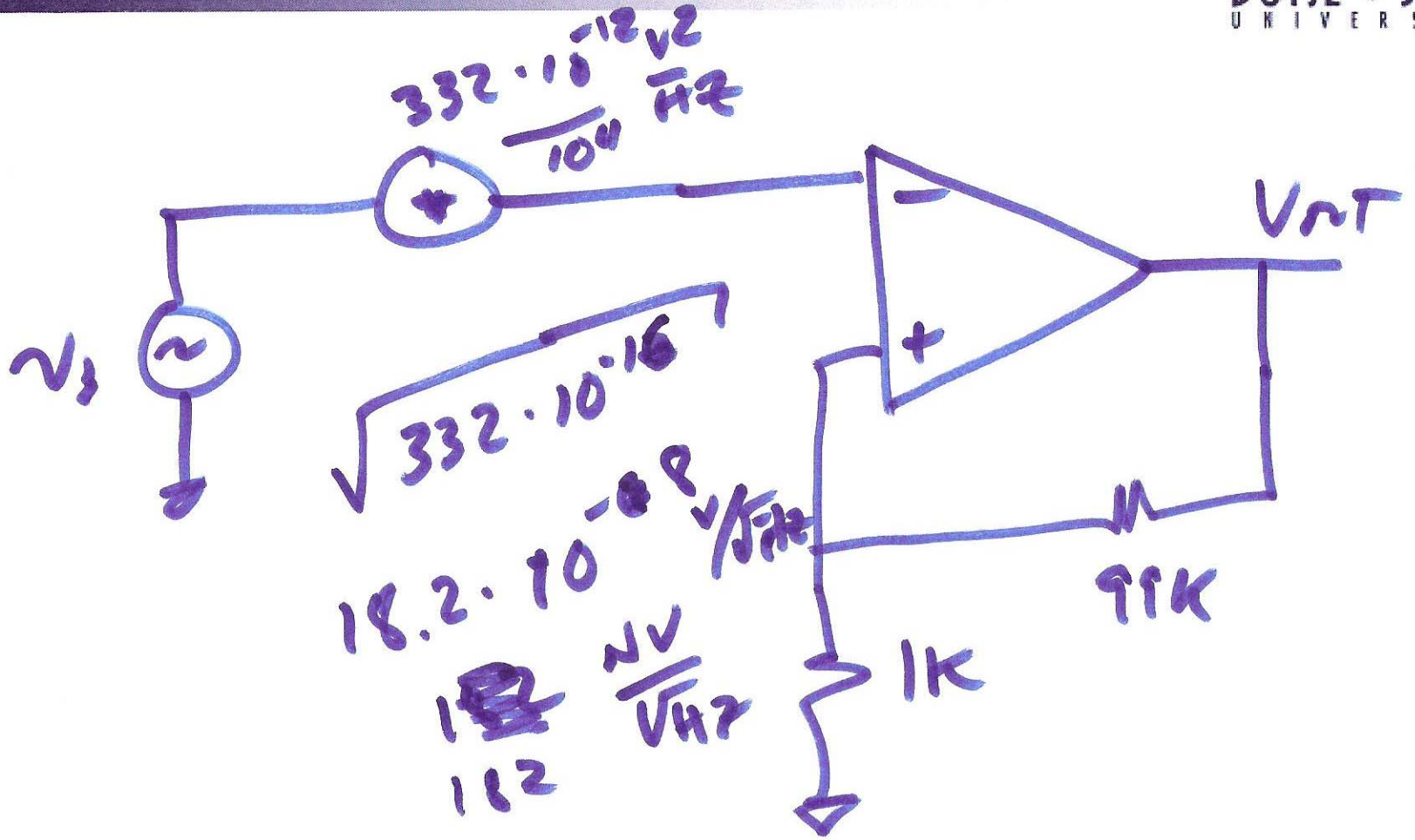
$= e_N(f) =$

$332 \cdot 10^{-12} \frac{V^2}{Hz}$

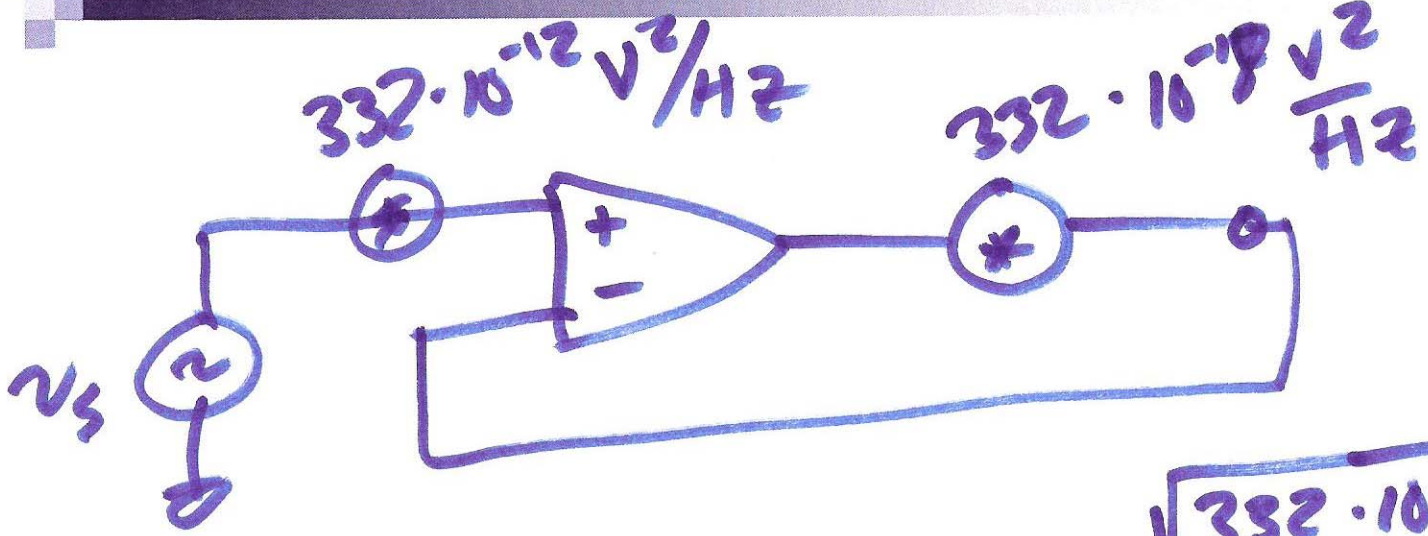
$e_N^2(f) = \frac{V_{onoise}^2(f)}{10^4}$



4)


$332 \cdot 10^{-12} V^2$
10 Hz
V_s
$\sqrt{332 \cdot 10^{-16}}$
$18.2 \cdot 10^{-9}$ V/$\sqrt{Hz}$
1 nV/$\sqrt{Hz}$
1Ω
V_{nT}
99K
1K

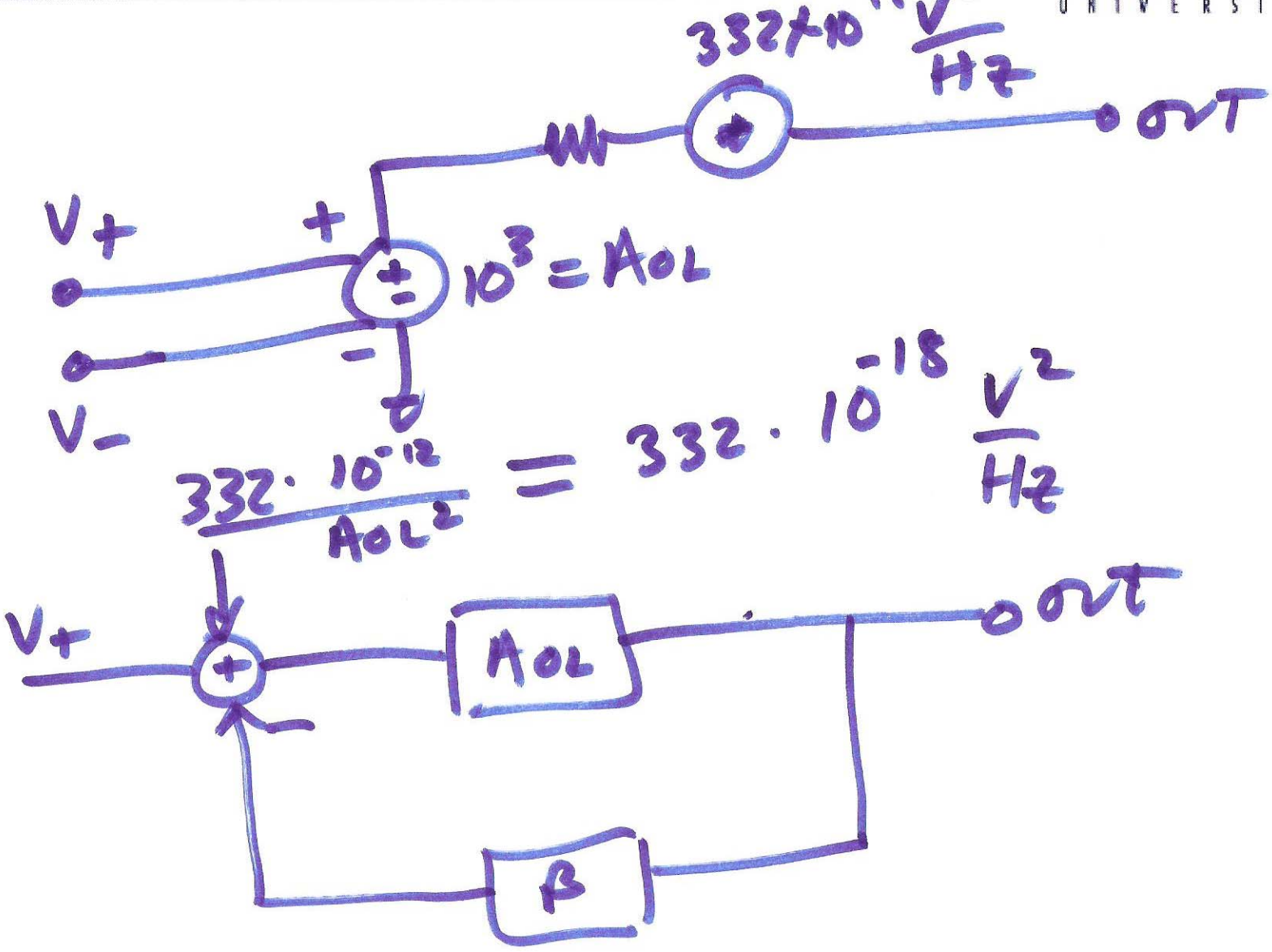
$V_{nT} =$



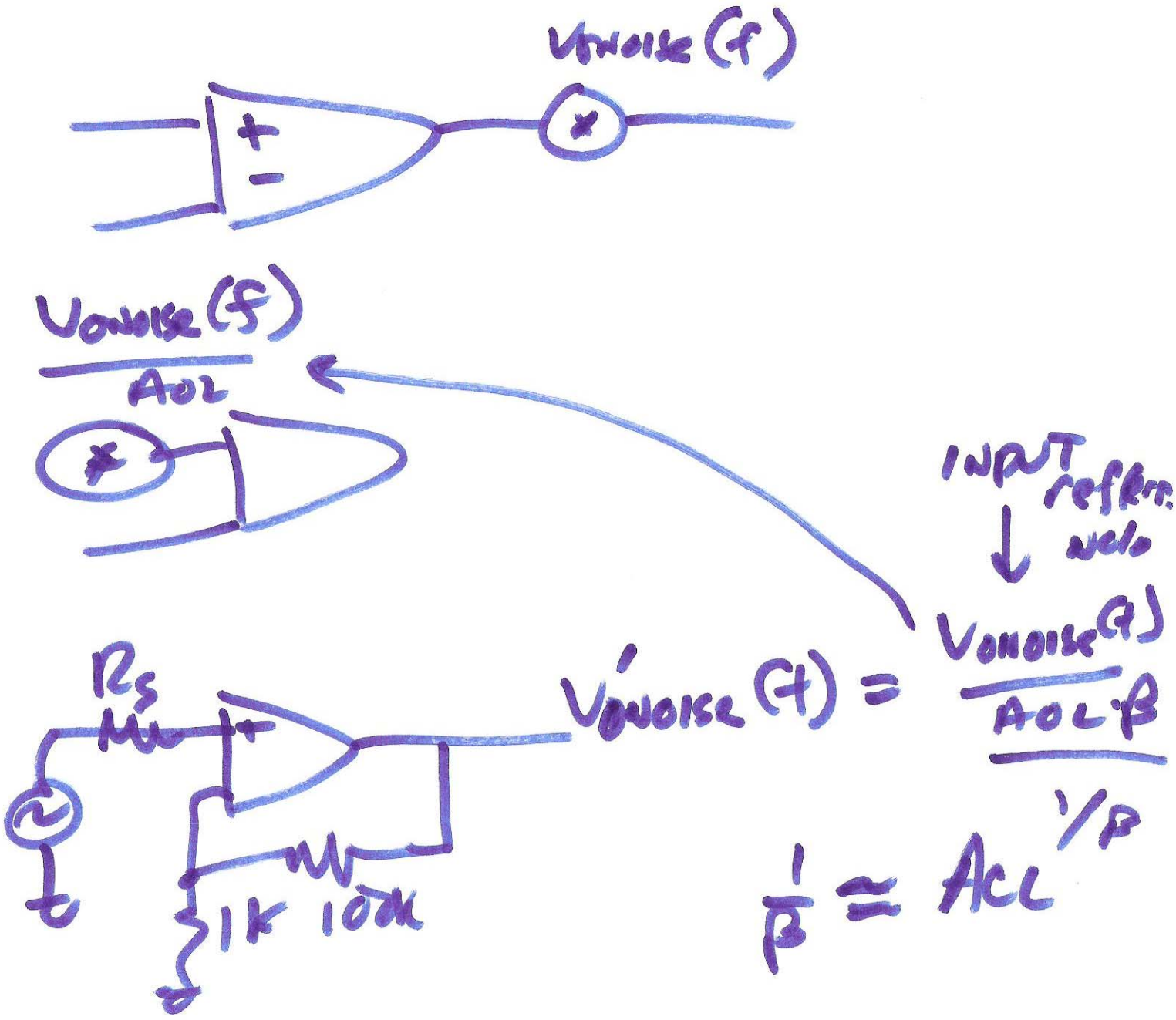
$$\sqrt{332 \cdot 10^{-12}}$$

$$18.2 \cdot 10^{-6}\ \frac{V}{\sqrt{Hz}}$$

6)


$332\times10^{-12}\ \frac{V^2}{Hz}$
OUT
V_+
V_-
$10^3 = A_{OL}$
$\frac{332\cdot10^{-12}}{A_{OL}^2} = 332\cdot10^{-18}\ \frac{V^2}{Hz}$
V_+
A_{OL}
OUT
B

7)


$V_{ONOISE}(f)$
+
−
$V_{ONOISE}(f)$
A_{OL}
INPUT referred
$V_{ONOISE}(f)$
$V'_{ONOISE}(f) = \frac{V_{ONOISE}(f)}{A_{OL}\cdot\beta}$
R_S
1K
10K
$\frac{1}{\beta} \cong A_{CL}$ 1/β

8)