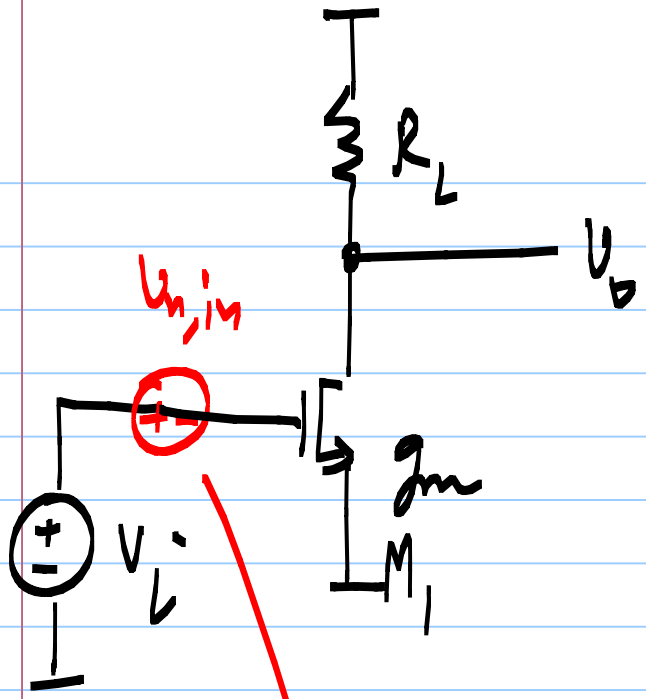
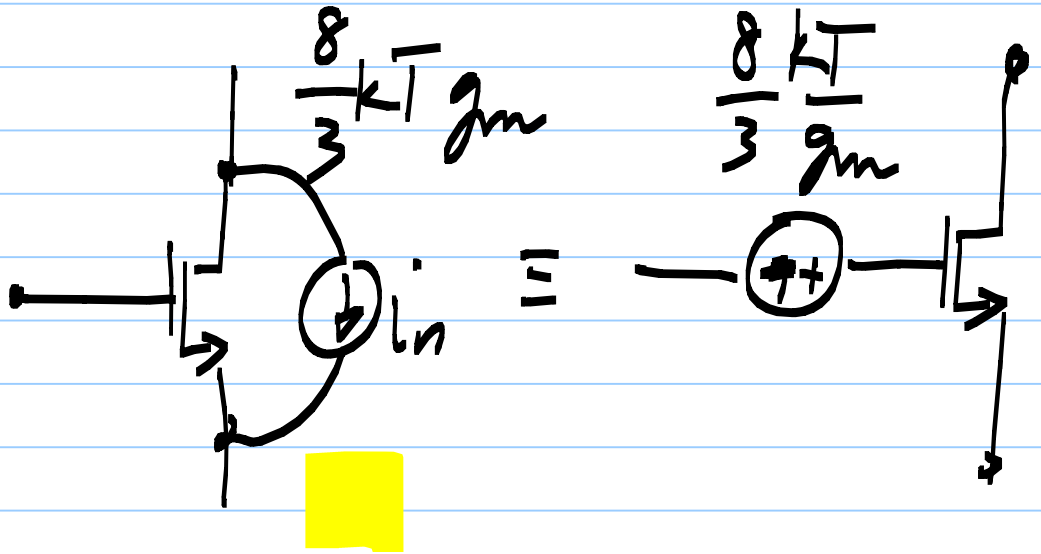


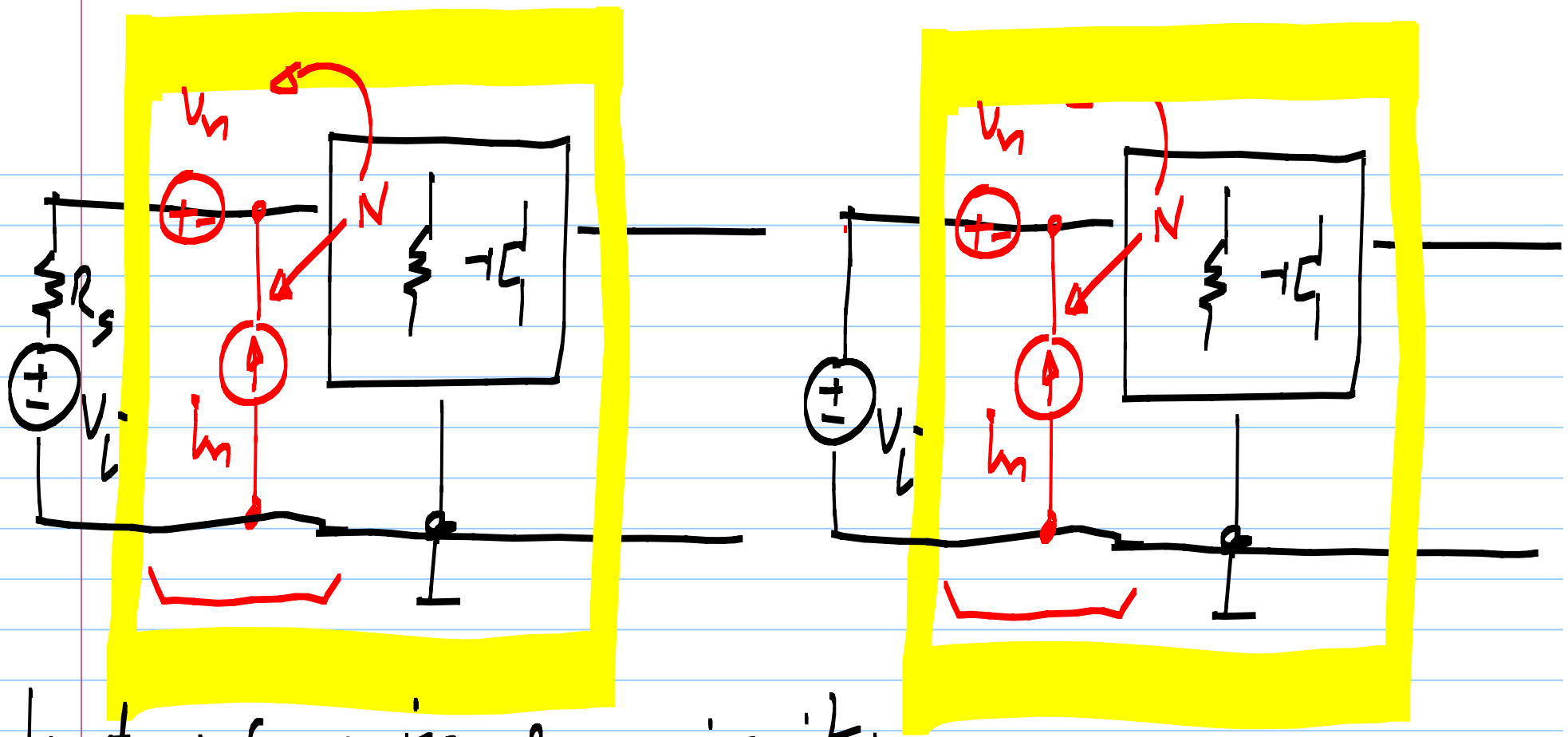
Input ref. noise

$$S_{v_o} = 4kTR_L\left[1+\frac{2}{3}\cdot g_m R_L\right]\frac{1}{(g_m R_L)^2}$$

$$S_{v_i} = \frac{8}{3}\frac{kT}{g_m} + \frac{4kTR_L}{(g_m R_L)^2}$$

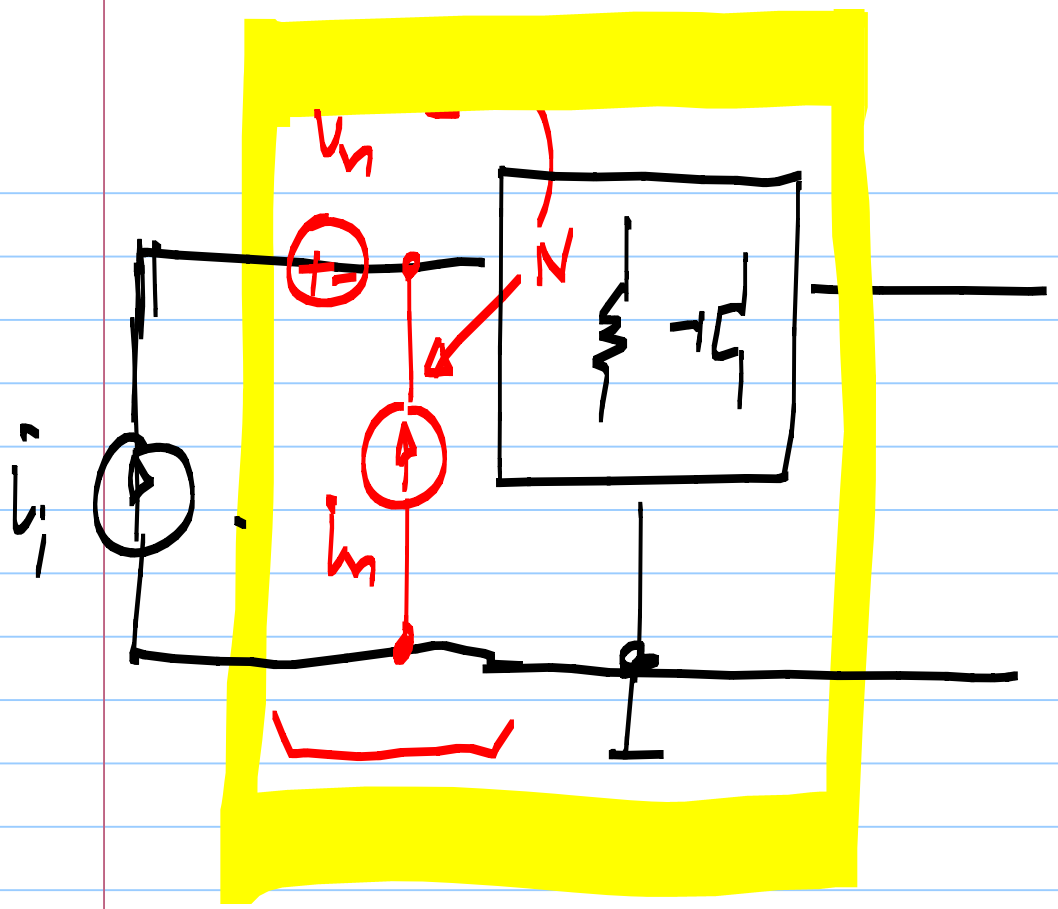
M_1



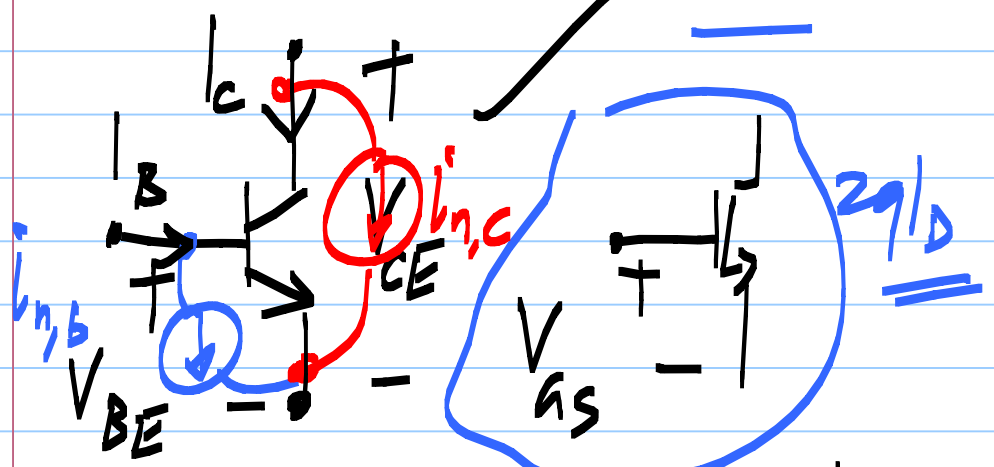


Input ref. noise of a circuit:

* Voltage source v_n & current source i_n which are correlated.


v_n
N
i_1
i_n

BJT



$S_{i_{n,b}} = 2qI_B$

shot noise

white

$S_{i_{n,c}} = 2qI_C$

electron charge

$|V_{GS} - V_t| < 6 \cdot V_t$

Active region:

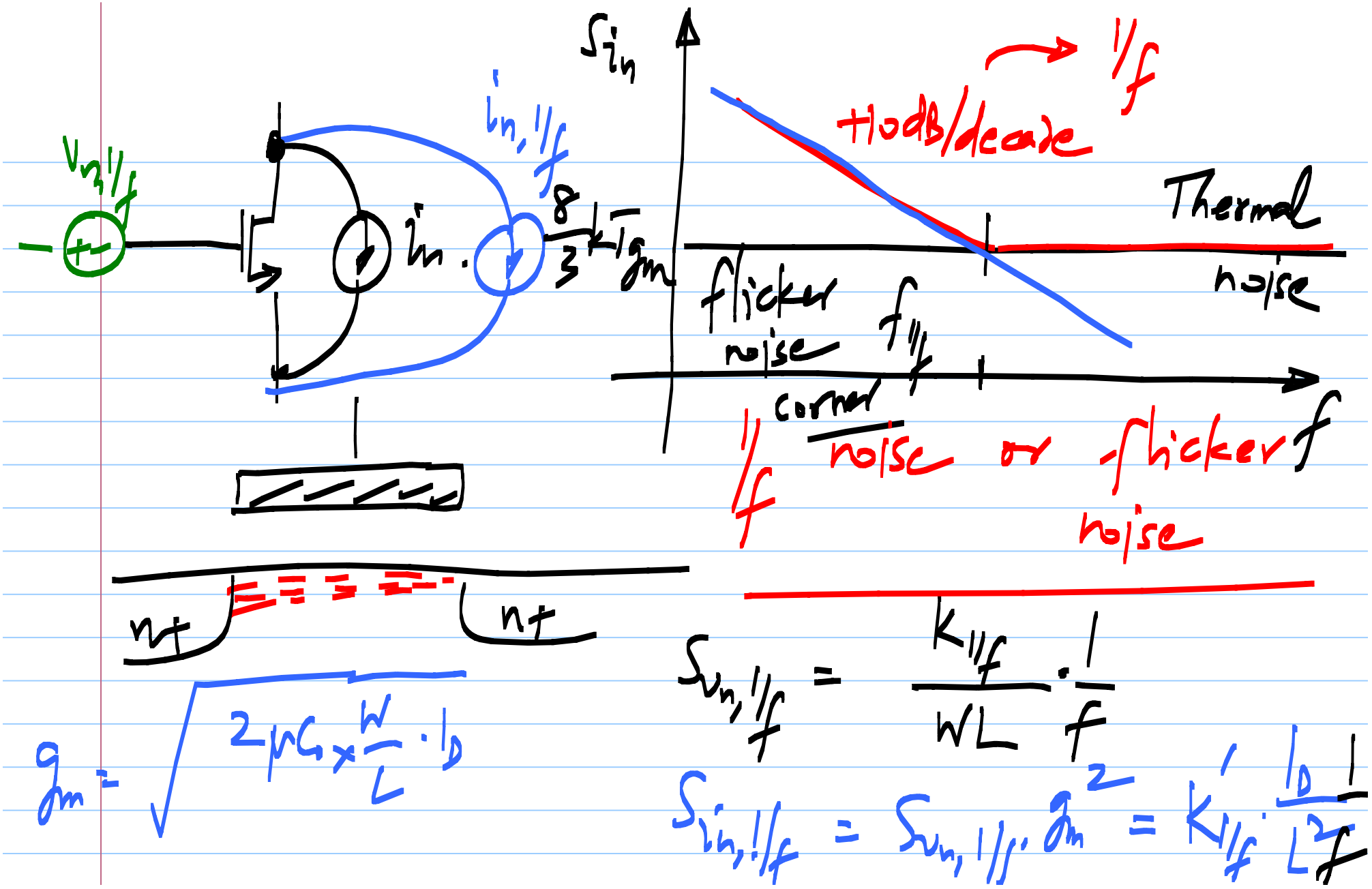
$V_{CE} > V_{CE,SAT}$

$(0.7\ V)$

$I_C = \beta I_B = I_S\left[\exp\left(\frac{V_{BE}}{V_t}\right) - 1\right]$

$g_m = \frac{qI_C}{kT}$

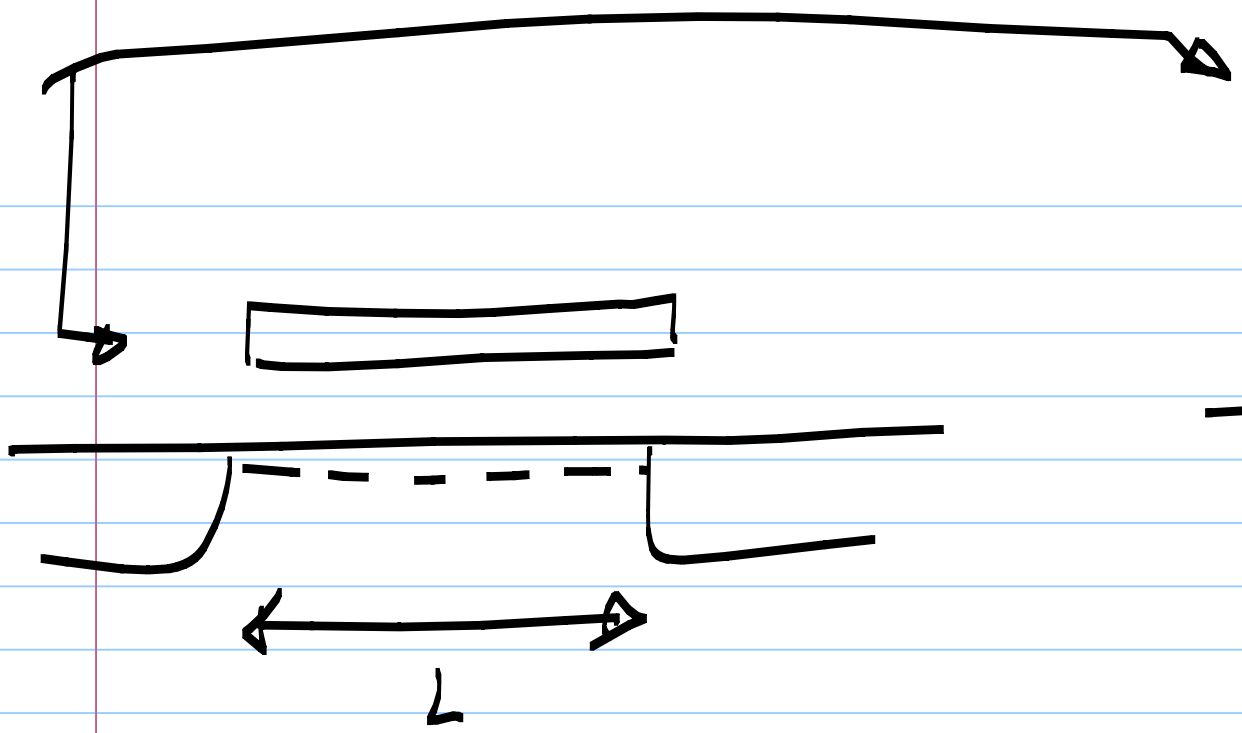
$2kT\,g_m$

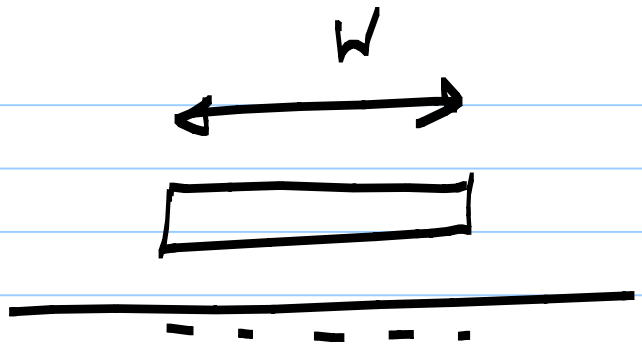


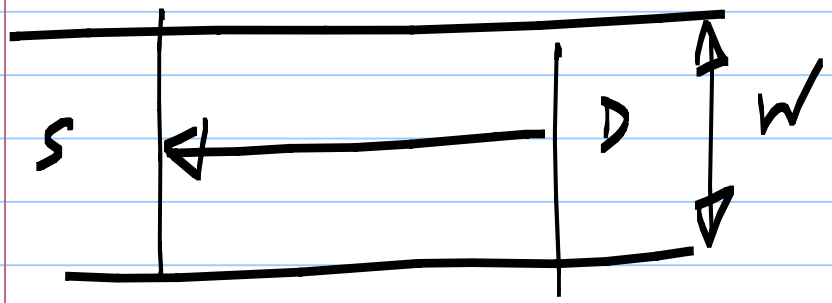
$$g_m = \sqrt{2\mu C_{ox}\frac{W}{L}\cdot I_D}$$

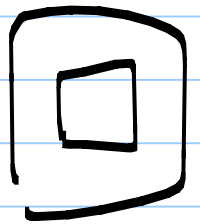
$$S_{v_n,1/f} = \frac{K_{1/f}}{WL}\cdot\frac{1}{f}$$

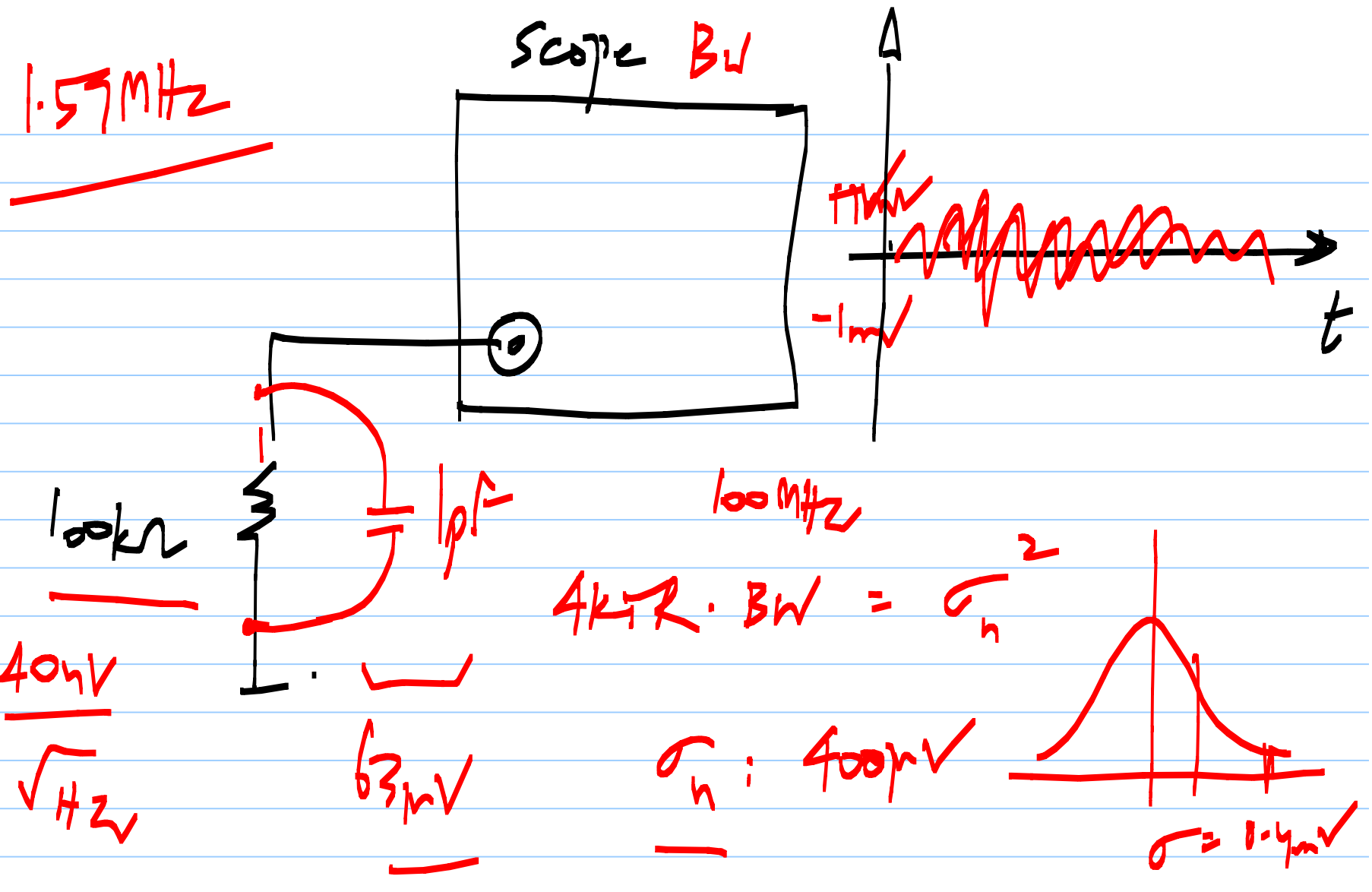
$$S_{i_n,1/f} = S_{v_n,1/f}\cdot g_m^2 = K'_{1/f}\cdot\frac{I_D}{L^2}\cdot\frac{1}{f}$$


L


W


S
D
W




1.57MHz
Scope BW
+1mV
-1mV
t
100kΩ
1pF
100MHz
40nV
√Hz
63μV
4kTR · BW = σn²
σn : 400μV
σ = 0.4μV