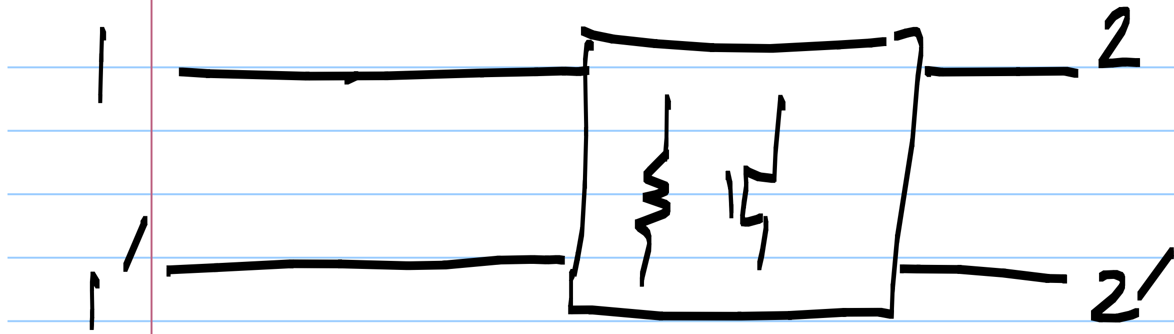
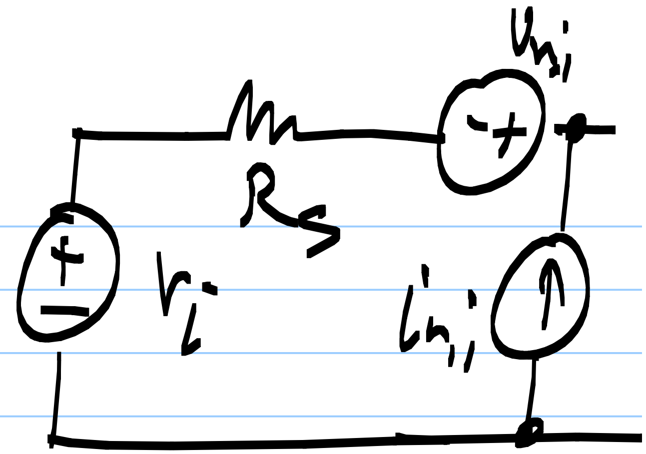
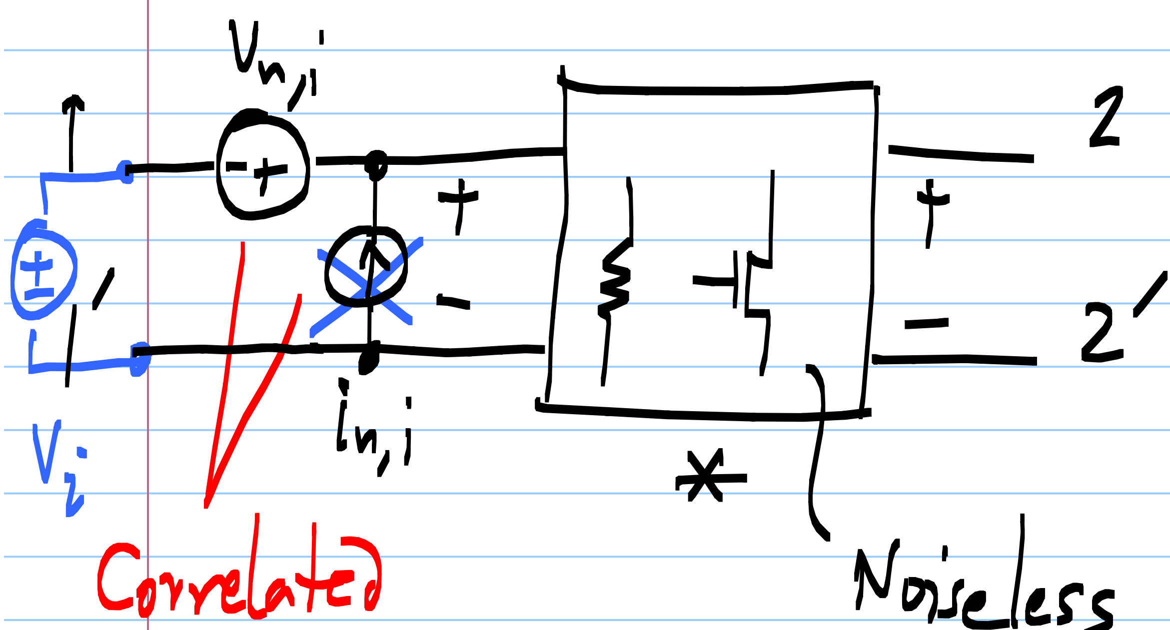
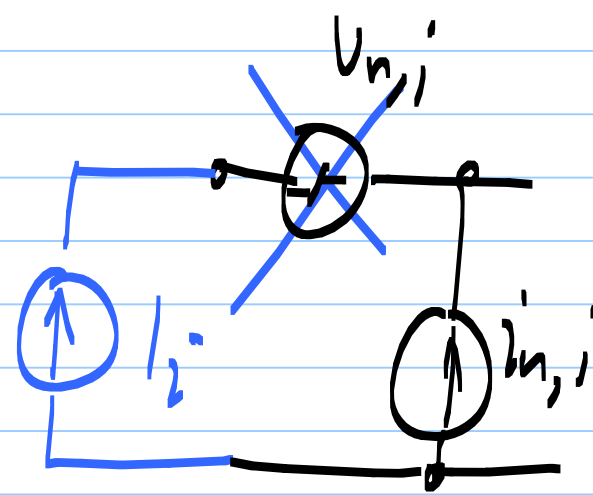
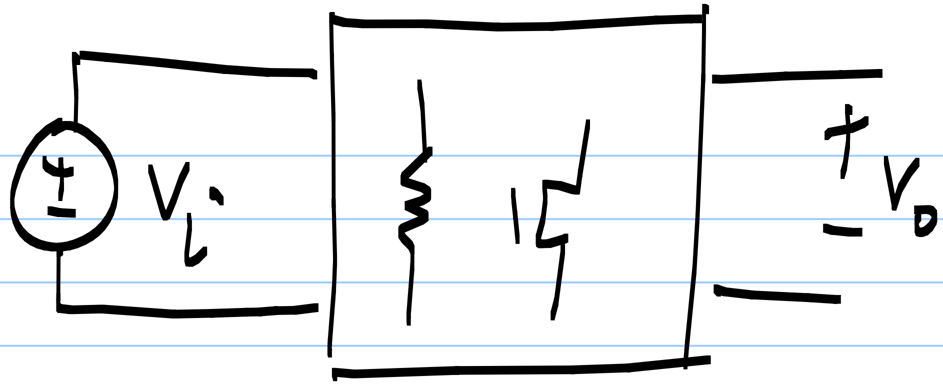

1
1'
2
2'


v n,i
R S
v i
i n,i

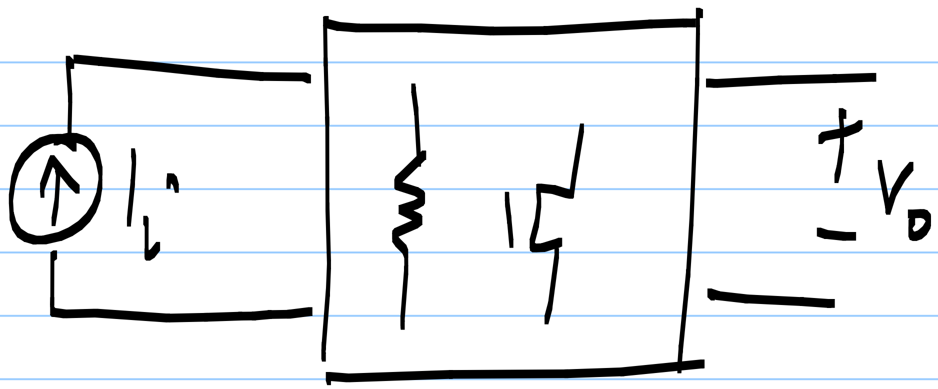
=


V n,i
i n,i
V i
1'
2
2'
Correlated
Noiseless

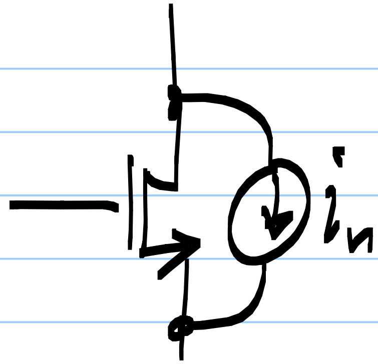

V n,i
I i
i n,i

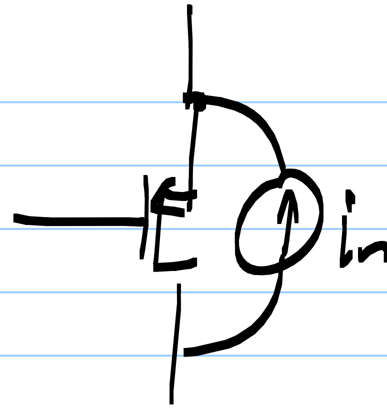


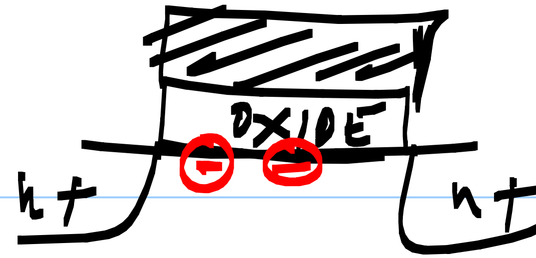
$v_{n,i}$: value of v_i which gives the same output noise as the noisy circuit



$v_{n,i}$ & $i_{n,i}$: Correlated

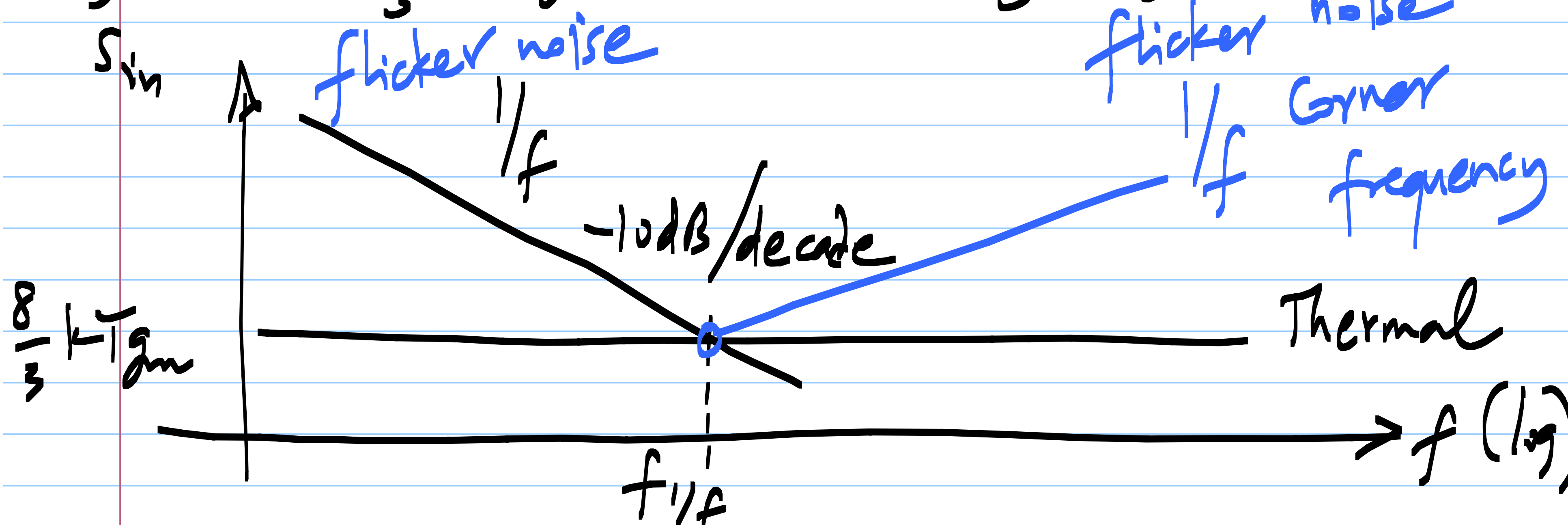






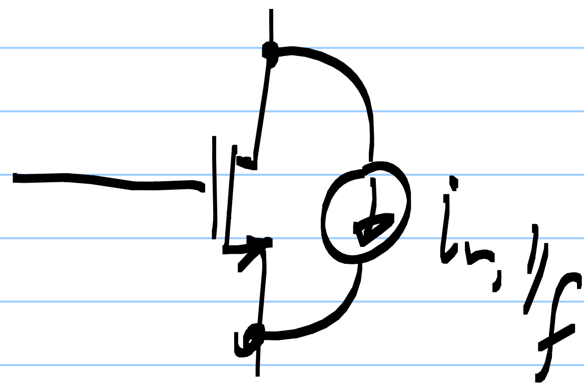
(log) $S_{in} = \frac{8}{3} kT g_m$

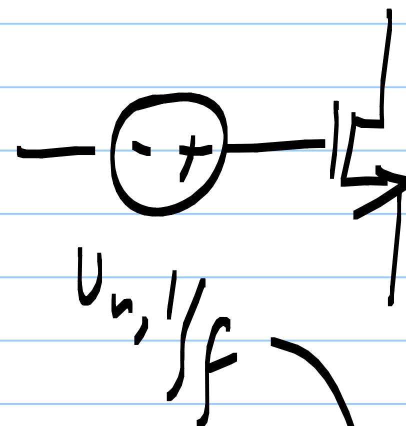
$S_{in} = \frac{8}{3} kT g_m$



Flicker noise spectral density.

(Saturation region)





$$g_m \cdot v_{n,1/f} = i_{n,1/f}$$

Spectral density

$$S_{i_{n,1/f}} = g_m^2 \cdot S_{v_{n,1/f}} \qquad S_{v_{n,1/f}} = \frac{K}{WL} \cdot \frac{1}{f}$$

Bias point: V_{GS} ; I_D

$$g_m = \frac{2 I_D}{V_{GS} - V_T}$$

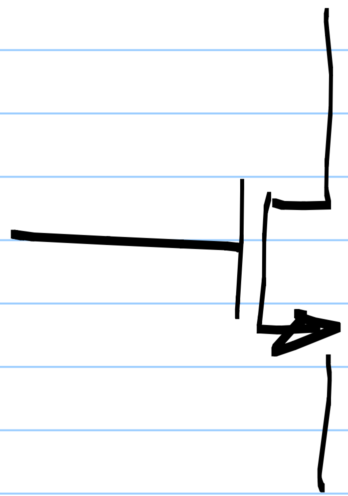
$$g_m^2 = 2\mu C_{ox} \frac{W}{L} \cdot I_D$$

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

$$= \mu C_{ox} \frac{W}{L} (V_{GS} - V_T)$$

$$= \underbrace{\frac{K'}{L^2} \cdot \frac{I_D}{f}}$$

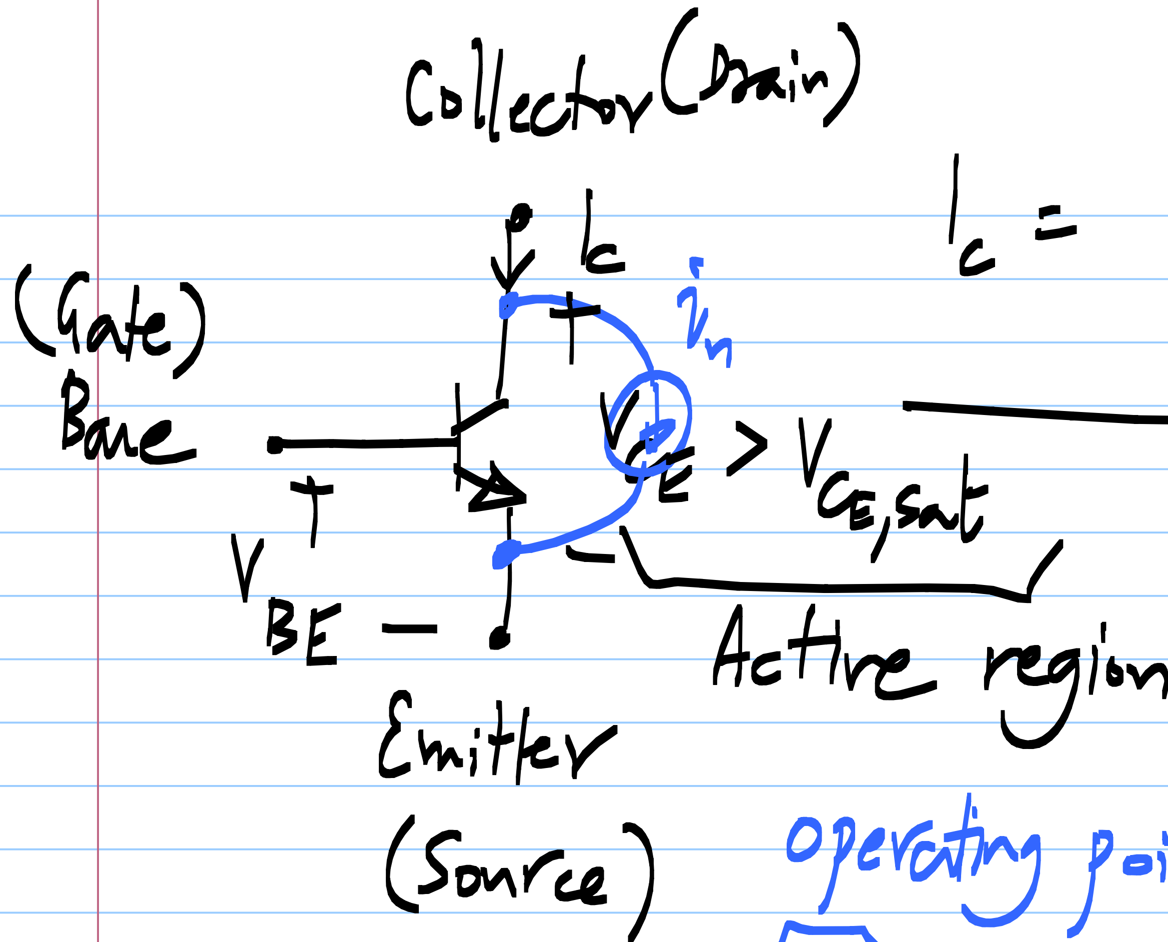
$$S_{in, 1/f} = 2\mu C_{ox} \frac{W}{L} \cdot I_D \cdot \frac{K}{WL} \cdot \frac{1}{f} .$$



$+$

$\geq (V_{GS} - V_T)$

$-$



$$I_c = I_s \exp\left(\frac{V_{BE}}{V_t}\right)$$

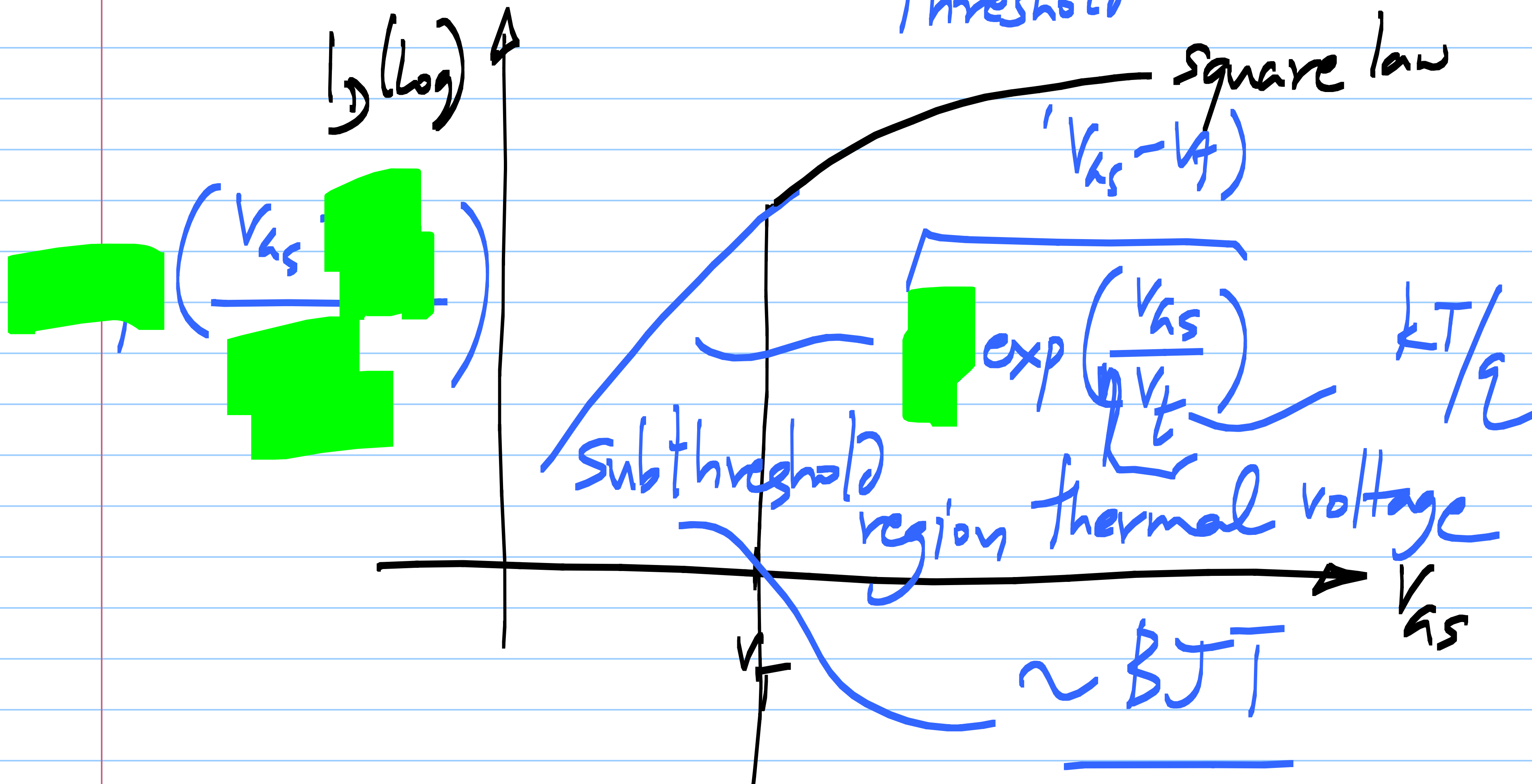
$$g_m = \frac{I_c}{V_t} = \frac{q \cdot I_c}{kT}$$

operating point current

$$S_{i_n} = 2qI_c = 2kT\,g_m$$

$$I_D = \frac{\mu C_{ox}}{2} \frac{W}{L} \left(V_{GS} - V_T \right)^2$$

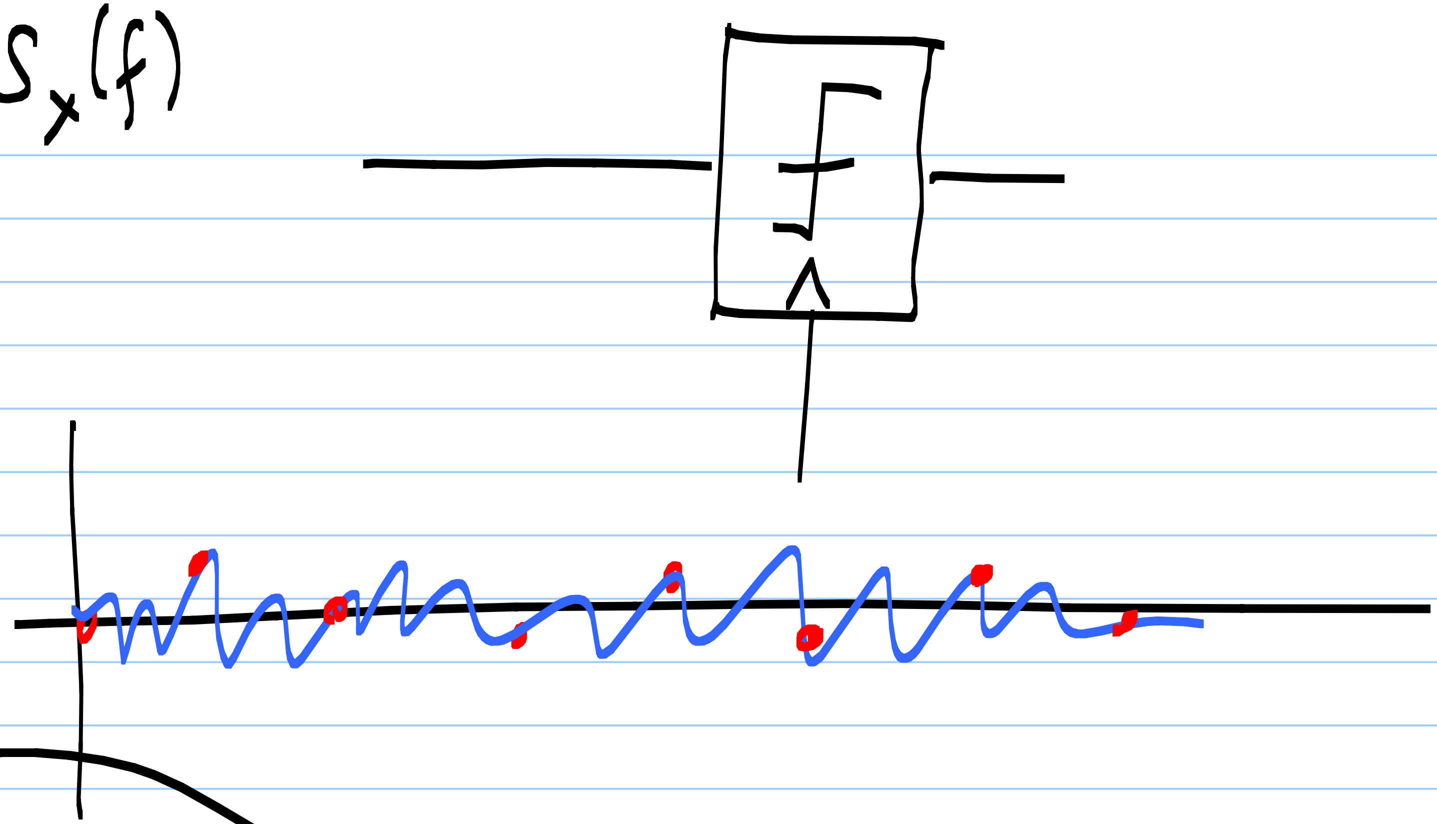
Threshold



$S_x(f)$

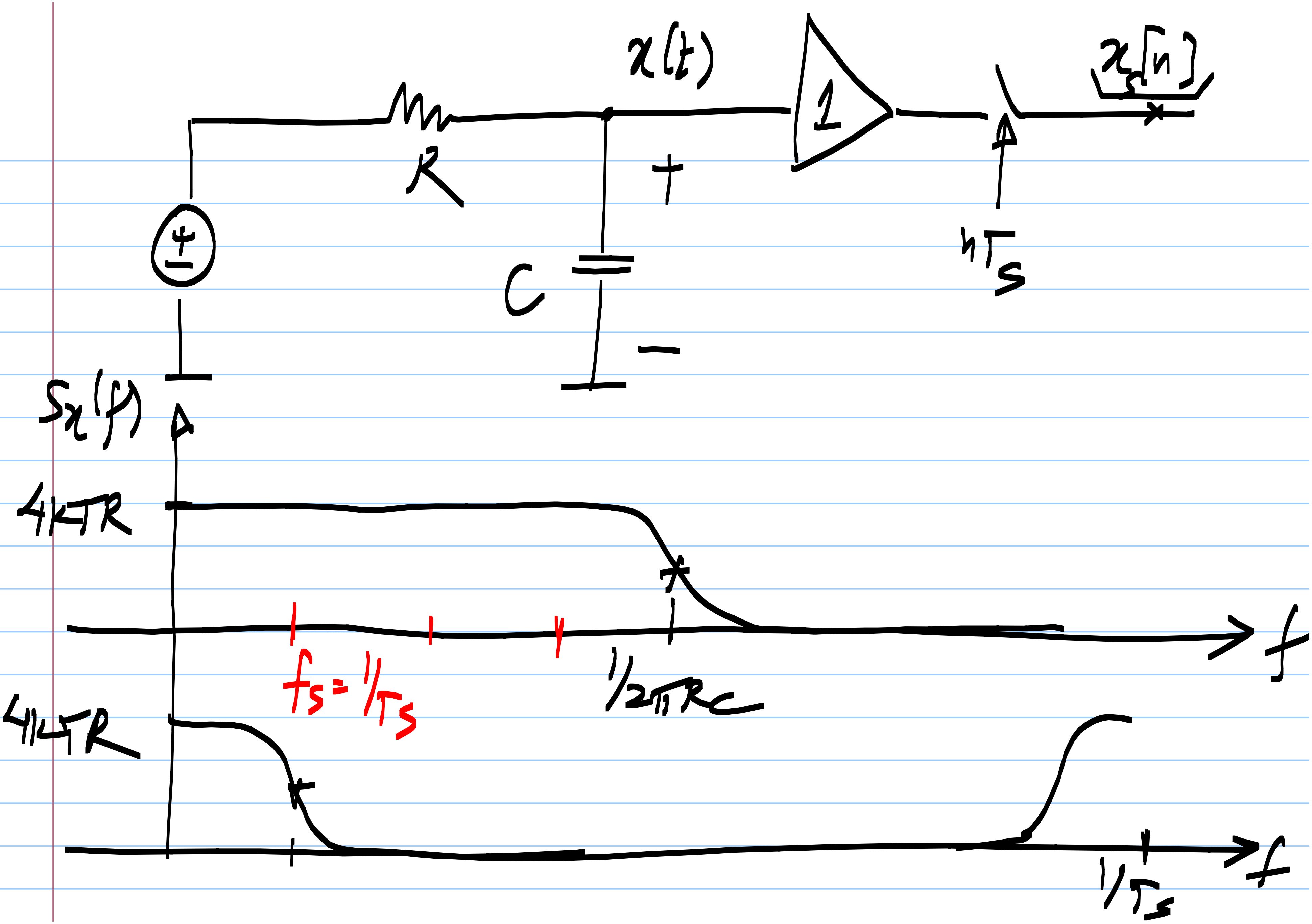
σ_x^2

$x(t)$



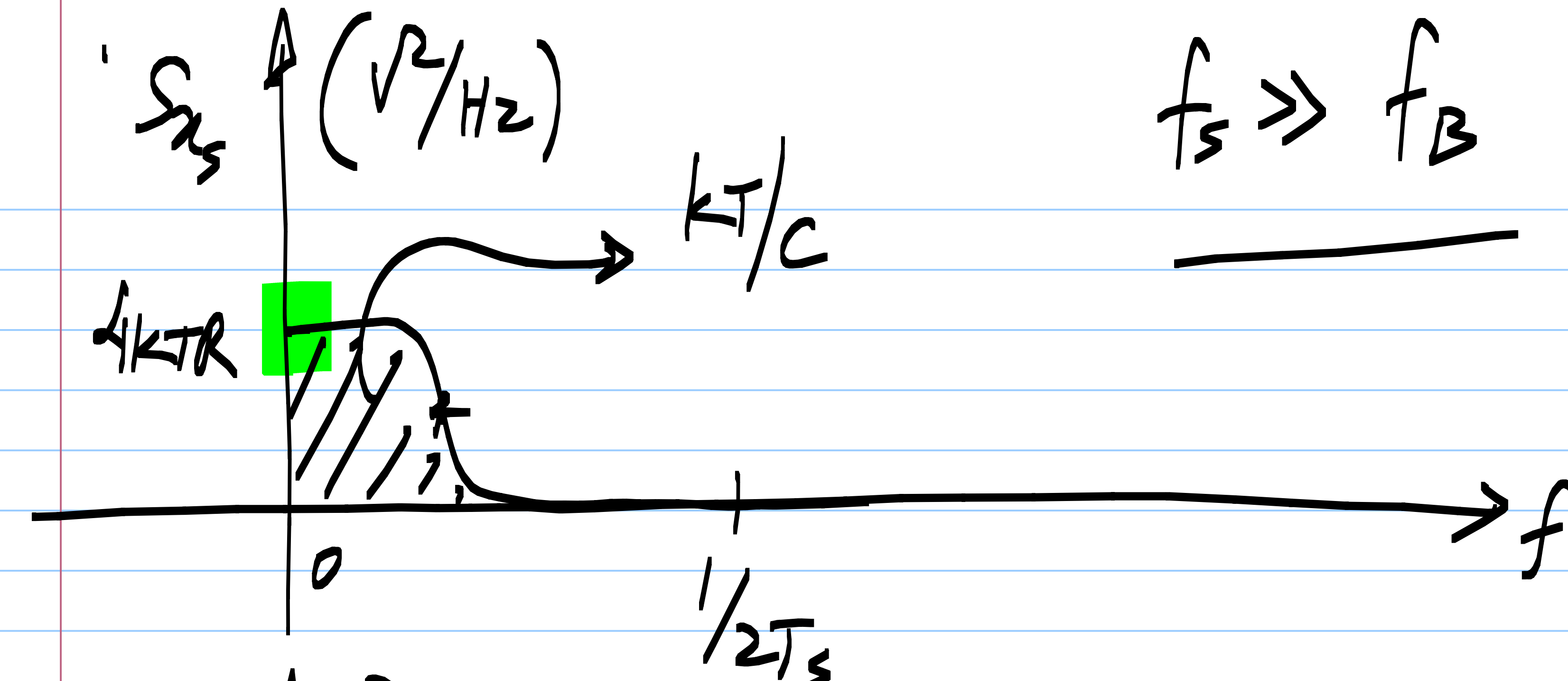
$x_s[n] = x(nT_s)$?

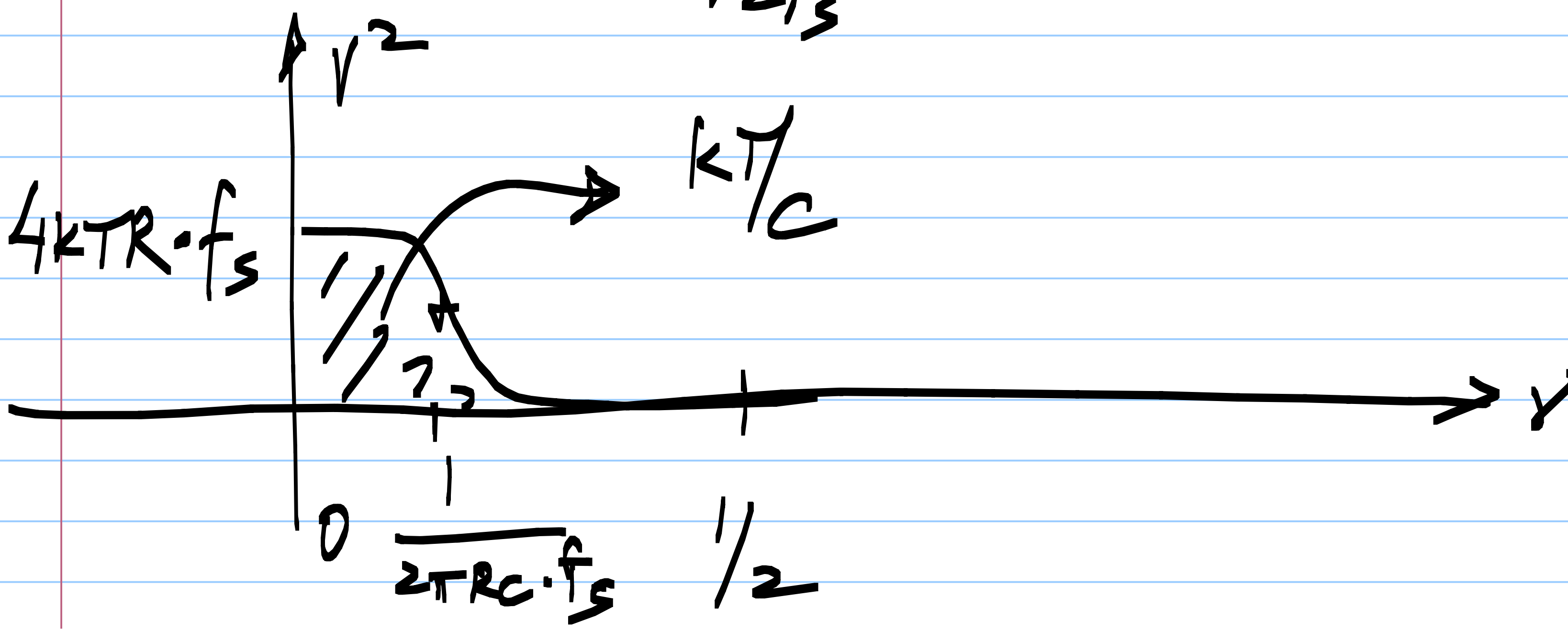
σ_x^2



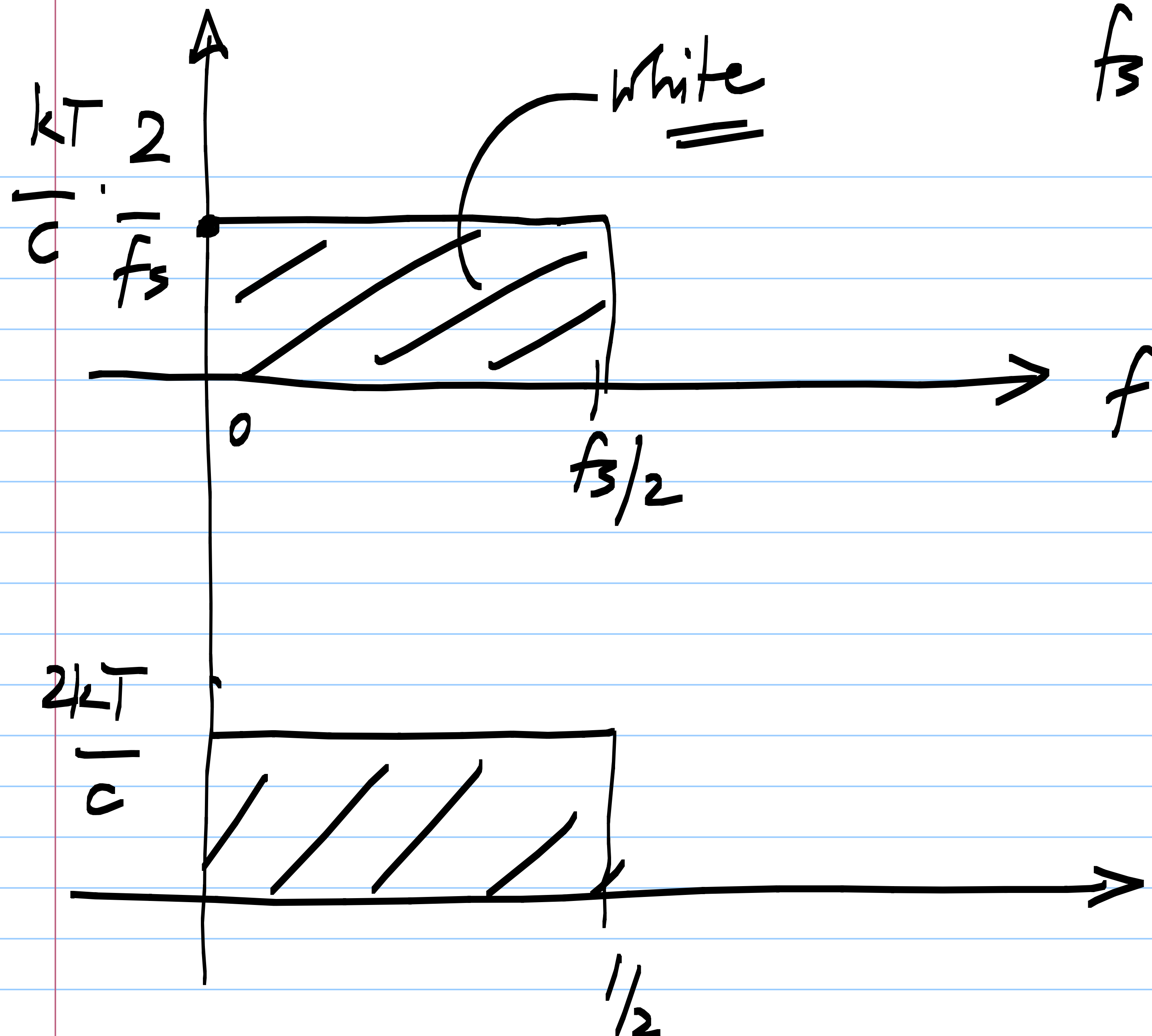
R
x(t)
1
x_s[n]
+
C
−
nT_s
S_x(f)
4kTR
f_s = 1/T_s
1/2πRC
f
4kTR
1/T_s
f

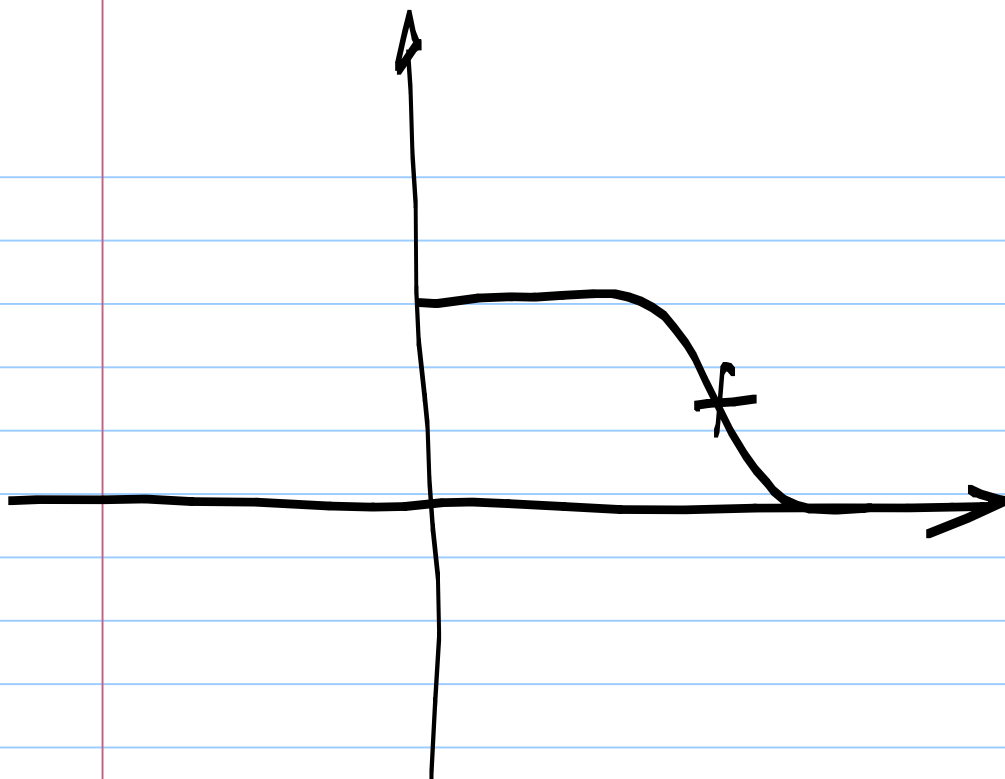
$f_s \gg f_B$





$f_s \ll f_B$





$$\frac{4kTR}{1+(2\pi fRC)^2}$$