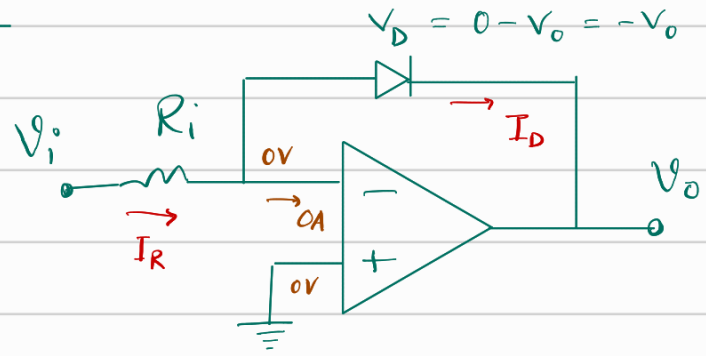
Logarithmic Amplifier :-



$$I_R = I_D$$

$$\Rightarrow \frac{V_i - 0}{R_i} = I_s e^{\left(\frac{V_D}{nV_T}\right)}$$

$$\Rightarrow \frac{V_i}{R_i} = I_s e^{\left(-V_o/nV_T\right)}$$

$$\Rightarrow e^{\left(-V_o/nV_T\right)} = \frac{V_i}{I_s R_i}$$

$$\Rightarrow -\frac{V_o}{nV_T} = \ln\left(\frac{V_i}{I_s R_i}\right)$$

$$\Rightarrow V_o = -nV_T \ln\left(\frac{V_i}{I_s R_i}\right)$$

$-\ln(2)$

$I_d = I_s e^{\frac{V_D}{nV_T}}$

$V_T = \frac{kT}{q}$

$I_s = ?$ # Input $V_i = 1V$:

$$V_o = -nV_T \ln\left(\frac{1}{I_s R_i}\right)$$

$V_o = 0 \rightarrow R_i = 2.53 M\Omega$

$I_s = (2.53 \times 10^6)^{-1}$

$= 3.95 \times 10^{-7} A$

$R_i = 2.53 M\Omega$, $V_i = 2V$

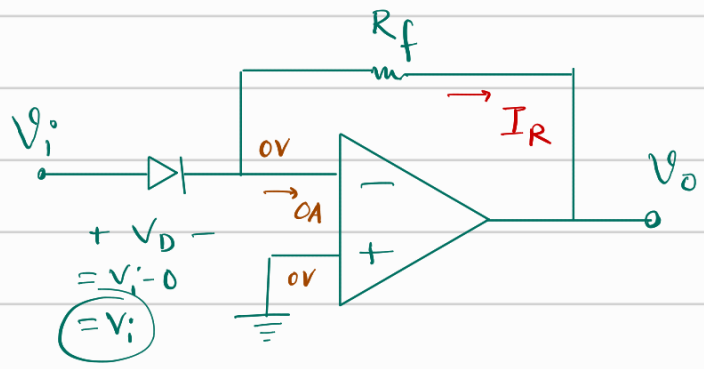
$-\ln(2)$

$+ \{\ln(2) + \ln(3)\}$

$-\ln(3)$

$\ln(2.3) = \ln(6)$.

Exponential / Anti-logarithmic Amplifier :-



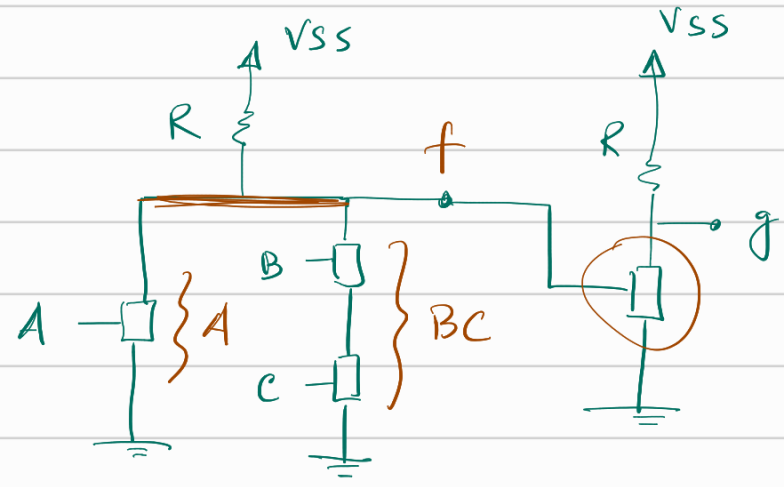
$$I_D = I_R$$

$$\Rightarrow I_s e^{\left(\frac{V_i}{nV_T}\right)} = \frac{0 - V_o}{R_f}$$

$$\Rightarrow V_o = -I_s R_f e^{\left(\frac{V_i}{nV_T}\right)}$$

MOSFET (Switches as logics) :-

$f = \overline{A + B \cdot C}$



$\overline{A + B \cdot C}$

$g = \overline{\overline{A + B \cdot C}} = \overline{f}$

$f = \overline{A + BC}$ $\quad g = \overline{f} = A + BC$

HW

$f = \overline{A\bar{B}}$ # $f = (A+B)C$

$f = (AB+BC)\overline{AD}$