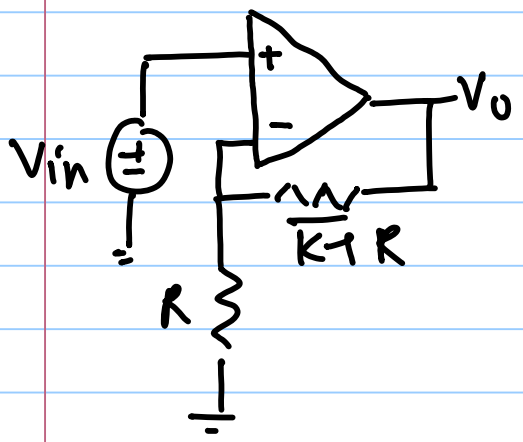
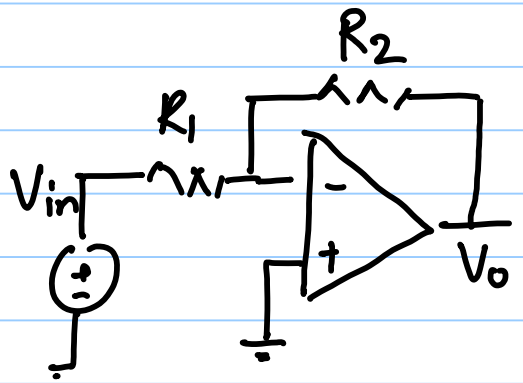
Lecture #7

Note Title 01-02-2022

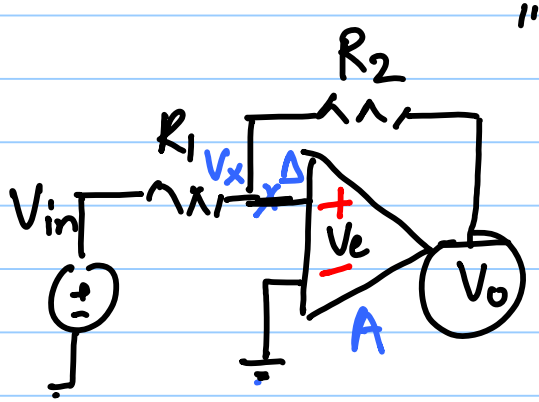


$$\frac{V_o}{V_{in}} = K$$



$$\frac{V_o}{V_{in}} = -\frac{R_2}{R_1}$$

"Positive feedback"

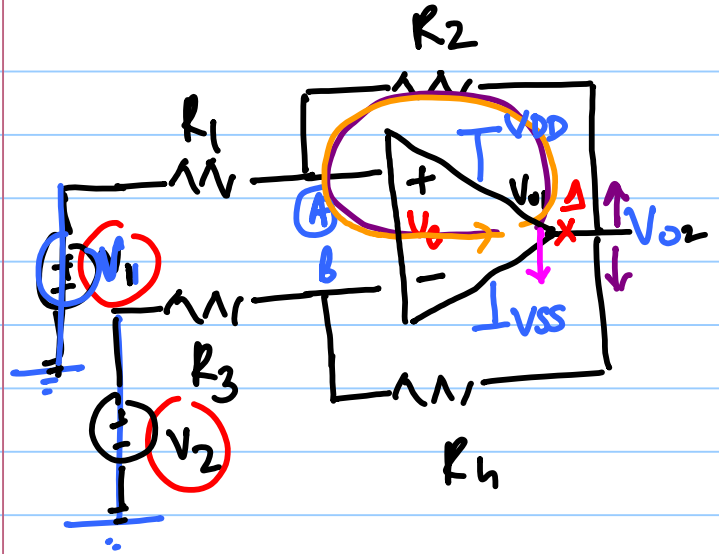


$$\frac{V_o}{V_{in}} =$$

$$\frac{V_o}{V_e} = \frac{G_m}{sC}$$

$V_e = \Delta \xrightarrow{V_o} A\Delta$

$$V_x = \frac{R_1}{R_1+R_2} \cdot A\Delta$$



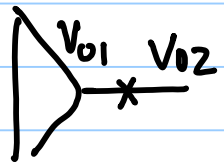
$V_o = f(V_1, V_2)$

Whether it is in negative or positive feedback?

$V_e = V_A - V_B$

Apply $+\Delta$ at V_{O2}

$$V_e = \left(\frac{R_1}{R_1+R_2} - \frac{R_3}{R_3+R_h}\right)\Delta$$

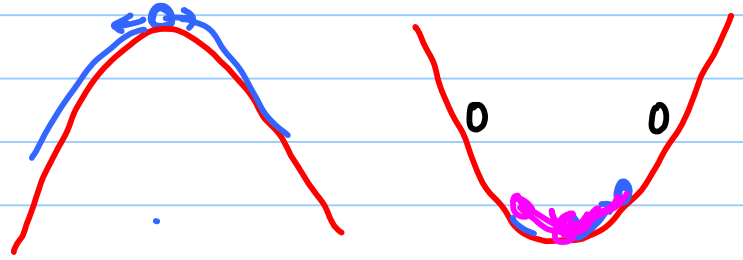


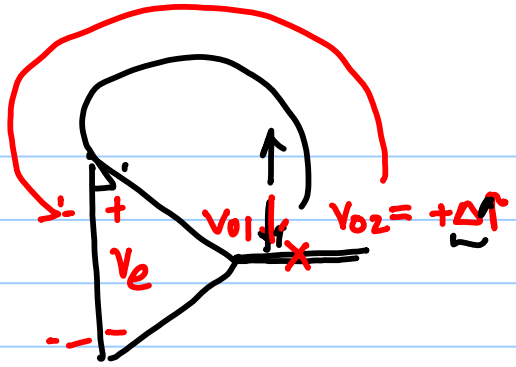
if $V_e > 0 \rightarrow V_{o1}$ +ve

if $V_e < 0 \rightarrow V_{o1}$ -ve

} +ve feedback, -ve feedback

if it is negative feedback. then $V_A = V_B$ ✓

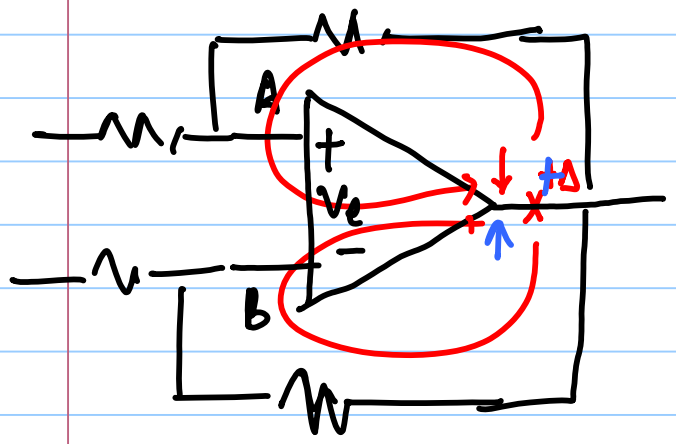


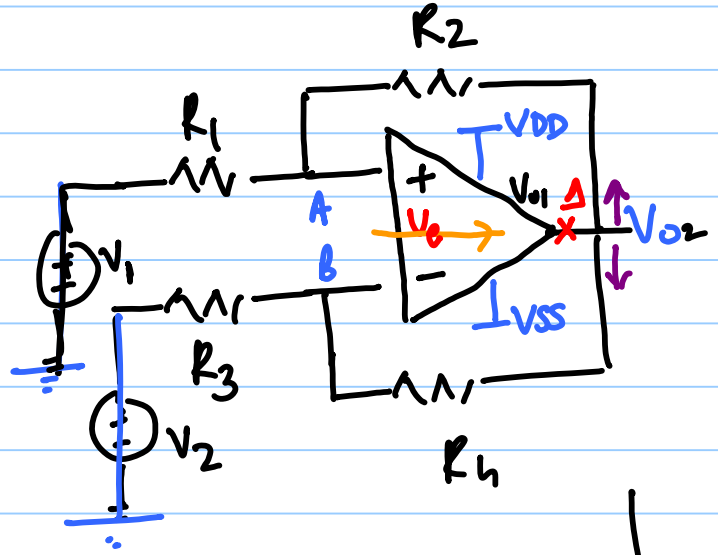


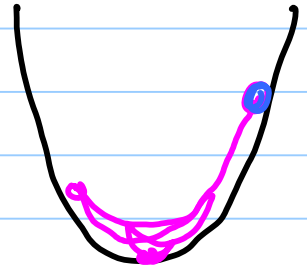
$$\frac{V_{o1}}{V_e} = +ve$$

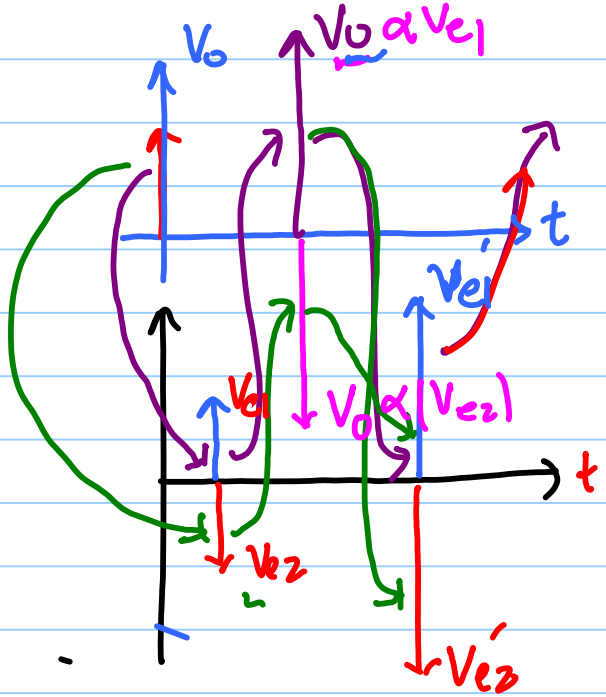
$$V_{o1} = +ve(A) \times V_e$$

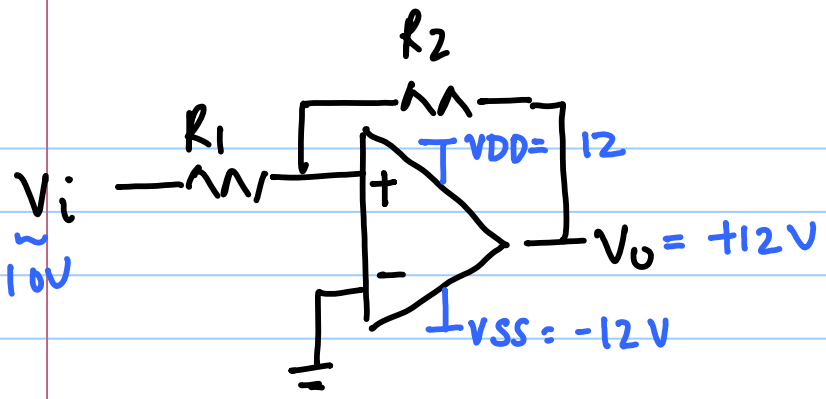
$$= +ve(A) \times (-ve) \cdot \Delta$$

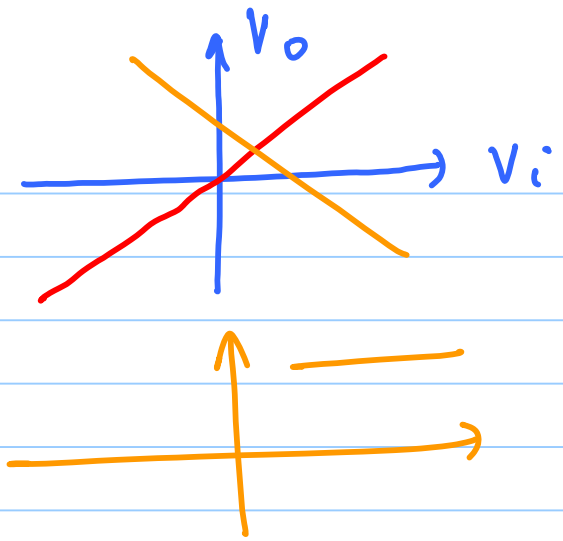


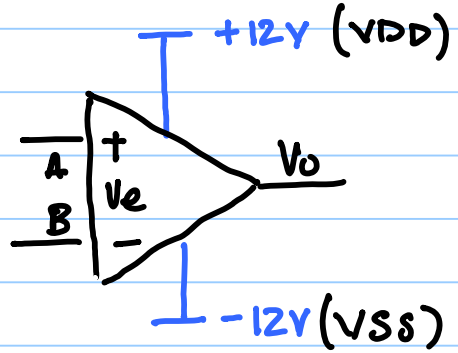




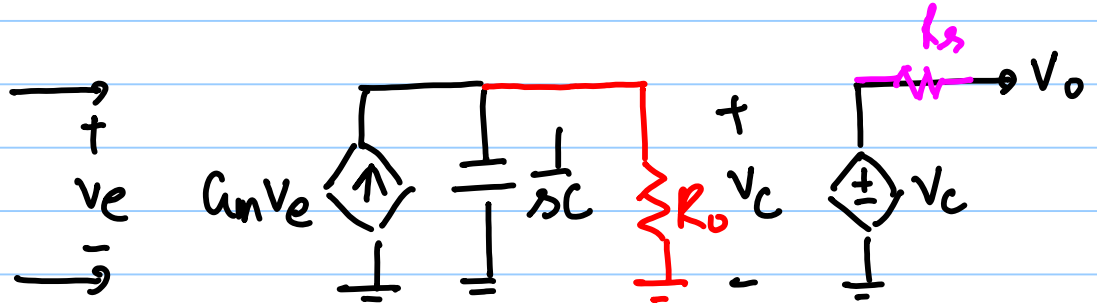




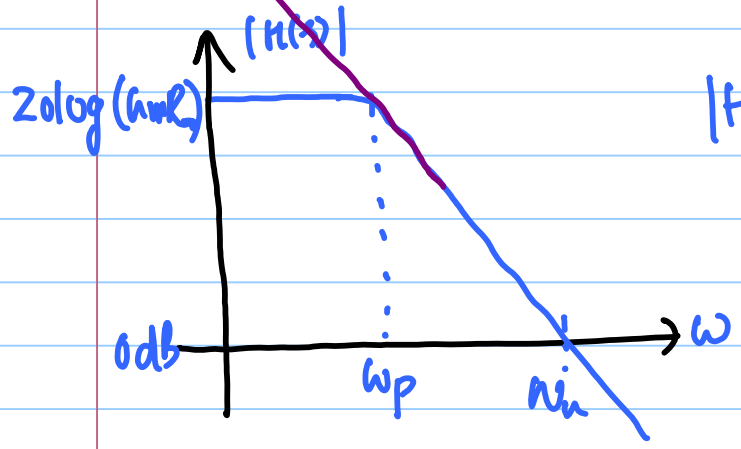




$$\frac{V_o(s)}{V_e(s)} = \frac{G_m}{sC}$$



$V_{SS} \le V_o \le V_{DD}$



$$|H(s)| = \frac{V_o(s)}{V_e(s)} = \frac{G_m R_o}{1 + sCR_o}$$

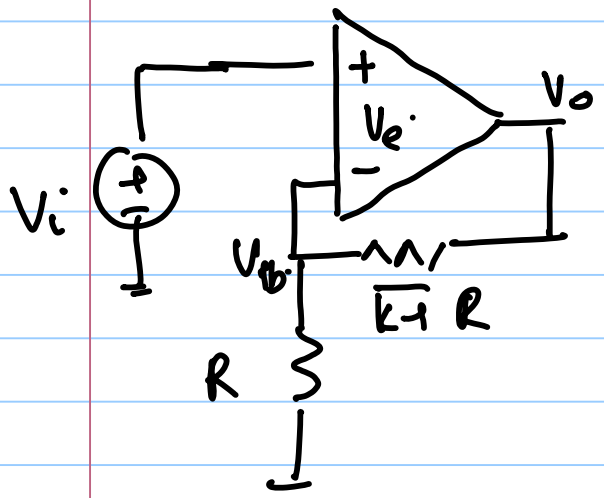
$$\text{pole} = -\omega_p = \frac{-1}{CR_o}$$

$A_o = G_m R_o$ (DC gain)

DC gain of $H(s)$ $= |H(s = j \cdot 0)|$

$$|H(j\omega_u)| \simeq 1 = \frac{G_m R_o}{\sqrt{1+\frac{\omega_u^2}{\omega_p^2}}} \simeq \frac{G_m R_o}{\omega_u/\omega_p}$$

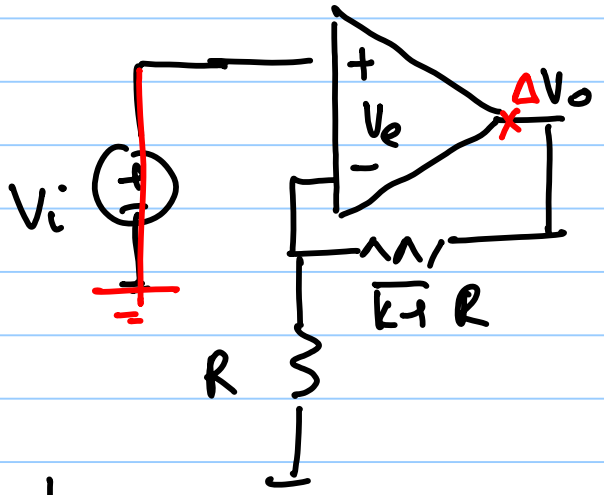
$$\omega_u = \frac{G_m}{C}$$



$$\left(V_i - \frac{V_o}{K}\right) \cdot A_o = V_o$$

$$V_o = \frac{V_i}{\frac{1}{K} + \frac{1}{A_o}}$$

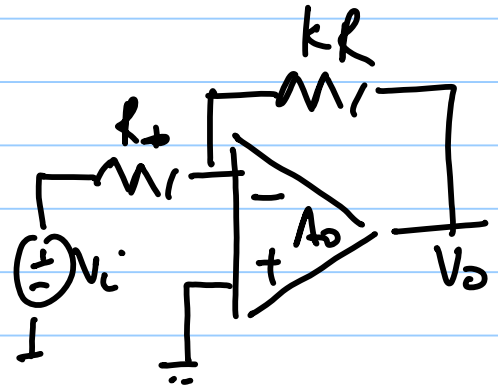
$$V_o = \frac{K V_i}{(1 + K/A_o)} \xrightarrow{A_o \to \infty}$$



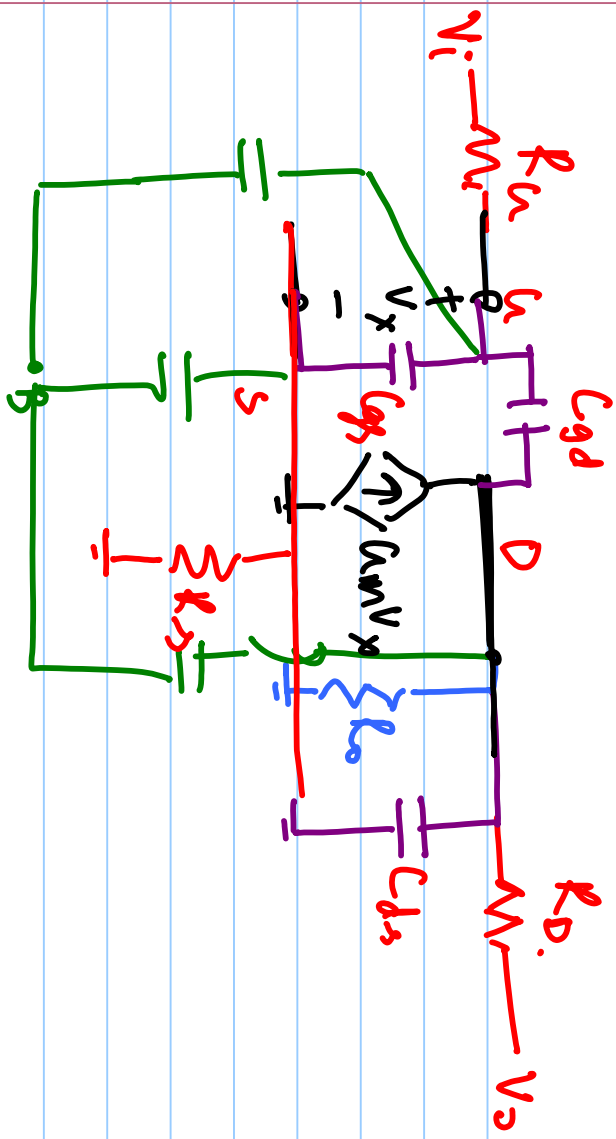
$$V_e = 0 - \frac{R}{K \cdot K} \cdot \Delta$$

$$= -\frac{\Delta}{K}$$

$$V_o = K V_i$$



$$\frac{V_o}{V_e} = A_o$$


V_i
R_G
G
V_x
C_{gs}
C_{gd}
S
D
$g_m V_x$
r_o
R
C_{ds}
R_D
V_o