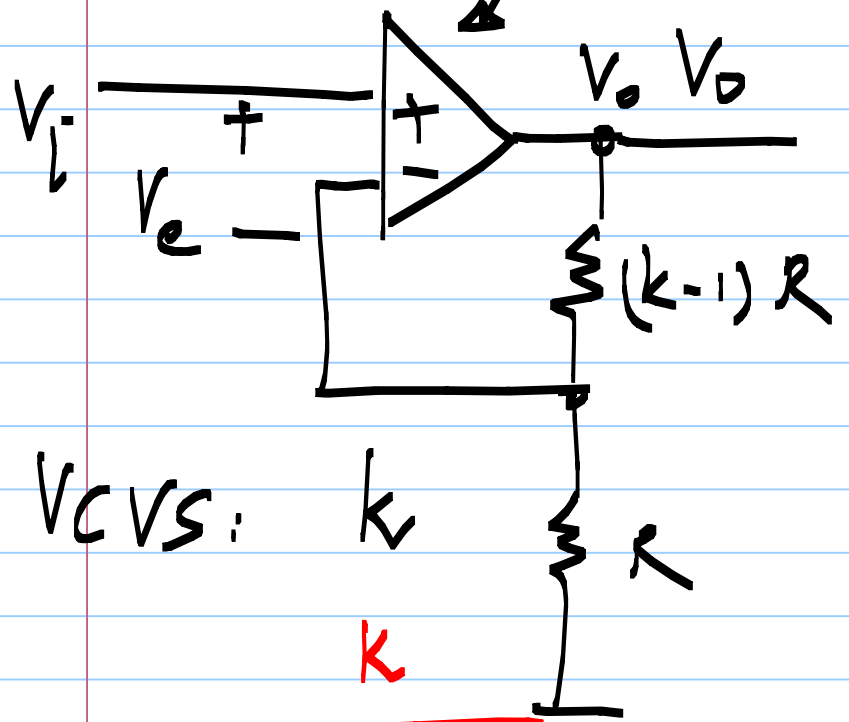
EE2019

$$\frac{V_o}{V_e} = \frac{A_o}{1 + s \cdot \frac{A_o}{\omega_u}}$$

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

24/1/2018



VCVS: k

$$\frac{k}{1 + k/A_o}$$

$$V_o = k \cdot V_i \cdot \frac{1}{1 + k/A_o}$$

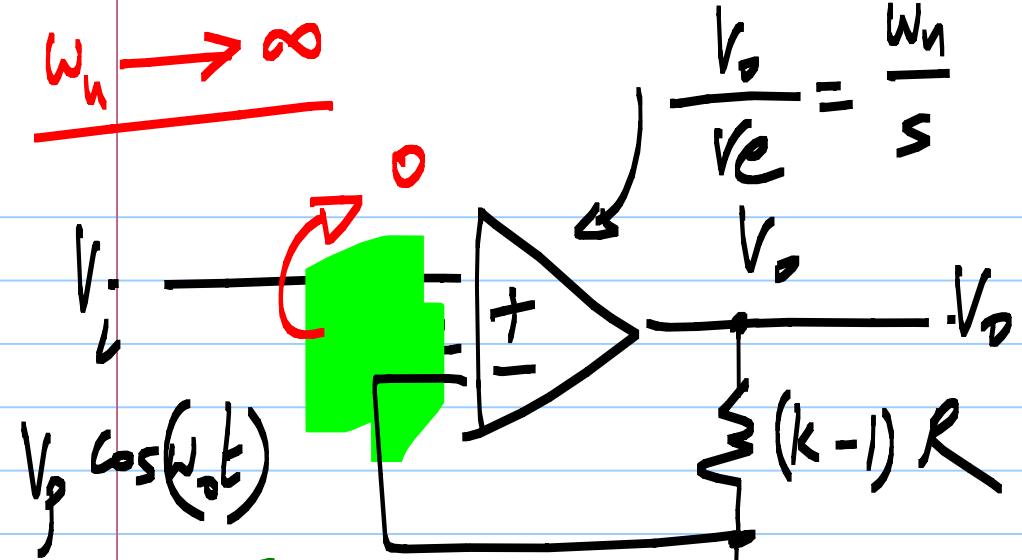
$$V_e = \frac{k V_i}{k + A_o} \simeq \frac{}{A_o}$$

$$\frac{V_o}{V_i} = \frac{k}{1 + k/A_o}$$

(dc steady state)

$\omega_u \to \infty$

$\frac{V_o}{V_e} = \frac{\omega_u}{s}$



$V_i = V_p \cos(\omega_0 t)$

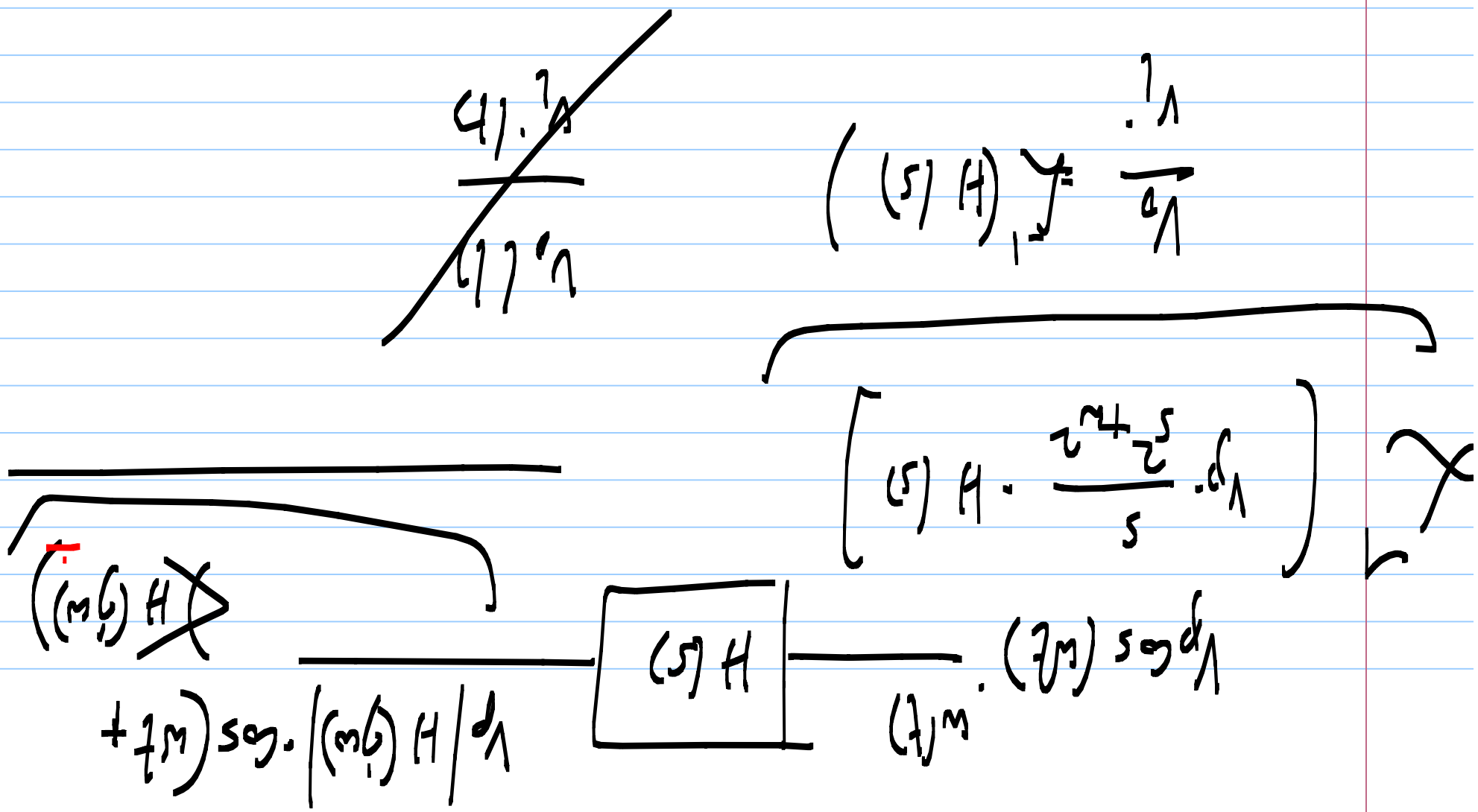
In sinusoidal steady state,

$$\frac{V_o}{V_i} = \frac{k}{1 + k \cdot \frac{s}{\omega_u}}$$

$$V_o = k V_p \frac{1}{\left(1 + k \frac{j\omega}{\omega_u}\right)} \cdot \cos\left(\omega t - \tan^{-1} \frac{k \cdot \omega}{\omega_u}\right)$$

(steady state)

$\frac{k\omega}{\omega_u} \ll 1$



opamp: Integrator $\frac{\omega_u}{s}$

dc: ∞ gain : Ideal behavior

[$V_e \to 0$ in dc steadystate]

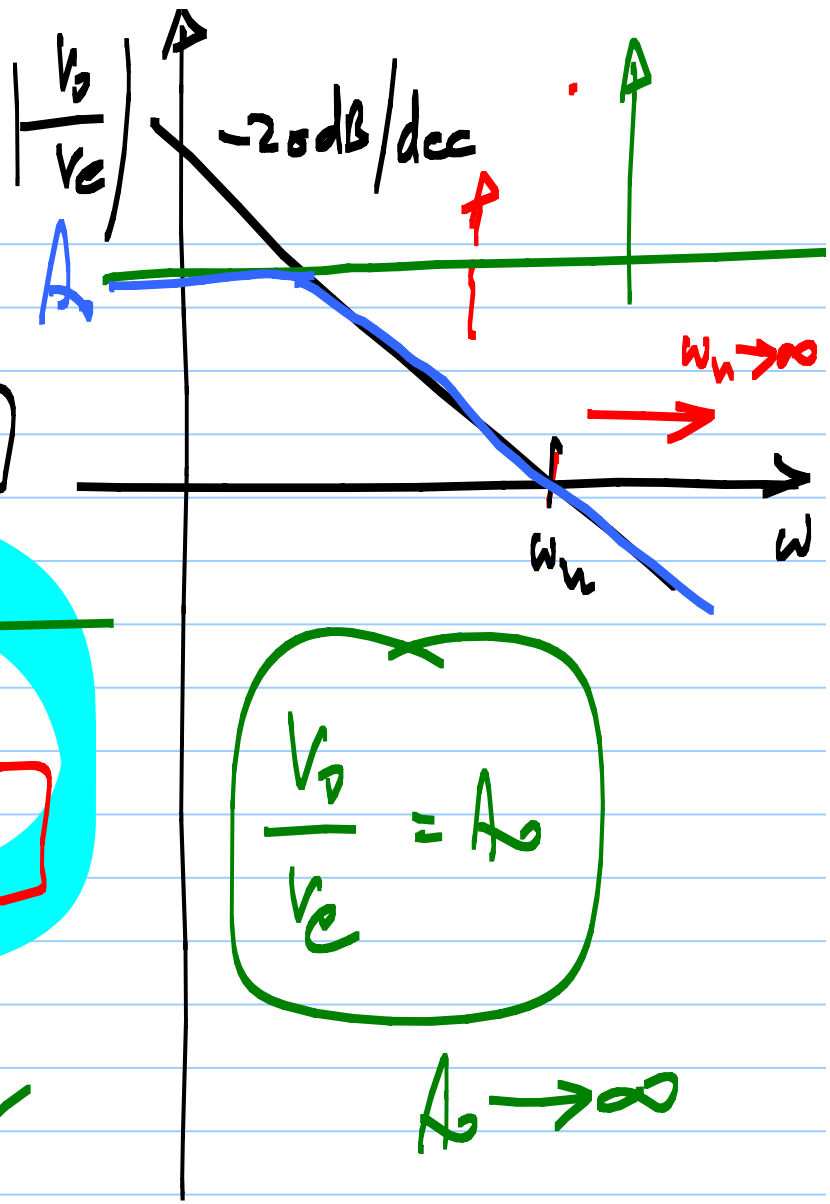
$\omega_u \to \infty$: IDEAL opamp

∞ gain every where

[$V_e \to 0$ @ all frequency]

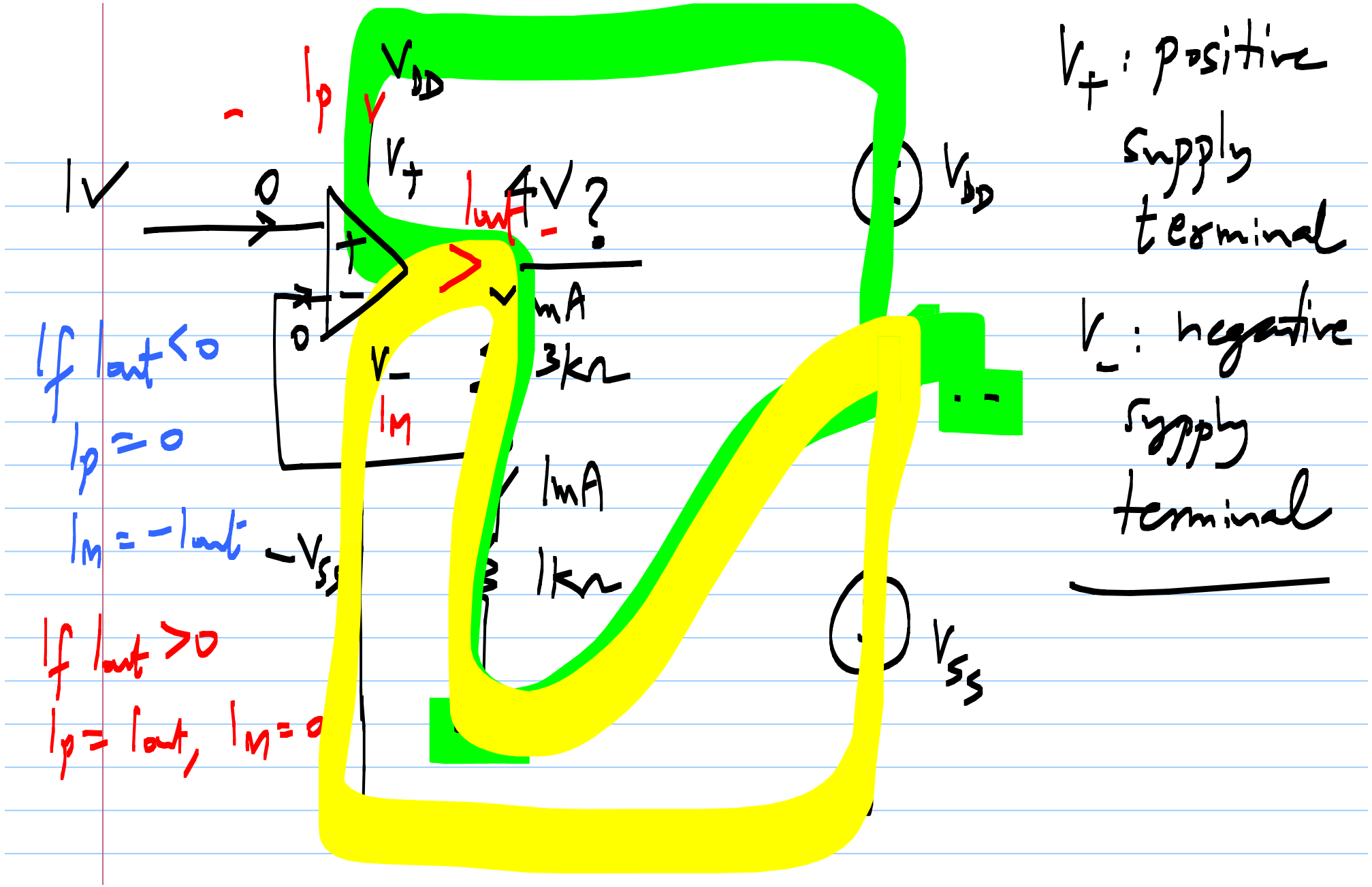
Real opamp: finite dc gain

opamp = High gain amplifier



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

$A_o \to \infty$


V_{DD}
I_p
V
V_+
$1V$
0
I_{out}
$4V$?
V_{DD}
V_-
I_M
3kΩ
1mA
1kΩ
$-V_{SS}$
V_{SS}
If $I_{out} < 0$
$I_p = 0$
$I_M = -I_{out}$
If $I_{out} > 0$
$I_p = I_{out}$, $I_M = 0$
V_+ : positive supply terminal
V_- : negative supply terminal

Supply currents in an opamp

Most efficient case:

If $I_{out} \geq 0$, $I_p = I_{out}$, $I_m = 0$

If $I_{out} < 0$, $I_p = 0$, $I_m = -I_{out}$

Slightly more realistic $I_b > 0$

If $I_{out} \geq 0$, $I_p = I_{out} + I_b$, $I_m = I_b$

$I_{out} < 0$, $I_p = I_b$ $I_m = -I_{out} + I_b$