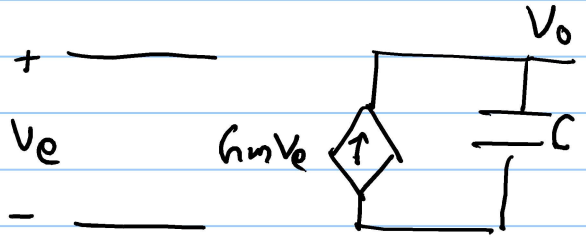
EE2019 Analog Systems & Lab

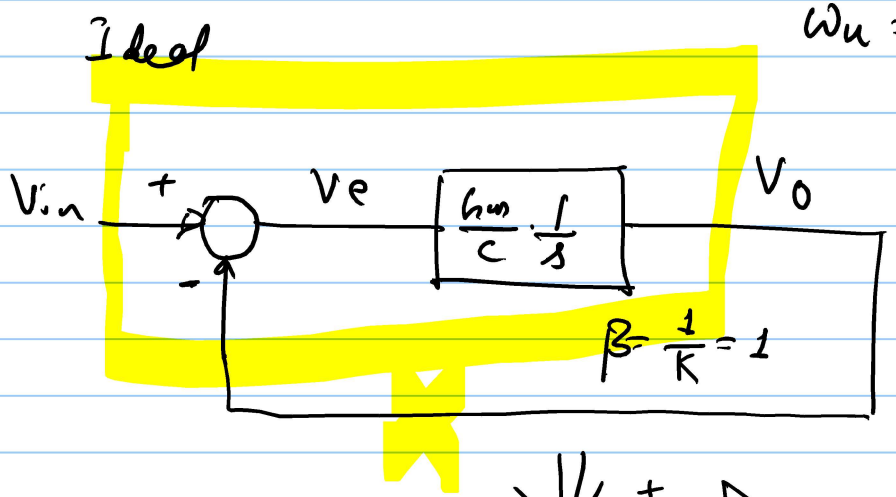
Note Title 1/28/2020

Ideal Vs Real Integrator:



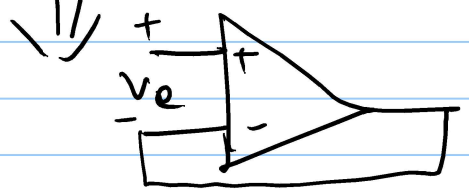
$$\frac{V_o}{V_e} = \frac{G_m}{C} \cdot \frac{1}{s}$$

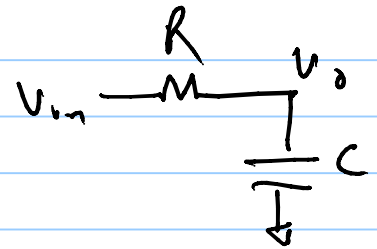
$$\omega_u = \frac{G_m}{C}$$



$$\frac{V_o}{V_{in}} = \frac{1}{1 + \frac{C}{G_m} s} = \frac{1}{1 + \frac{s}{\omega_u}}$$

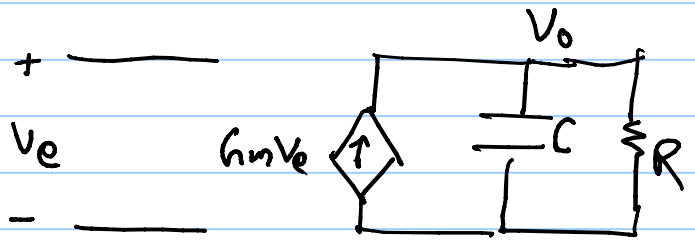
$$\omega_p = \frac{G_m}{C}$$





$$\frac{V_o}{V_{in}} = \frac{1}{1+RCs}$$

$$\omega_p = \frac{1}{RC}$$



$$\frac{V_o}{V_e} = \frac{G_m R}{1 + RCs}, \quad \omega_p = \frac{1}{RC}$$

G_m - Ideal or real

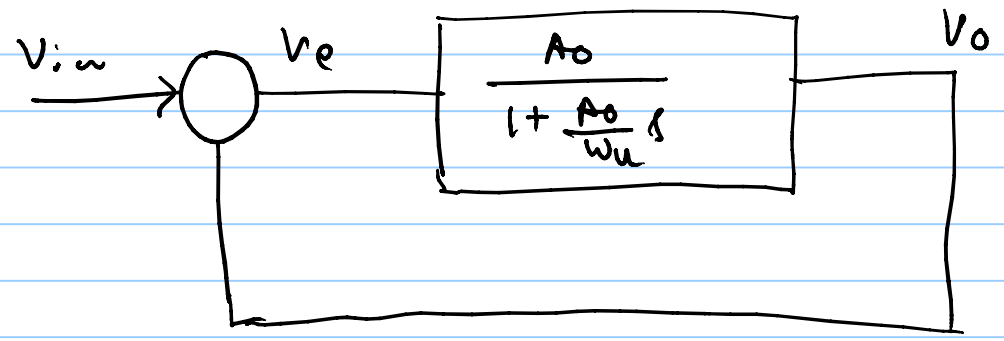
$$A_o = G_m R$$

$$R = \frac{A_o}{G_m}$$

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

$$\omega_p = \frac{\omega_u}{A_o}$$

$$\frac{\omega_u}{A_o} = \frac{1}{RC} \quad \text{or} \quad \omega_u = A_o \times \frac{1}{RC}$$

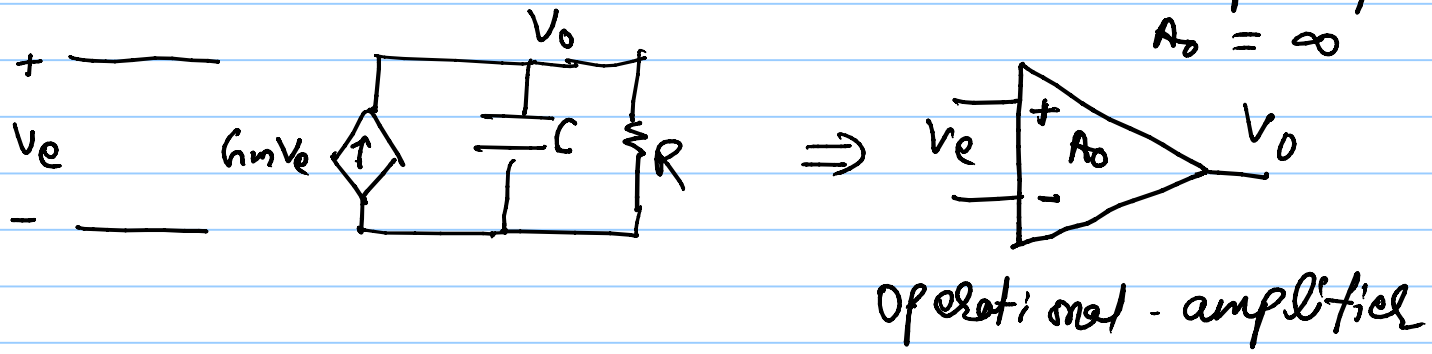


$$\frac{V_o}{V_{in}} = \frac{\frac{A_0}{1+\frac{A_0}{\omega_u}s}}{1+\frac{A_0}{1+\frac{A_0}{\omega_u}s}} = \frac{A_0}{1+\frac{A_0}{\omega_u}s+A_0}$$

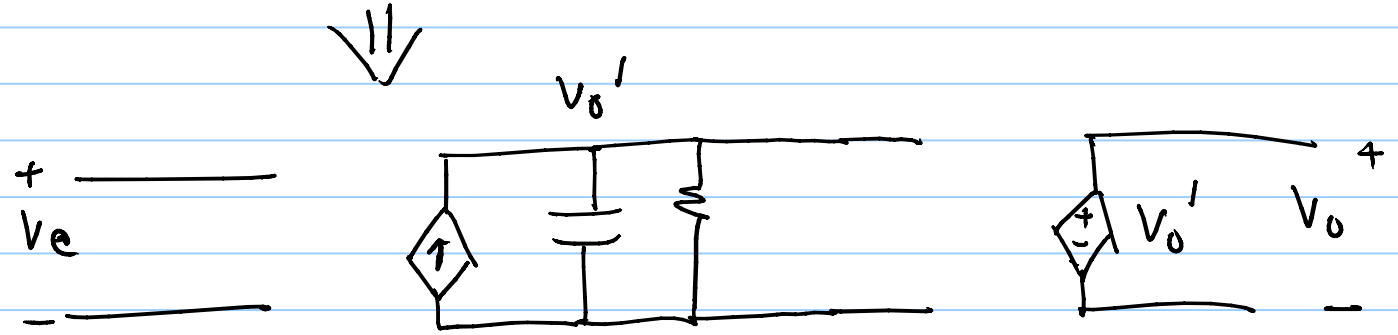
$$= \frac{A_0}{1+A_0} \cdot \frac{1}{1+\frac{A_0}{1+A_0}\cdot\frac{s}{\omega_u}}$$

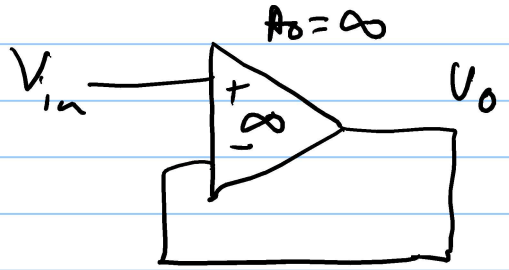
$A_0 >> 1$

$$\frac{V_o}{V_{in}} \simeq \frac{1}{1+\frac{s}{\omega_u}}$$ which is same as ideal integrator.



Operational-amplifier

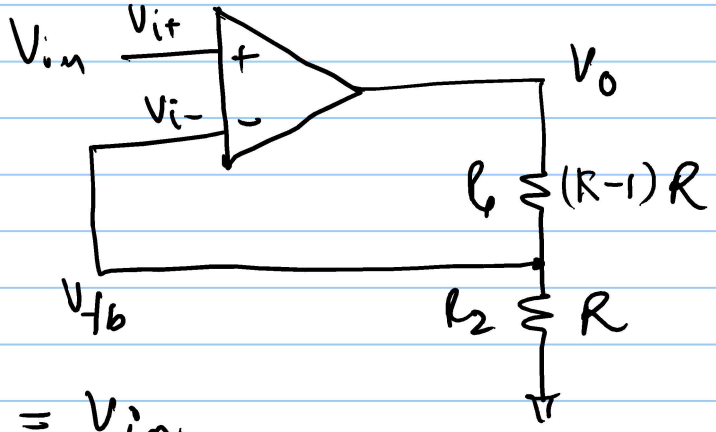




$$V_0 = V_{in}$$

or $K = 1$

Unity Gain Amplifier or buffer

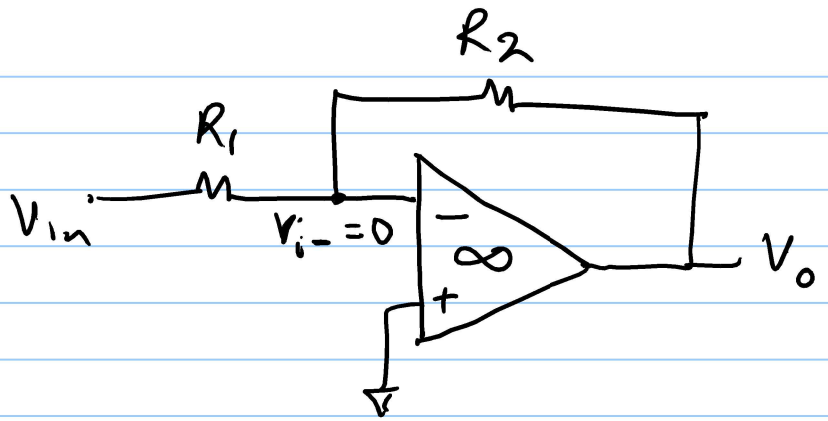


$$\frac{V_0}{V_{in}} = K = 1 + \frac{R_1}{R_2}$$

Non-inverting amplifier

$V_{fb} = V_{in}$

$V_{i+} = V_{i-} \Rightarrow$ Virtual short



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

$$\frac{V_{in} - 0}{R_1} = \frac{0 - V_o}{R_2} \Rightarrow \frac{V_o}{V_{in}} = -\frac{R_2}{R_1}$$

Inverting amplifier