

#

Analog Circuits

6 Feb

Ckt's "opamp Based"

integrator ✓

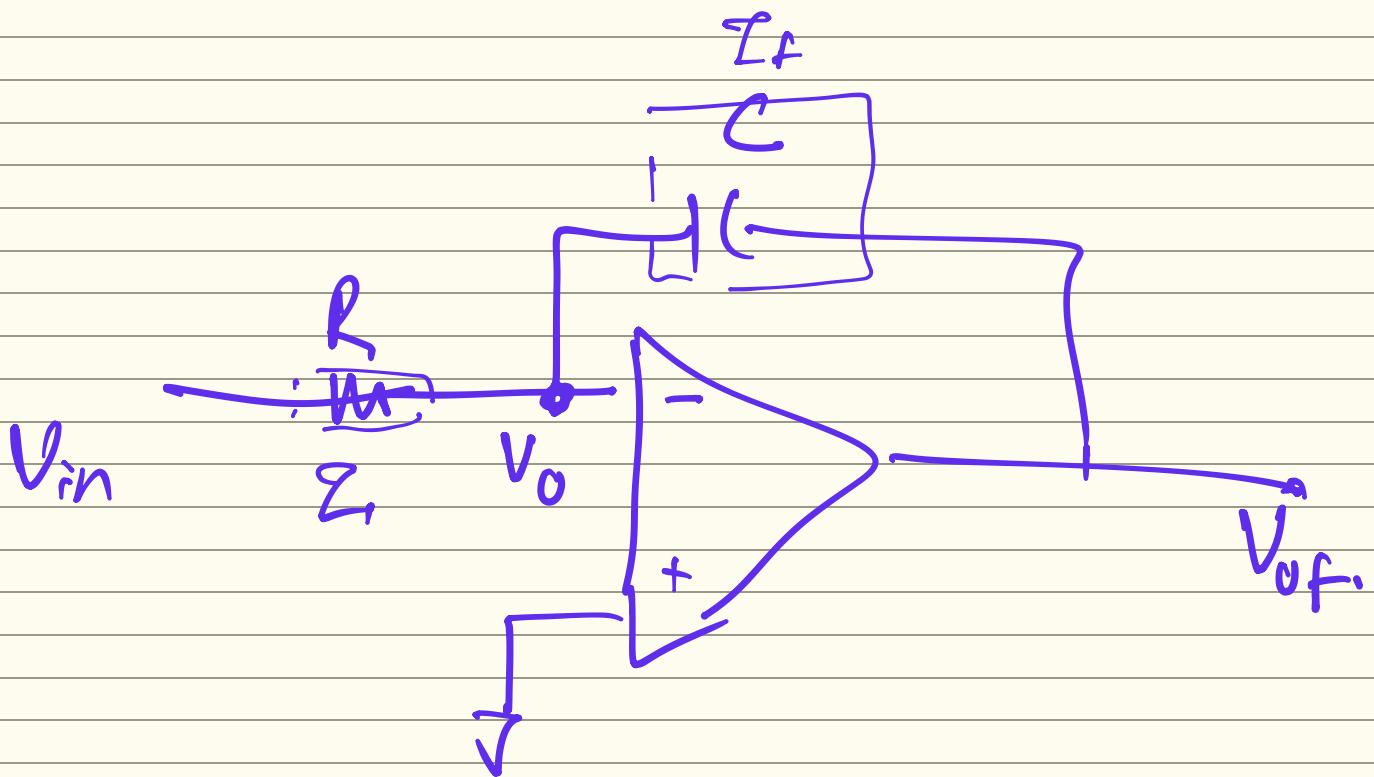
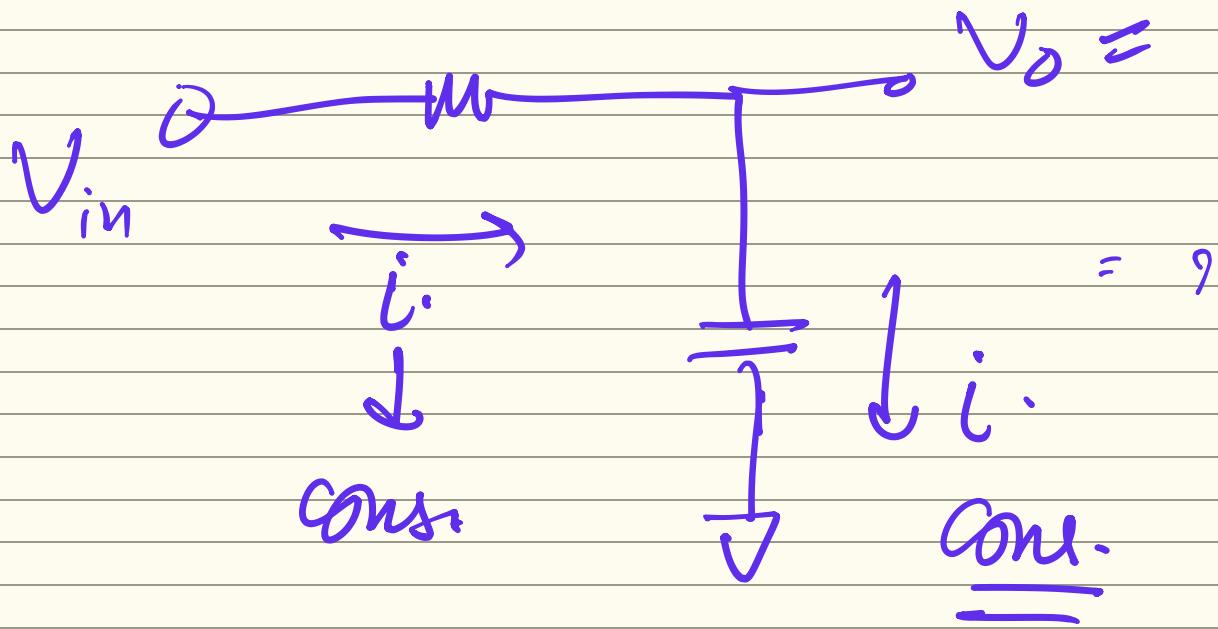
Differentiator ✓

Precision amplifiers ✓

Wave form generators ✓

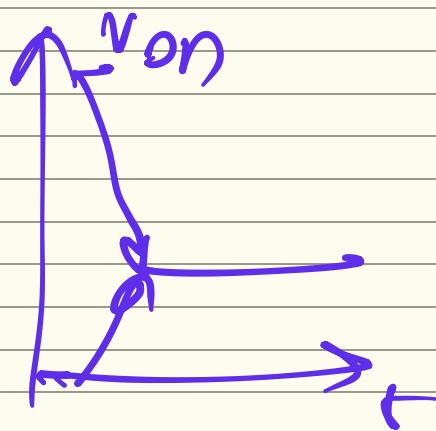
#

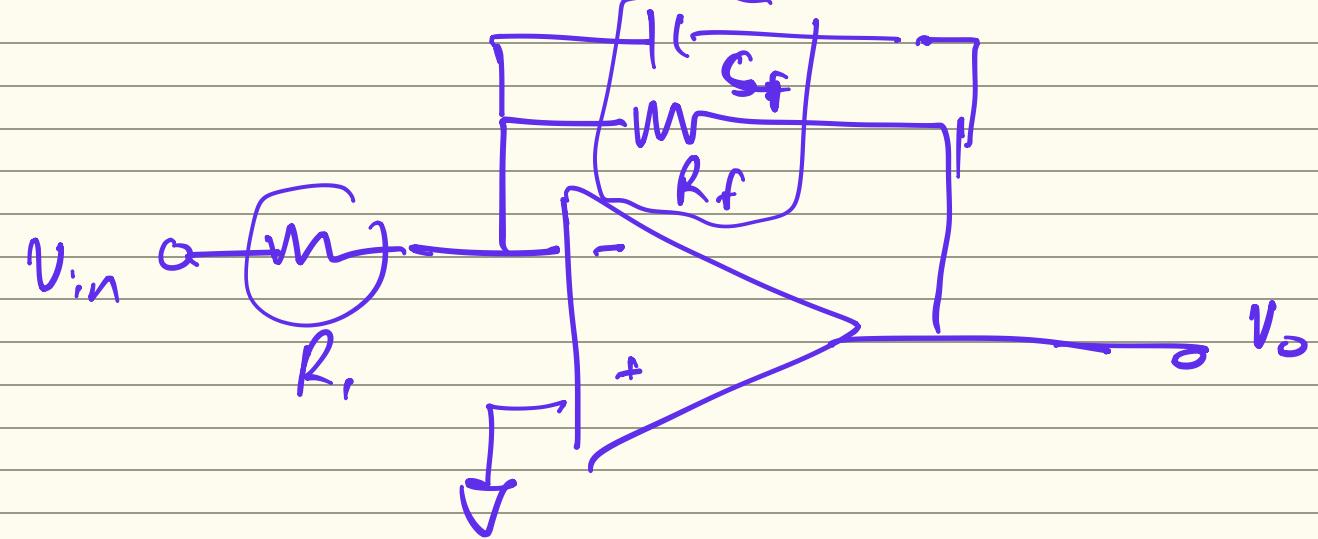
Integrator



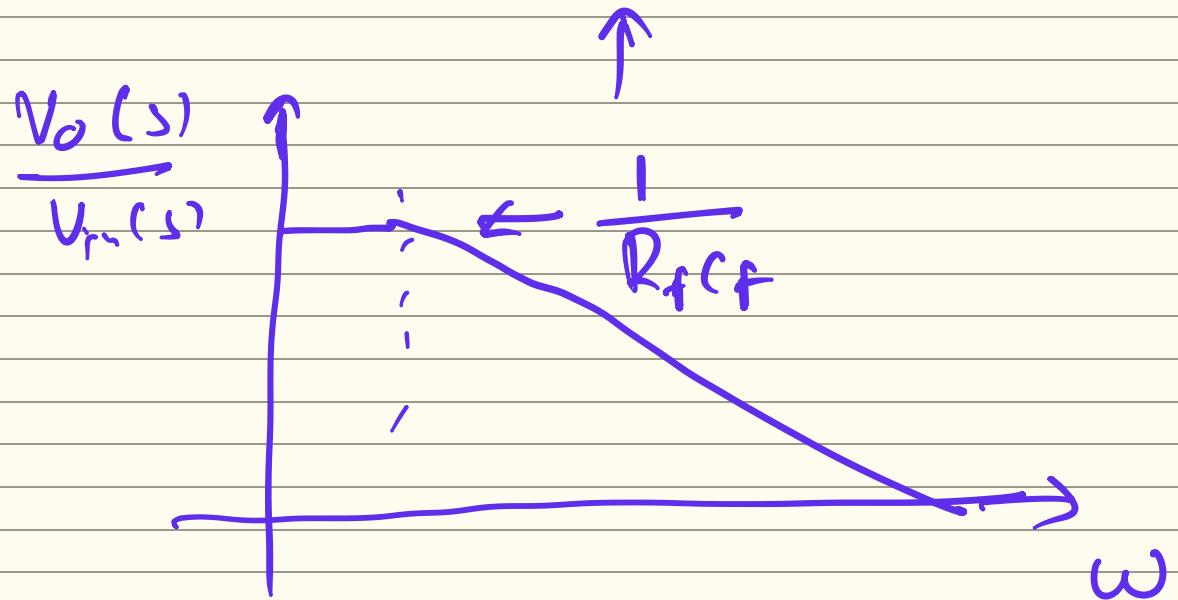
$$V_{o1} = - \frac{1}{S_C \cdot R} V_{in} \approx - \frac{I_f}{Z_1} V_{in}(+)$$

$$\frac{V_o(s)}{V_{in}(s)} = \frac{1}{S.C.R}$$

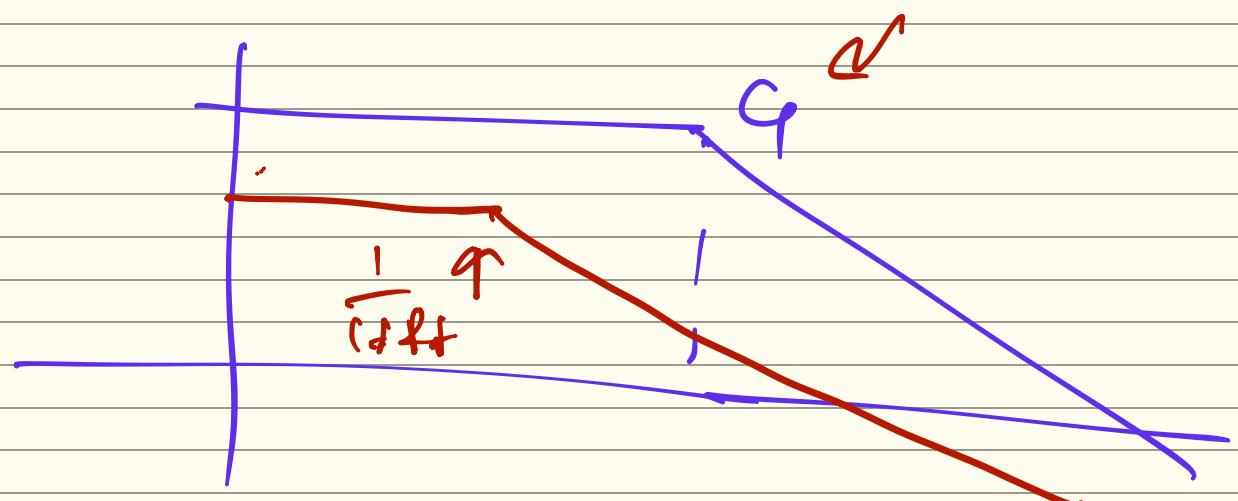




$$\frac{V_o(s)}{V_{in}(s)} = \frac{1}{(R_f C_f + 1) \cdot R_i}$$



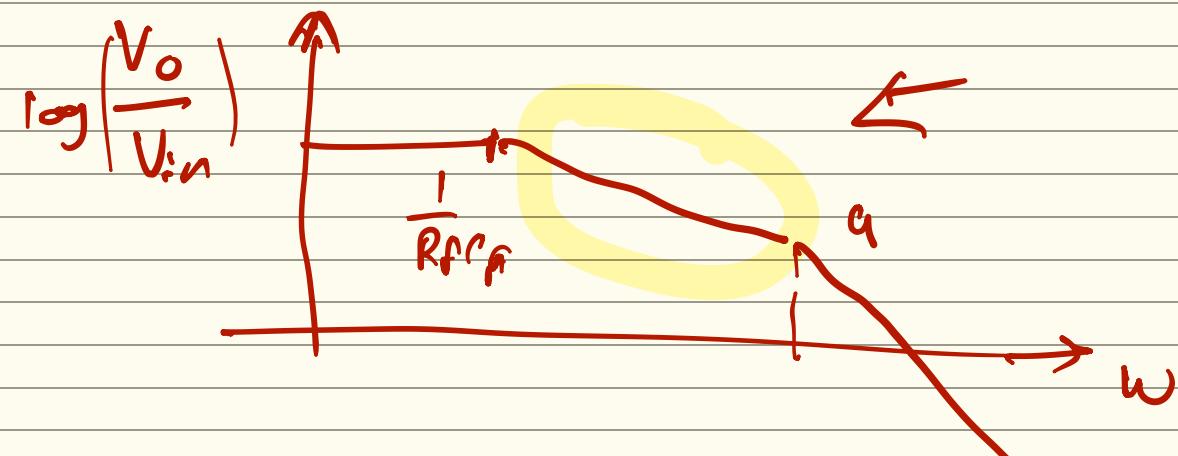
$$A \left(1 + \frac{S}{a} \right)$$



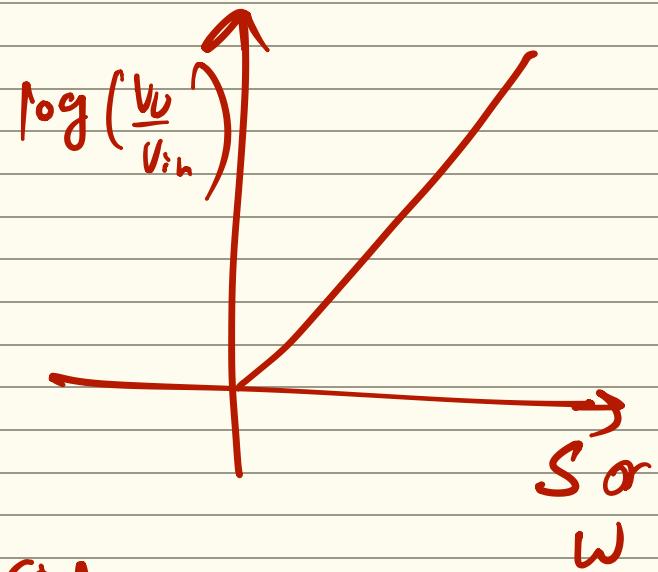
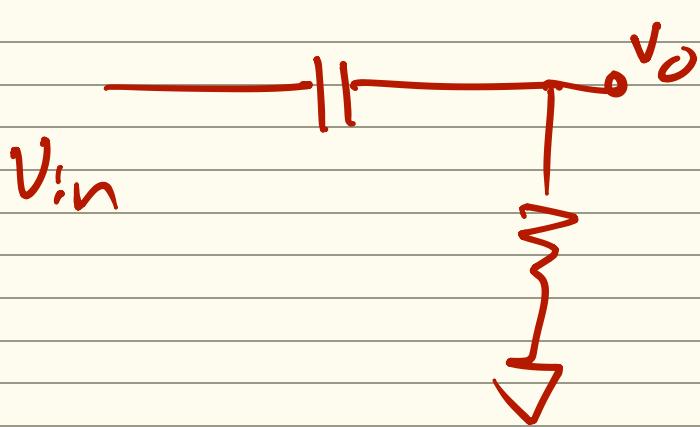
$$\frac{V_o}{V_{in}} = \frac{1}{(R_F C_F S + 1) R_i \left(1 + \frac{S}{a} \right)}$$

int.

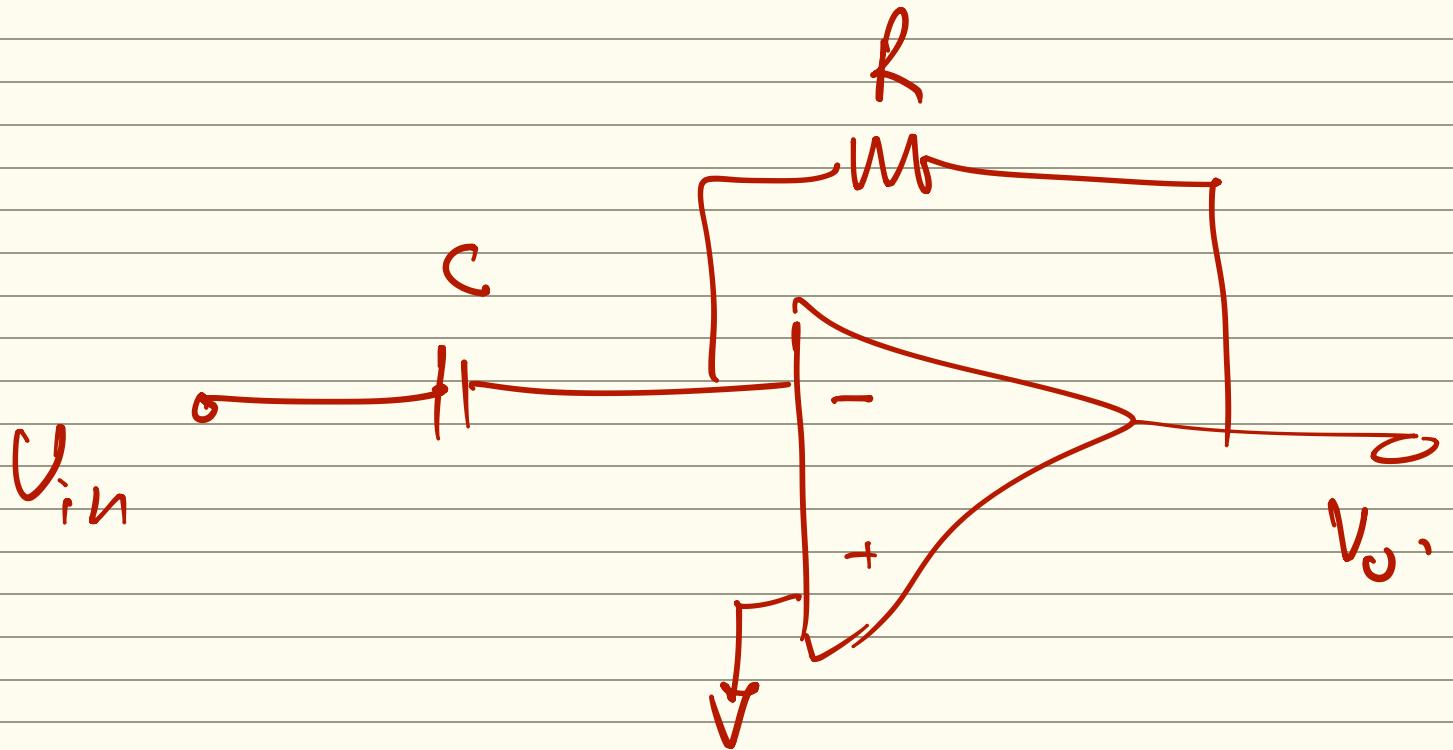
ω_{open}

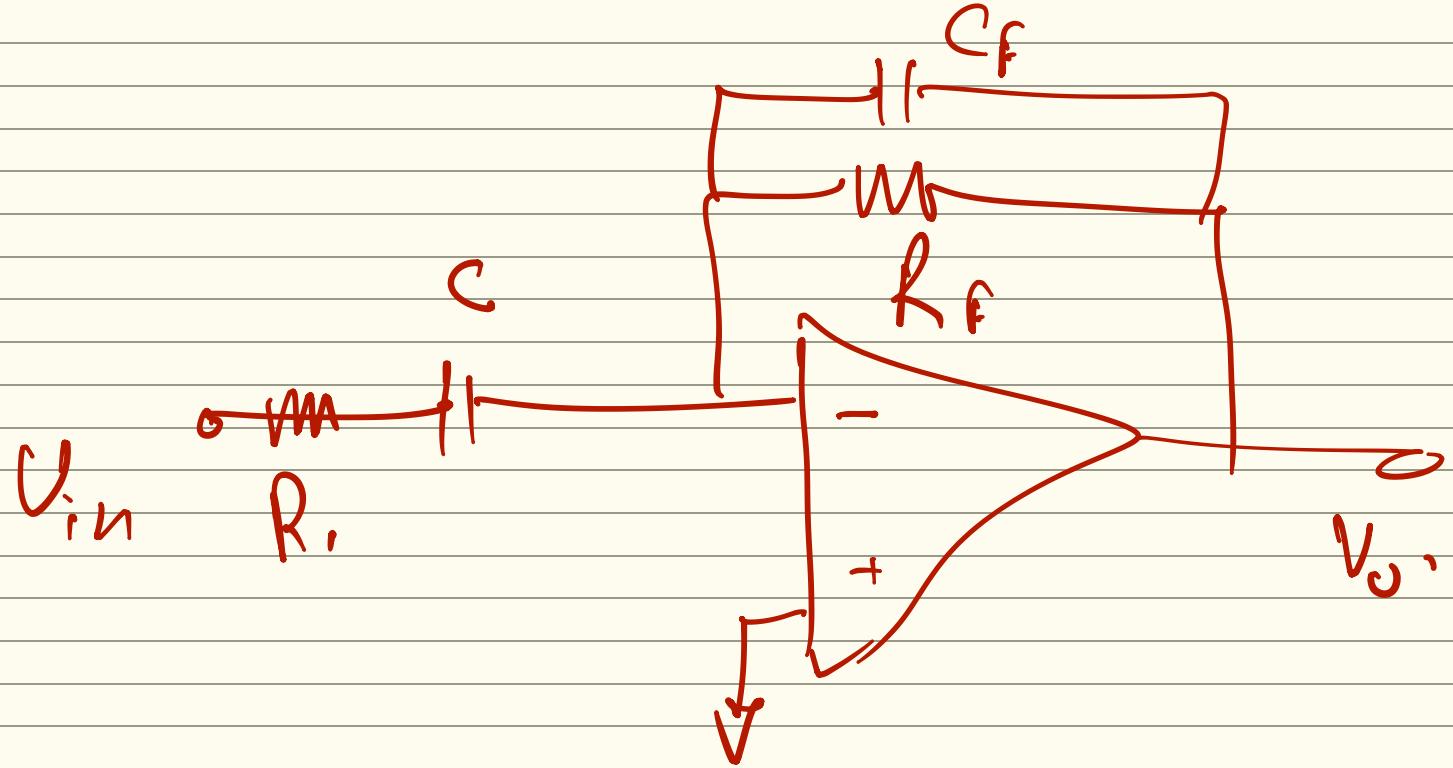


Differentiator

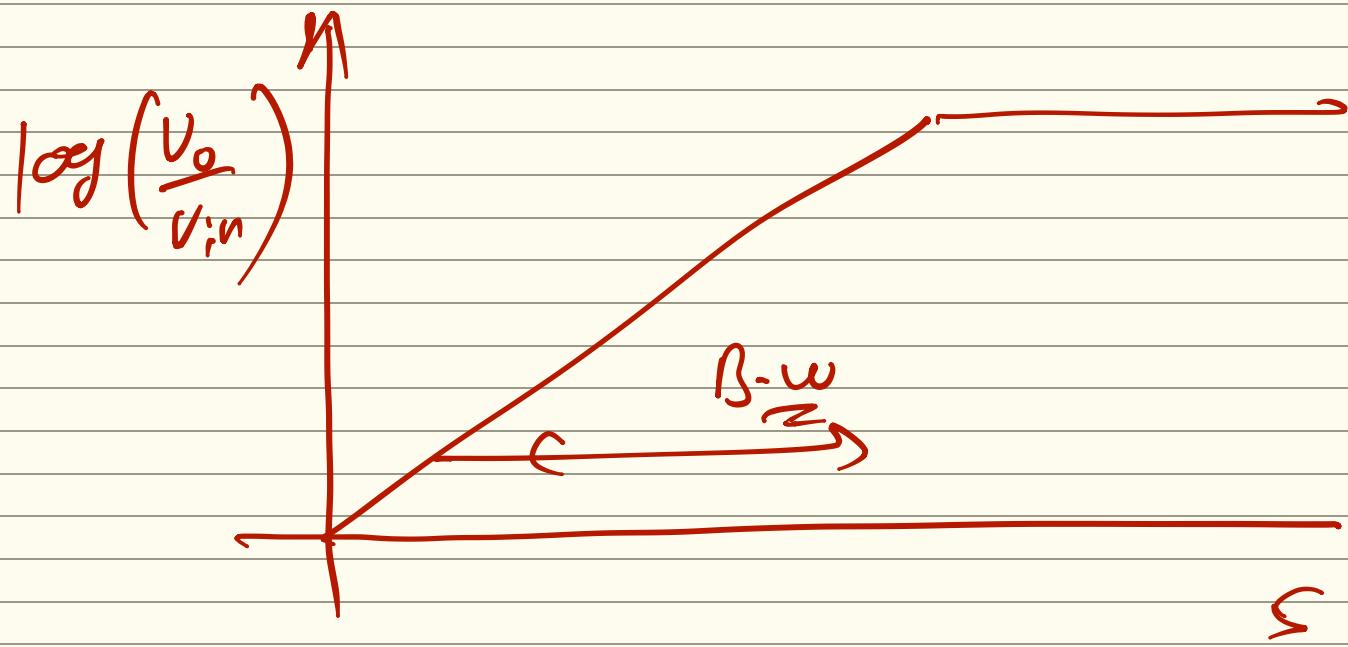


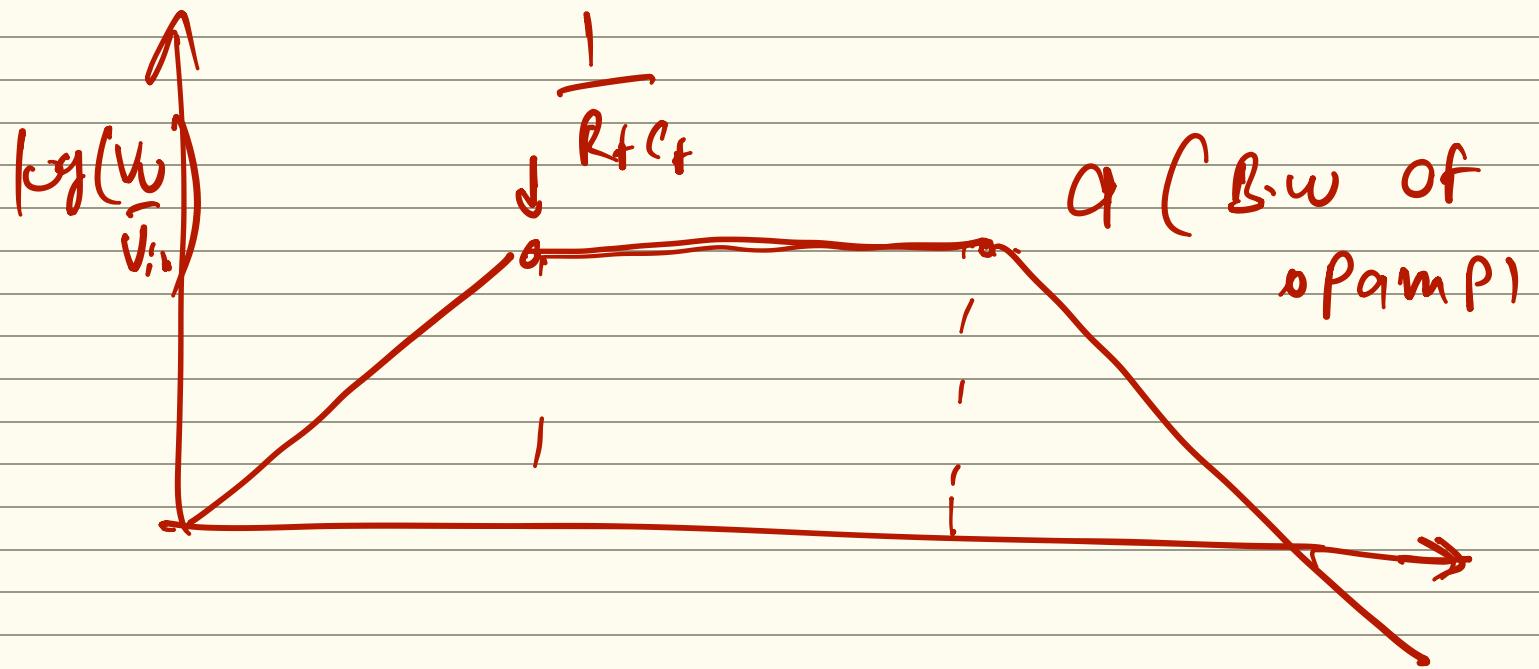
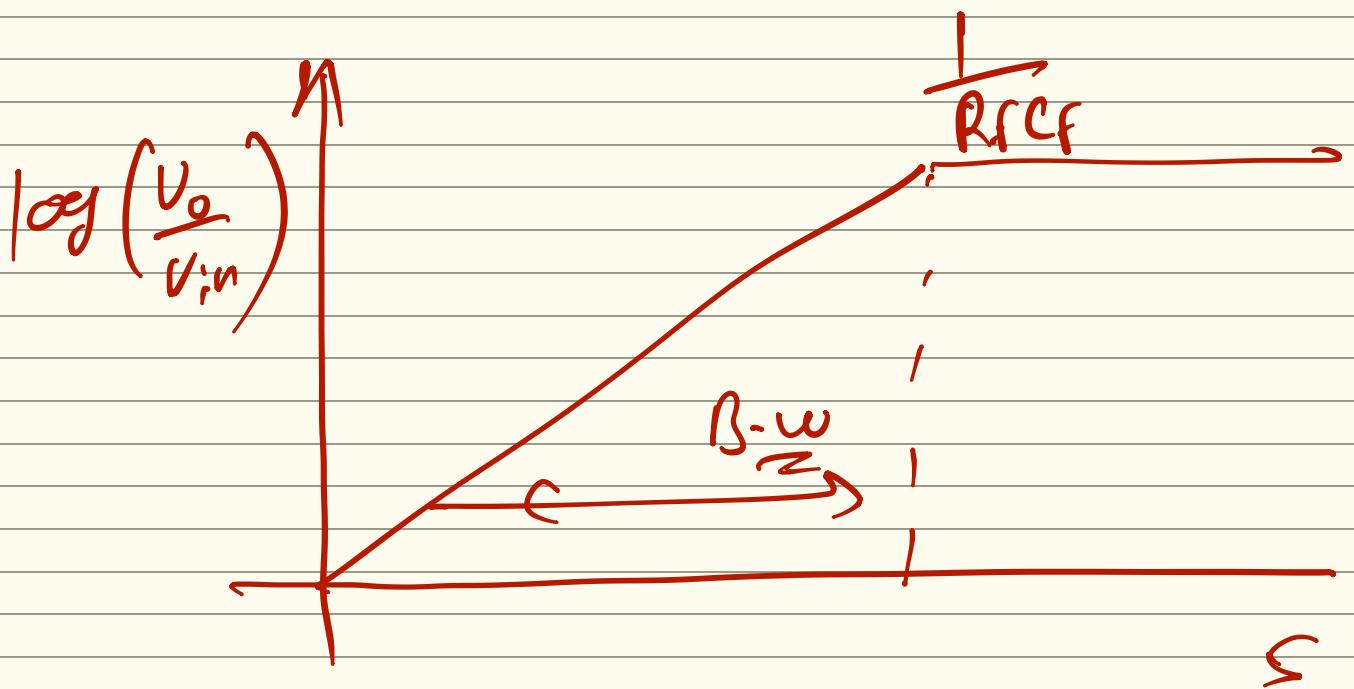
$$V_o(s) = A \cdot s \cdot V_{in}(s)$$

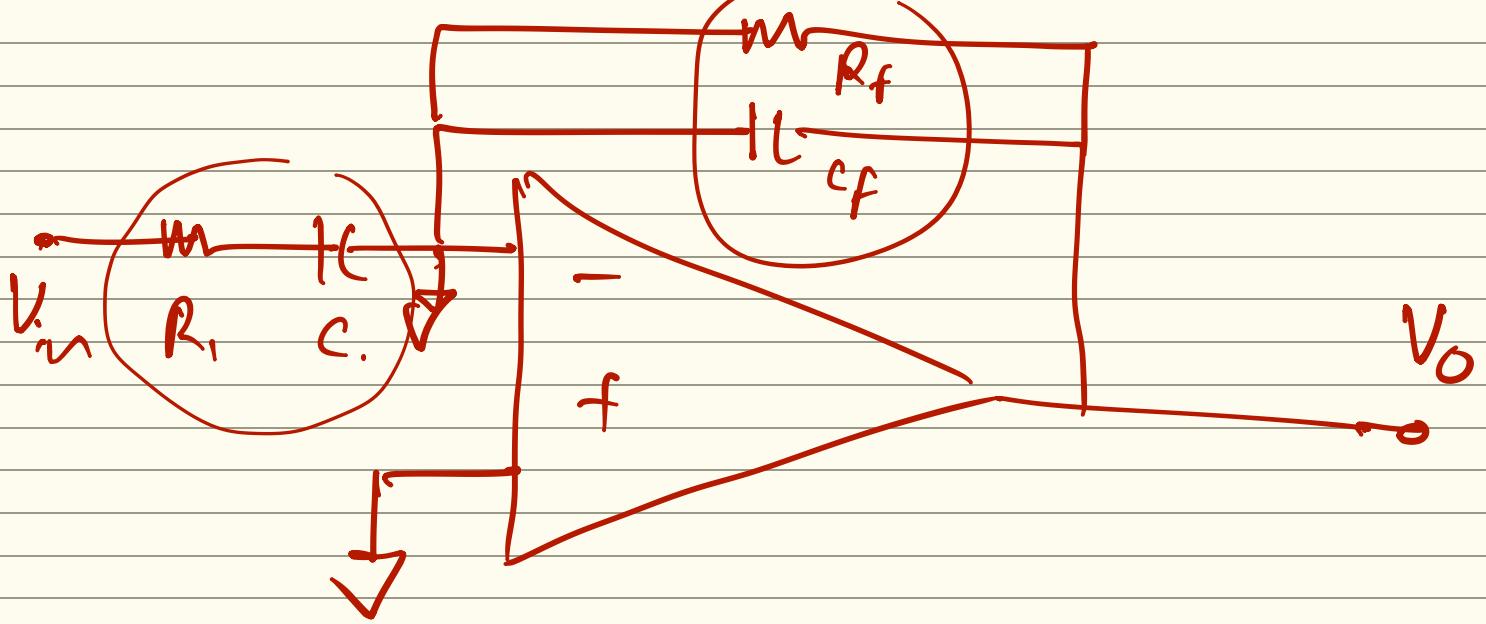




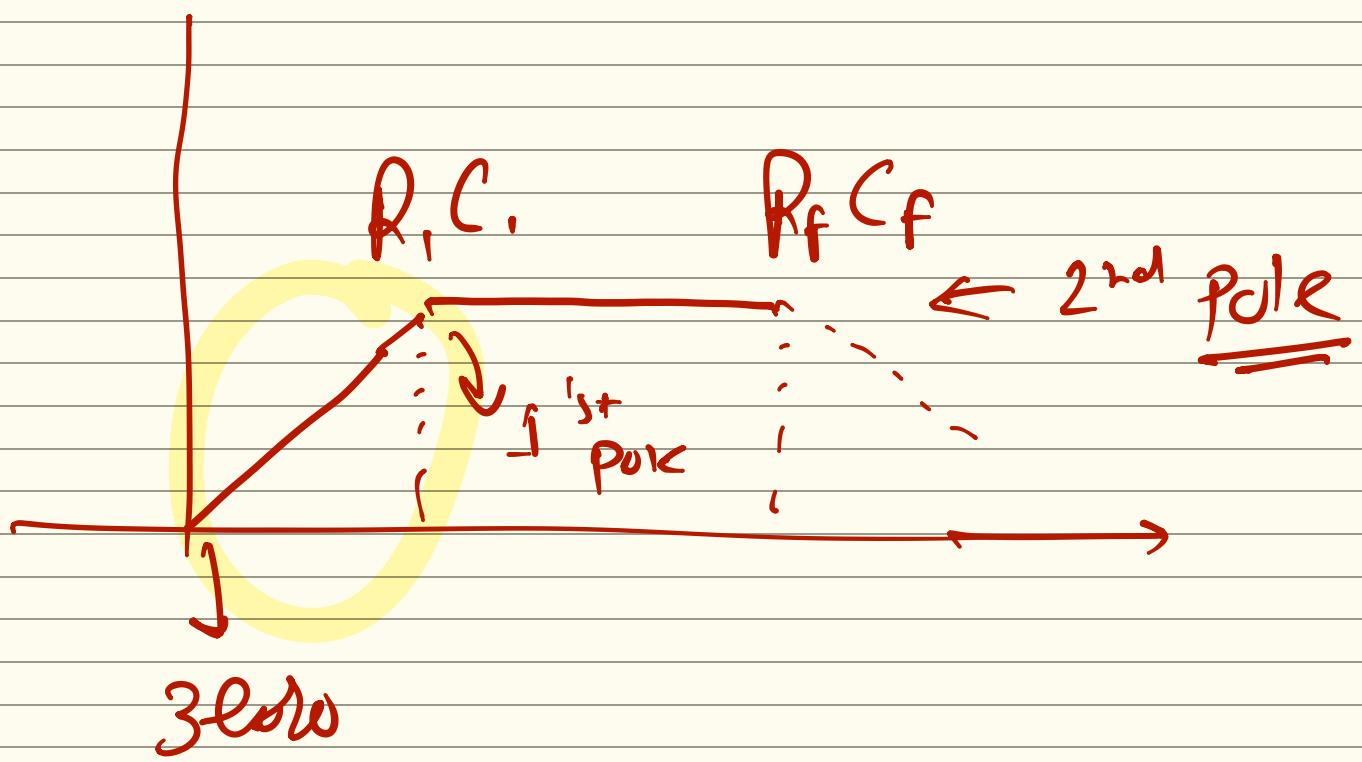
$$V_o(s) = \frac{s C \cdot V_{in}(s)}{1 + G R_f s}$$

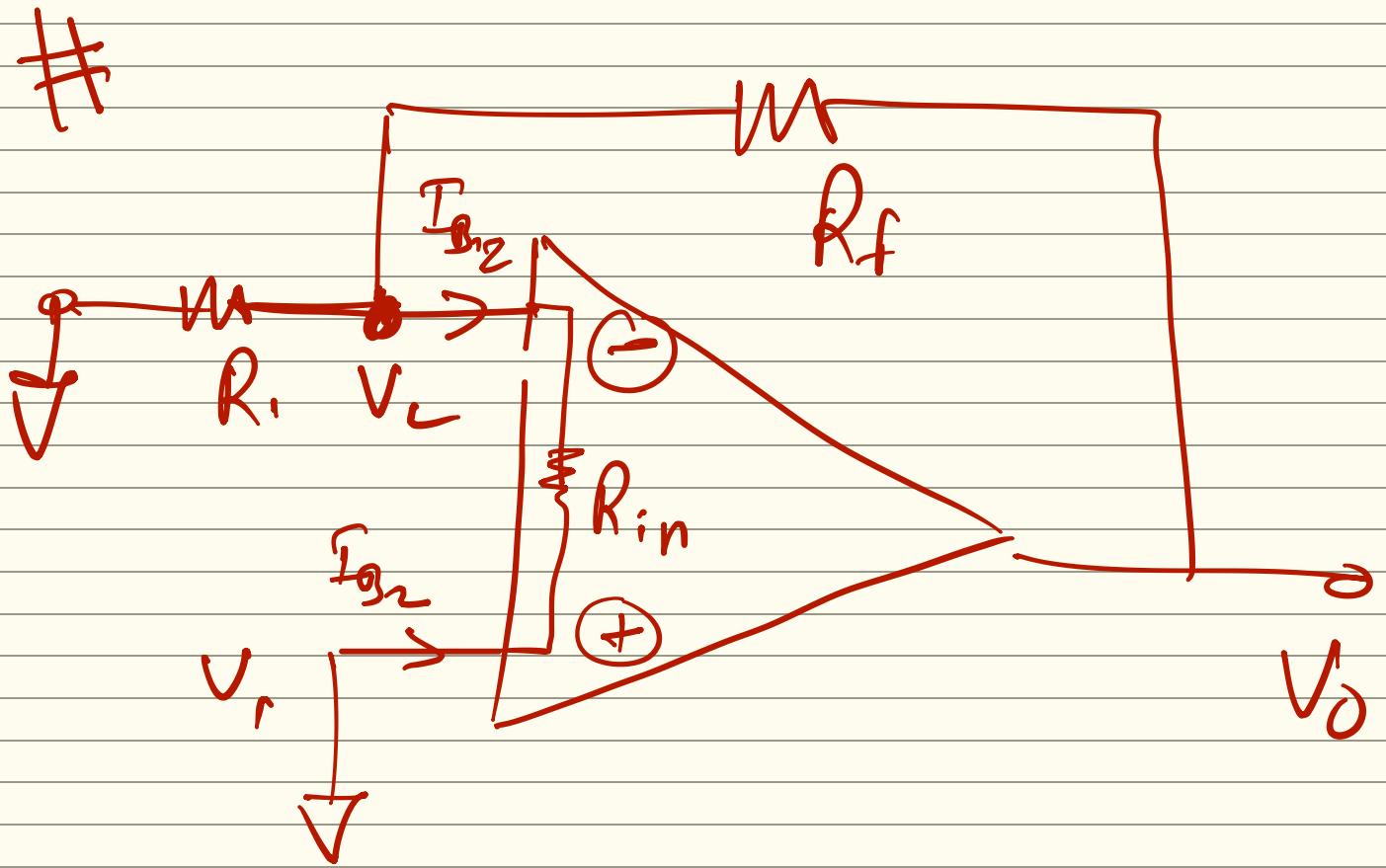






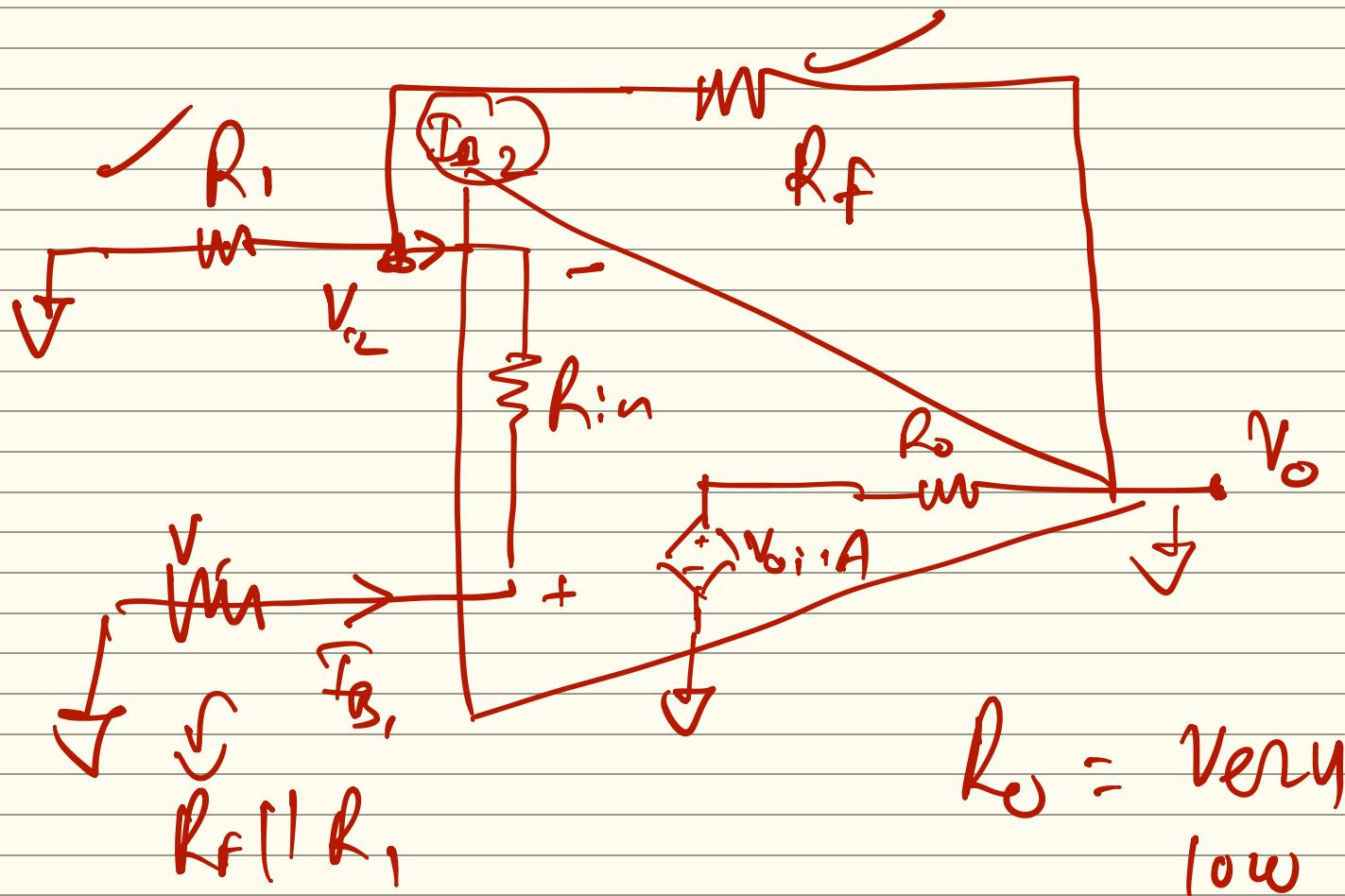
$$A(s) = \frac{SCR}{(1 + R_1 C_1)(1 + R_F C_F)}$$





$$I_{B1} = I_{B2} = I_B$$

Bias current of op-amp



I_{B2}

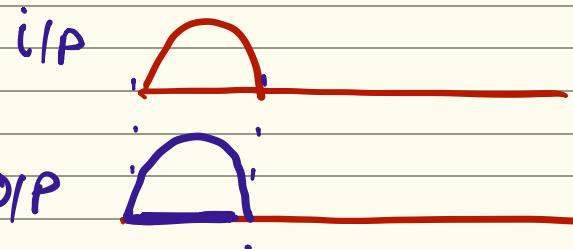
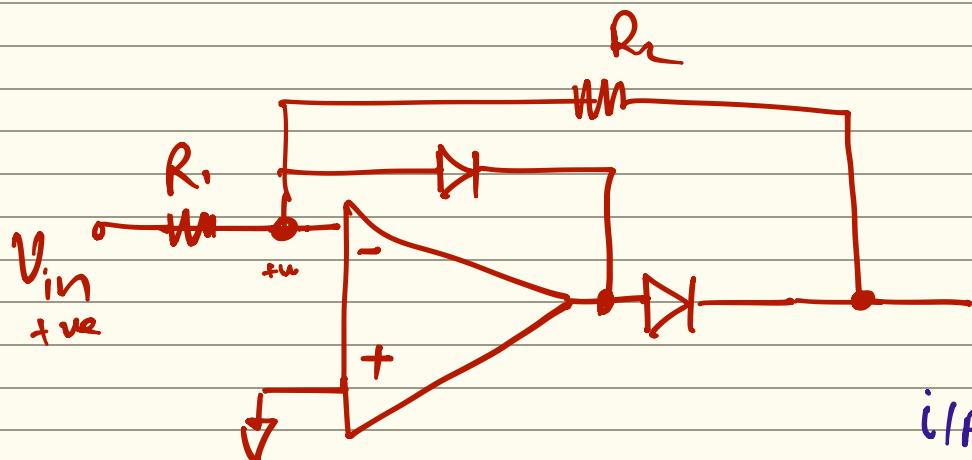
$V_{io} = \text{very low}$

$$V_2 = f(I_{B2})$$

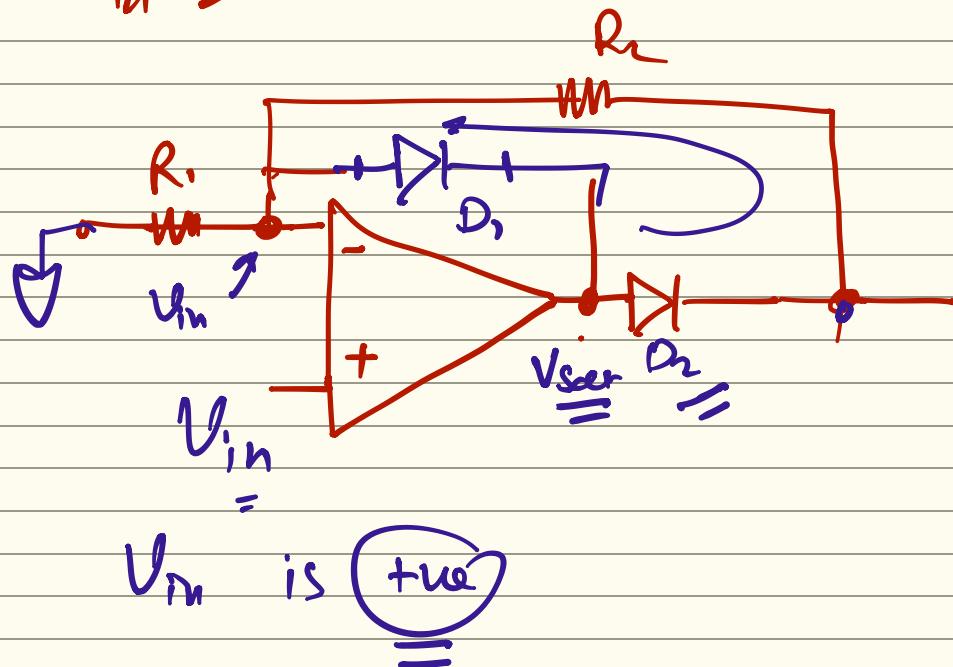
$$\Sigma = (R_f \parallel R_i) \cdot I_B$$

Analog Electronics

13 Feb



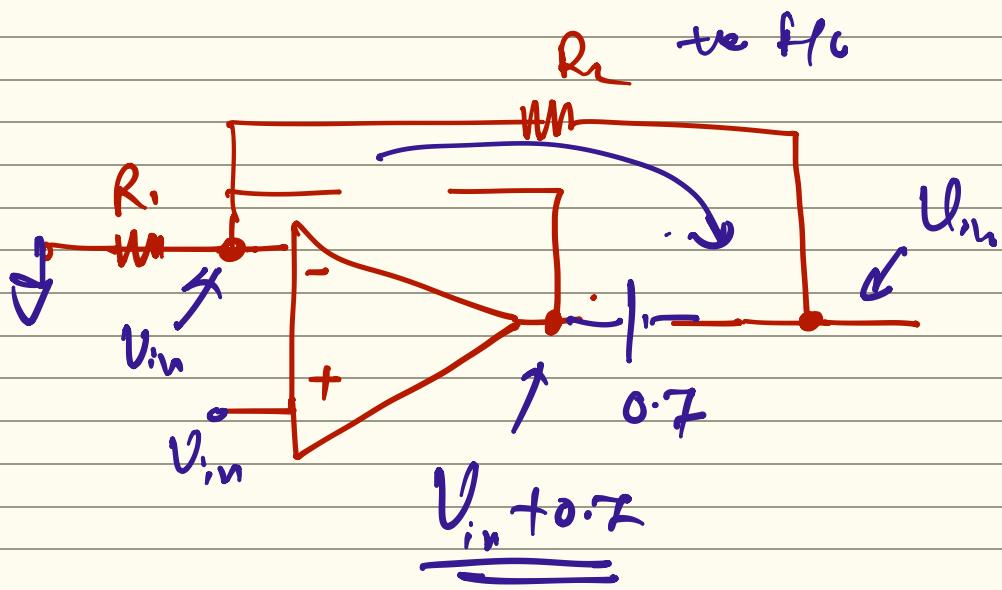
When $V_{in} > 0$

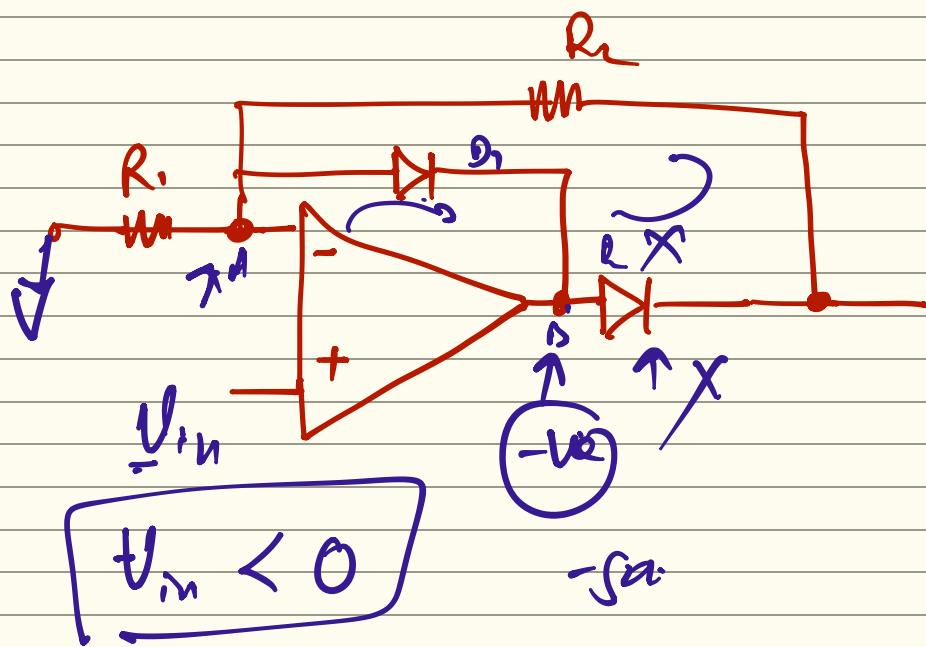


$$D_1 = R \cdot B$$

$$D_2 = f \cdot B$$

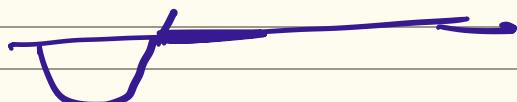
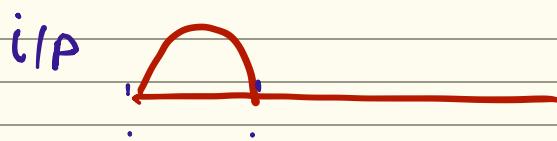
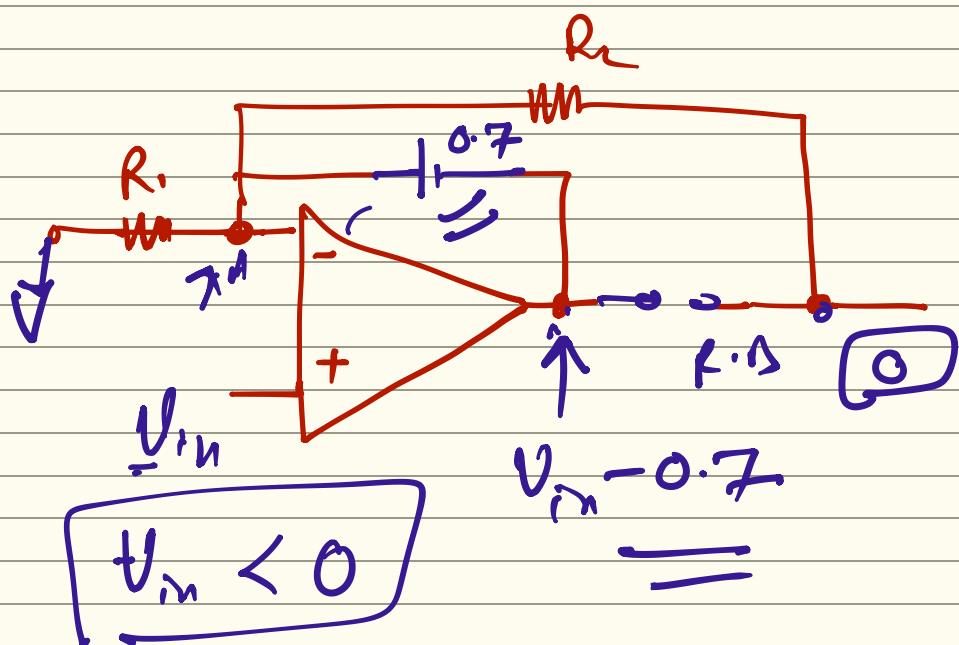
V_{in} is

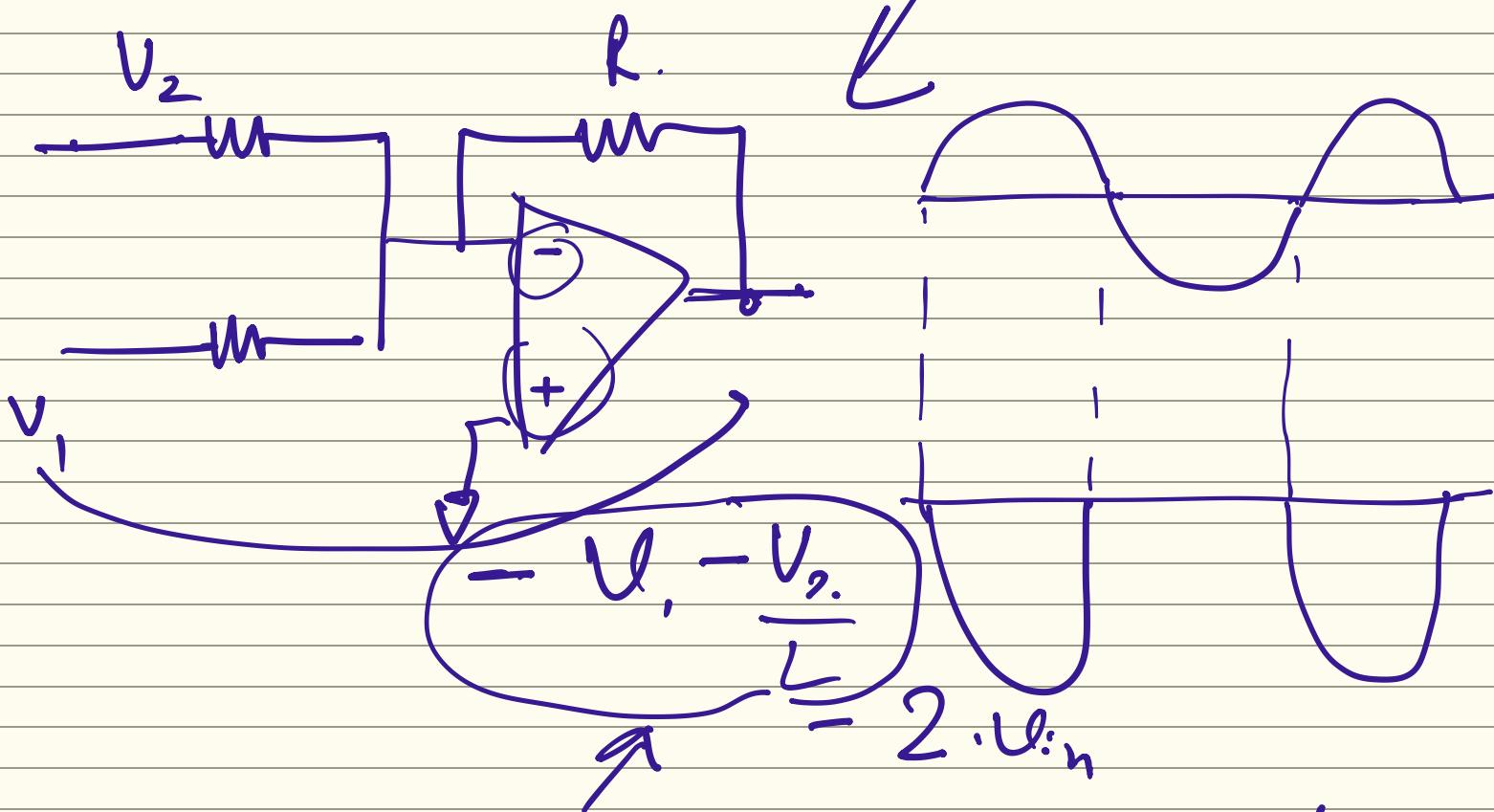
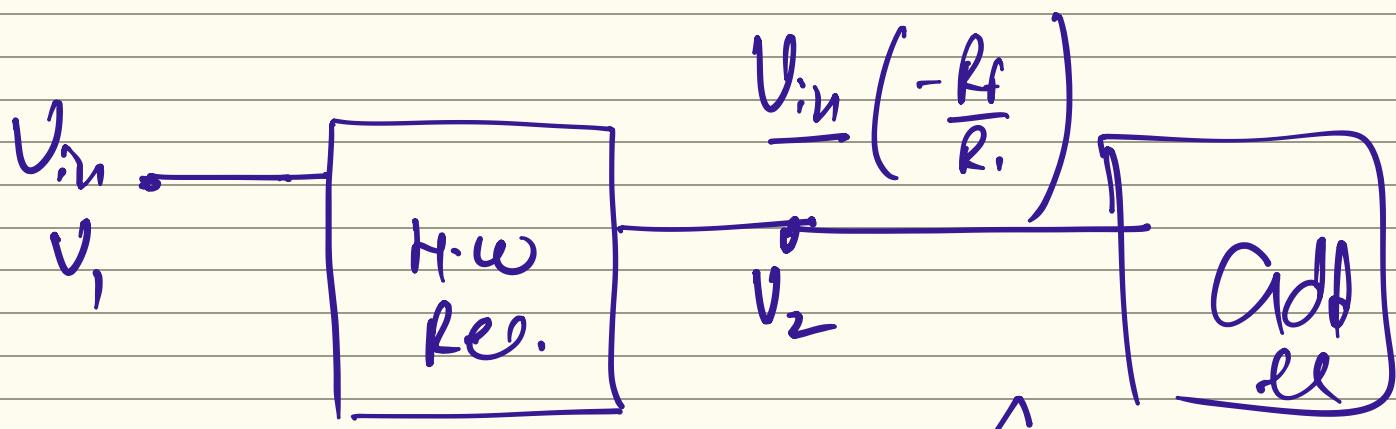




$$Q_1 = FB$$

$$Q_2 = R \cdot \eta$$

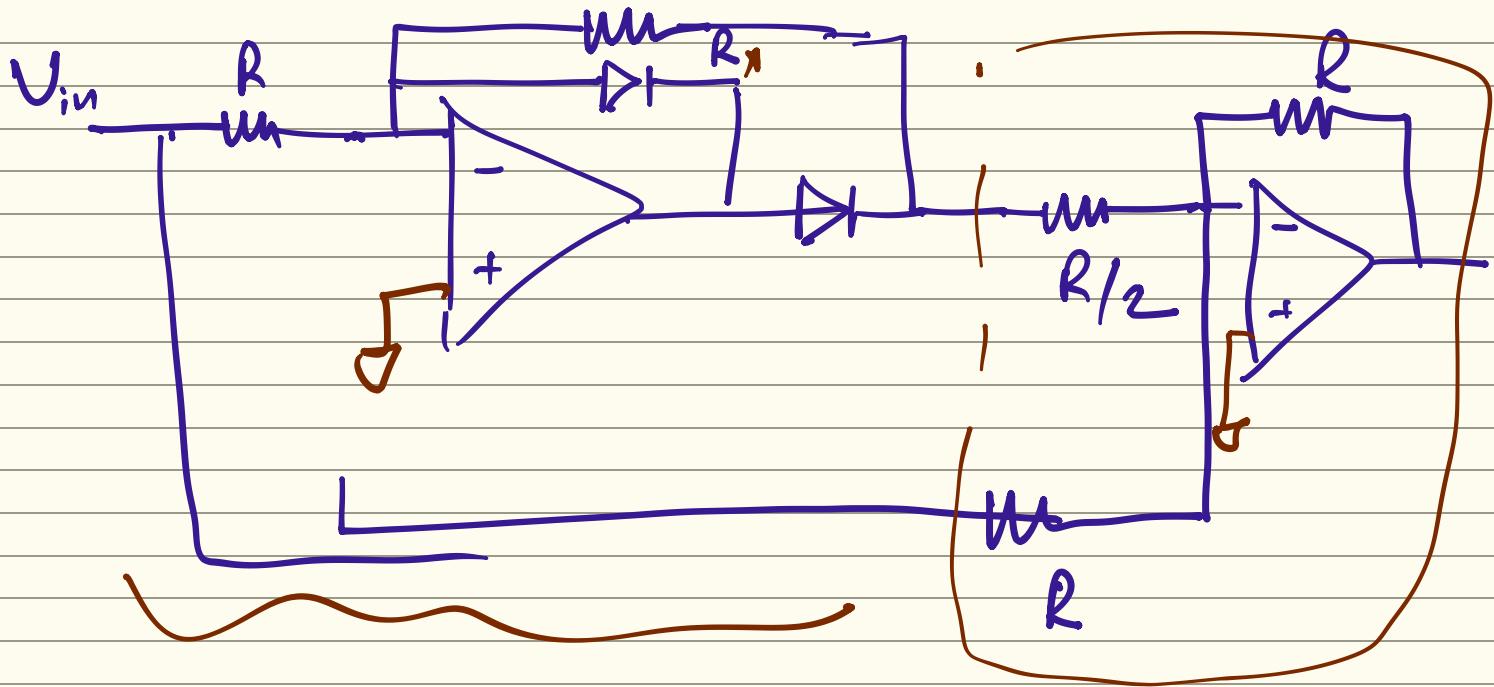




$$\Rightarrow -\frac{V_2}{2} = V_{in}$$

Waveforms:

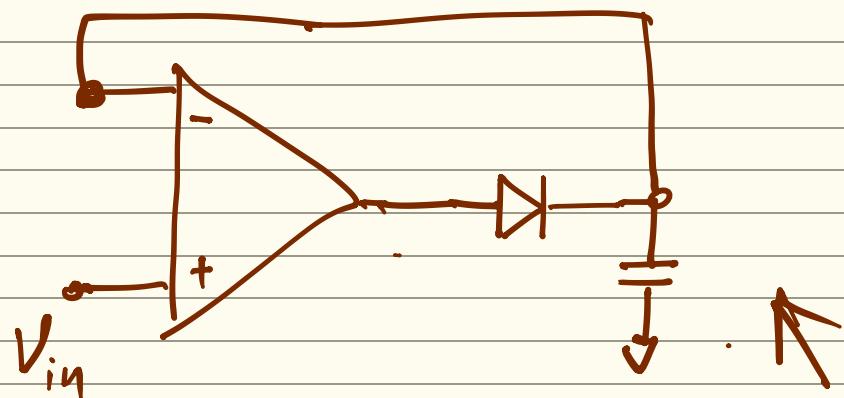
- Input voltage V_{in} : A square wave.
- Output V_2 : An inverted square wave.
- Feedback signal: A waveform that is zero during the high phase of V_{in} and reaches a maximum negative value during the low phase of V_{in} .
- Summing junction: A point where the feedback signal and the input signal are summed to produce the final output.
- Final output: The resulting square wave output.



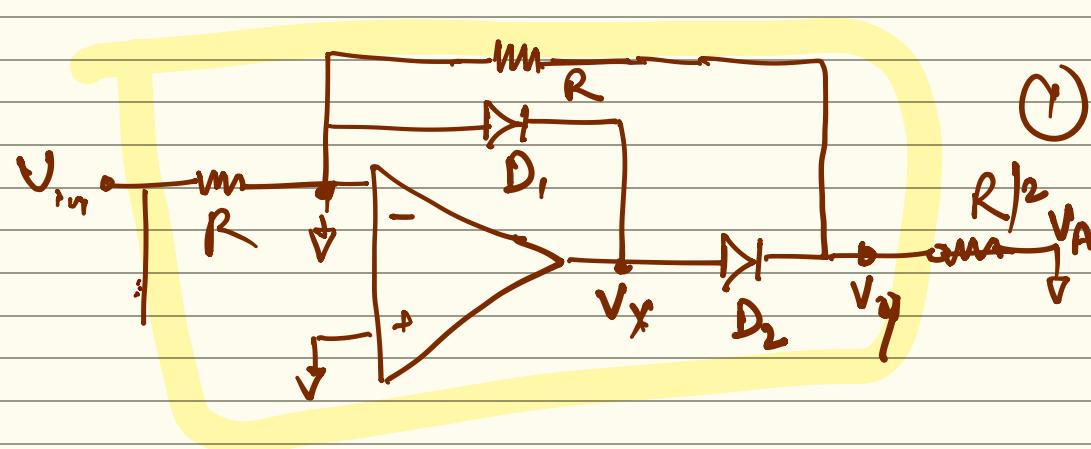
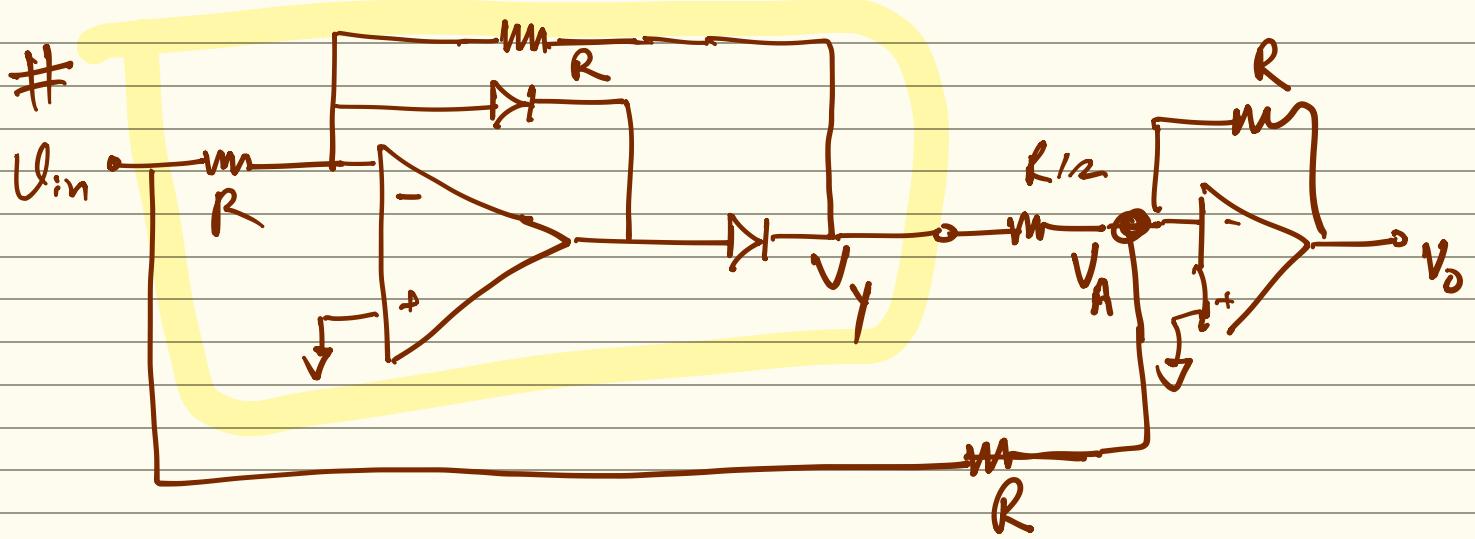
P. H. W. R.

adder

— no —



— el —



(1) When V_{in} is
 $-ve \Rightarrow V_x$ will
 be $+ve$
 $D_2 \rightarrow f.B$
 $D_1 \rightarrow R.B$

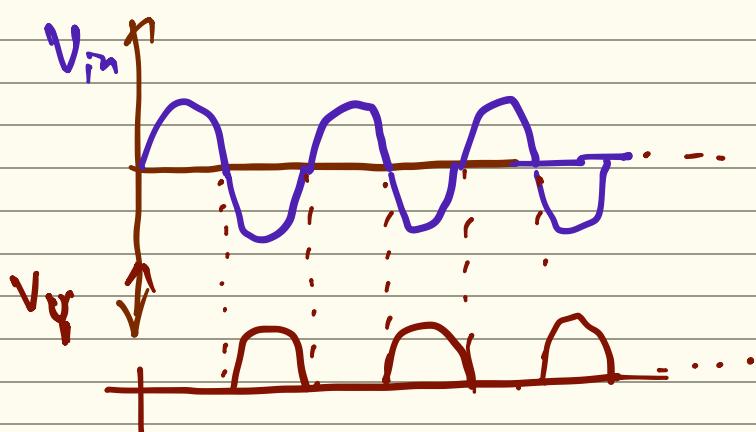
$$V_y = -\frac{R}{R} \cdot V_{in} = -V_{in}$$

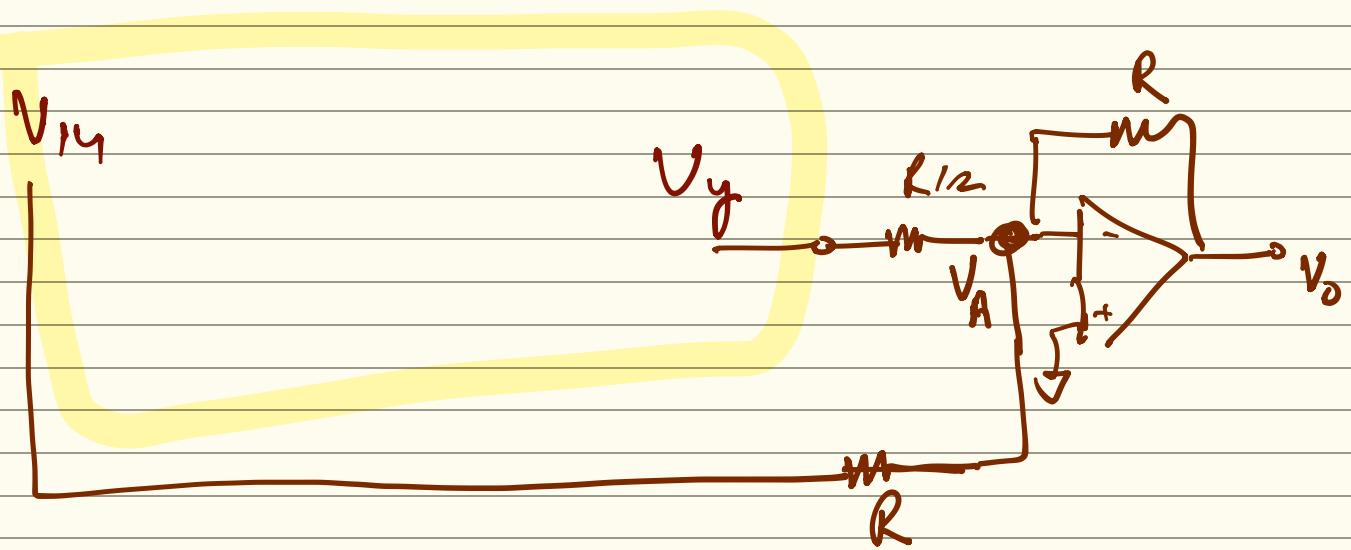
(2) When we have $V_{in} > 0$

V_x will be $-ve \Rightarrow D_2$ will be $R.B$
 D_1 will be $f.B$

$$\boxed{V_y = 0}$$

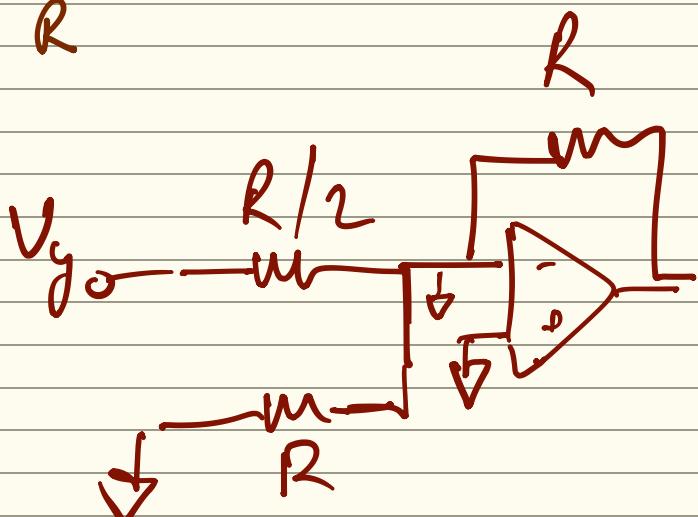
hence we will get inverted $-ve$ half of the
 in peer from 1'st part of the circuit



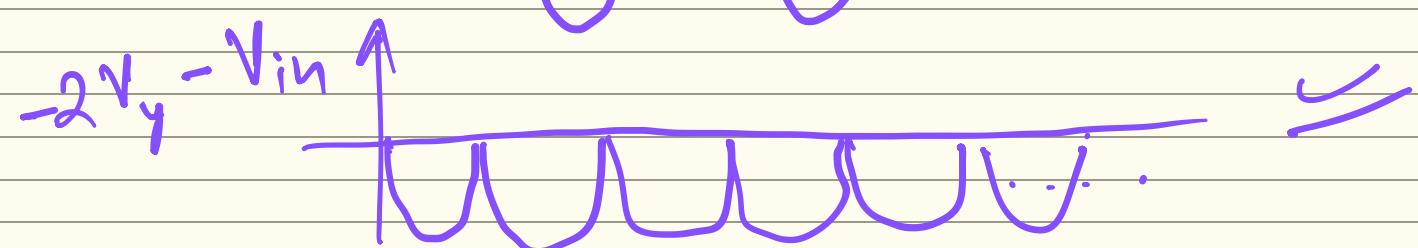
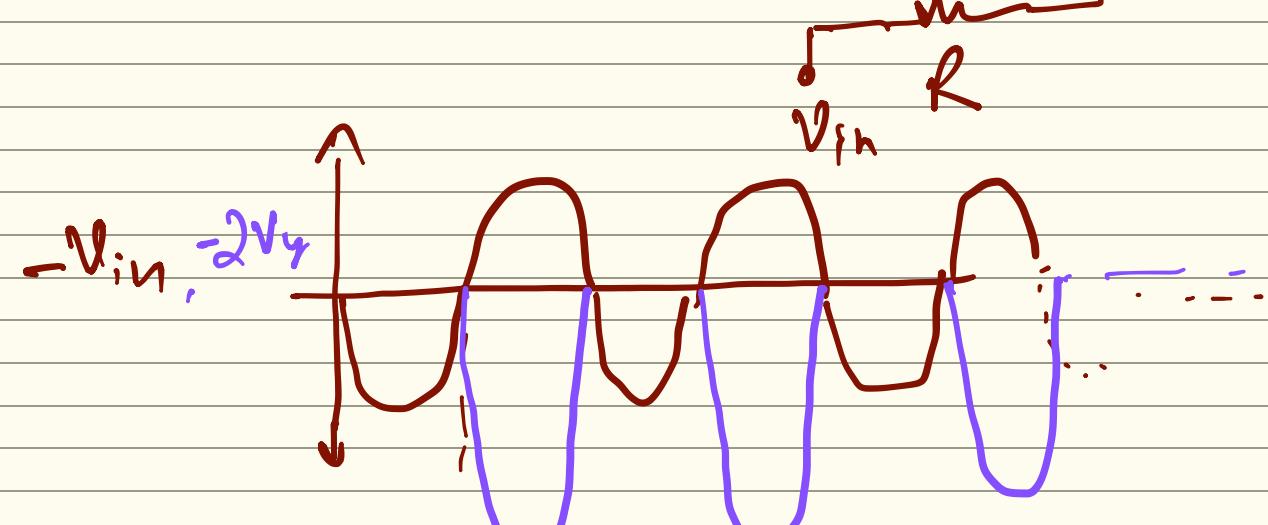
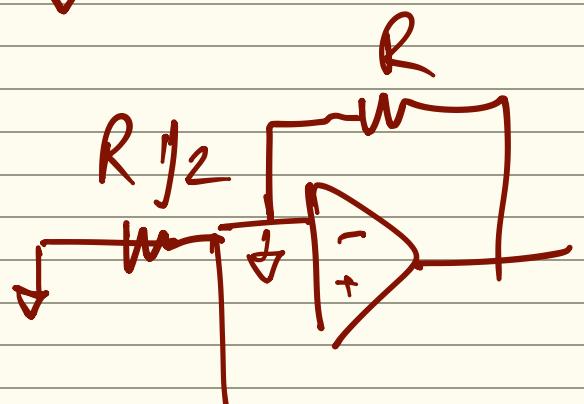


$$V_O =$$

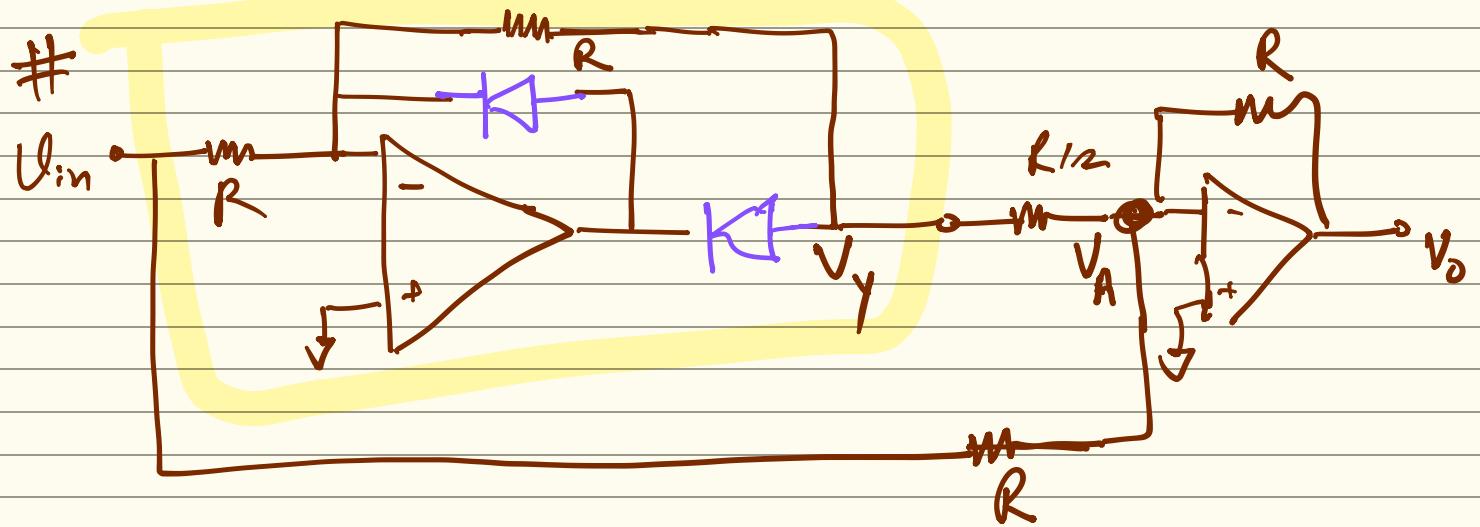
$$- V_Y \cdot \frac{R}{R_{12}} - V_{in} \frac{R}{R}$$



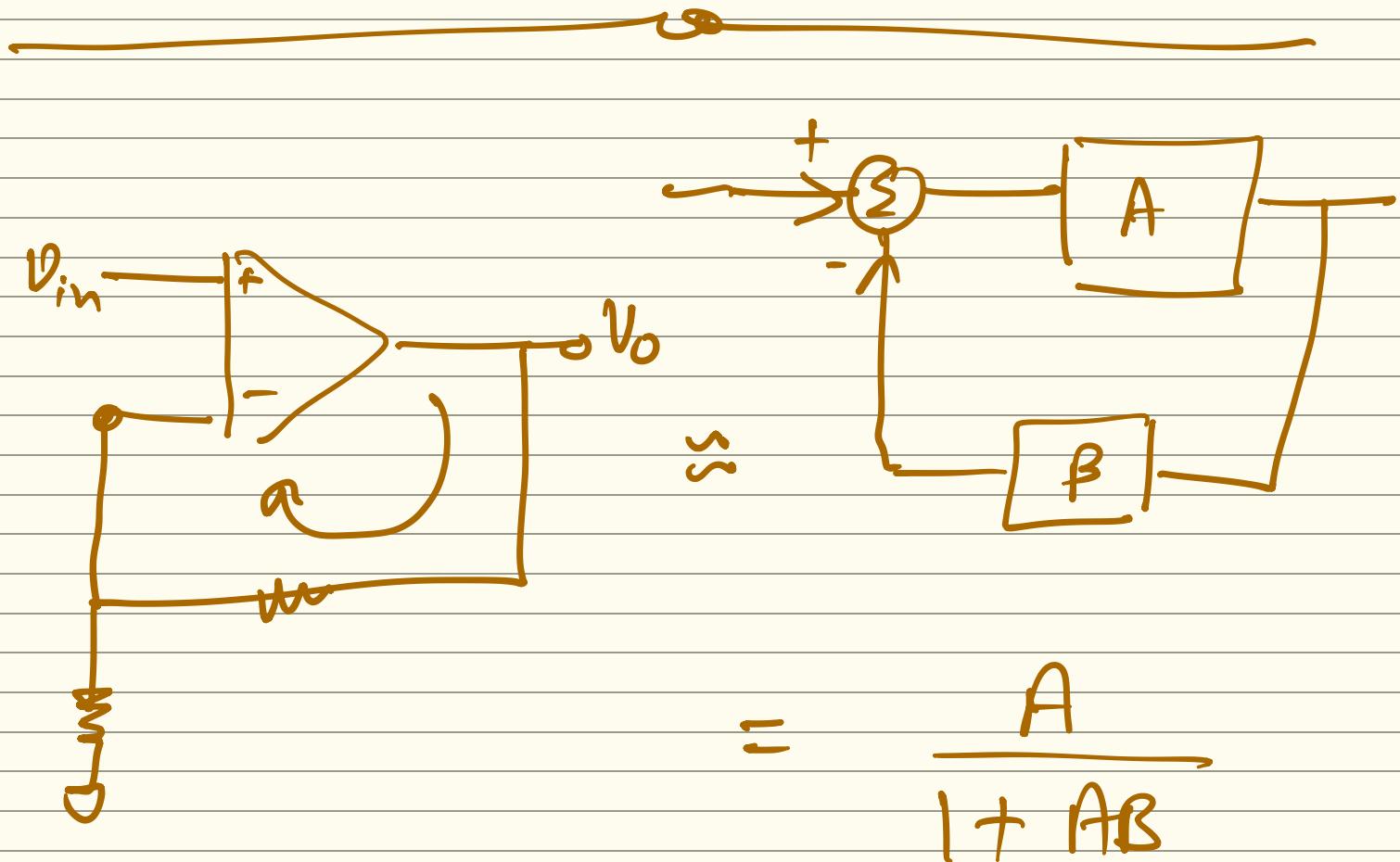
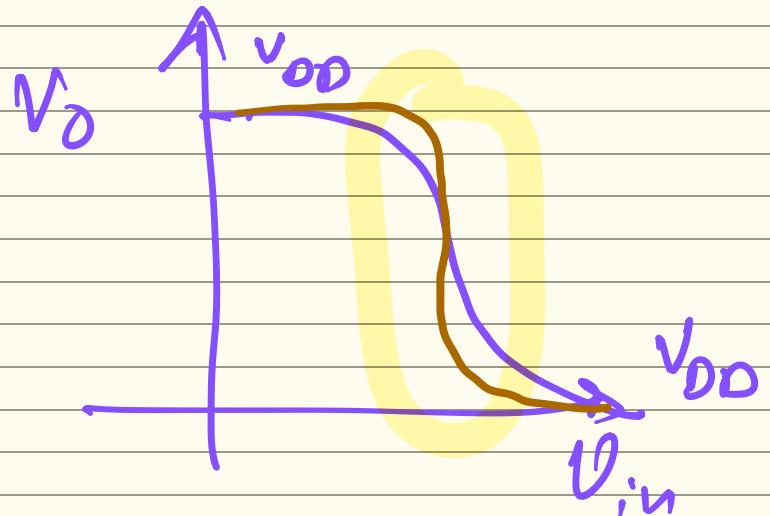
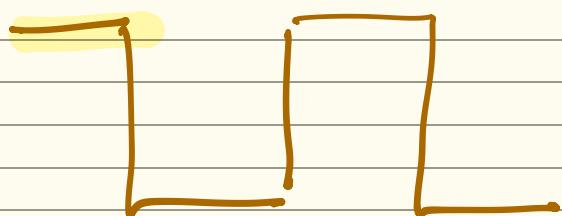
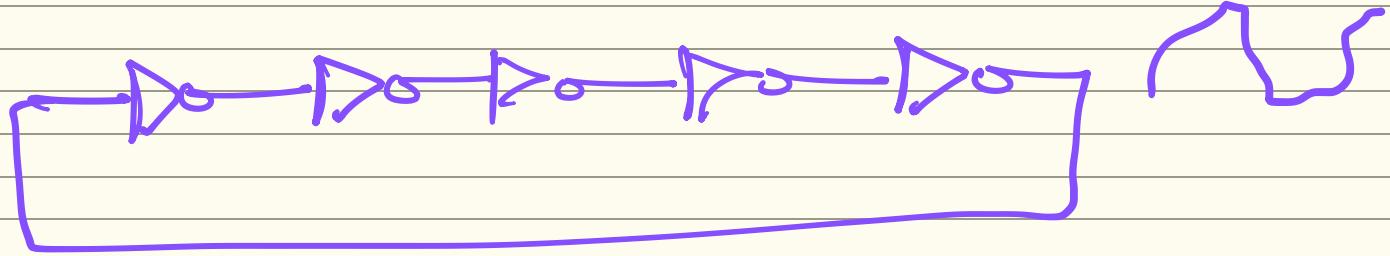
$$= -2V_Y - V_{in}$$

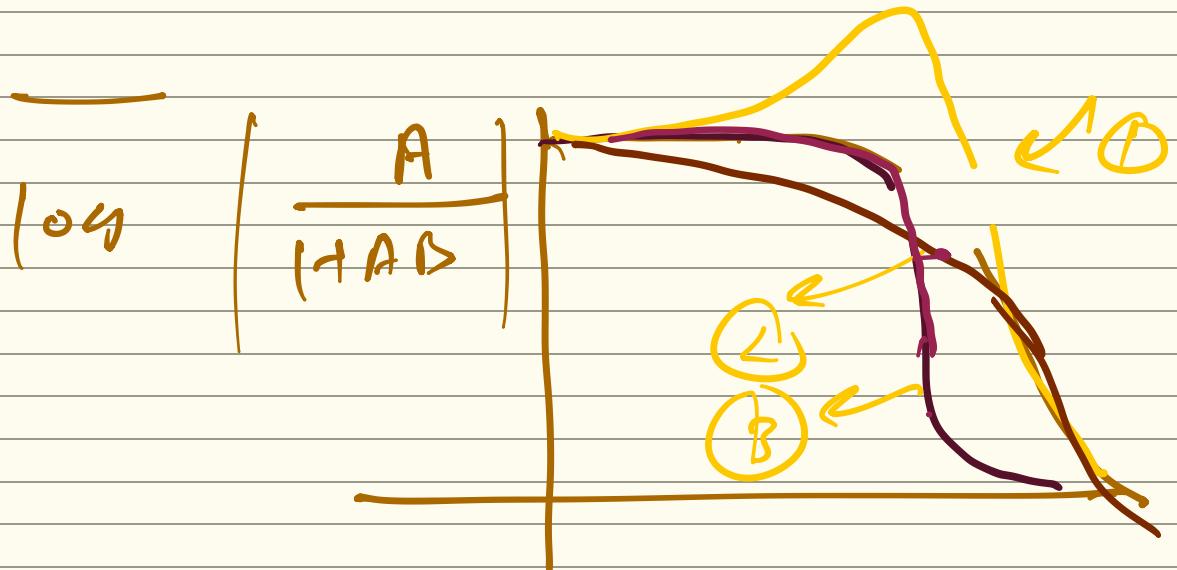


Try This →



co ce

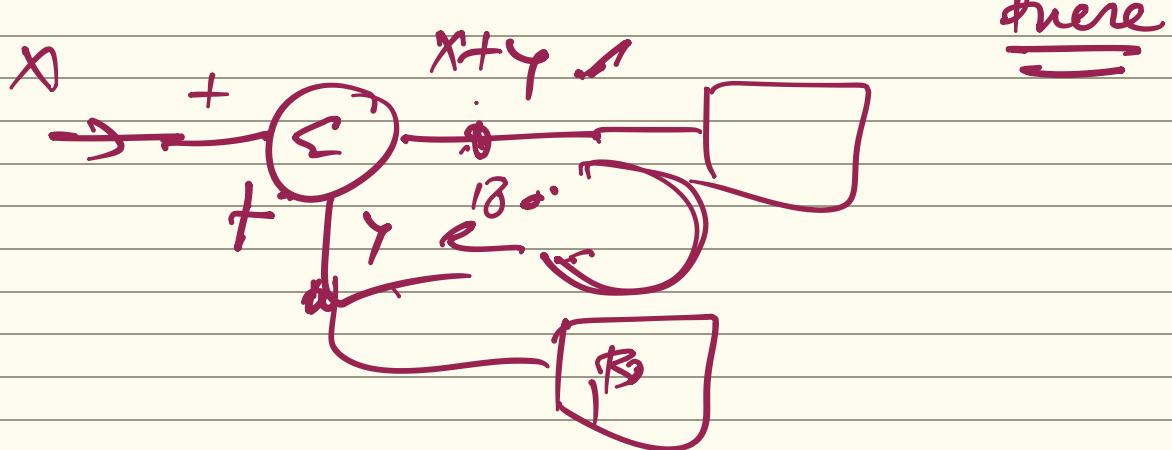




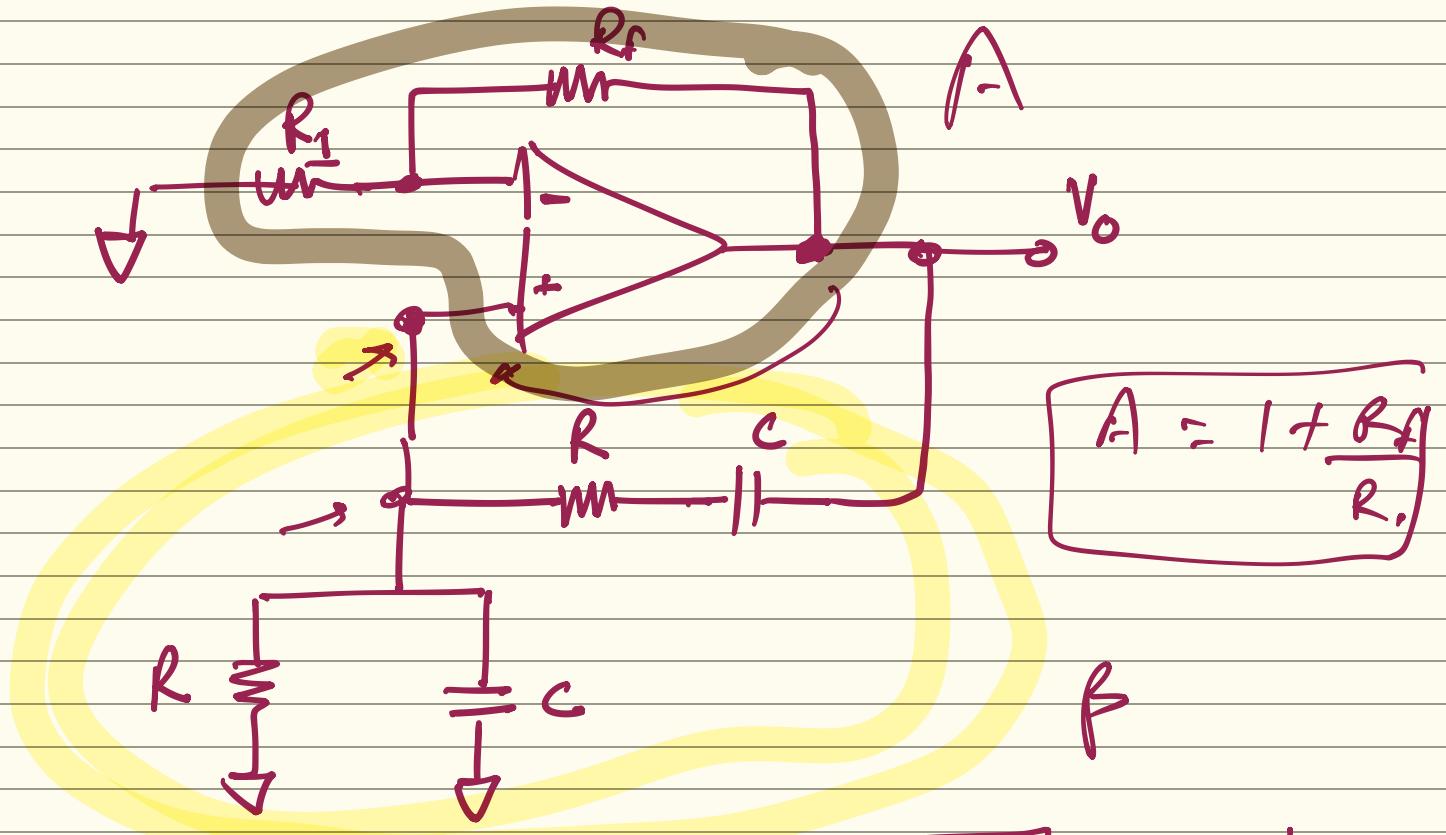
Condition: for oscillation

$\angle AOB = \pm 180^\circ \quad \} \rightarrow \text{when the } f_{16} \text{ is there}$

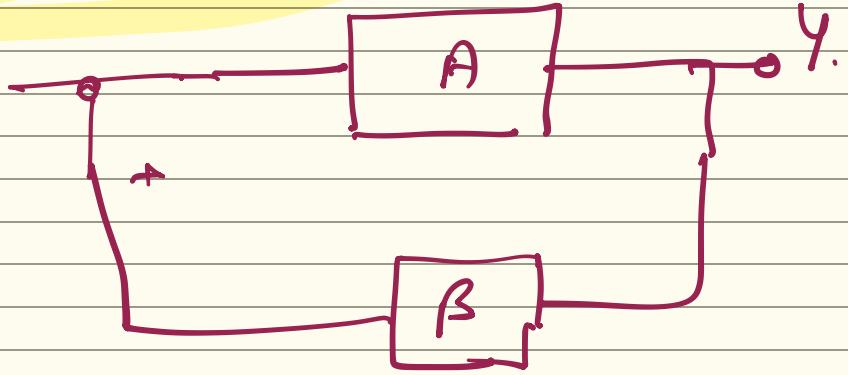
otherwise $\angle AOB = 0^\circ \text{ or } 360^\circ \quad \} \text{ when the } f_{16} \text{ is there}$



Wein Bridge Oscillator

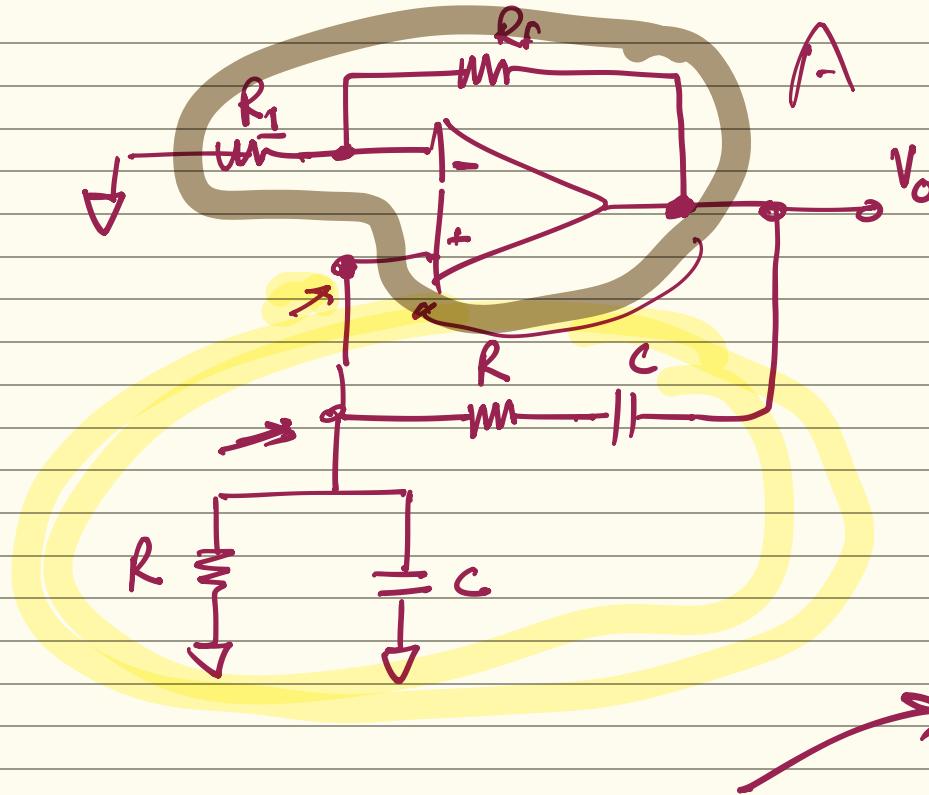


$$\frac{A}{1 - AB}$$



$$|AB| = 1$$

$$\angle A\beta = 0^\circ$$



$$A \cdot \beta = 1$$

$$\angle A\beta = 0^\circ$$

$$\Rightarrow A(\omega) \cdot \beta = 1 + C \cdot j$$

$$\beta = \frac{V_o \cdot R}{(RSC + 1)}$$

$$\frac{R}{(RSC + 1)} + \frac{SCR + L}{SC}$$

$$= \frac{V_o \cdot R \cdot SC}{RSC + (RSC + 1)^2}$$

$$\frac{V_P}{R} \left(\frac{1}{R} + \frac{1}{C} \right) = \frac{V_o \cdot RSC}{RSC + 2RSC + R^2C^2S^2 + 1}$$

$$\beta = \frac{RSC}{RSC + 2RSC + R^2C^2s^2 + 1}$$

$$A\beta = \left(1 + \frac{R_f}{R_i}\right) \left\{ \frac{RSC}{3RSC + R^2C^2s^2 + 1} \right\}$$

$$(1+0j) = \left(1 + \frac{R_f}{R_i}\right) \left\{ \frac{j\omega RC}{3j\omega RC + 1 - R^2C^2\omega^2} \right\}$$

$$\underbrace{3j\omega RC + 1 - \omega^2 R^2 C^2}_{Im} = \left(1 + \frac{R_f}{R_i}\right) \underbrace{j\omega RC}_{Im}$$

$$1 - \omega^2 R^2 C^2 = 0$$

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

$$f = \frac{1}{2\pi RC}$$



$$\underbrace{3j\omega R_C}_{Im} = \left(1 + \frac{R_f}{R_i}\right) \underbrace{j\omega R_C}_{Im}$$

$$\underbrace{3\omega R_C}_{Im} = \left(1 + \frac{R_f}{R_i}\right) \omega R_C$$

$$3 = \left(1 + \frac{R_f}{R_i}\right) \cdot 1$$

$$\boxed{\frac{R_f}{R_i} = 2} \quad \Leftarrow$$