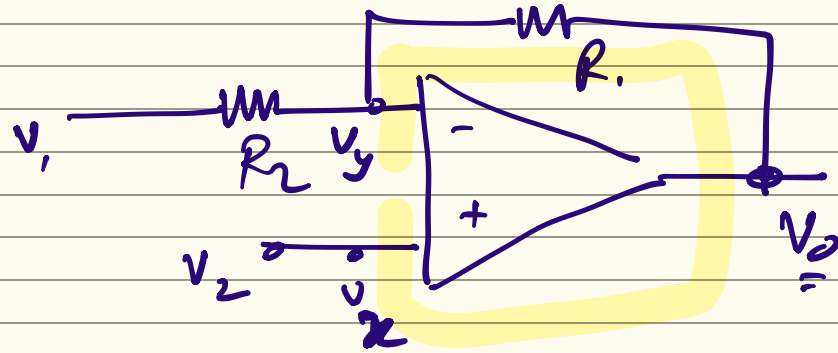
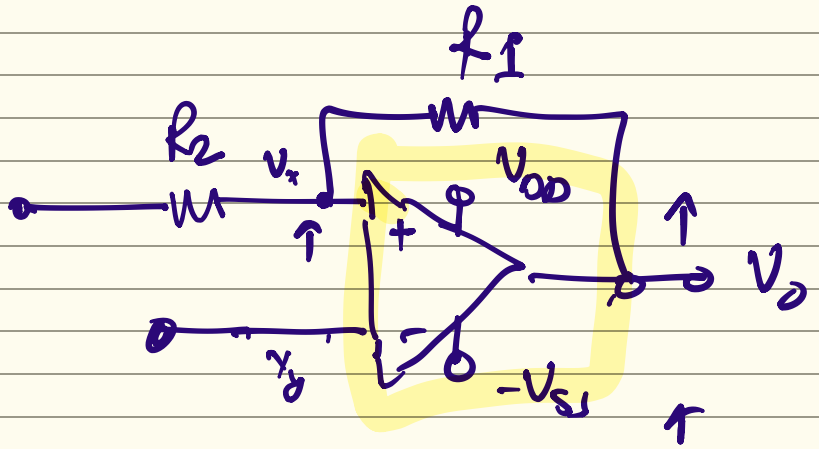
Analog Elec

FEB-03

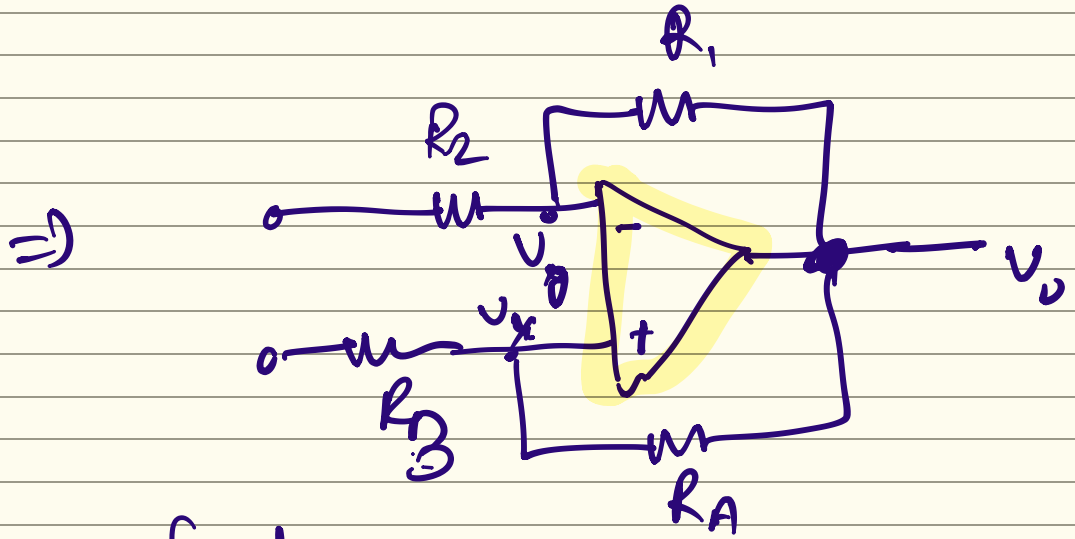


$$V_o = \frac{-R_1}{R_2} V_{in}$$

$$V_o = \left(1 + \frac{R_1}{R_2}\right) V_{in}$$



$$A(V_x - V_y) = V_o$$



+ve feedback $\beta_+ = \frac{R_B}{R_B + R_A}$ for $\frac{R_2}{R_2 + 1}$ -ve feedback

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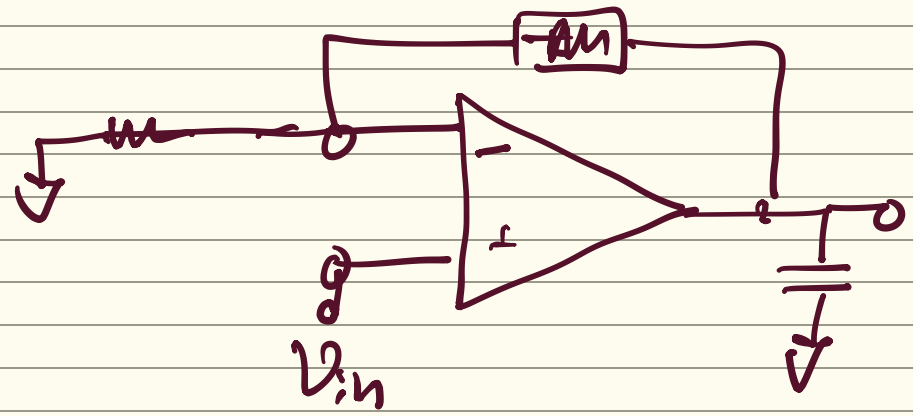
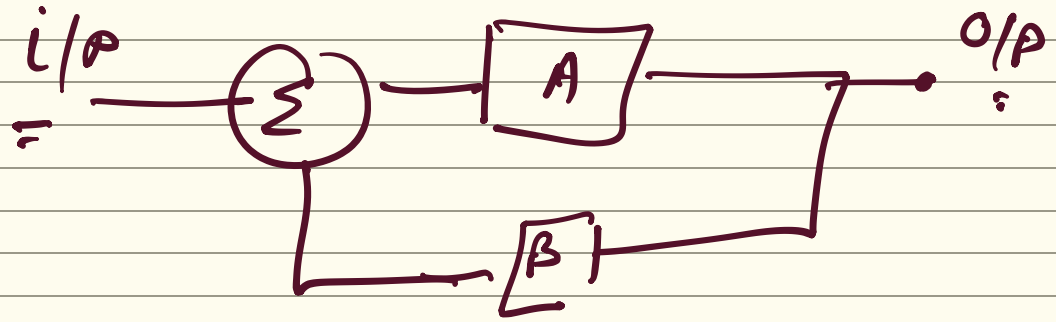
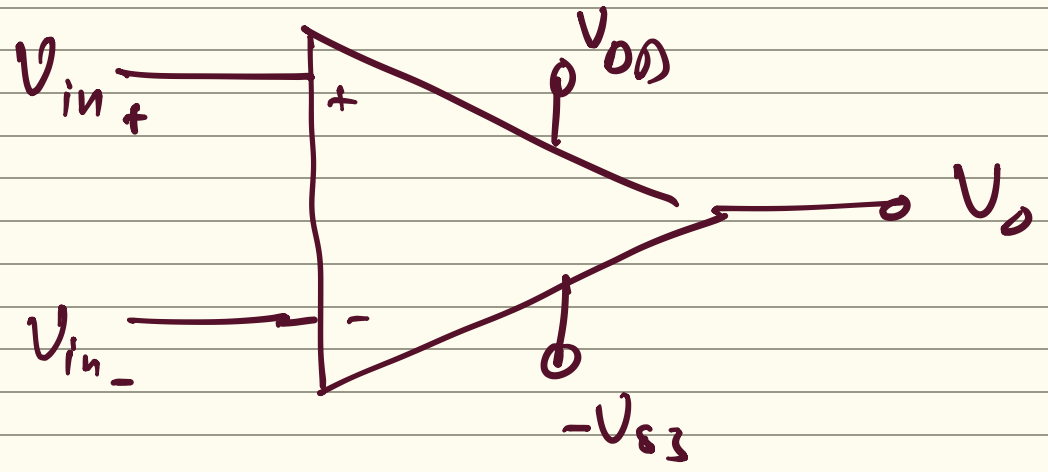


$$\frac{A}{1+\frac{s}{a}} \quad ; \quad a = B \cdot \omega_{op.}$$

$$\frac{\frac{A}{1+AB}}{1+\frac{s}{a(1+AB)}} \quad ; \quad a(AB+1) = B\omega_{CL}$$

(-ve) feed back



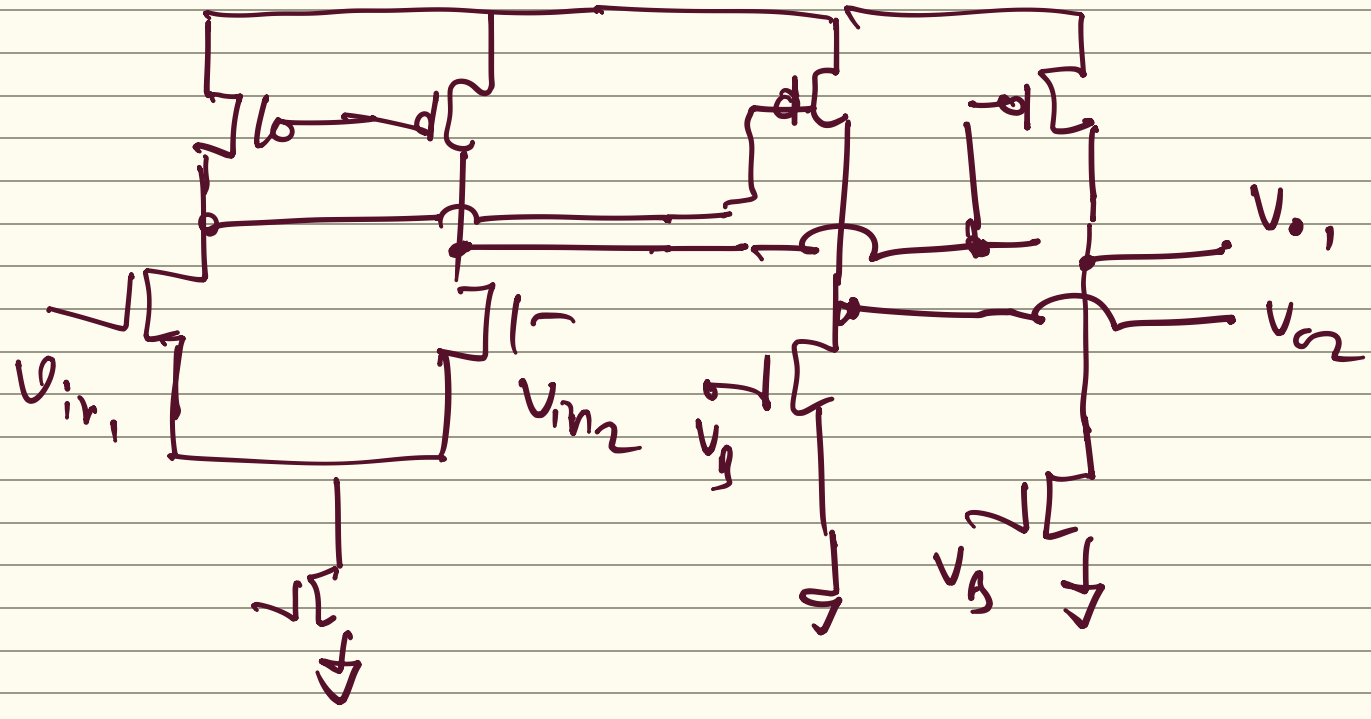


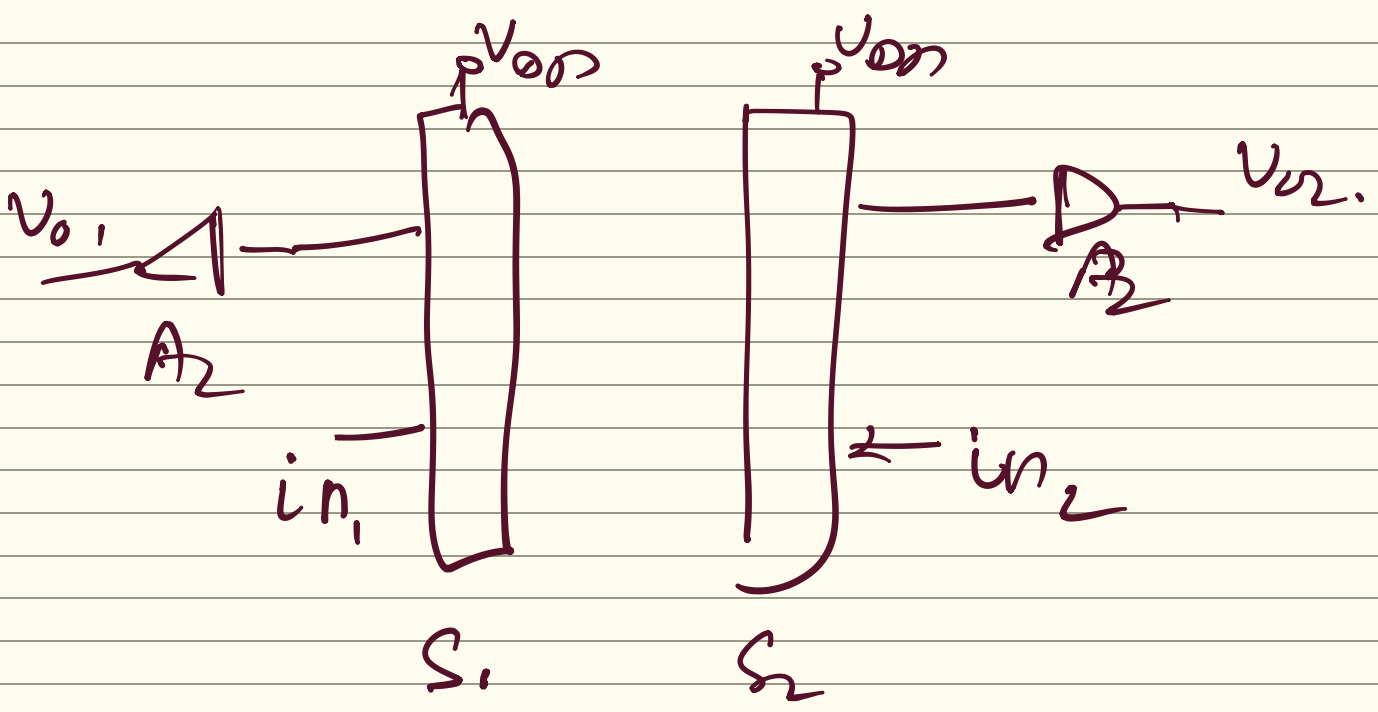
$$A\left(V_{in+} - V_{in-}\right) = V_o$$

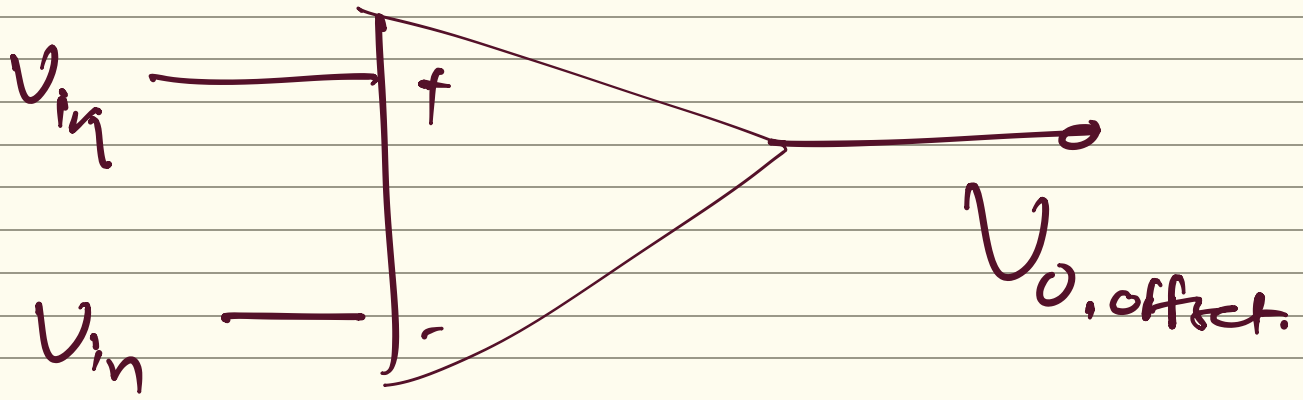
$\Rightarrow$ when $V_{in+} = V_{in-}$

then ?

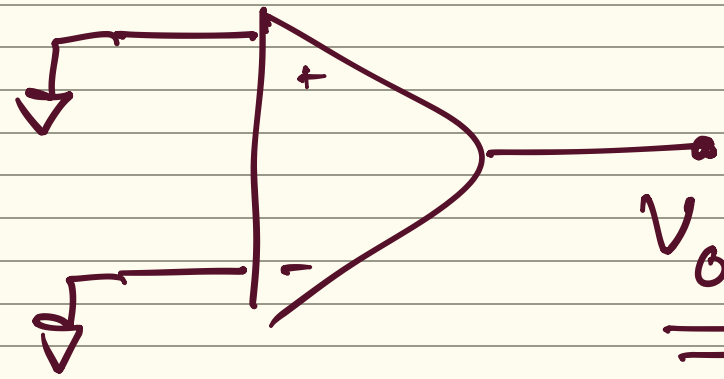
$V_o = ? = 0 \quad \infty$





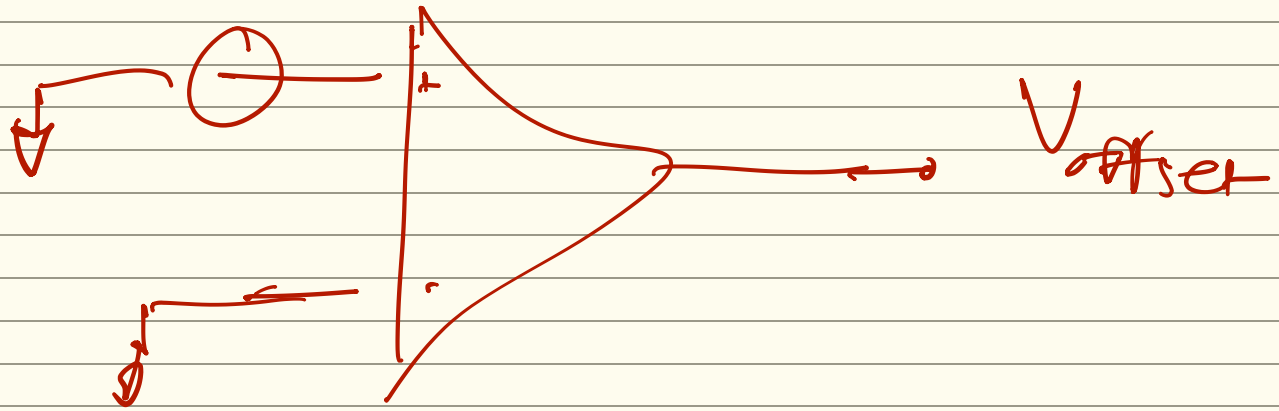


$$A\left(V_{in} - V_{in}\right) \neq 0$$

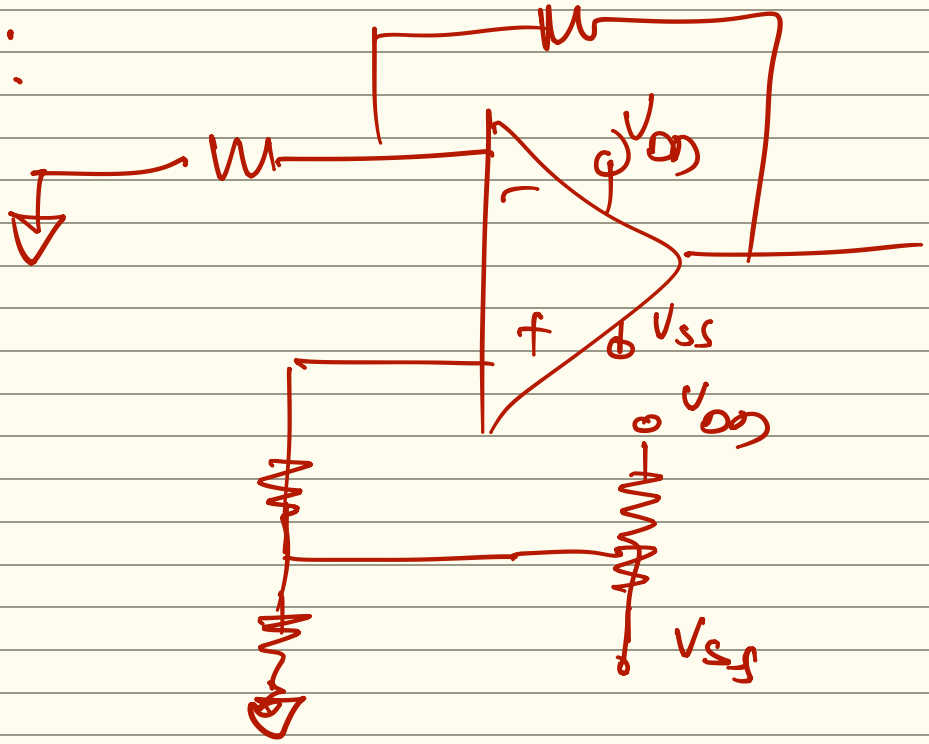


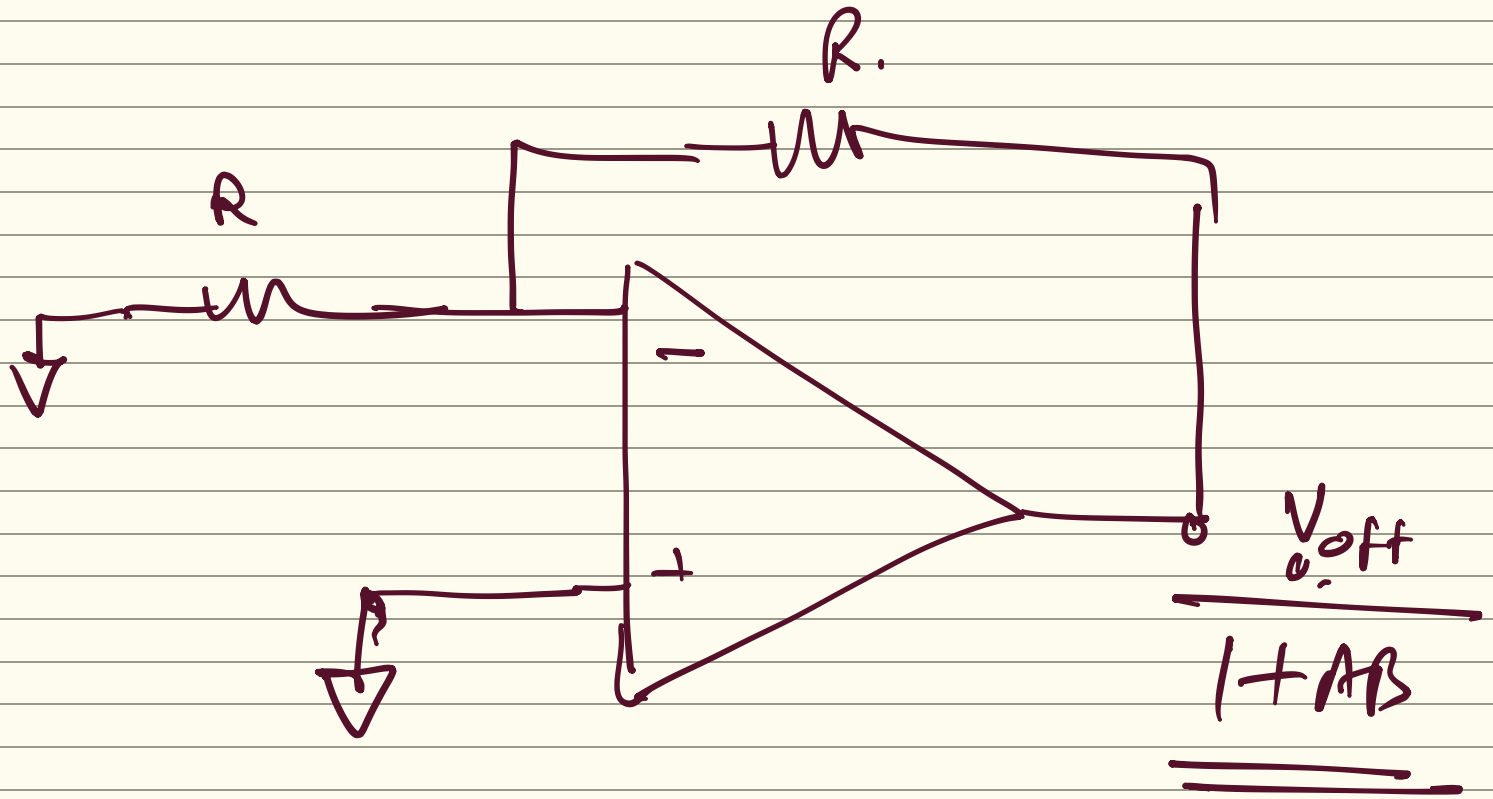
$V_{o,off}$ = Due to Mismatch / other reasons

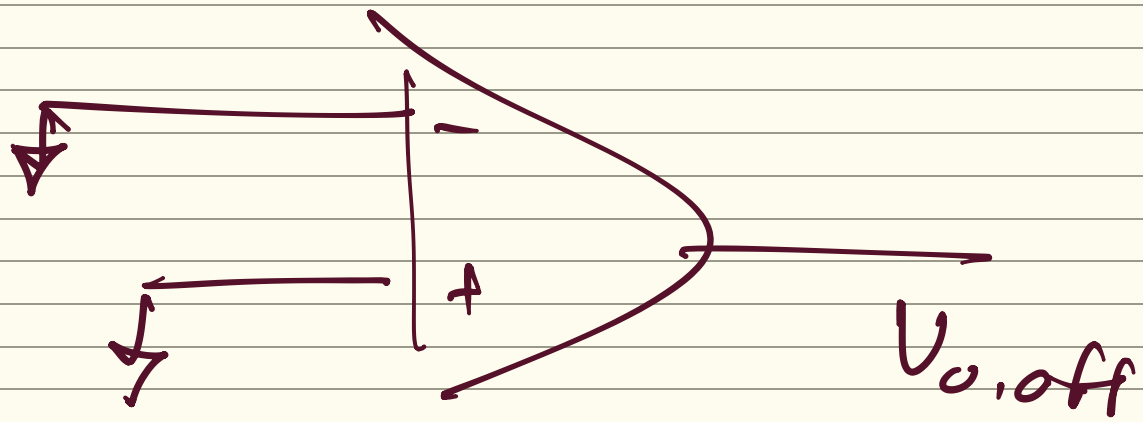
$V_{off/A} = V_{i,off}$



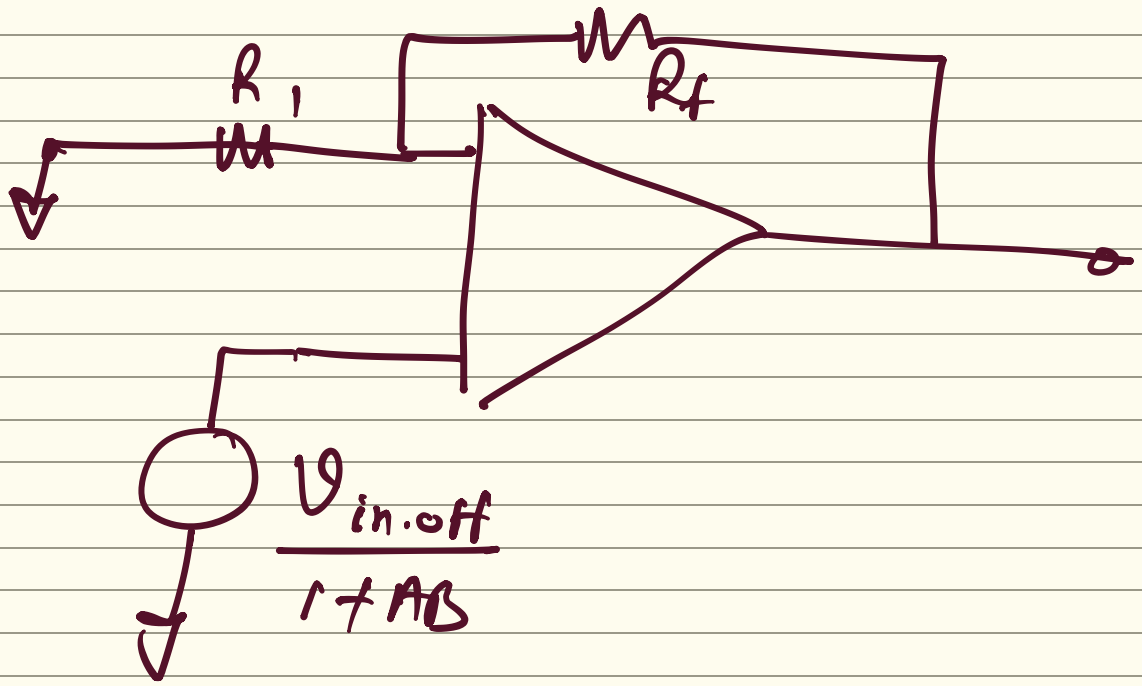
Correction:







$$V_{o,off,fb} = \frac{V_{o,off,ol}}{1+AB}$$



input referred Noise

$\Rightarrow$ $\frac{\text{o/p Noise}}{A_{OL}}$

i/p $>>$ $N_{\text{i/p referred}}$

High gain →

↓ Better stability (-ve feedback)

↓ Linearity -ve f/b

↓ low i/p referred Noise

↓ Better B.W (-ve f/b)

↓ low i/p offset

Analog Elx

6 Feb

Ckts "opamp Based"

integrator ✓

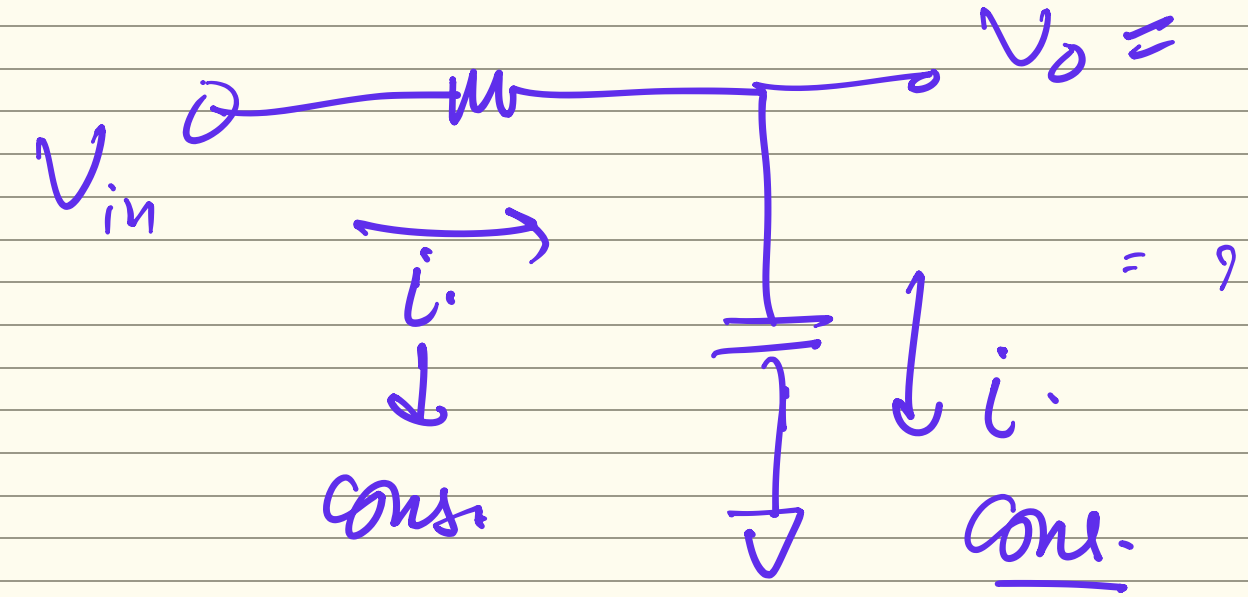
Differentiator ✓

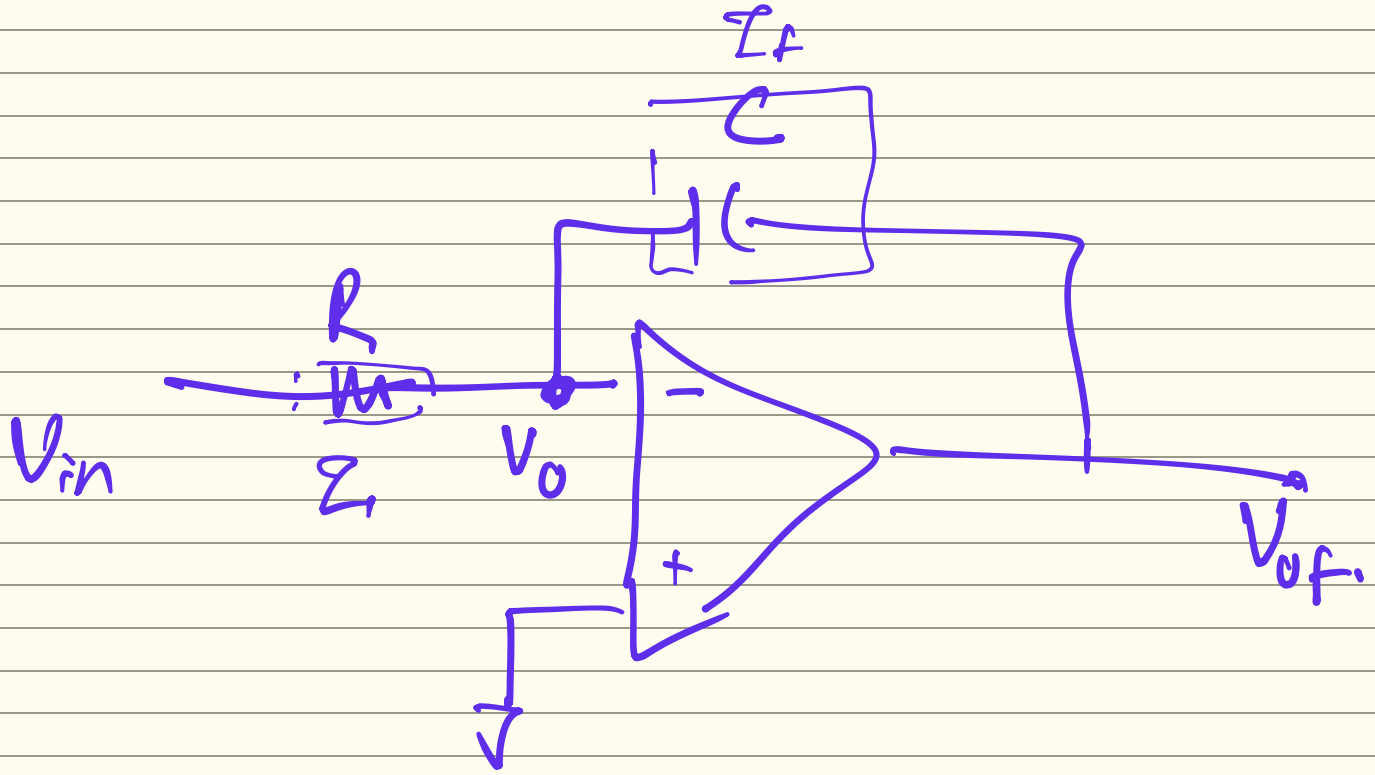
Precision amplifiers ✓

Wave form generators ✓

#

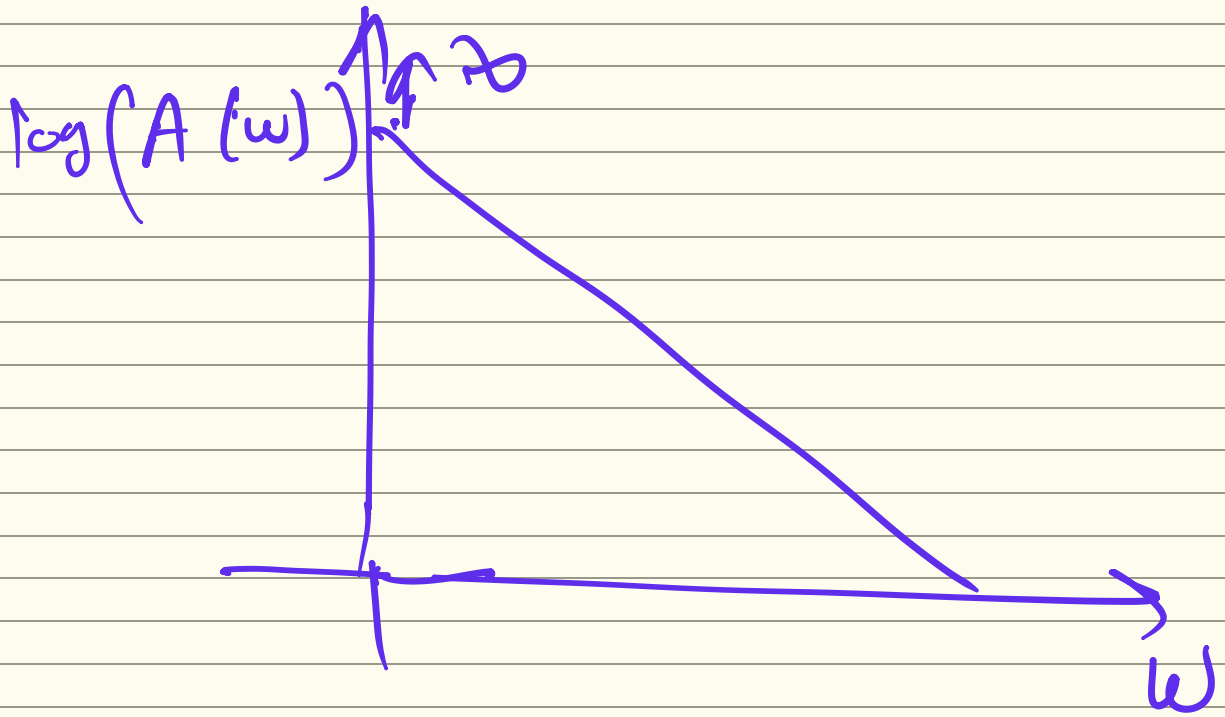
Integrator

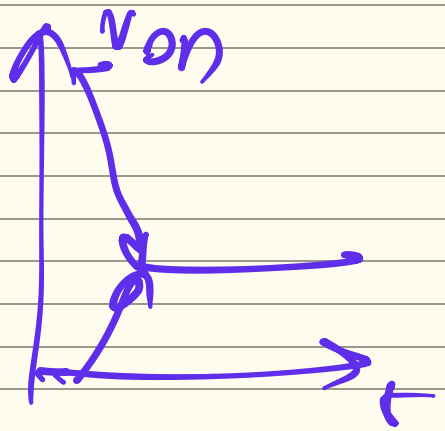


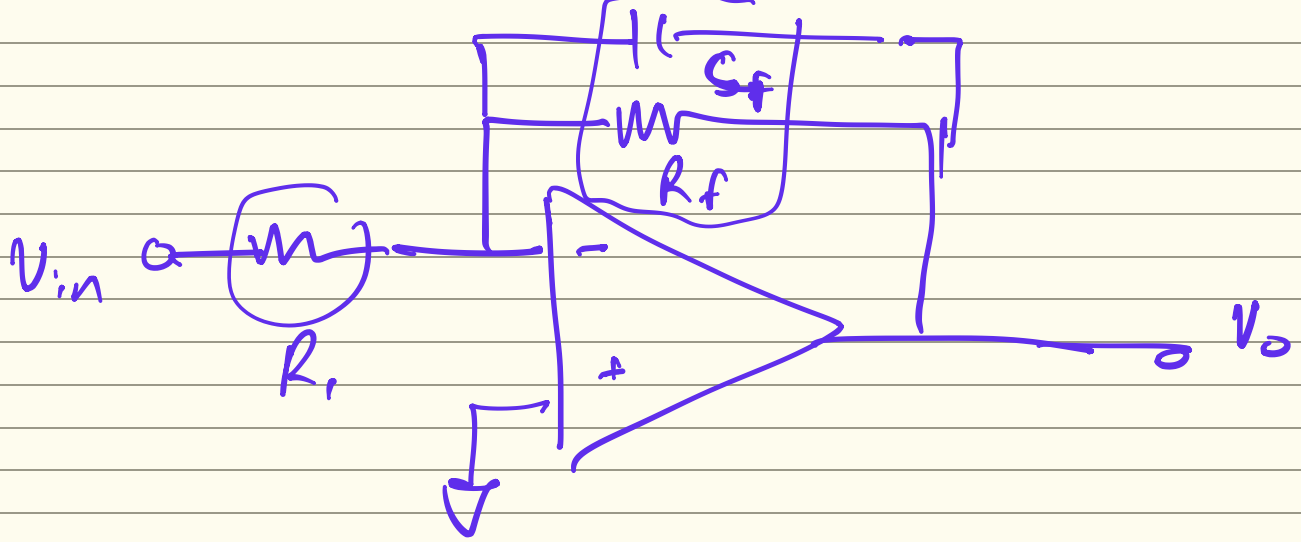


$$V_{of} = -\frac{1}{sC \cdot R} \mathcal{V}_{in}(t) = -\frac{I_f}{I_1} \mathcal{V}_{in}(t)$$

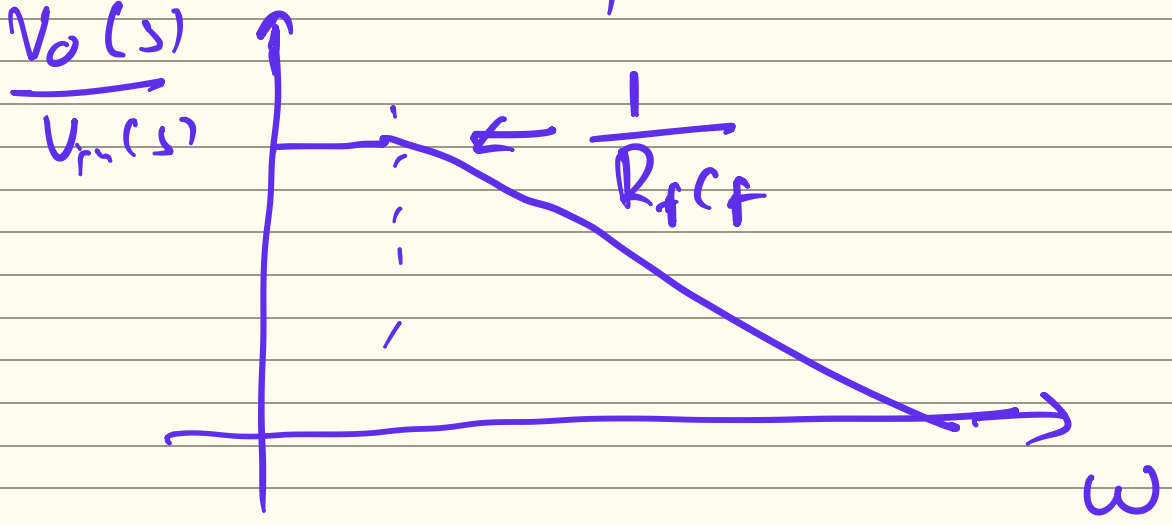
$$\frac{V_o(s)}{V_{in}(s)} = \frac{1}{sC \cdot R}$$



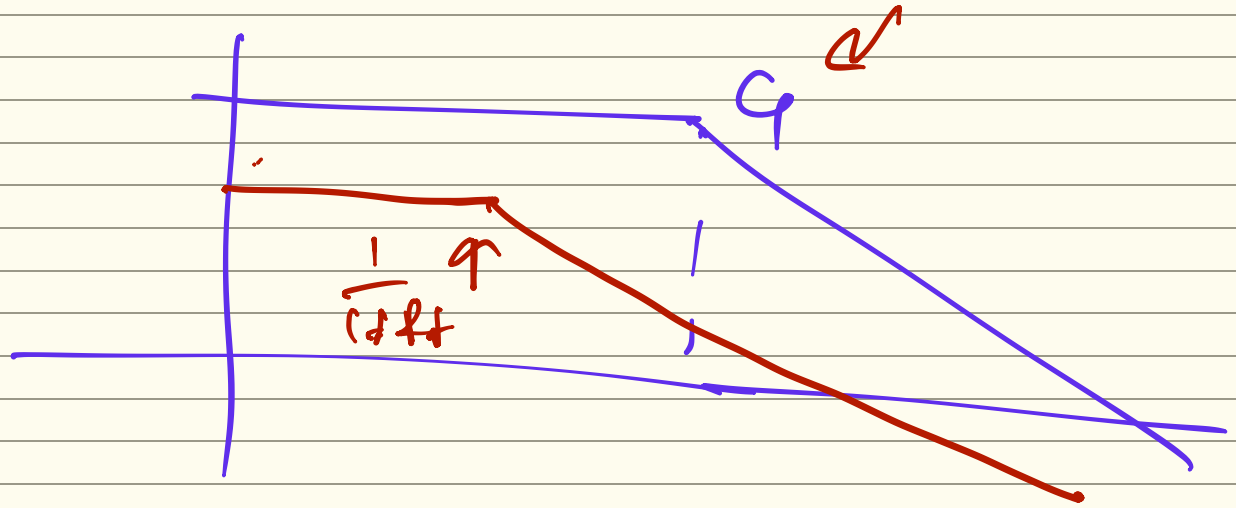




$$\frac{V_o(s)}{V_{in}(s)} = \frac{1}{(R_f s C_f + 1) \cdot R_1}$$



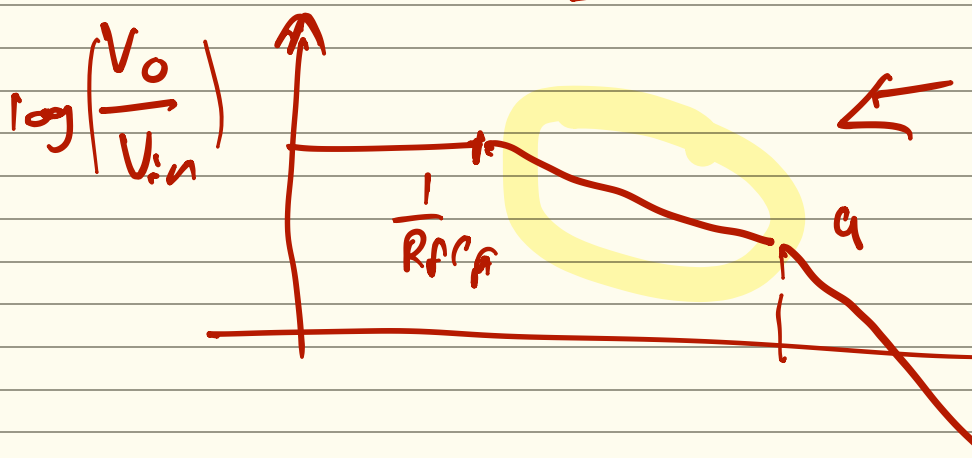
$$\frac{A}{\left(1+\frac{s}{a}\right)}$$



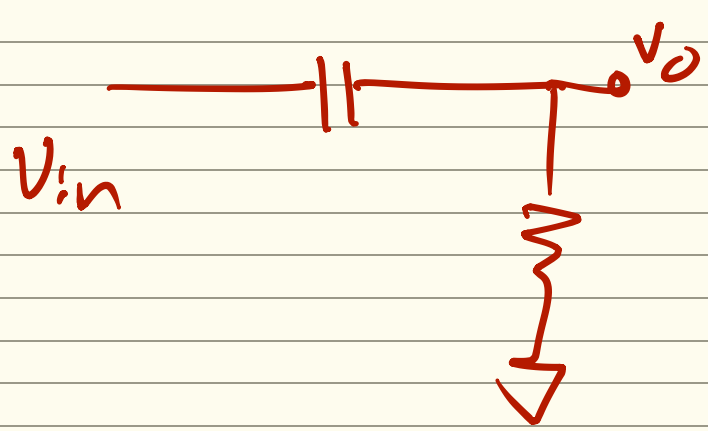
$$\frac{V_o}{V_{in}} = \frac{1}{(R_f C_f s + 1) R_1 \left(1+\frac{s}{a}\right)}$$

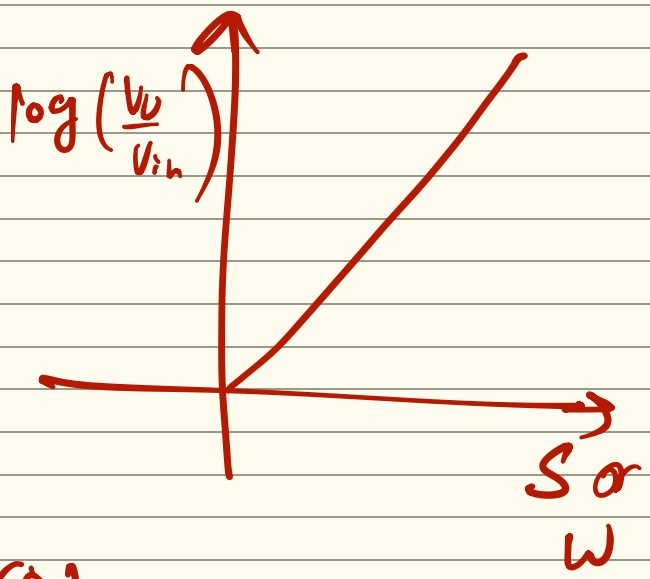
int.

B.W opamp

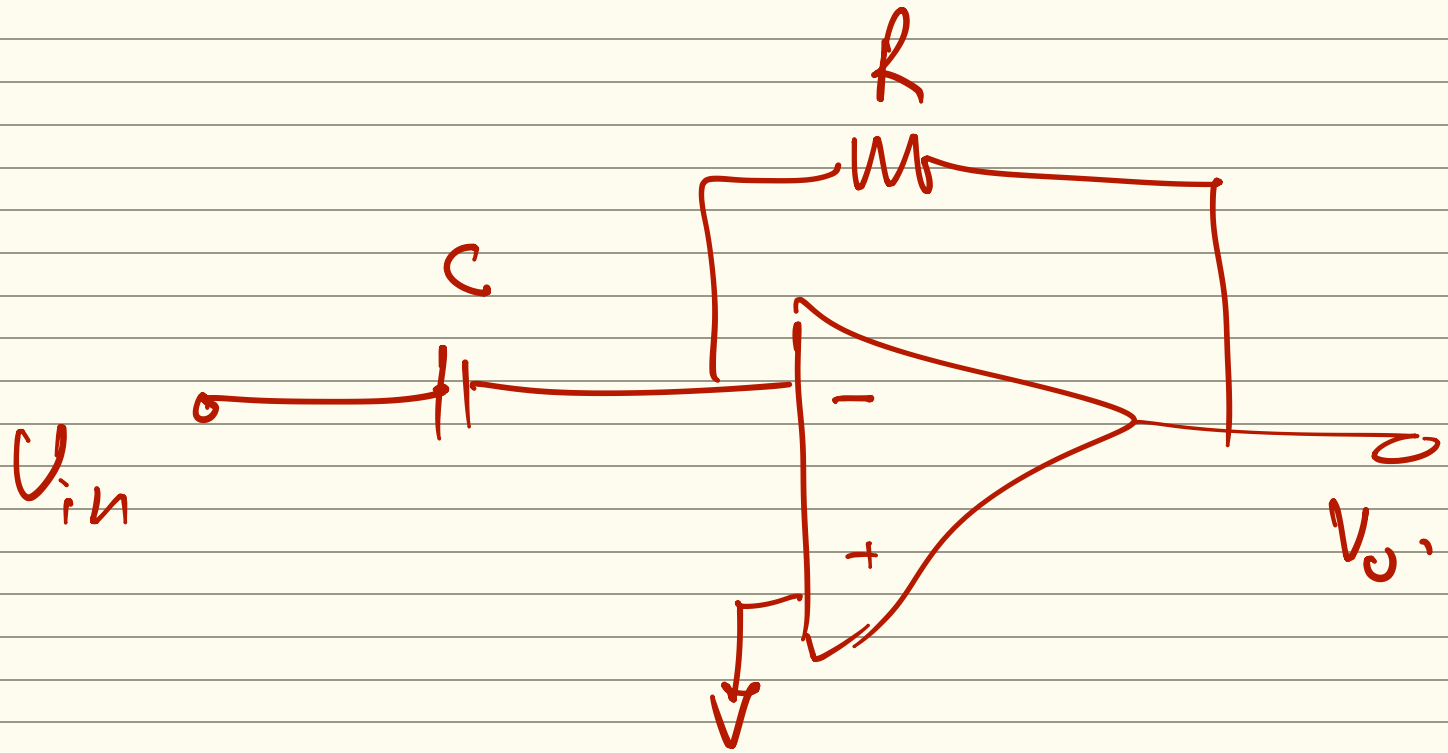


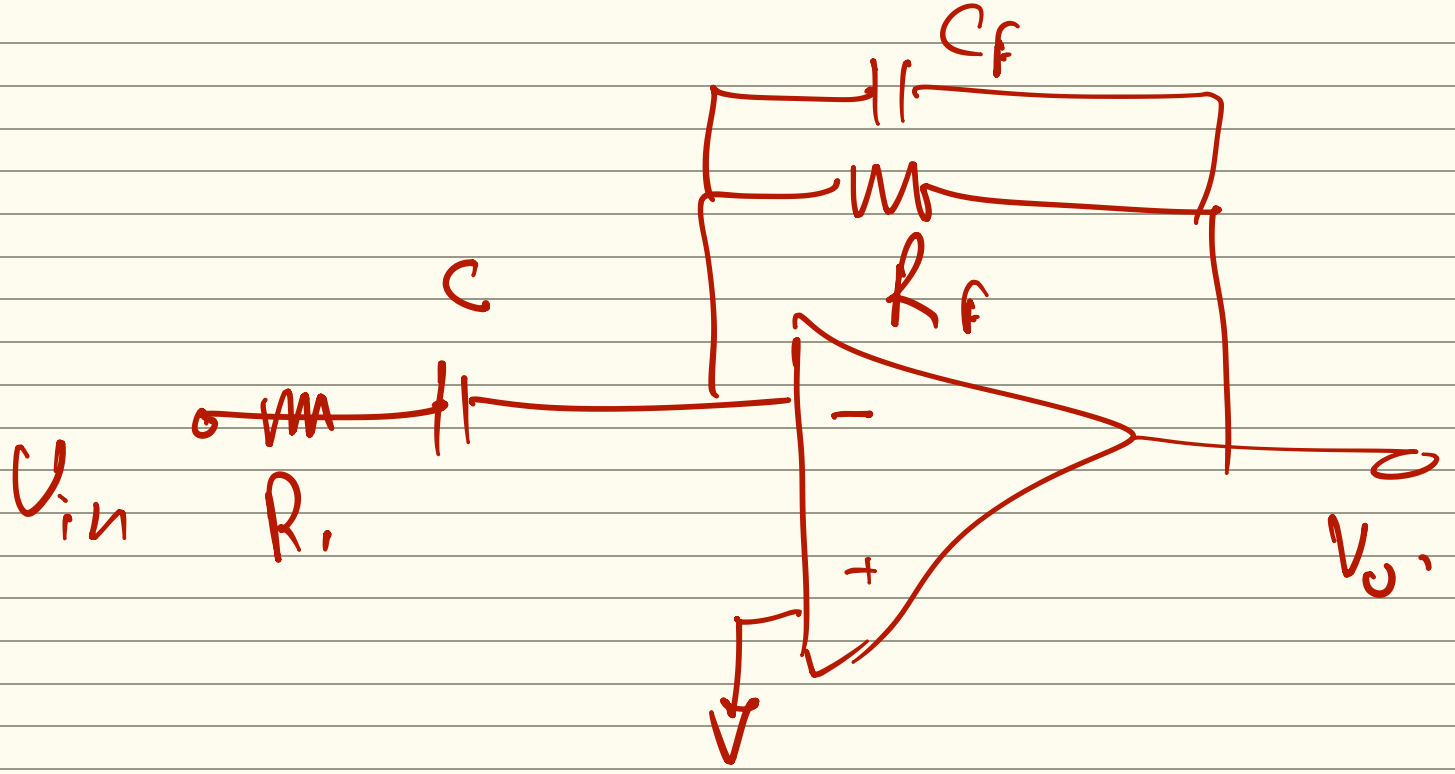
Differentiator



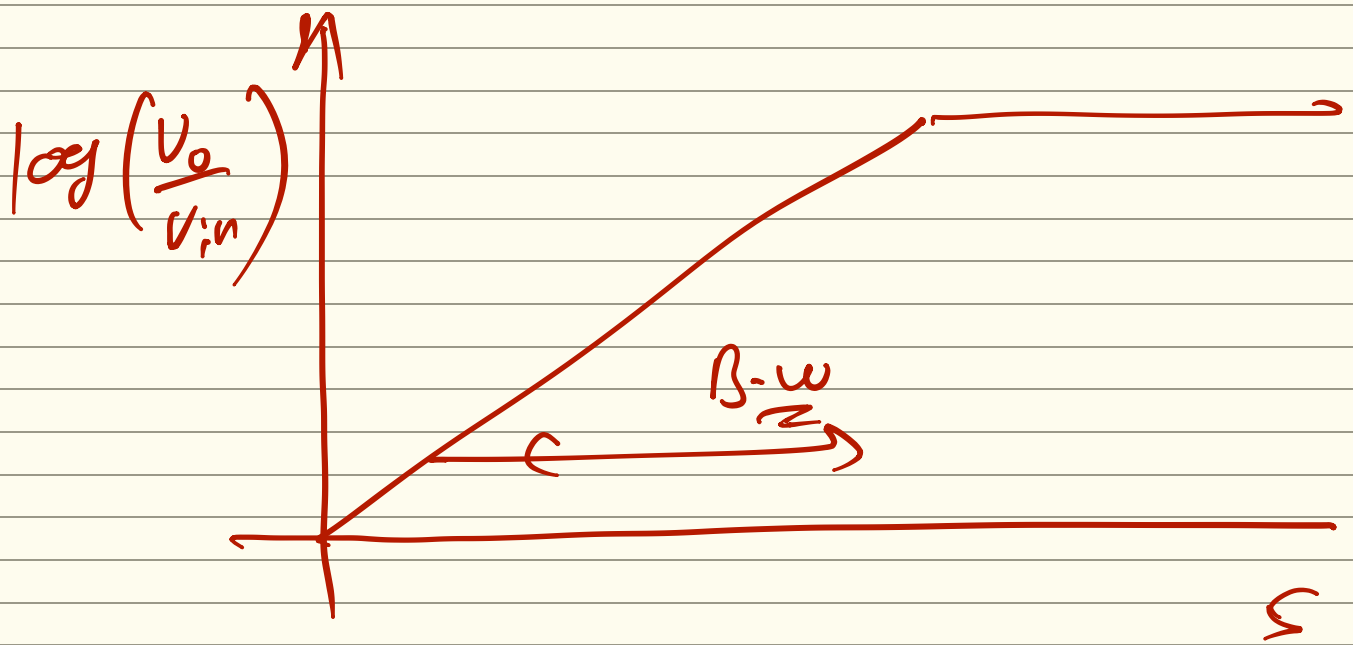


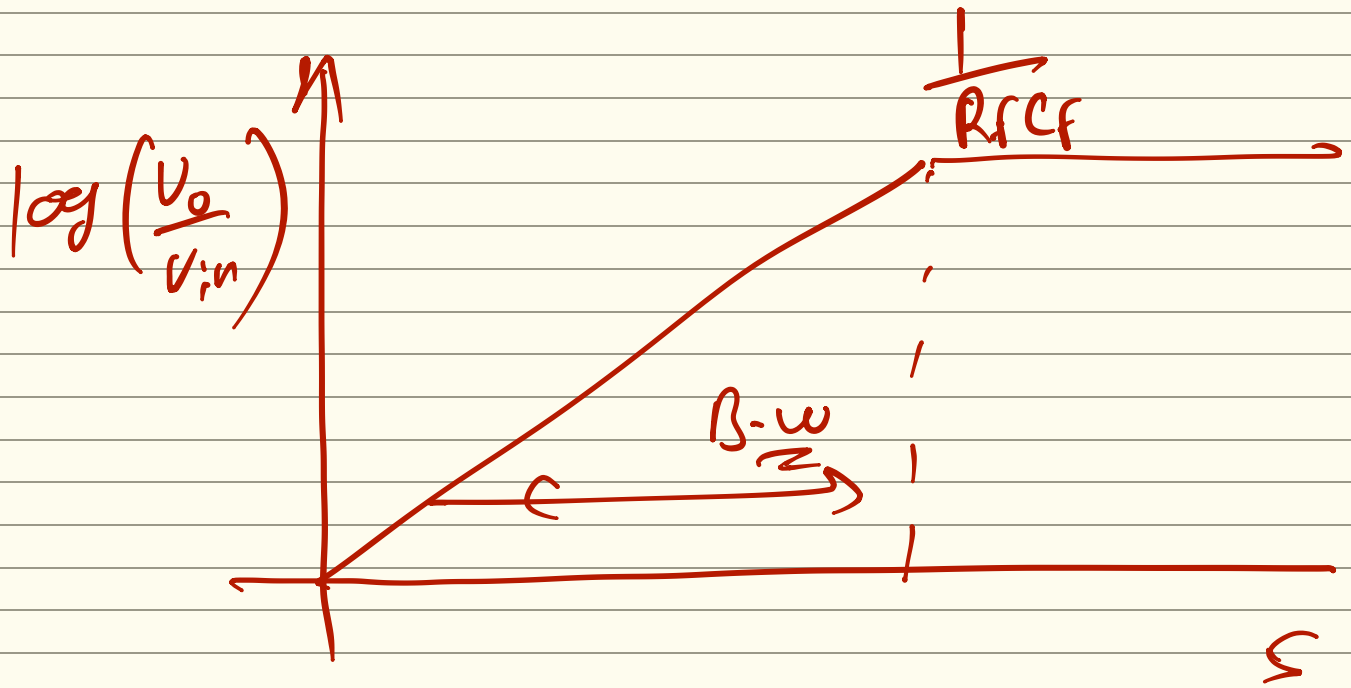
$$V_o(s) = A\,s\cdot V_{in}(s)$$

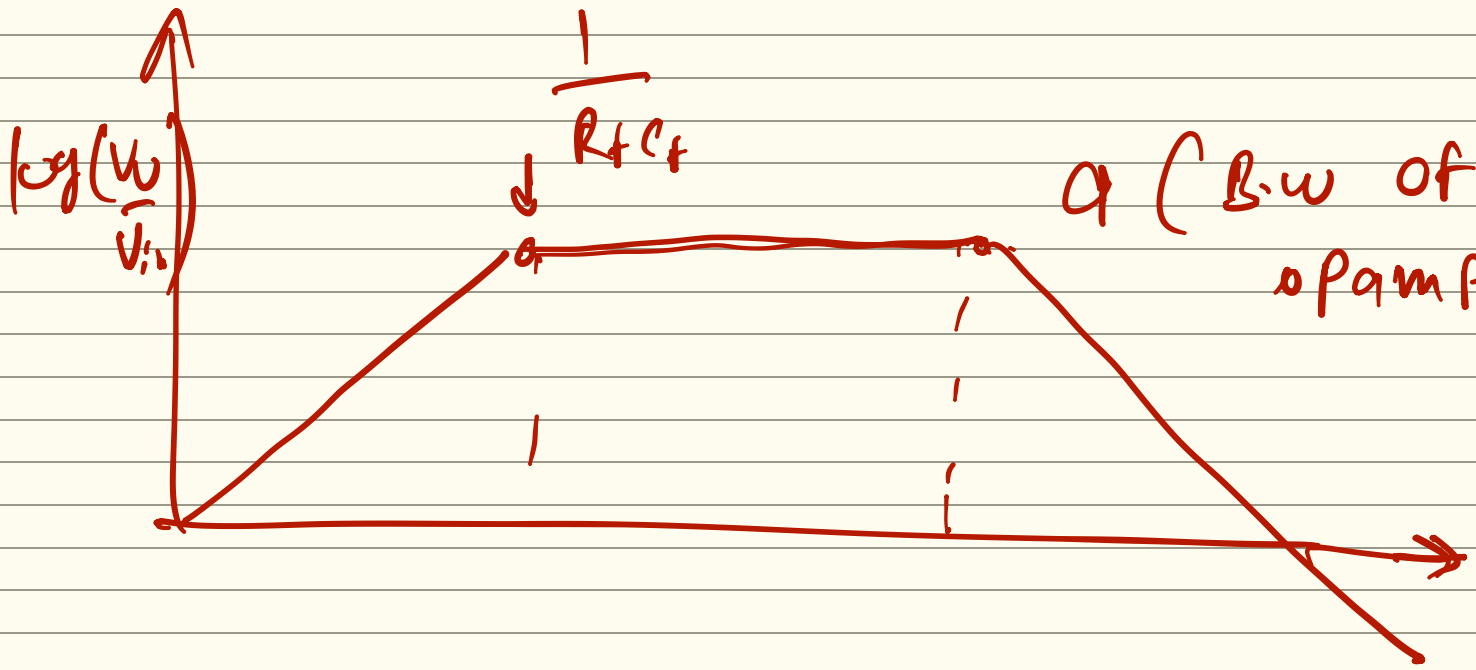


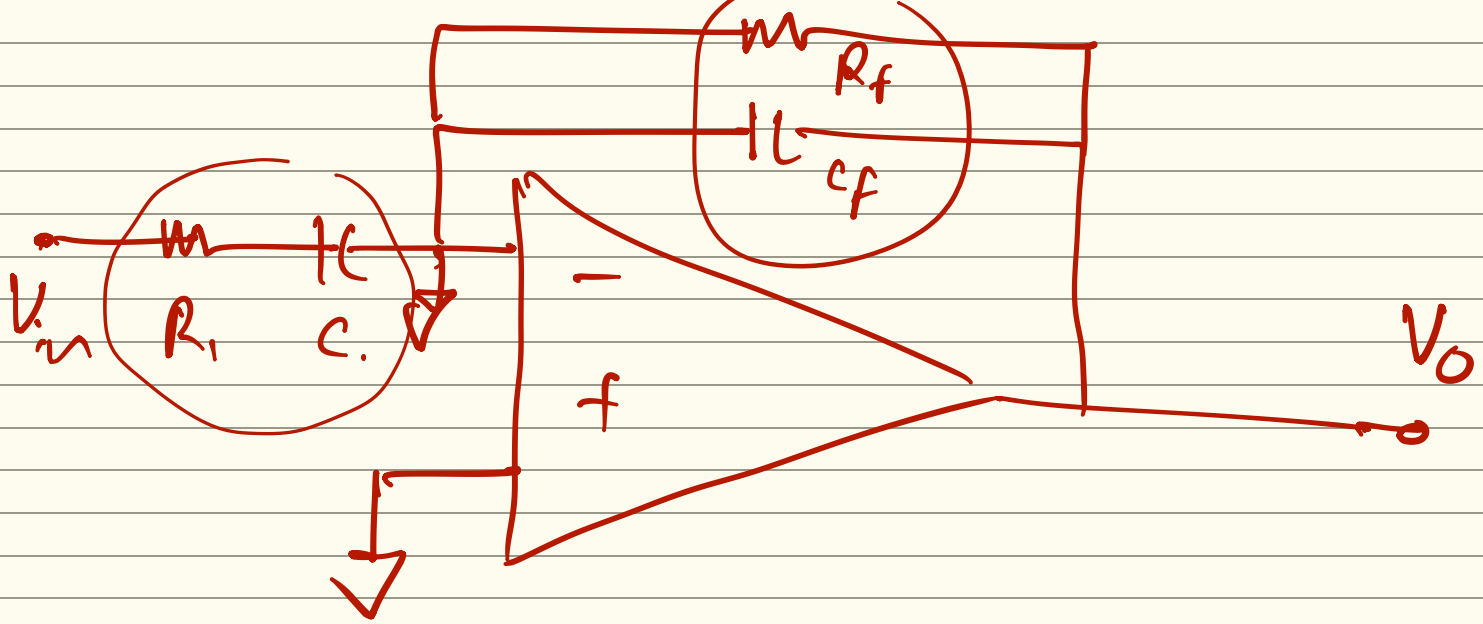


$$V_o(s) = \frac{sC_1 V_{in}(s)}{1 + C_f R_f s}$$

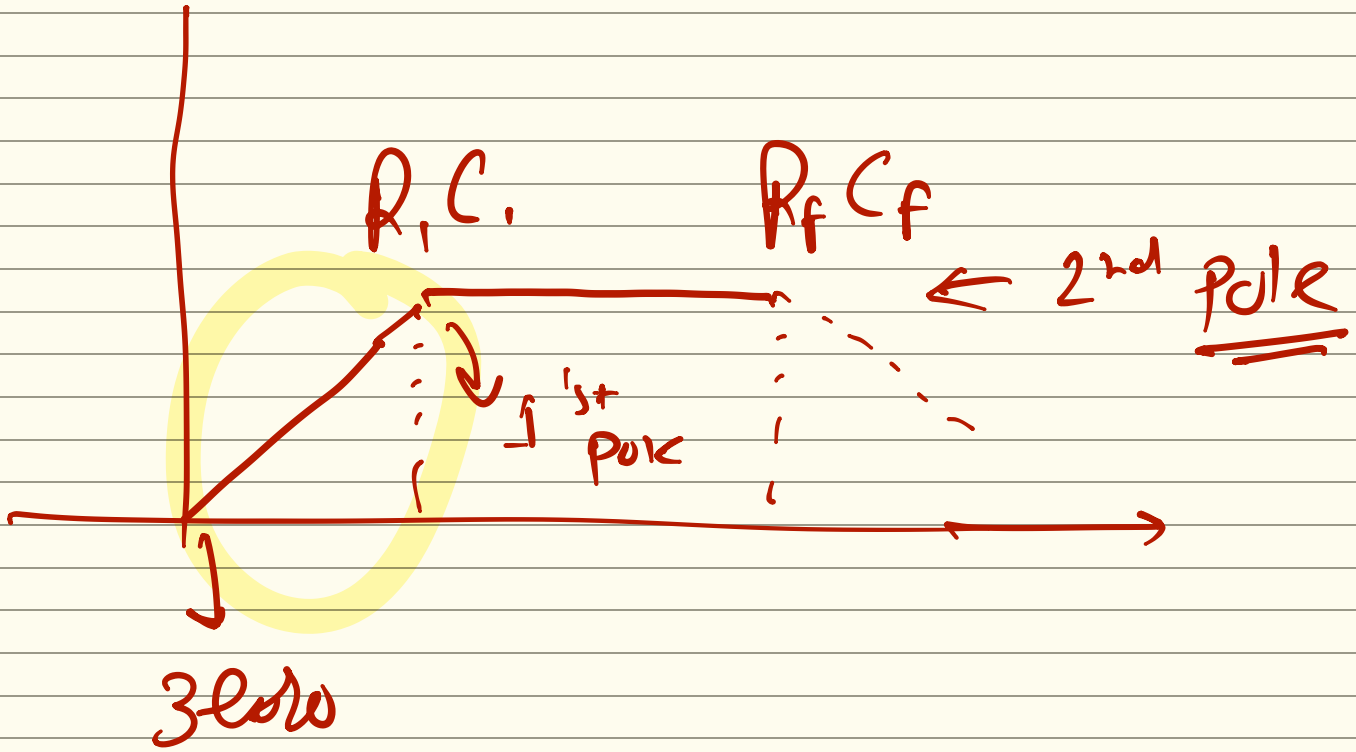



log (Vo/Vin)
1/RfCf
B.W
f


log(Vo/Vin)
1/RfCf
a (B.w of opamp)



$$A(s) \Rightarrow \frac{sCR}{(1+R_1C_1)(1+R_fC_f)}$$



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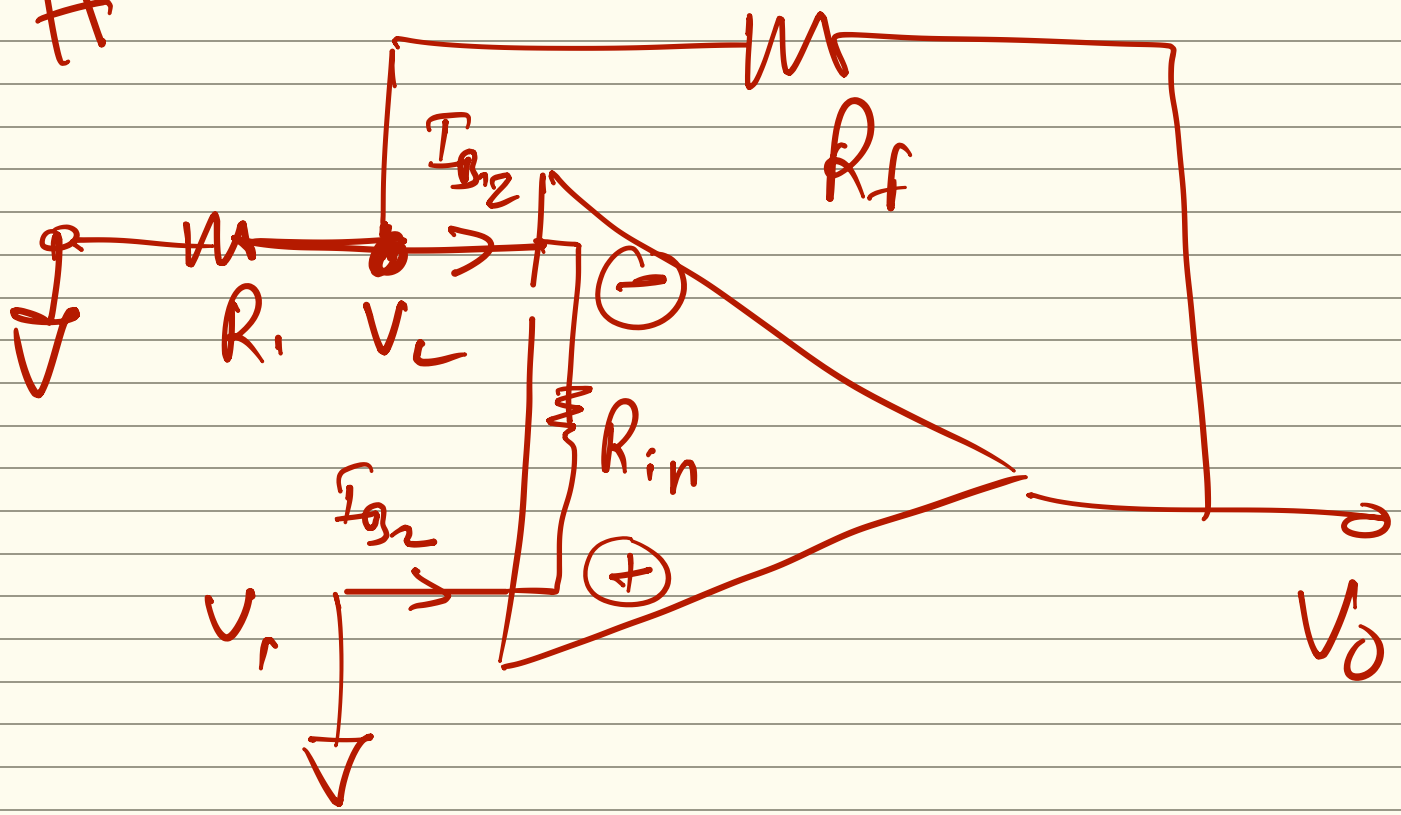
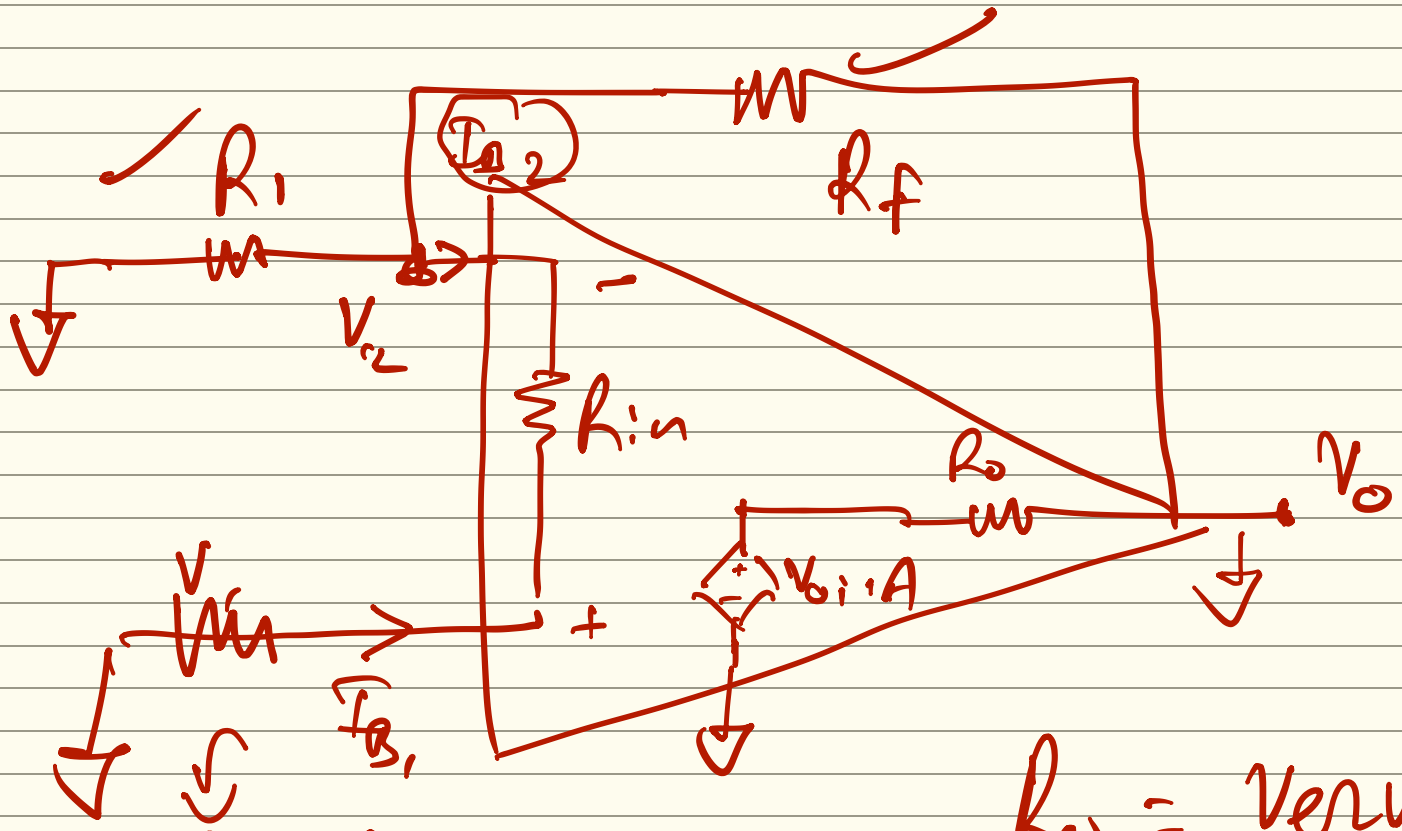


$$I_{B_1} = I_{B_2} = I_B$$

Bias current of op-amp



R_o = very low

V_{io} = very low ≈ 0

I_{B_2}.

$$V_2 = f(I_{B_2})$$

$$= (R_f \| R_1) \cdot I_{B_1}$$