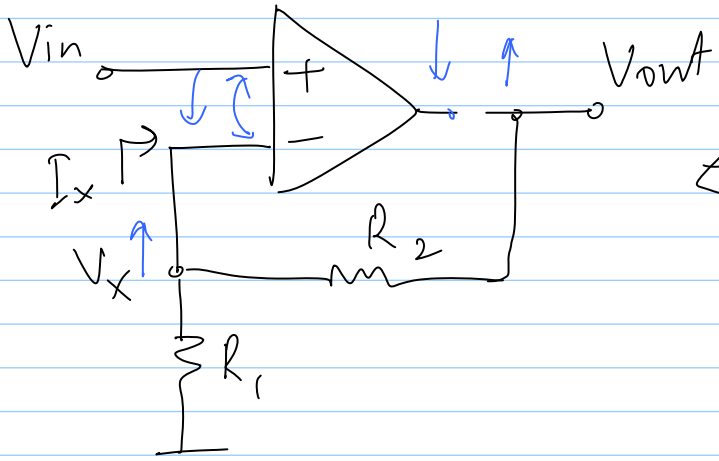
18-9-12

Lec 21

VCVS

V_{in}, $V_{out} = AV_{in}$



⇐ Negative f/b.

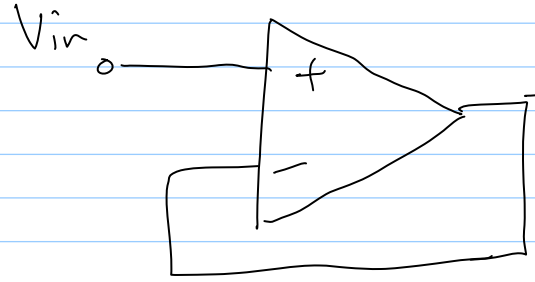
1) $V_x = V_{in}$

2) $I_x = 0 \Rightarrow V_x = \dfrac{R_1}{R_1+R_2} V_{out}$

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

Gain of 1

* $R_2 = 0$
* $R_1 = \infty$
* both $R_2 = 0$ & $R_1 = \infty$



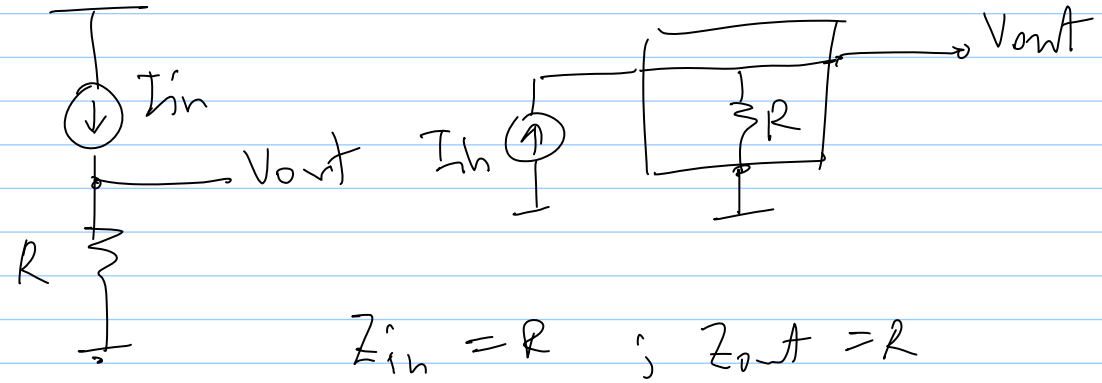
Voltage follower

$V_{out} = V_{in}$

CCVS $\Rightarrow$ $Z_{in}=0$; $Z_{out}=0$

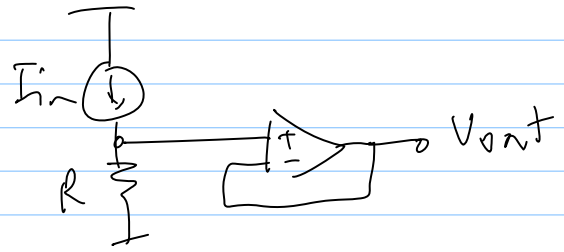
I_{in} ; $V_{out} = R I_{in}$

1)



$Z_{in} = R$; $Z_{out} = R$

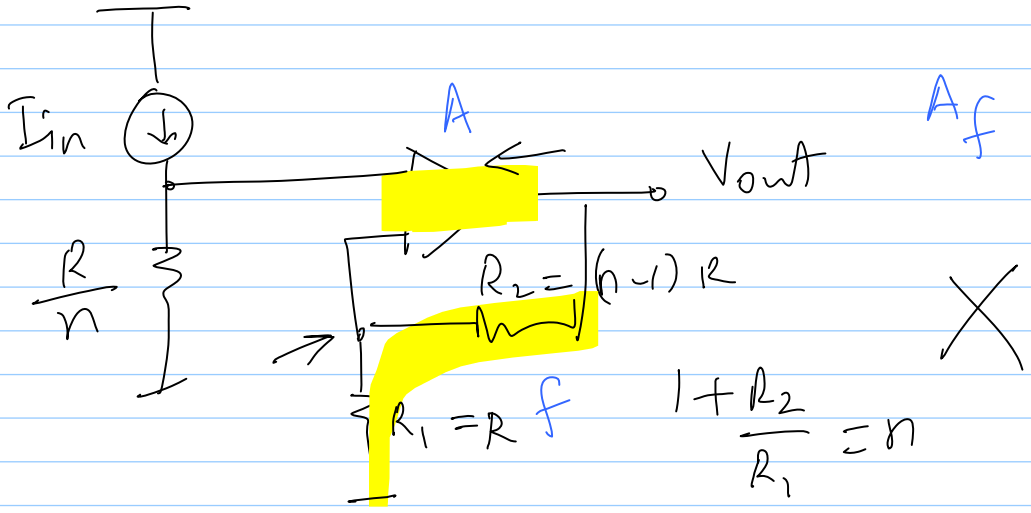
2)



$Z_{out} = 0$

$Z_{in} = R$

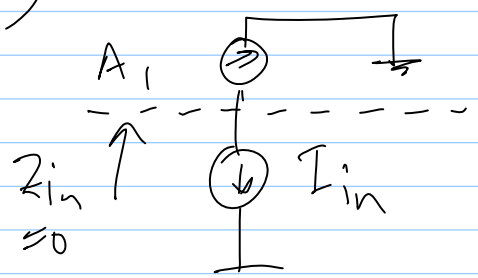
3)



$A_f \to \infty$

$1 + \frac{R_2}{R_1} = n$

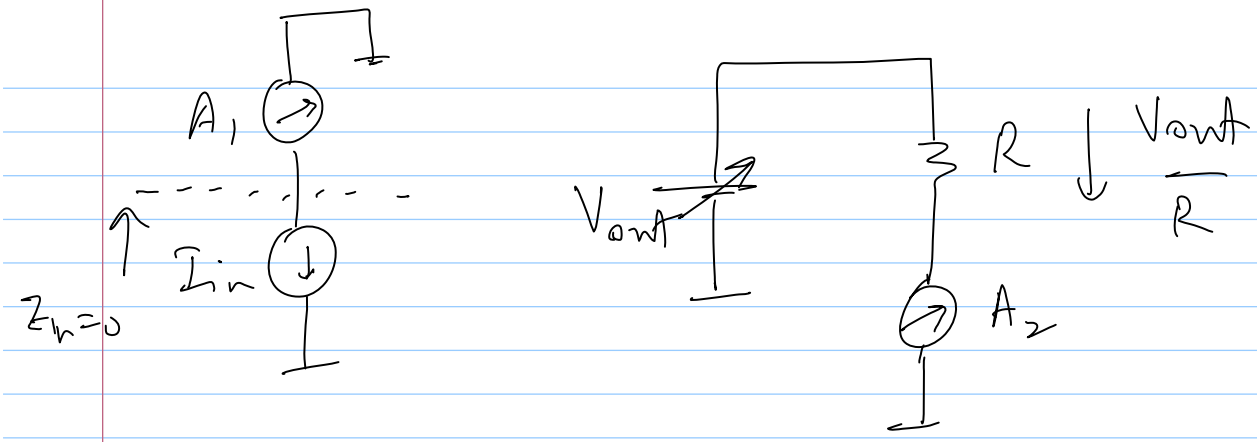
4)



S.C. to gnd @ input

$V_{out} = R I_{in}$

$\frac{V_{out}}{R} = I_{in}$

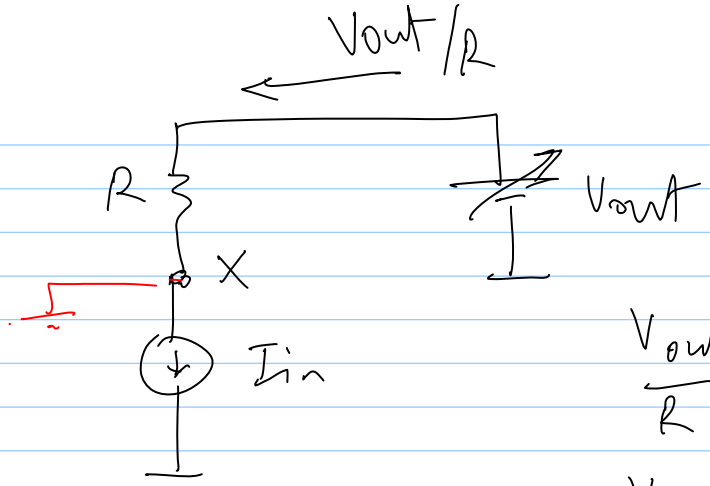


* Measure A_1, A_2

* $A_1 > A_2 \Rightarrow I_{in} > \frac{V_{out}}{R} \Rightarrow \uparrow V_{out}$

$A_1 < A_2 \Rightarrow I_{in} < \frac{V_{out}}{R} \Rightarrow \downarrow V_{out}$

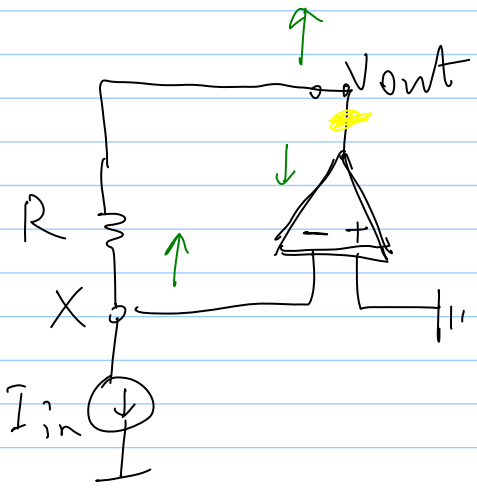
comparing $A_1 - A_2 \Rightarrow$ connect in Series

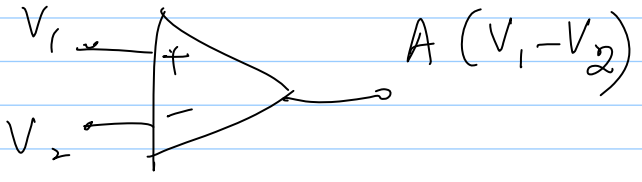


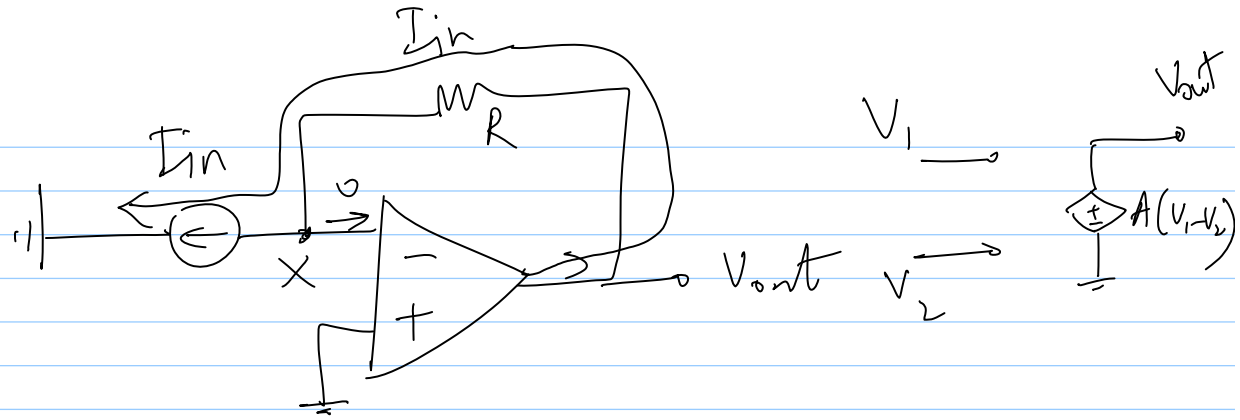
$\frac{V_{out}}{R} = I_{in}$

$\frac{V_{out}}{R} > I_{in} \Rightarrow V_x \uparrow \left(\downarrow V_{out}\right)$

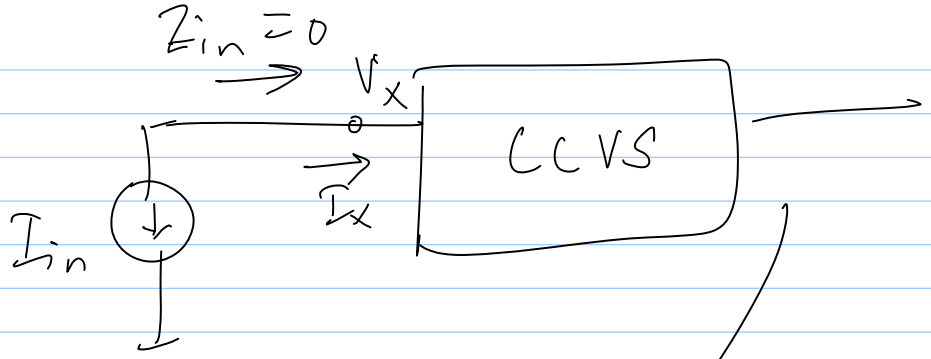
$\frac{V_{out}}{R} < I_{in} \Rightarrow V_x \downarrow \left(\uparrow V_{out}\right)$



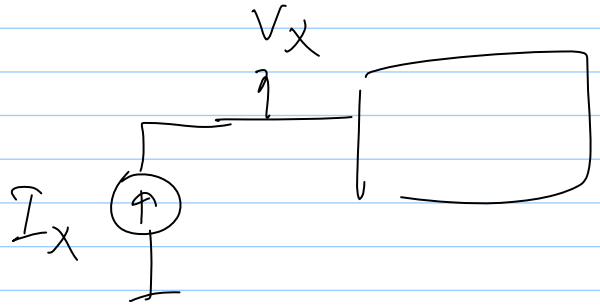


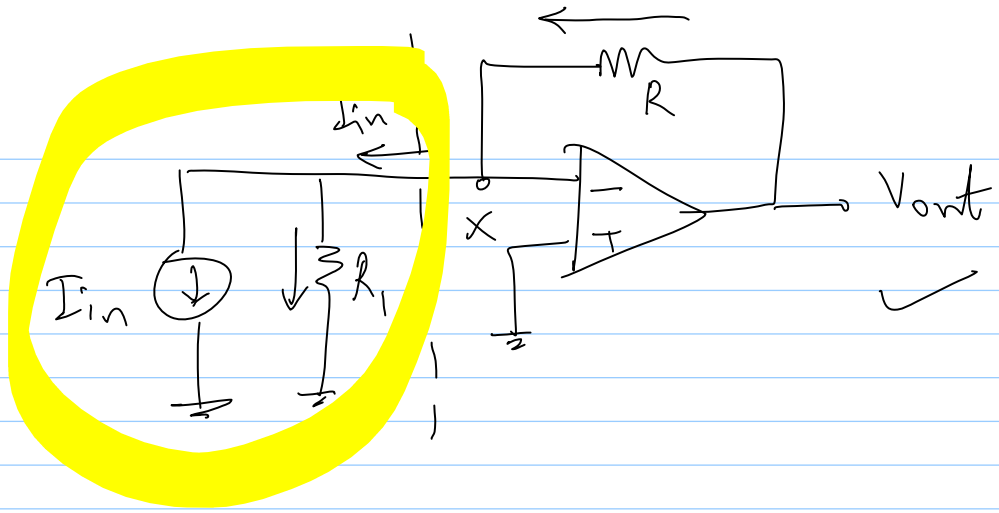


* $V_X = 0 \Rightarrow Z_{in} = 0$
* $\frac{V_{out} - V_X}{R} = I_{in} \Rightarrow \boxed{V_{out} = R I_{in}}$
* $Z_{out} = 0$
* X = Virtual ground



$$Z_{in} = \frac{V_x}{I_x}$$

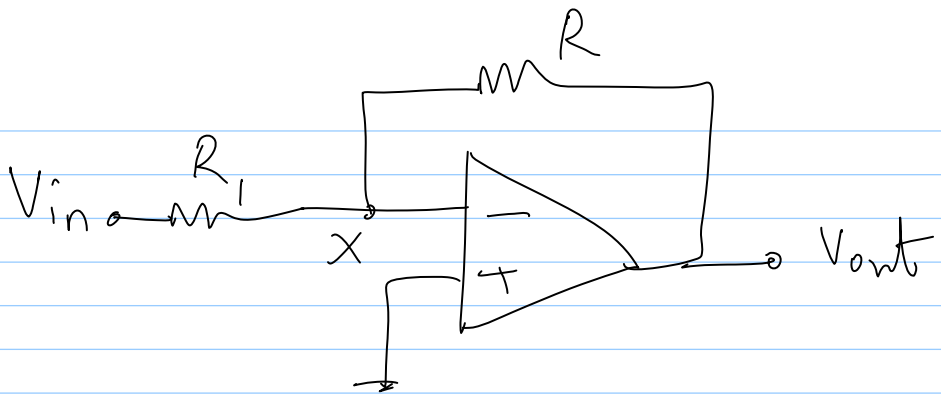




* $V_X = 0 \Rightarrow I_{R_1} = 0$

R_1 does not matter

$$\boxed{V_{out} = R I_{in}}$$



* $V_X = 0$, $I_{opamp} = 0$

$$\frac{V_{in}}{R_1} = \frac{-V_{out}}{R}$$

$$\boxed{\frac{V_{out}}{V_{in}} = \frac{-R}{R_1}}$$

Inverting Amplifier