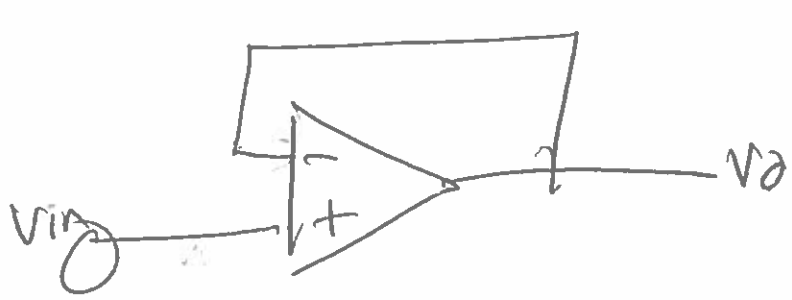
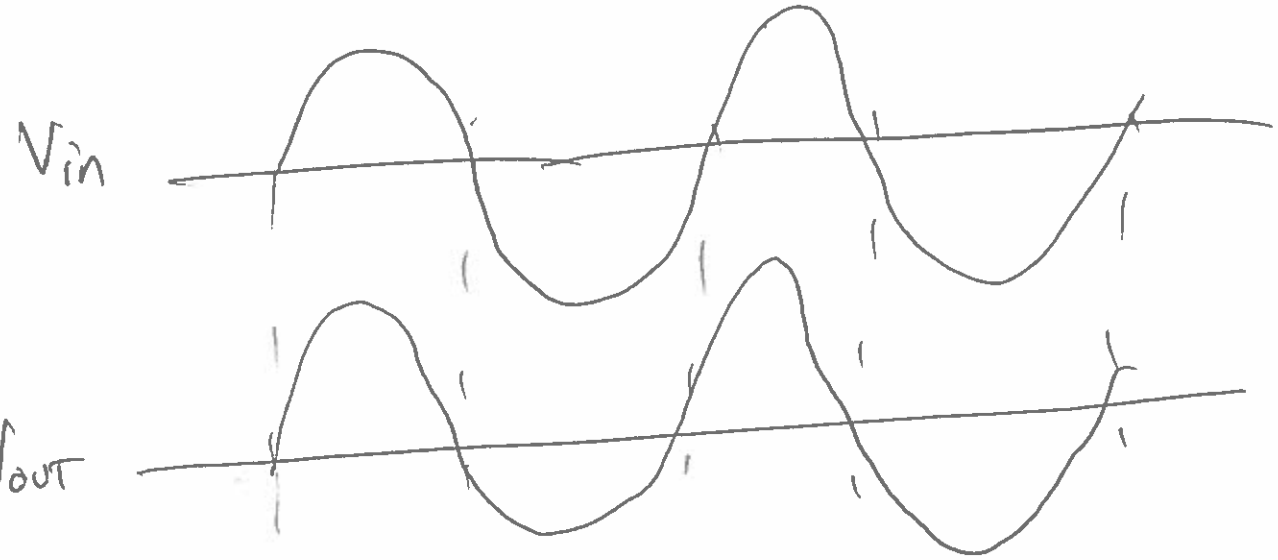
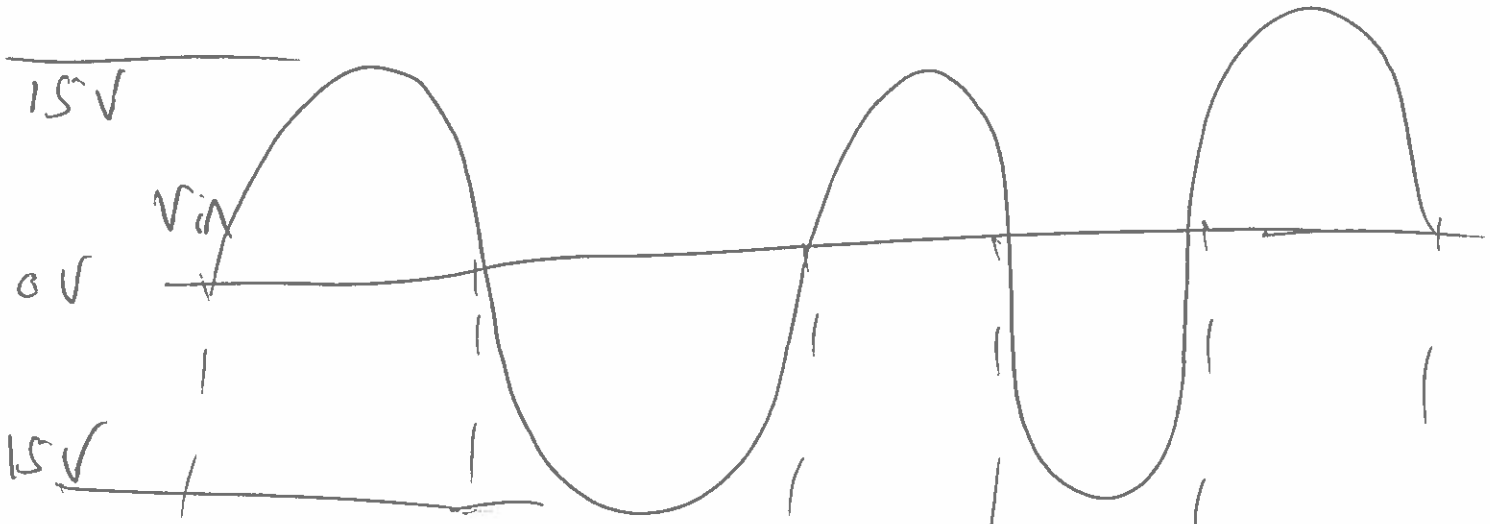
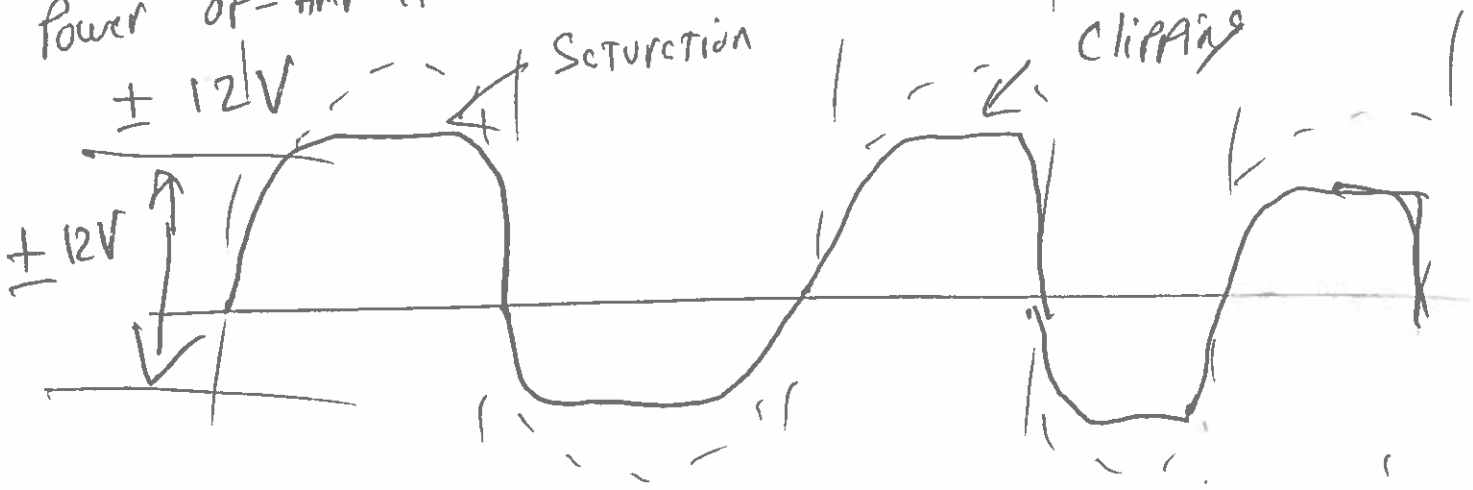


Voltage follower (Buffer)





Power op-amp ex



Amplification also known Gain of circuit

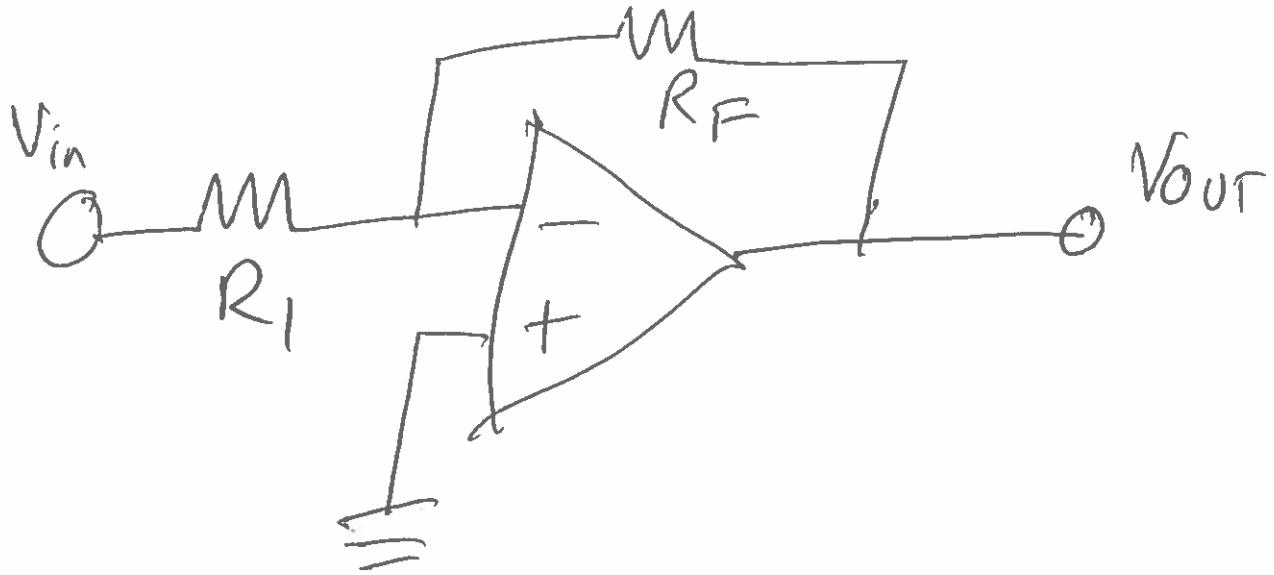
$$G = \frac{V_{OUT}}{V_{IN}}$$

For a voltage follower $G = +1$

Why use a voltage follower or Buffer

A wire gives same result.

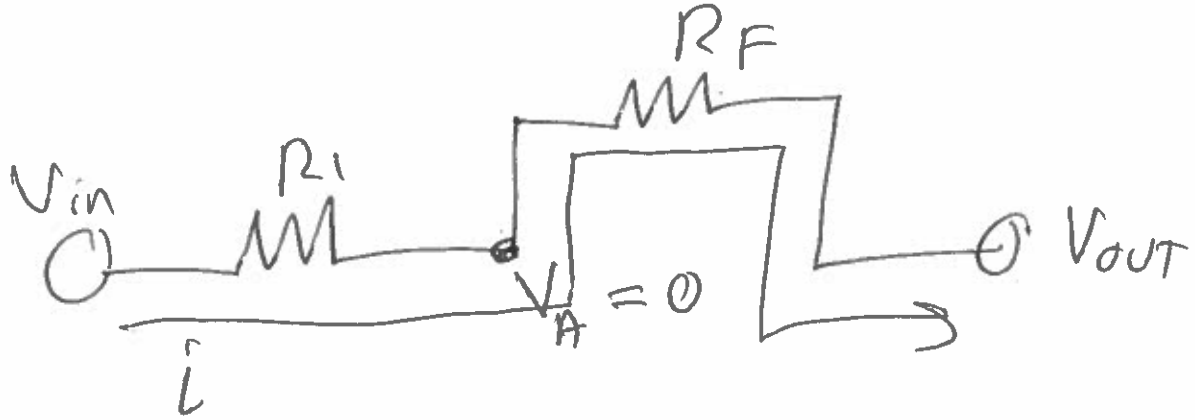
Protection! keep sensitive instruments from getting too much current or voltage.



$V_{OUT} = ?$

2nd rule of op-amps

inputs Draw No current



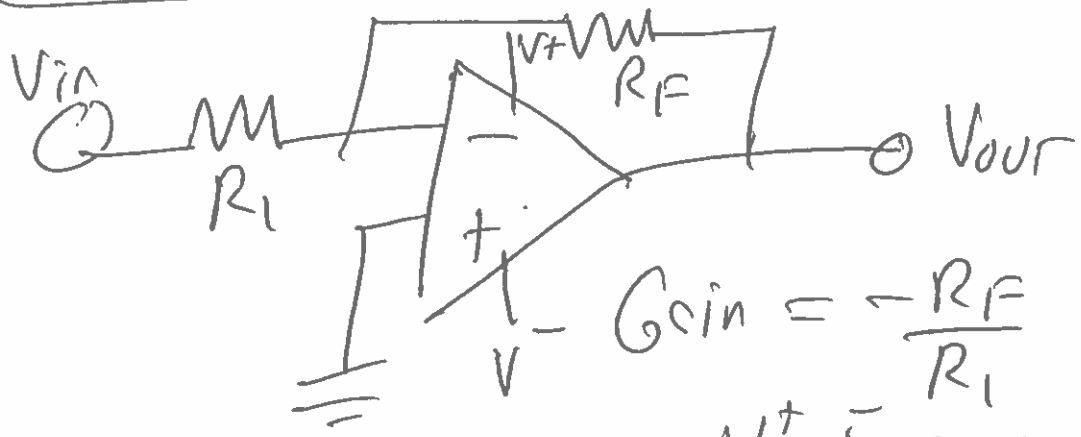
1rst rule of op-amps

V_o must adjust to make $V_- = V_+$

$$i = \frac{V_{in} - 0}{R_1} = \frac{0 - V_{out}}{R_F}$$

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

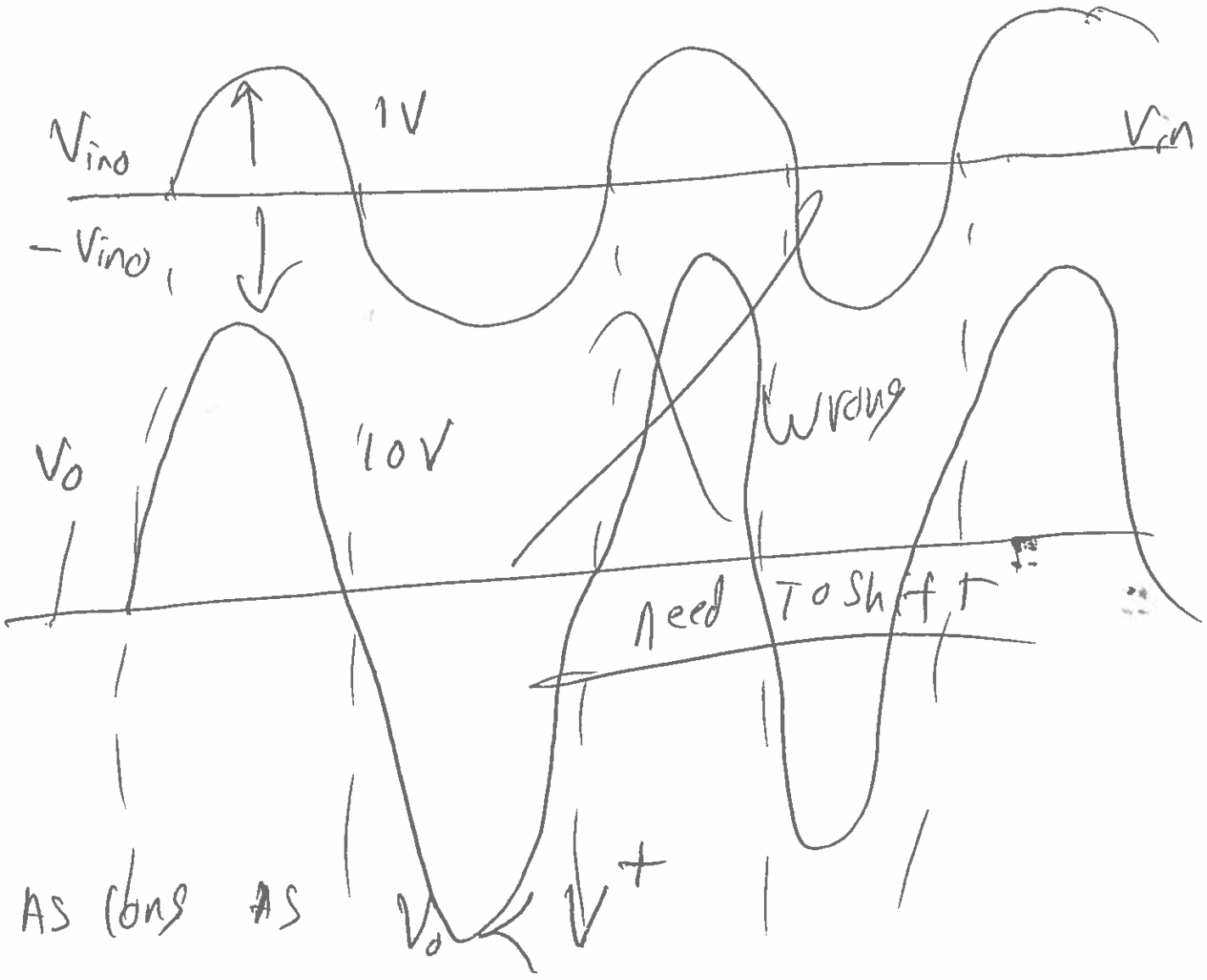
Inverting-Amplifier

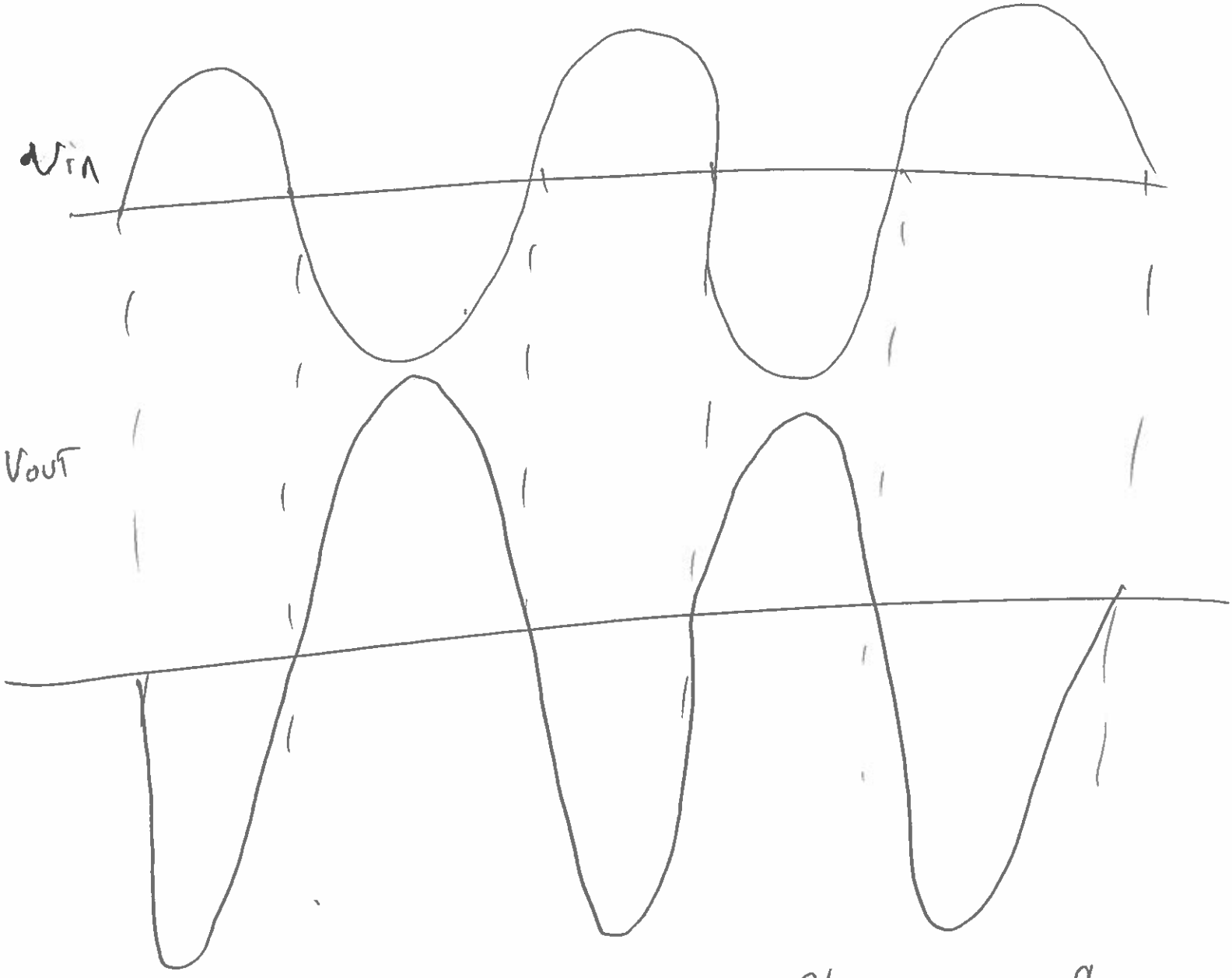


$$\text{Gain} = -\frac{R_F}{R_1}$$

V^+, V^- Pins 7, 4 $\Rightarrow$ Power op-Amp

Let $R_F = 10 R_1$





inverting AMPLIFIER Phase = 180°

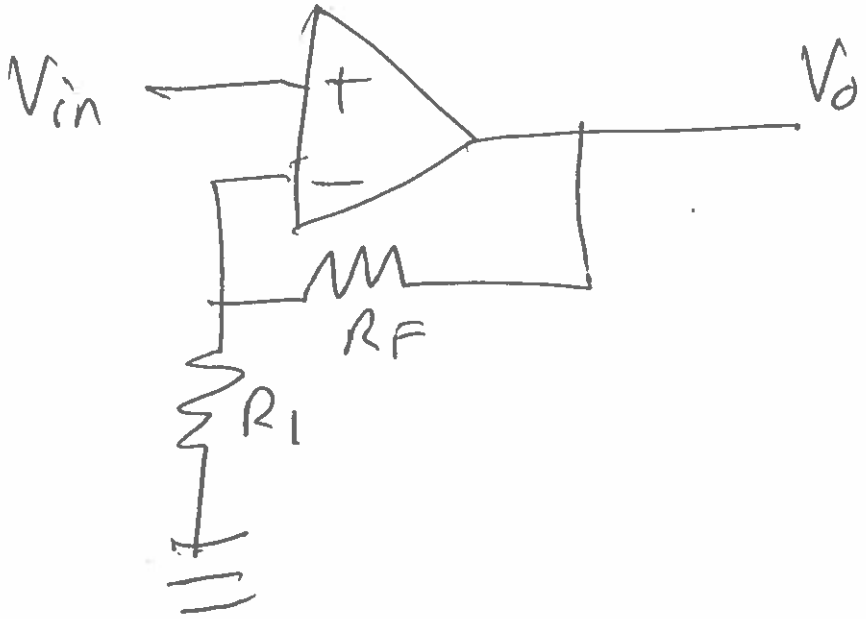
Positive Vs Negative Feed back

Positive feed back

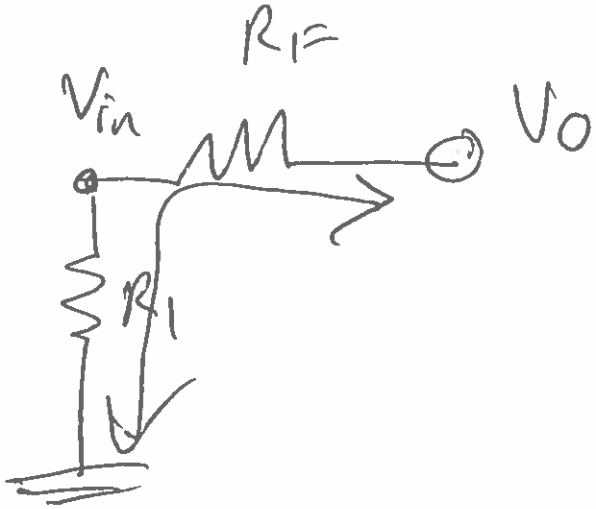
$$V_o = K V_{in}$$

Negative feed back

$$V_o = K (V_{in} - V_{ref})$$



Current



$$i = \frac{V_{in} - V_o}{R_F} = \frac{0 - V_{in}}{R_1}$$

$$V_{in} - V_{OUT} = + \frac{R_F}{R_1} V_{in}$$

$$V_{OUT} = V_{in} + \frac{R_F}{R_1} V_{in}$$

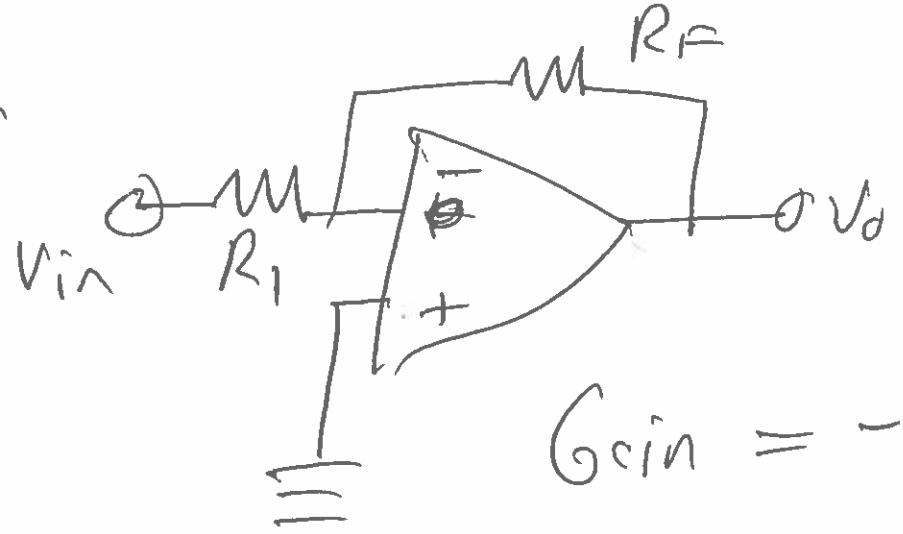
$$\boxed{V_{OUT} = \left(1 + \frac{R_F}{R_1}\right) V_{in}}$$

$$G_{ain} = +\left(1 + \frac{R_F}{R_1}\right)$$

Non-Inverting Amplifier

Minimum $G_{ain} = 1$ if $R_F = 0$ (Short circuit)

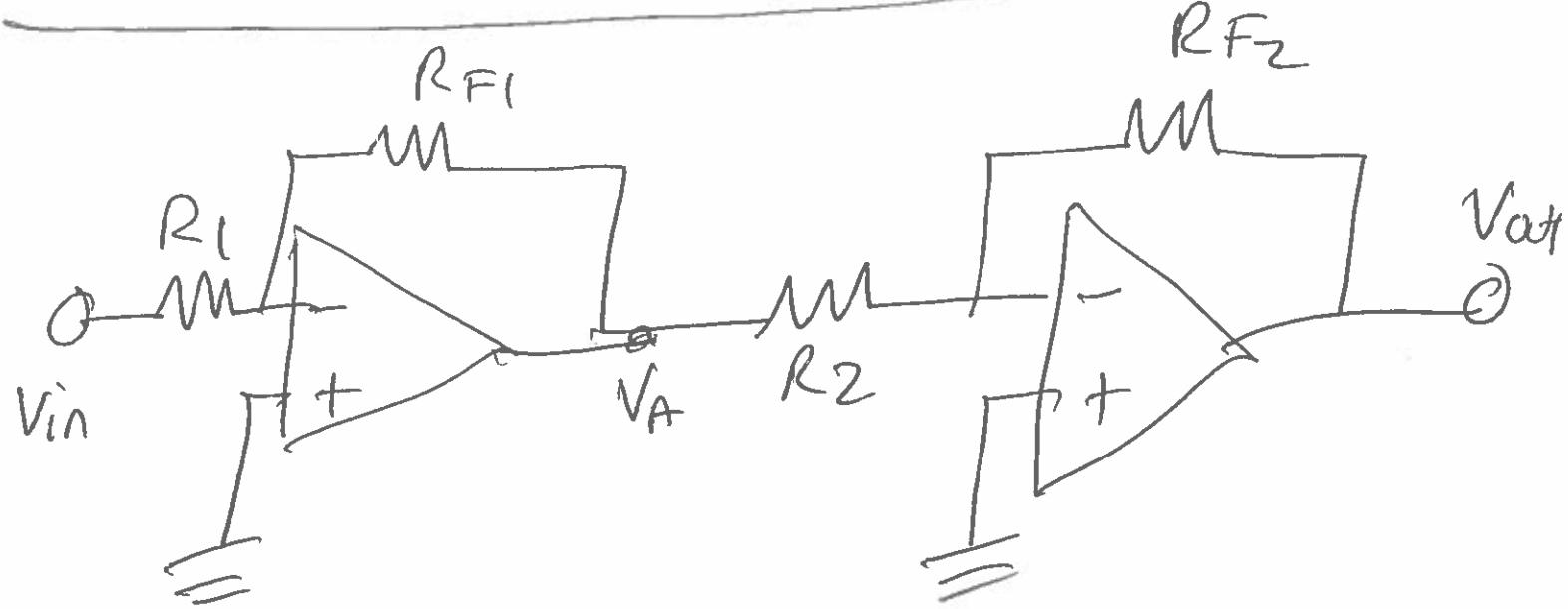
Remember



$$G_{ain} = -\frac{R_F}{R_1}$$

if $R_1 > R_F$ Gain smaller

Alternative Non-inverting Amplifier



$$V_A = -\frac{R_{F1}}{R_1}(V_{in})$$

$$V_{OUT} = -\frac{R_{F2}}{R_2} V_A$$

$$V_{OUT} = \left(\frac{R_{F2} R_{F1}}{R_2 R_1}\right) V_{in}$$

Use $R_{F2} = R_2$