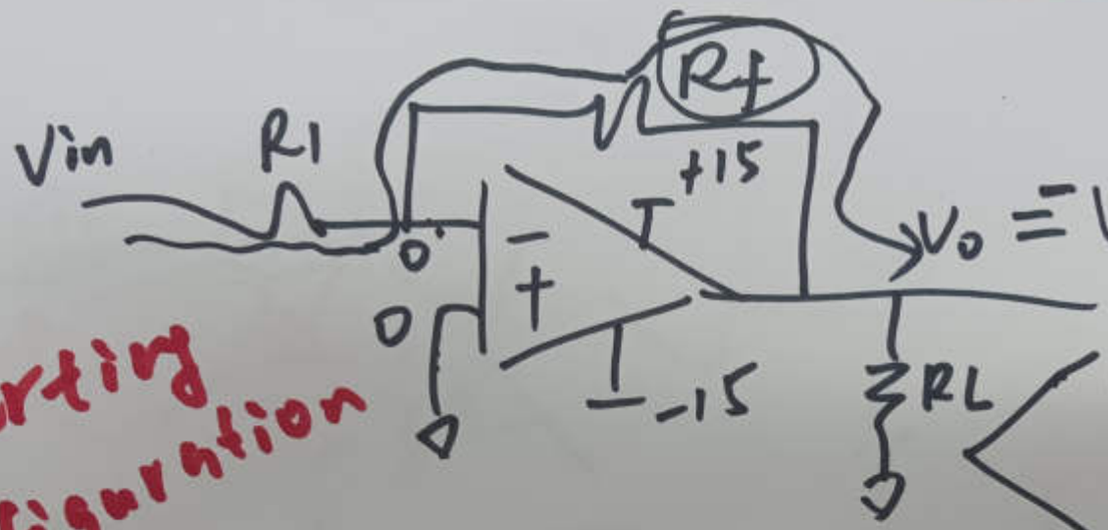



Inverting configuration

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

$$V_{in} R_f = -R_1 V_o$$

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

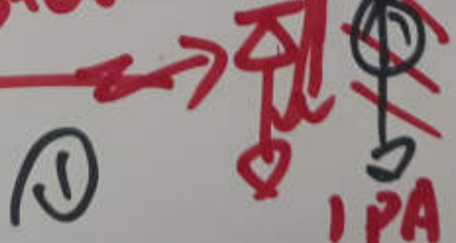
1MX1M

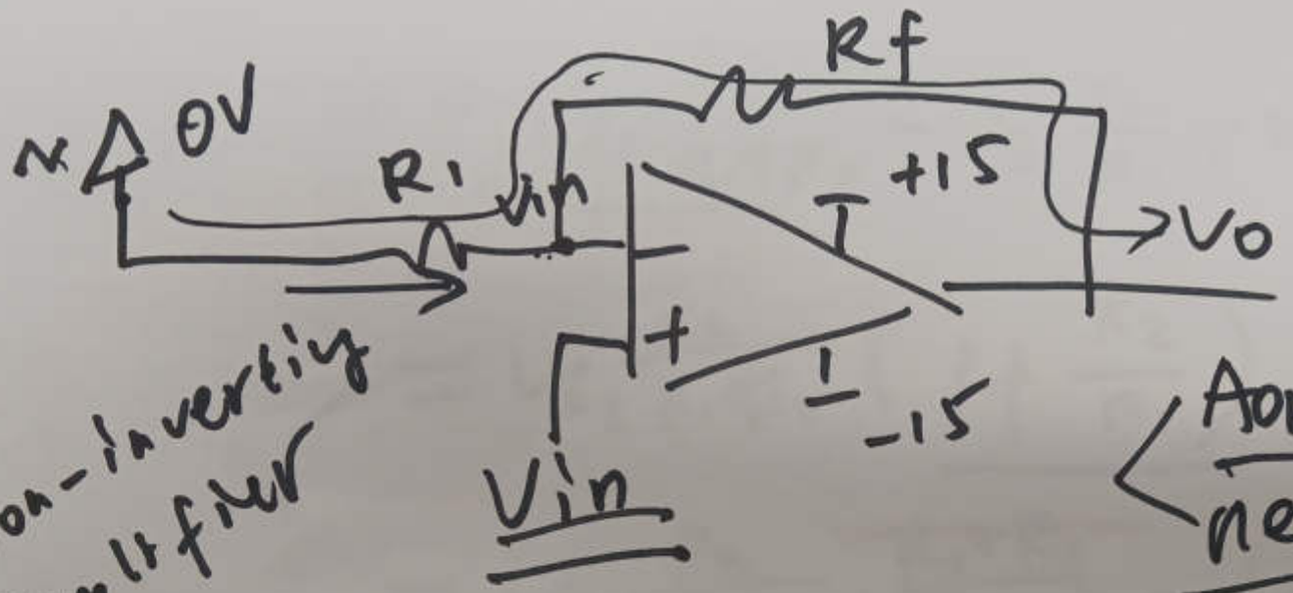
CMOS imager

photodiode

TIA → Transimpedance Amplifier

Current → Voltage

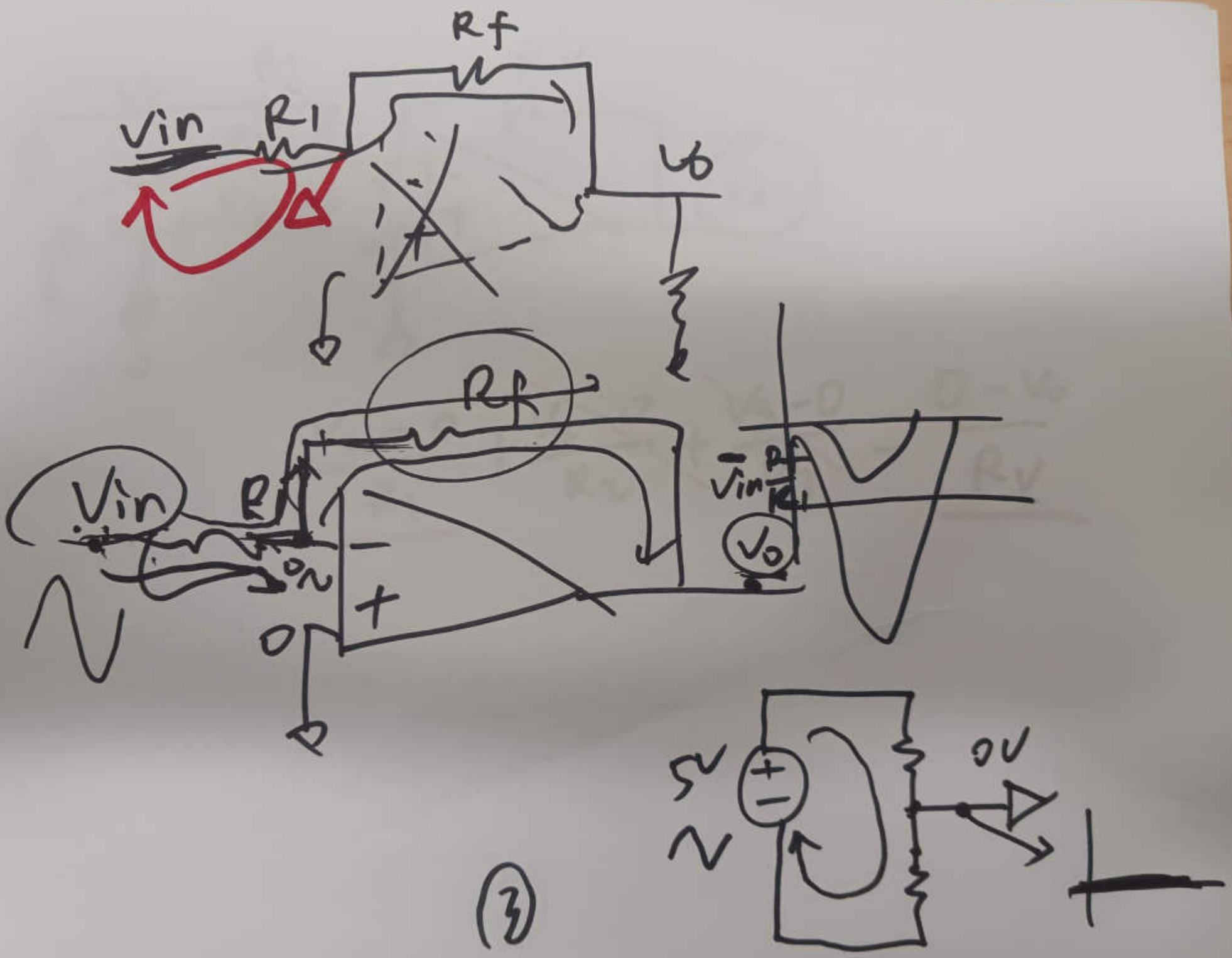


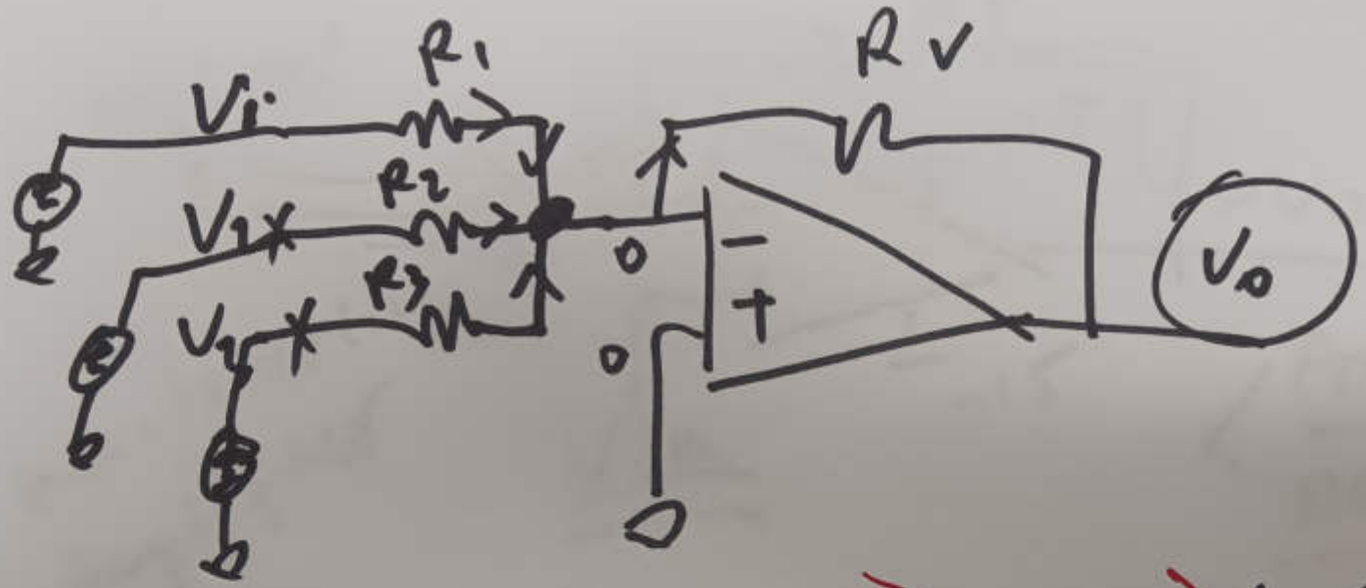

$$\frac{0 - V_{in}}{R_1} = \frac{V_{in} - V_o}{R_f}$$

$$-V_{in} R_f = V_{in} R_1 - V_o R_1$$

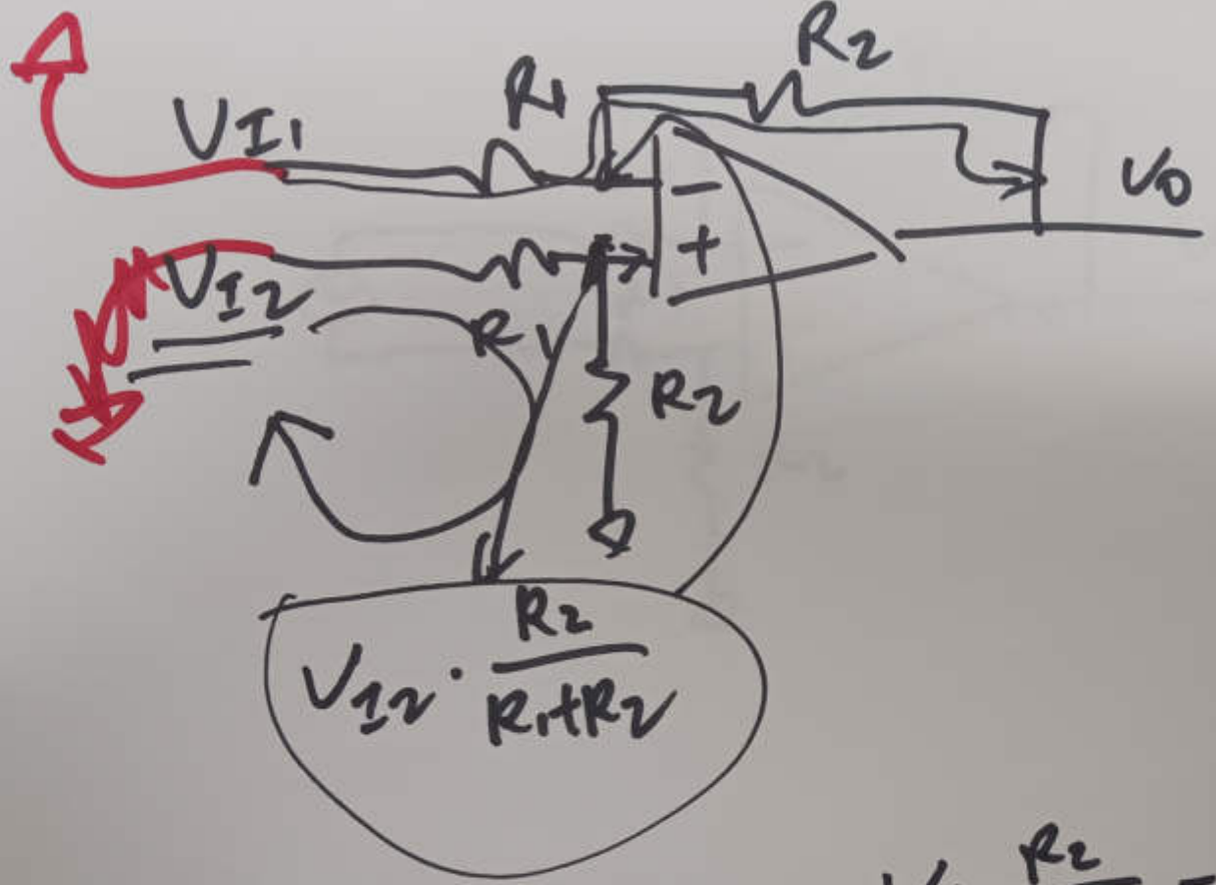
$$V_o R_1 = V_{in} (R_f + R_1)$$

$$\boxed{\frac{V_o}{V_{in}} = \frac{R_f + R_1}{R_1} = 1 + \frac{R_f}{R_1}}$$

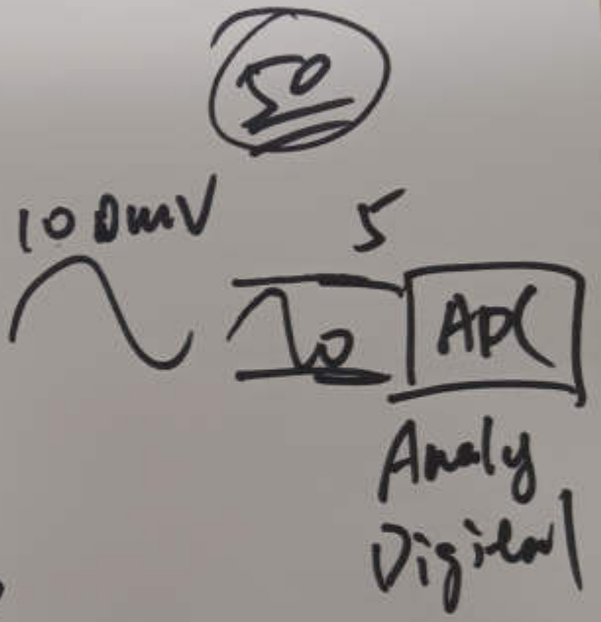

Rf
Vin
R1
Vo
Rf
Vin
R1
0V
Vin
Vo
5V
0V




$$\frac{V_1 - 0}{R_1} + \cancel{\frac{V_2 - 0}{R_2}} + \cancel{\frac{V_3 - 0}{R_3}} = \frac{0 - V_o}{R_V}$$




Difference/Differential Amplifier




$$\frac{V_{I1} - V_{I2} \cdot \frac{R_2}{R_1+R_2}}{R_1} = \frac{V_{I2} \cdot \frac{R_2}{R_1+R_2} - V_o}{R_2}$$

$$V_{I1} \cdot R_2 - V_{I2} \frac{R_2^2}{R_1+R_2} = V_{I2} \frac{R_1 R_2}{R_1+R_2} - V_o R_1$$

$$V_o R_1 = V_{I2} \frac{R_1 R_2}{R_1+R_2} - V_{I1} \cdot R_2 + V_{I2} \frac{R_2^2}{R_1+R_2}$$

$$V_o = V_{I_2}\frac{R_2}{R_1+R_2} - V_{I_1}\frac{R_2}{R_1} + V_{I_2}\frac{R_2}{R_1(R_1+R_2)}$$

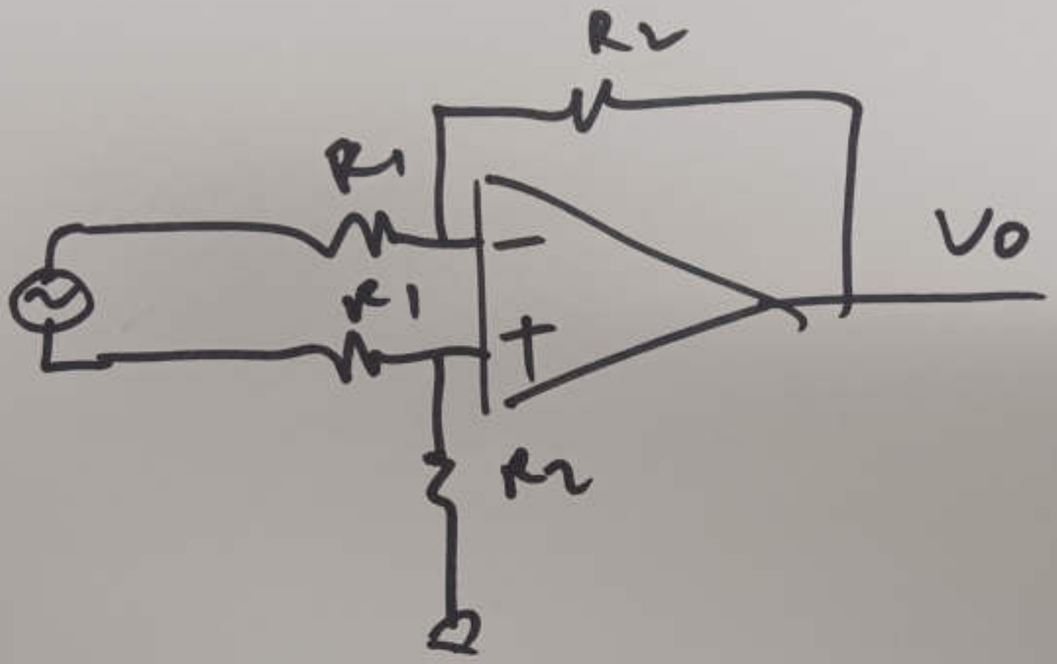
$$= V_{I_2}\frac{R_2}{R_1+R_2}\left(1+\frac{R_2}{R_1}\right) - V_{I_1}\frac{R_2}{R_1}$$

$$= V_{I_2}\frac{R_2}{R_1+R_2}\cdot\frac{R_1+R_2}{R_1} - V_{I_1}\frac{R_2}{R_1}$$

$$= V_{I_2}\cdot\frac{R_2}{R_1} - V_{I_1}\frac{R_2}{R_1}$$

$$= \left(V_{I_2} - V_{I_1}\right)\frac{R_2}{R_1}$$

($V_{I_1} = 0$)


R2
R1
R1
Vo
R2