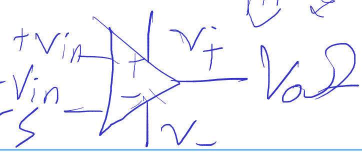
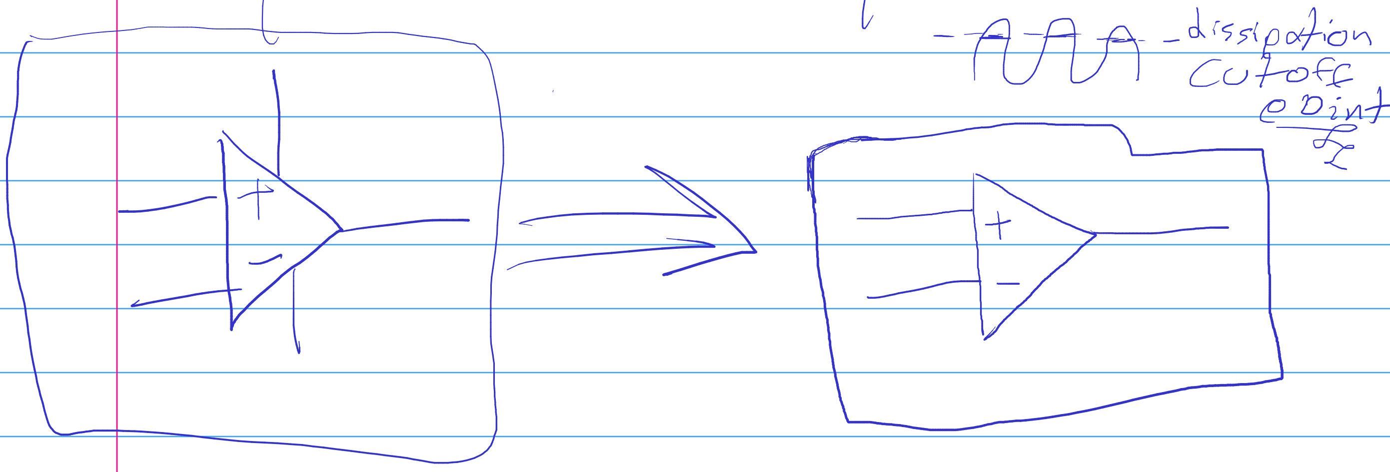
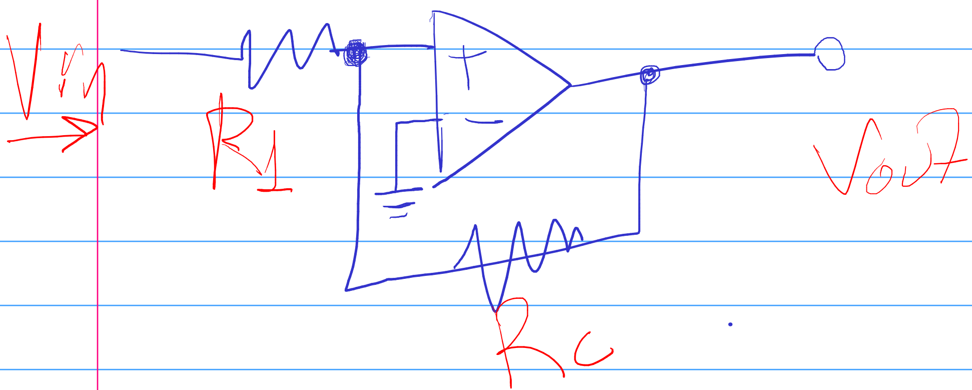
Operational Amplifiers



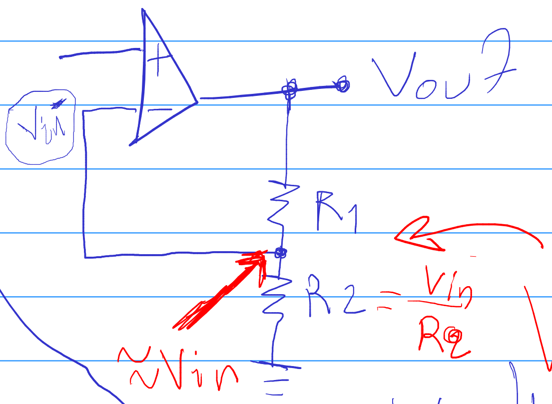




Non-Inverting Amp (?)

Case 1

$A_0 \to \infty$



$R_2 = \frac{V_{in}}{R_2}$

feedback goes to (-) always(?)

Fair enough?

$V_{1in} \approx V_{2in}$

$$\underbrace{V_{out}}_{\text{finite}} = \underbrace{(V_{in_1} - V_{in_2})}_{\text{very small}} \underbrace{A_0}_{\text{very large}}$$

$$\boxed{V_{out} = \frac{V_{in}}{R_2}(R_1+R_2)}$$

$I \cdot R_1 + R_2$

$$\frac{V_{in}}{R_2} = \frac{V_{out}}{R_1+R_2}$$

Voltage Gain:

$$\frac{V_{out}}{V_{in}} = 1 + \frac{R_1}{R_2}$$

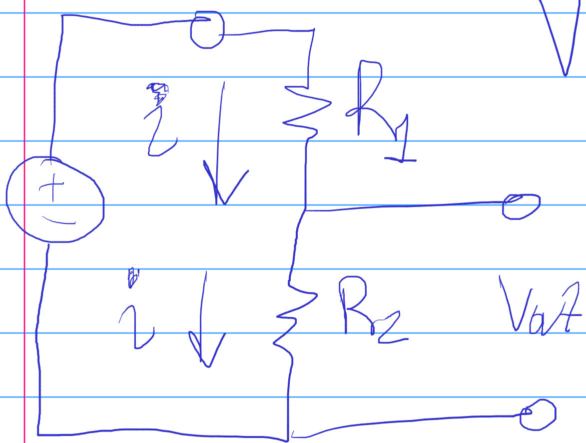
Ground:

A point of reference for voltage. A loop for current.

Case 2: A_0 not very high
II

Voltage Divider:

Allows you to div the voltage between 2 resistors. Therefore allowing you to step down the voltage, from a power supply. To any other voltage you require.



$V = I \cdot R \qquad V_i = i(R_1 + R_2)$

$i = V_i / (R_1 + R_2)$

$\boxed{V_0 = i R_2}$

$i = V_0 / R_2$

μετράμε τα Vout που αφορά ΜΟΝΟ τον R_2

Since: i is the same cause it's a series circuit i same everywhere so,

$$\frac{V_0}{R_2} = \frac{V_i}{R_1 + R_2} \Rightarrow V_{out} = \left(\frac{V_i}{R_1 + R_2}\right) \cdot R_2$$

IMPORTANT! or

$$\boxed{V_{in} \cdot \frac{R_2}{R_1 + R_2}}$$

Case 2:

A_0 not very high

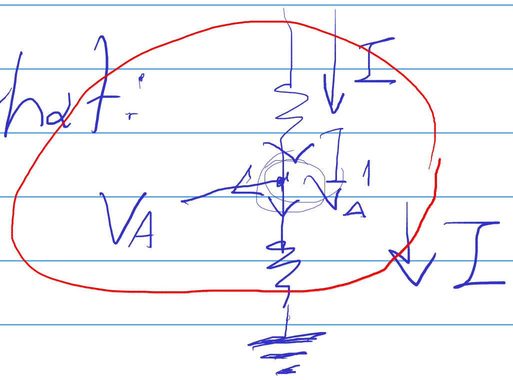
We cannot assume $\boxed{V_{1in} \approx V_{2in}}$

finite gain of OP. AMP.

how does it affect PERFORMANCE

We this as we can see a resistive divider.

So we know that:



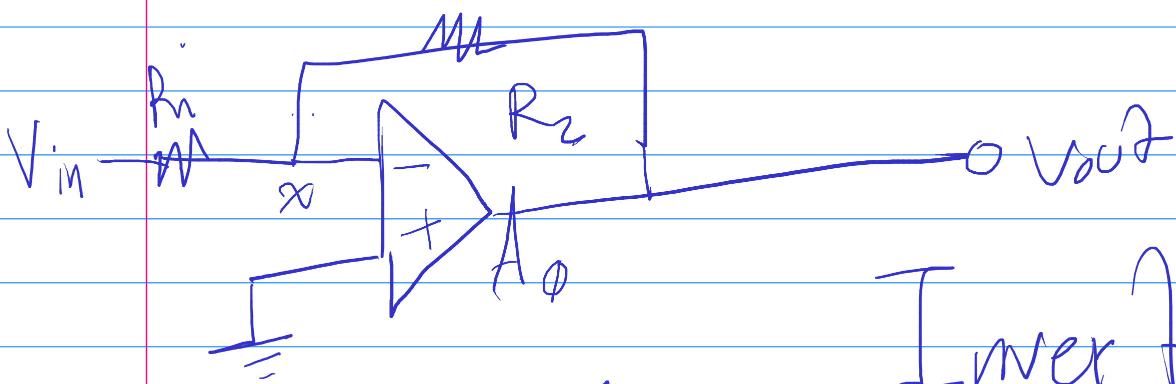
$$\frac{V_A}{R_2} = \frac{V_0}{R_1+R_2}$$

$$V_A = V_0 \frac{R_2}{R_1+R_2}$$

$$V_{out} = (V_{in+} - V_{in-}) \cdot A_0$$

$$\left(V_{in} - V_{out} \cdot R_2/(R_1 - R_2)\right) A_0 = V_{out}$$

$$\frac{V_{out}}{V_{in}} = \frac{A_0}{1 + \frac{R_2}{R_1+R_2} \cdot A_0}$$

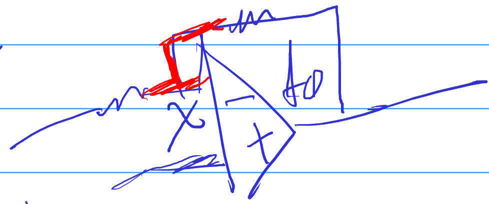


Inverting Amplifier

Gain is Negative

Case 1: $A_0 \to \infty$

One of the input is 0 so thee other one has to be next 0 as welle node x (virtual GRD) very close to $\emptyset$.



Current through $R_1 = \dfrac{V_{in} - V_x}{R_1}$

$\approx V_{in}/R_1$ since $V_x \approx \emptyset$

Since $V_{i(-)}$ has high impedance it goes around the loop.

Then through R_2. Then the output of the op-amp.

$$\frac{V_{in}}{R_1} \cdot R_2 = \cancel{V_x}^{\,\emptyset} - V_{out}$$

$$V_{out} = -\frac{V_{in}}{R_1} \cdot R_2$$

So the Gain

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

The dif. between the 2 is. Input Impedance along with other parameters.

Vin(+) ⇧ Vin(-) ⇩

Input Imp approximately $\left[\frac{1}{R_1}\right]$
