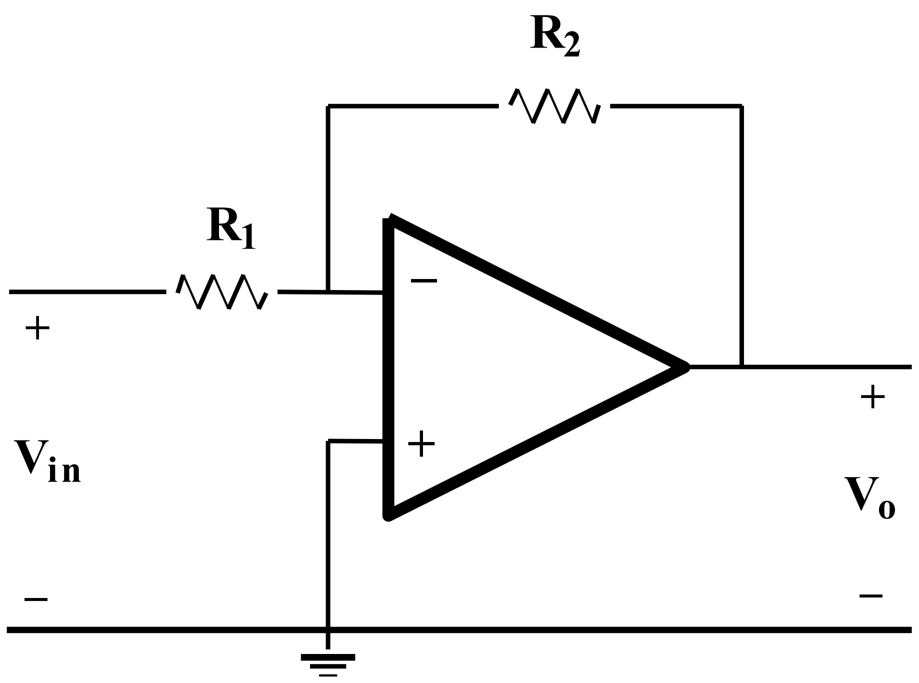
UNIT-2
Lecture-2

(ideal and non ideal) based Circuits

Operational Amplifiers

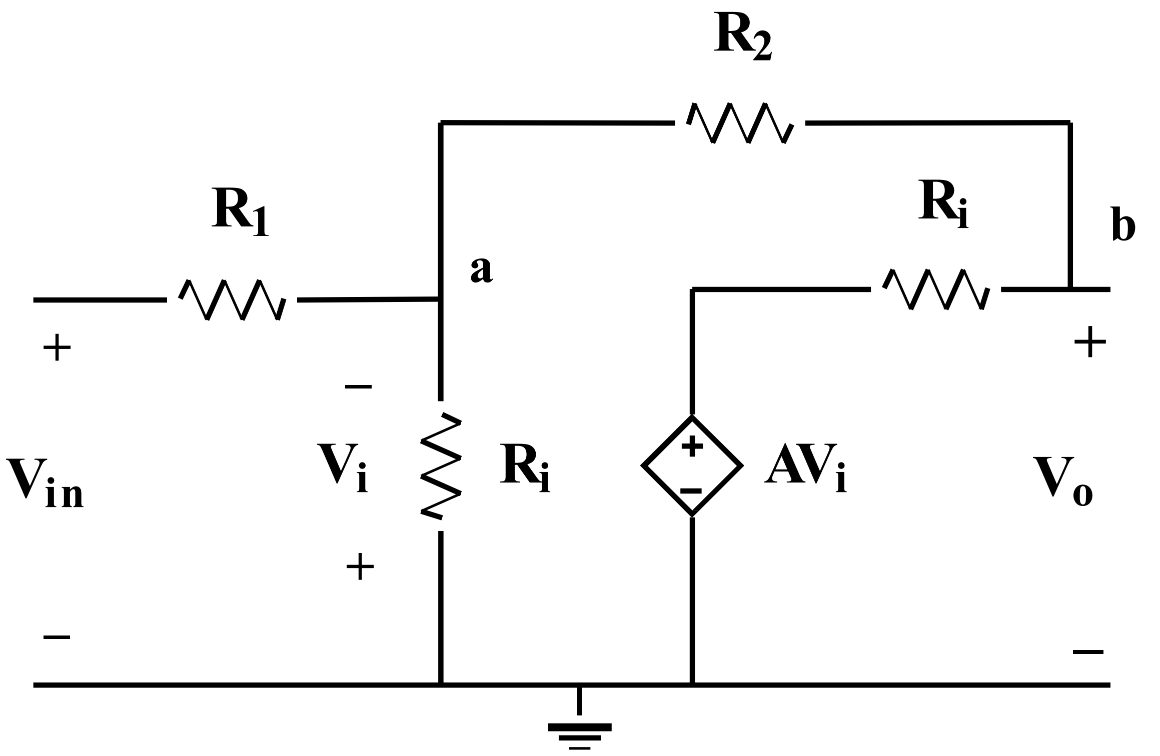
<u>Application:</u> As an application of the previous model, consider the following configuration. Find V_o as a function of V_{in} and the resistors R_1 and R_2.



Op amp functional circuit.

Operational Amplifiers

In terms of the circuit model we have the following:



Total op amp schematic for voltage gain configuration.

Operational Amplifiers

For most all operational amplifiers, R_i is 1 meg Ω or larger and R_o is around 50 Ω or less. The open-loop gain, A, is greater than 100,000.

Ideal Op Amp:

The following assumptions are made for the ideal op amp.

$$1.\ \boldsymbol{Infinite\ \ open-loop\ \ gain};\ \boldsymbol{A} \cong \infty$$

$$2.\ \boldsymbol{Zero\ \ output\ \ ohms};\ \boldsymbol{R_o} = 0$$

$$3.\ \boldsymbol{Infinite\ \ input\ \ ohms};\ \boldsymbol{R_i} = \infty$$

Ideal Op Amp:

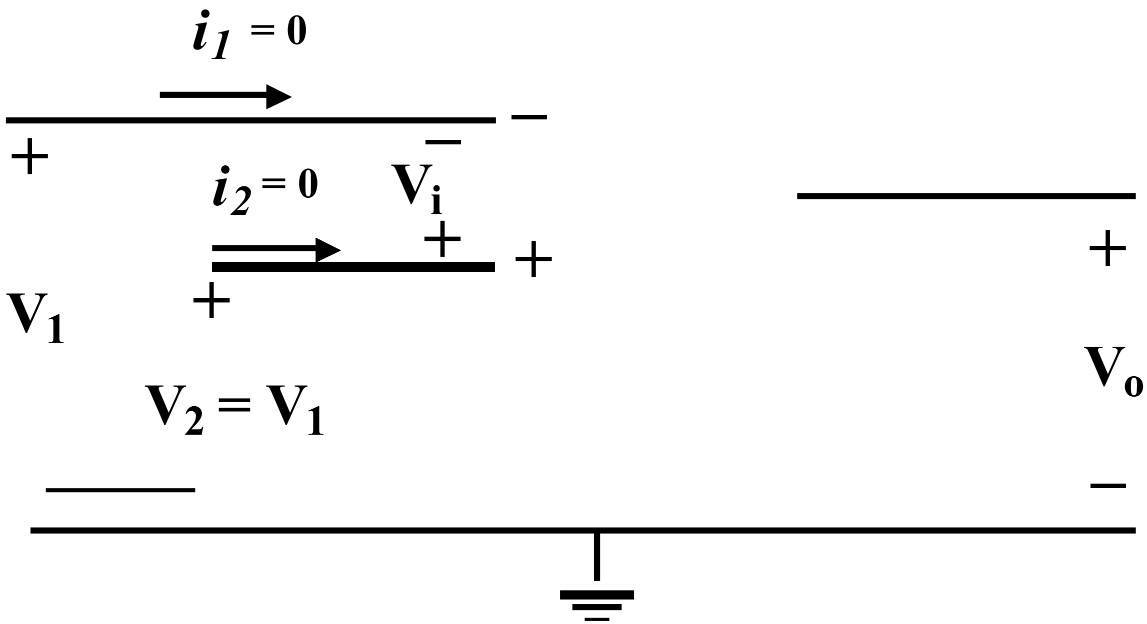


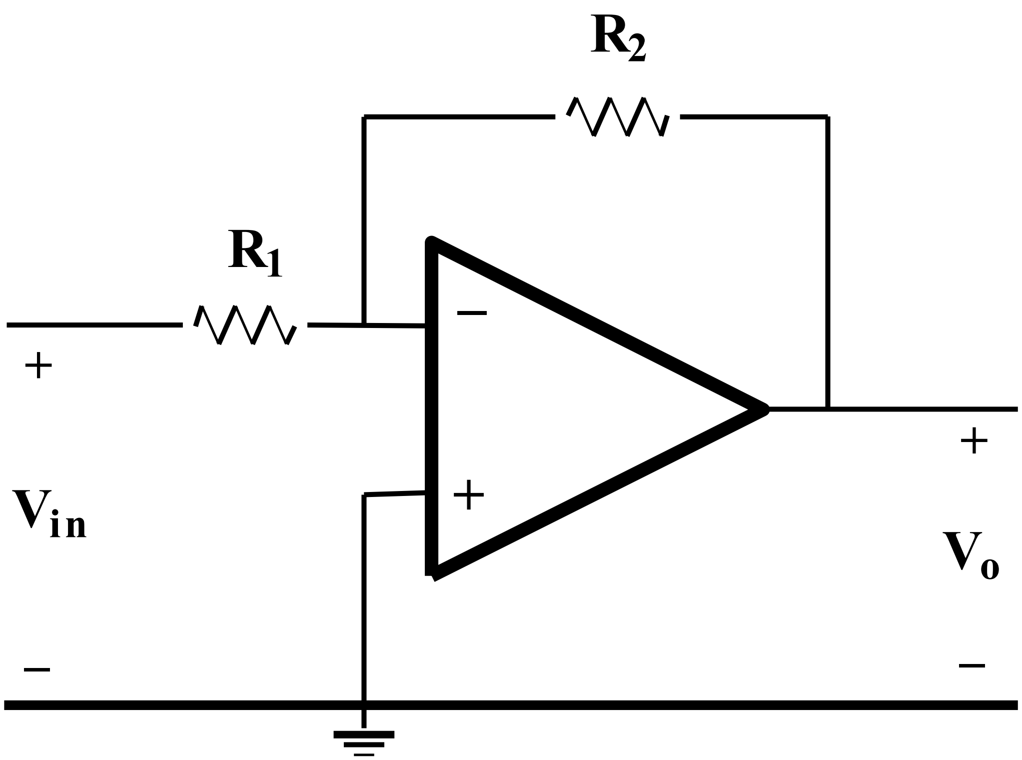
Figure 8.9: Ideal op amp.

(a) $i_1 = i_2 = 0$: Due to infinite input resistance.

(b) V_i is negligibly small; $V_1 = V_2$.

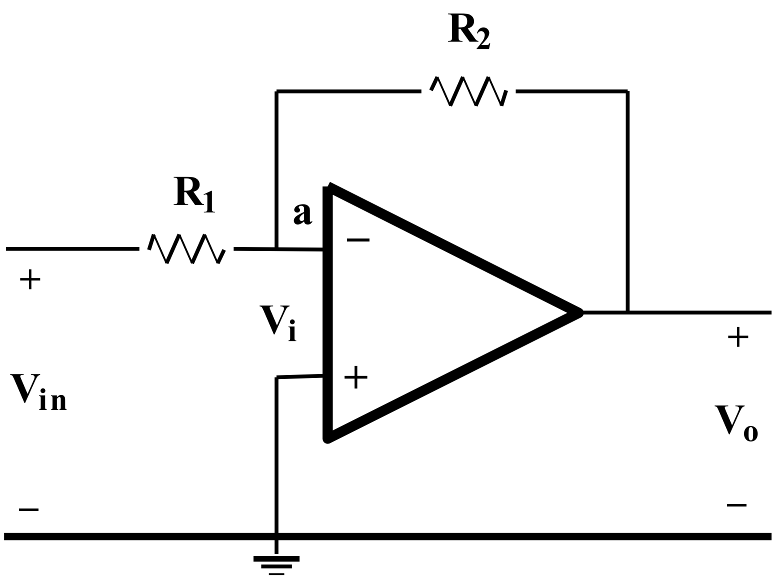
Ideal Op Amp:

Find V_o in terms of V_{in} for the following configuration.



Gain amplifier op amp set-up.

Ideal Op Amp:



Writing a nodal equation at (a) gives;

$$\frac{(V_{in}+V_i)}{R_1} = -\frac{(V_i+V_o)}{R_2}$$

Ideal Op Amp:

$$\frac{(V_{in}+V_i)}{R_1} = \frac{-(V_i+V_o)}{R_2}$$

With V_i = 0 we have; $$V_0 = \frac{-R_2}{R_1} V_{in}$$

With R_2 = 4 kΩ and R_1 = 1 kΩ, we have

$$\boldsymbol{V_o = -4V_{in}}$$

Earlier we got $\longrightarrow$ $$V_o = -3.99V_{in}$$

Ideal Op Amp:

At this point in circuits we are not able to appreciate the utility . We will revisit this at a later point in circuits but for now we point out that judicious selections of $Z_{fb}(s)$ and $Z_{in}(s)$ leads to important applications in

- Analog Filters
- Analog Compensators in Control Systems
- Application in Communications