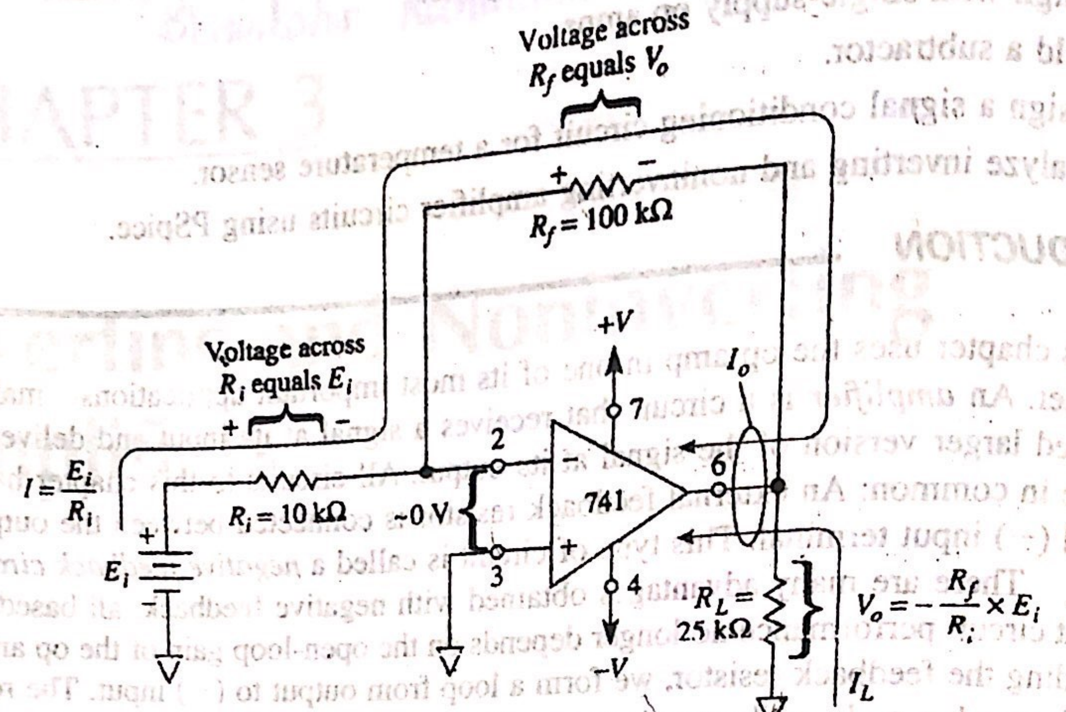

FIGURE 3-1 A positive input voltage is applied to the (−) input of an inverting amplifier. R_i converts this voltage to a current, I; R_f converts I back into an amplified version of E_i.

0 V, so ground potential is at the (−) input. For this reason, the (−) input is said to be at

Example 3-1

For Fig. 3-1, let $R_f = 100\ \text{k}\Omega$, $R_i = 10\ \text{k}\Omega$, and $E_i = 1$ V. Calculate (a) I; (b) V_o; (c) A_{CL}.

R_{in} $\quad$ $V_{in} = 1V$ $\quad$ A_v

$$\text{Gain}(A_v) = \frac{V_{out}}{V_{in}} = \frac{-R_f}{R_{in}}$$

Solution (a) From Eq. (3-1a),

$$I = \frac{E_i}{R_i} = \frac{1\ \text{V}}{10\ \text{k}\Omega} = 0.1\ \text{mA}$$

(b) From Eq. (3-2a),

$$V_o = -\frac{R_f}{R_{in}} \times \overset{V_{in}}{E_i} = -\frac{100\ \text{k}\Omega}{10\ \text{k}\Omega}(1\ \text{V}) = -10\ \text{V}$$

(c) Using Eq. (3-2b), we obtain

$$A_{CL} = -\frac{R_f}{R_i} = -\frac{100\ \text{k}\Omega}{10\ \text{k}\Omega} = -10$$

This answer may be checked by taking the ratio of V_o to E_i:

$$A_{CL} = \frac{V_o}{E_i} = \frac{-10\ \text{V}}{1\ \text{V}} = -10$$

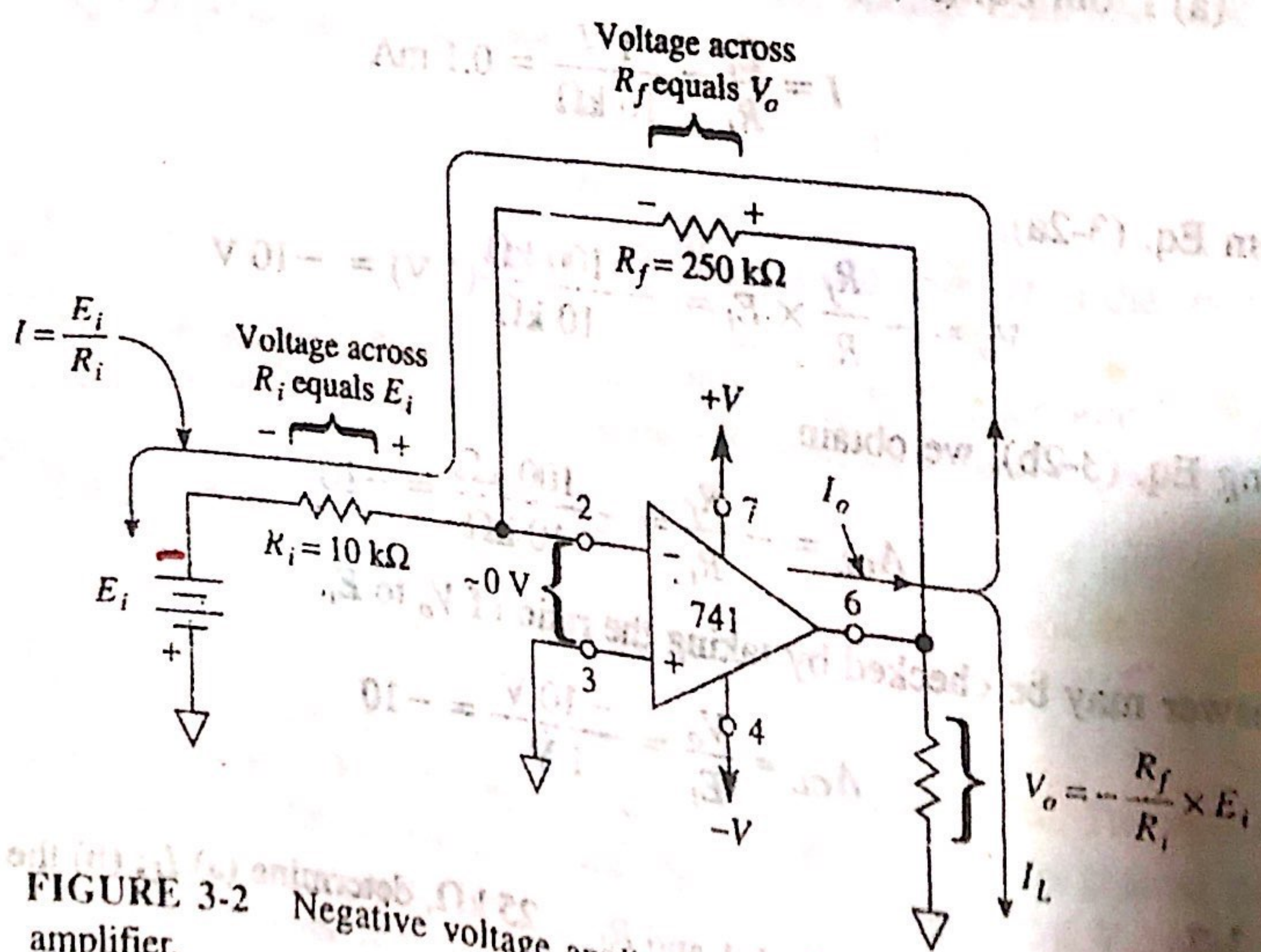

FIGURE 3-2 Negative voltage applied to the (−) input of an inverting amplifier.

Example 3-3

For Fig. 3-2, let $R_f = 250\ \text{k}\Omega$, $R_i = 10\ \text{k}\Omega$, and E_i = −0.5 V. Calculate (a) I; (b) the voltage across R_f; (c) V_o.

Vin

Solution (a) From Eq. (3-1a),

$$I = \frac{E_i}{R_i} = \frac{0.5\ \text{V}}{10\ \text{k}\Omega} = 50\ \mu\text{A} = 0.05\ \text{mA}$$

(b) From Eq. (3-1b),

$$V_{R_f} = I \times R_f$$
$$= (50\ \mu\text{A})(250\ \text{k}\Omega)$$
$$= 12.5\ \text{V}$$

(c) From Eq. (3-2a),

$$V_o = -\frac{R_f}{R_i} \times E_i = -\frac{250\ \text{k}\Omega}{10\ \text{k}\Omega}(-0.5\ \text{V}) = +12.5\ \text{V}$$

Thus the magnitude of the output voltage does equal the voltage across R_f, and $A_{CL} = -25$.