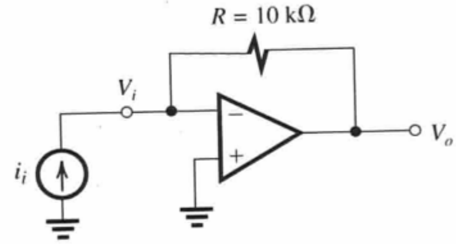
Ex: 2.5



From Table 1.1 we have:

$$R_m = \left.\frac{V_O}{i_i}\right|_{i_o = 0}, \text{ i.e., output is open circuit}$$

The negative input terminal of the op amp, i.e., V_i is a virtual ground, thus $V_i = 0$

$$V_O = V_i - Ri_i = 0 - Ri_i = -Ri_i$$

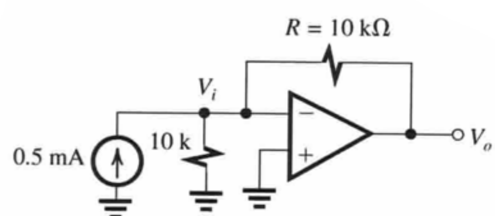
$$R_m = \left.\frac{V_O}{i_i}\right|_{i_o = 0} = -\frac{Ri_i}{i_i} = -R \Rightarrow R_m = -R$$

$$= -10\ \text{k}\Omega$$

$R_i = \frac{V_i}{V_i}$ and V_i is a virtual ground ($V_i = 0$),

thus $R_i = \frac{0}{i_i} = 0 \Rightarrow R_i = 0\ \Omega$

Since we are assuming that the op amp in this transresistance amplifier is ideal, the op amp has zero output resistance and therefore the output resistance of this transresistance amplifier is also zero. That is $R_O = 0\ \Omega$.



Connecting the signal source shown in Figure E2.5 to the input of this amplifier we have: V_i is a virtual ground that is $V_i = 0$, thus the current flowing through the 10 kΩ resistor connected between V_i and ground is zero. Therefore

$$V_O = V_i - R \times 0.5\ \text{mA} = 0 - 10\ \text{K} \times 0.5\ \text{mA}$$

$$= -5\ \text{V}$$

2.8

Circuit	v_o / v_I (V/V)	R_{in} (kΩ)
a	$\frac{-100}{10} = -10$	10
b	−10	10
c	−10	10
d	−10	10

virtual ground no current in 10 kΩ

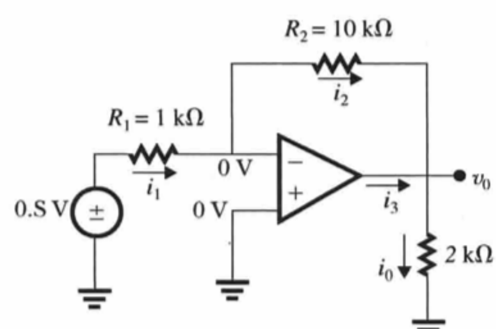
2.16

$$\frac{v_o}{v_I} = \frac{10\text{ k}}{1\text{ k}} = -10\text{ V / V}$$

$$v_o = -10\ v_I$$
$$= -10 \times (0.5)$$
$$= -5\text{ V/V}$$

In the figure

$$i_o = \frac{v_o}{2\text{ k}\Omega} = \frac{-5}{2\text{ k}\Omega} = -2.5\text{ mA}$$



$$i_1 = i_2 = \frac{0 - (v_o)}{10\text{ k}\Omega} = \frac{0 - (-5)}{10\text{ k}\Omega}$$
$$= +0.5\text{ mA}$$
$$i_3 = i_o - i_2 = -2.5 - 0.5$$
$$= -3\text{ mA}$$

This additional current is supplied by the op amp.