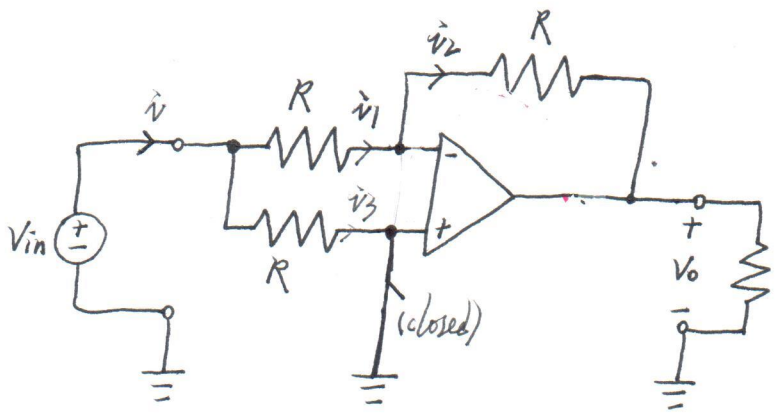
4.4



(b) with the switch closed

First, we verify that negative feedback is present.

According to the summing-point constraint:

$$i_1 = \frac{V_{in}}{R}$$

$$i_2 = i_1 = \frac{V_{in}}{R}$$

KVL:

$$i_2 R + V_o = 0$$

$$V_o = -\frac{V_{in}}{R} \cdot R = -V_{in}$$

$$\therefore A_V = \frac{V_o}{V_{in}} = -1$$

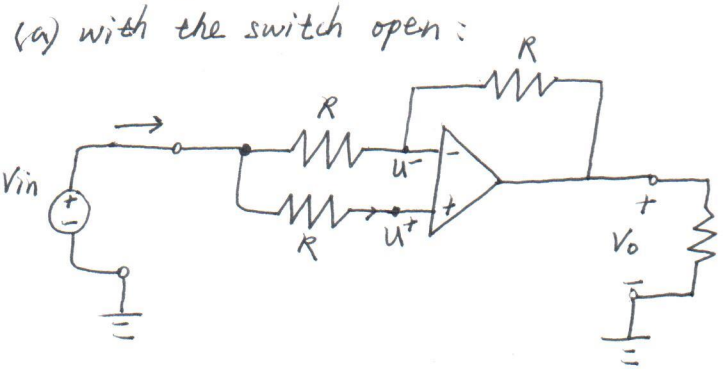
$$i_3 = \frac{V_{in}}{R}$$

KCL:

$$i = i_1 + i_3 = \frac{2V_{in}}{R}$$

$$R_{in} = \frac{V_{in}}{i} = \frac{R}{2}$$

(a) with the switch open:



$$\begin{cases} \dfrac{V_{in} - u^+}{R} = 0 \\ \dfrac{V_{in} - u^-}{R} = \dfrac{u^- - V_o}{R} \end{cases}$$

thus: $u^+ = u^- = V_{in}$

$$V_{in} = V_o$$

$$\therefore A_V = \frac{V_o}{V_{in}} = 1$$

$$Z_{in} = \frac{V_{in}}{0} = \infty \quad (\because V_{in} = u^-)$$