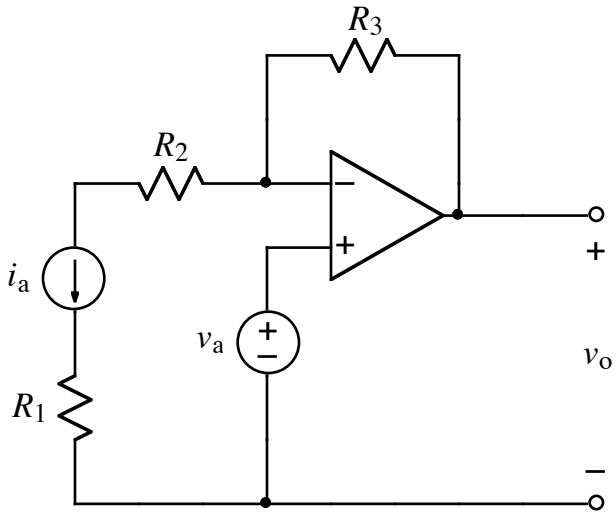
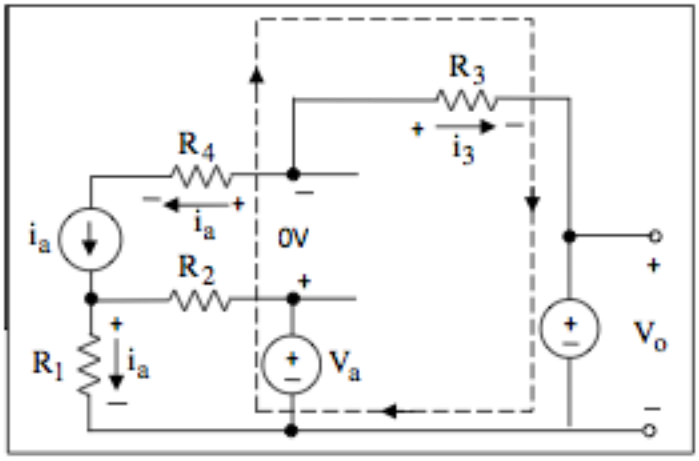
HOMEWORK #4 prob 5 solution

EX:



The op-amp operates in the linear mode. Using an appropriate model of the op-amp, derive an expression for v_o in terms of not more than i_a, v_a, R_1, R_2, and R_3.

SOL'N:



We first remove the op-amp and assume the op-amp output voltage has the value necessary to make the voltage drop across the op-amp inputs equal zero volts. One possible way of labeling the resulting circuit, consistent with the passive sign convention, is shown above (right).

Looking first for components in series that carry the same current, we see that R_4 and R_3 have equal but opposite currents:

$$i_3 = -i_a$$

Next, we look for voltage loops, making sure we use the 0 V drop across the op-amp inputs at least once. The small voltage loop shown on the diagram above yeilds the following Equation (using the current through R_3 as i_a:

$$+v_a + i_a R_3 - v_o = 0\,\text{V}$$

Solving for v_o:

$$\boxed{v_o = v_a + i_a R_3}$$