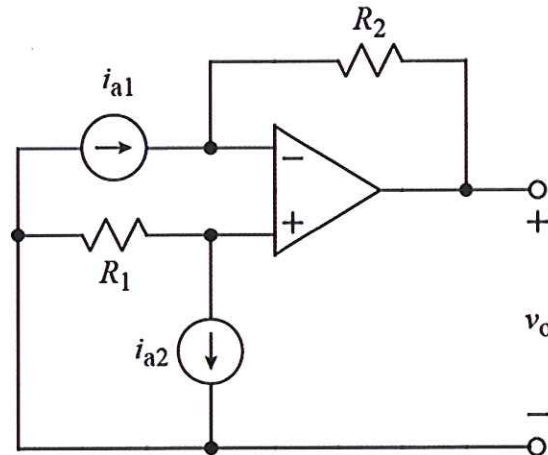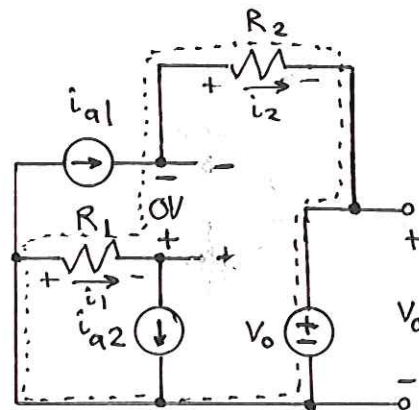Ex:

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_{a1}, i_{a2}, R_1, and R_2.

sol'n: We erase the op-amp and assume 0V across the op-amp inputs.

We use Ohm's law for v-drops across R's:

$$v_1 = i_1 R_1 \quad \text{and} \quad v_2 = i_2 R_2$$

The R's are in series with i sources.

$$i_1 = i_{a2} \quad \text{and} \quad i_2 = i_{a1}$$

The dotted line shows the only v-loop not passing through a current source.

$$-i_1 R_1 - 0v - i_2 R_2 - v_0 = 0v$$

We substitute for i_1 and i_2.

$$-i_{a2} R_1 - i_{a1} R_2 - v_0 = 0v$$

Solving for v_0, we have the expression we seek.

$$v_0 = -i_{a2} R_1 - i_{a1} R_2$$