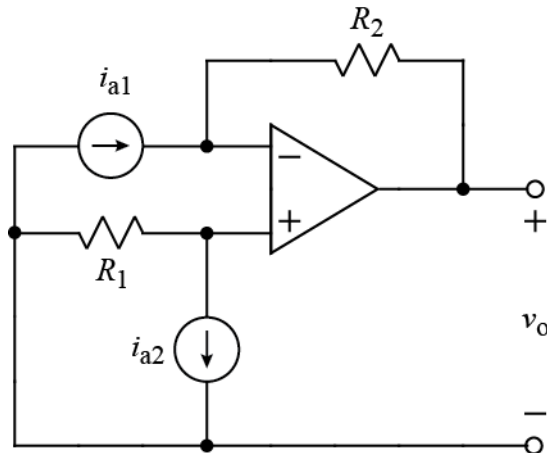


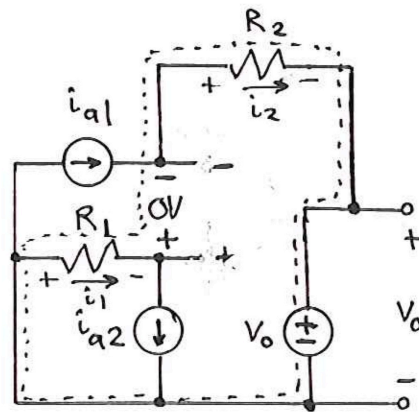
Ex:



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.

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

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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.

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