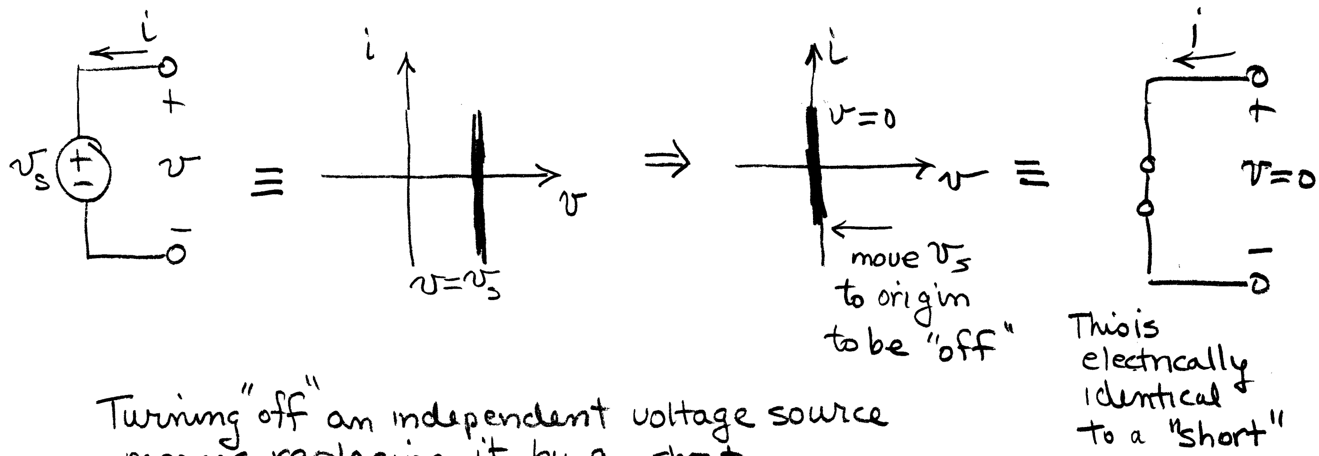
Superposition

Output can be found by finding the contribution to the output from each source.

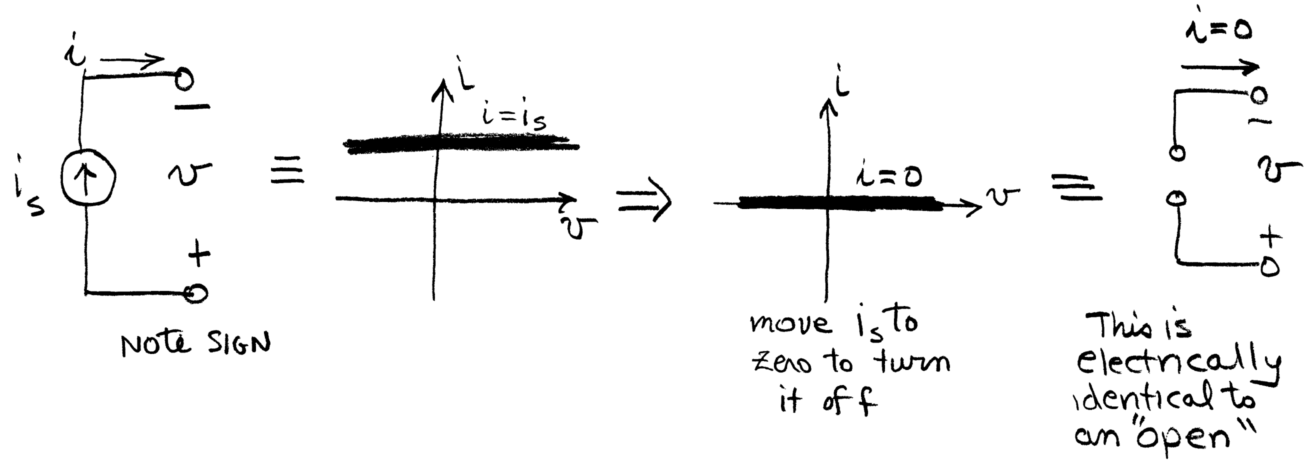
(1) "Turn Off" all independent sources except one and find output from that one alone.

(2) Repeat (1) for each independent source.

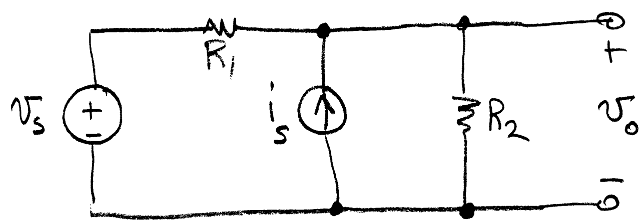
(3) Algebraically sum all outputs from each source.



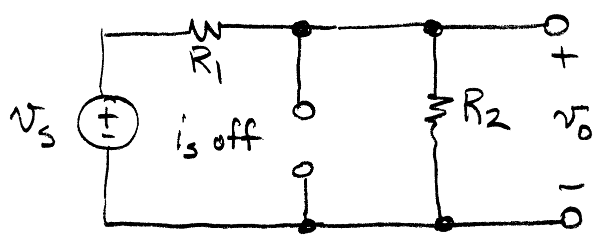
Turning "off" an independent voltage source means replacing it by a short.



Solve for v_o using superposition.



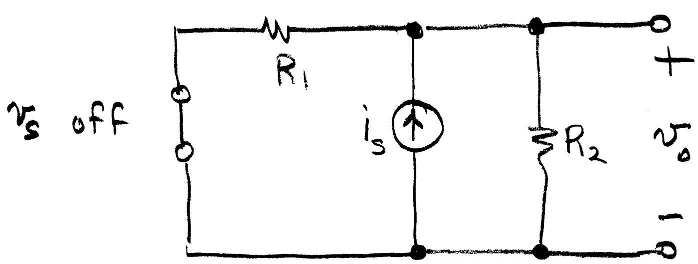
(a) "Turn off" i_s and find output due to v_s.



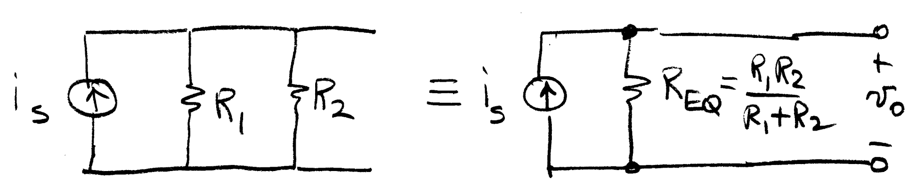
i_s becomes an "open" and the circuit is a voltage divider.

$$v_{o_v} = \frac{R_2}{R_1+R_2} v_s$$

(b) "Turn off" v_s and find output due to i_s.



This looks like two resistors in parallel.

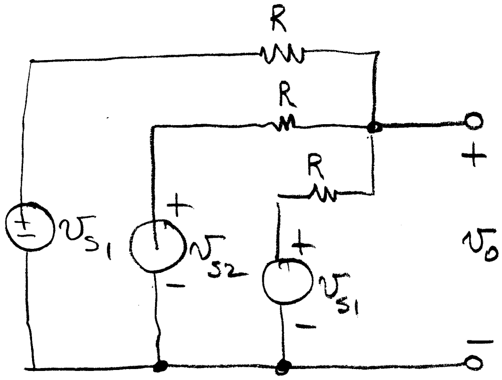


$$v_{o_i} = i_s \frac{R_1 R_2}{R_1+R_2}$$

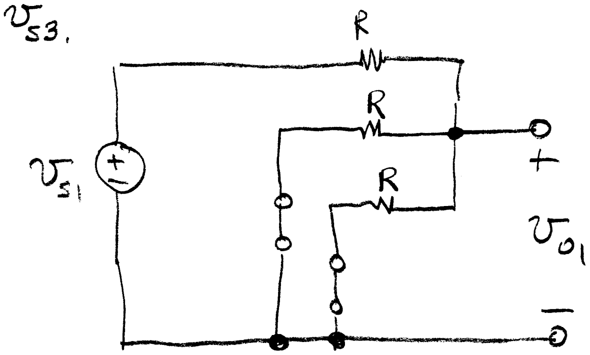
$$\therefore\ v_o = v_{o_v} + v_{o_i} = \frac{R_2}{R_1+R_2} v_s + \frac{R_1 R_2}{R_1+R_2} i_s$$

Example 3-12.

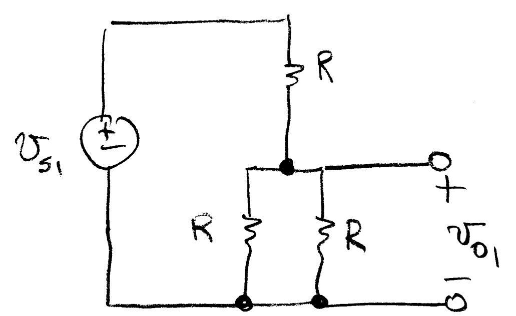
Show that the output is a weighted sum of the inputs v_{s1}, v_{s2}, and v_{s3}.



Turn off v_{s2} and v_{s3}.



Redrawing



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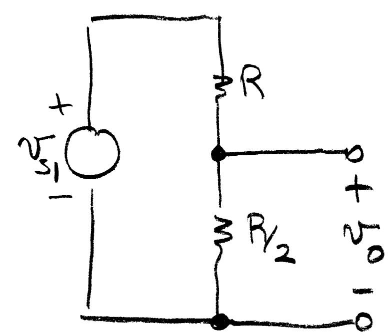

$$\therefore\ v_{o1} = \frac{R/2}{R + R/2}\, v_{s1} = \frac{R/2}{3R/2}\, v_{s1} = \frac{1}{3} v_{s1}$$

The other two source calculations are identical.

$$v_o = v_{o1} + v_{o2} + v_{o3} = \frac{1}{3} v_{s1} + \frac{1}{3} v_{s2} + \frac{1}{3} v_{s3}$$