ECE 2210 Lecture 4 notes Superposition

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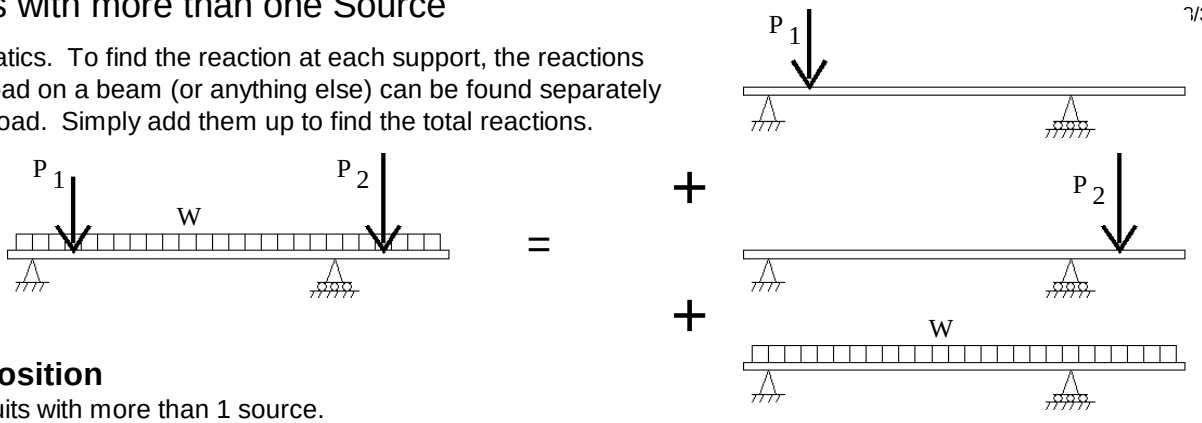
9/3/08,
?/31/09

Circuits with more than one Source

Recall Statics. To find the reaction at each support, the reactions to each load on a beam (or anything else) can be found separately for each load. Simply add them up to find the total reactions.

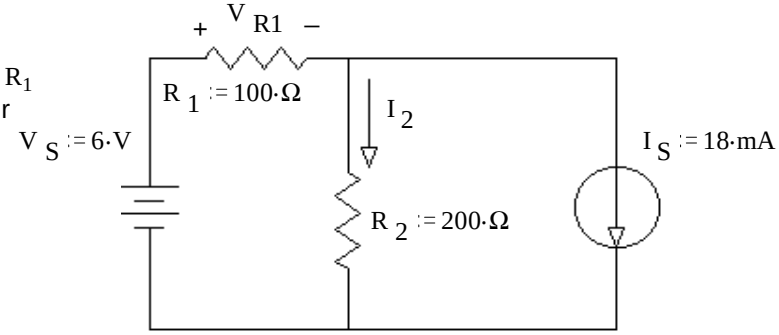


Superposition

For circuits with more than 1 source.

1) Zero all but one source.
   (To zero a voltage source, replace it with a short. To zero a current source, replace it with an open.)
2) Compute your wanted voltage or current due to the remaining source. Careful, some may be negative.
3) Repeat the first two steps for all the sources.
4) Sum all the contributions from all the sources to find the actual voltage or current. **Watch your signs!**

Ex1. Use the method of superposition to find the current I_2 (through R_2) and the voltage across R_1 (V_{R1}). Be sure to clearly show and **circle** your intermediate results.



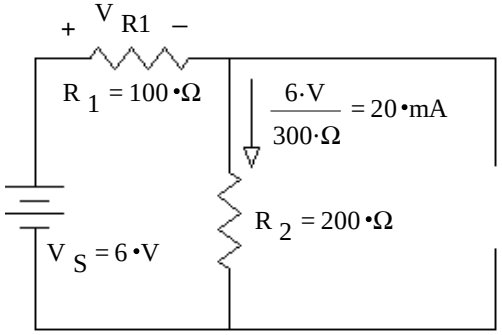
superposition:

Eliminate current source

$$I_{2.Vs} := \frac{V_S}{R_1 + R_2} \qquad I_{2.Vs} = 20\,\text{mA}$$

$$V_{R1.Vs} := \frac{R_1}{R_1 + R_2} \cdot V_S \qquad V_{R1.Vs} = 2\,\text{V}$$

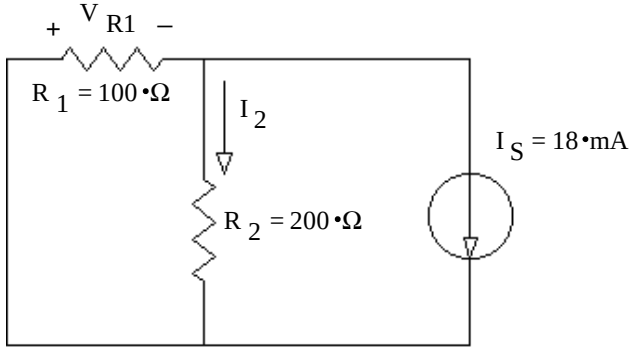
$20\,\text{mA} \cdot 100\,\Omega = 2\,\text{V}$



Eliminate voltage source

$$I_{2.Is} := -\frac{\frac{1}{R_2}}{\frac{1}{R_1} + \frac{1}{R_2}} \cdot I_S \qquad I_{2.Is} = -6\,\text{mA}$$

$$V_{R1.Is} := -I_{2.Is} \cdot R_2 \qquad V_{R1.Is} = 1.2\,\text{V}$$

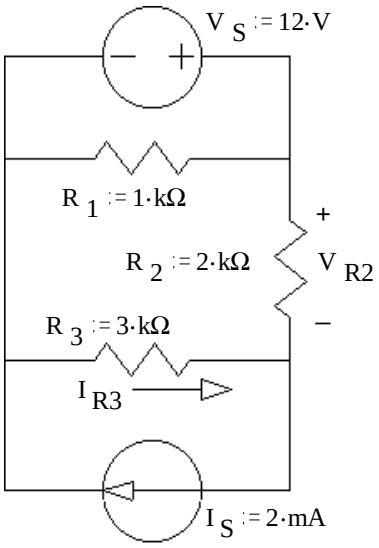


Add results

$$I_2 := I_{2.Vs} + I_{2.Is} \qquad I_2 = 14\,\text{mA}$$

$$V_{R1} := V_{R1.Vs} + V_{R1.Is} \qquad V_{R1} = 3.2\,\text{V}$$

Ex2. Use the method of superposition to find the voltage accross through R_2 and the current through R_3. Be sure to clearly show and **circle** your intermediate results.

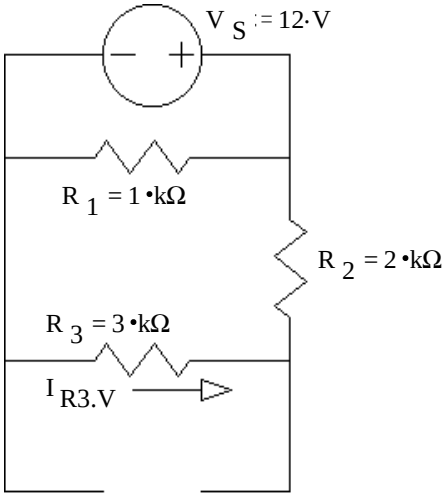


Eliminate current source

R_1 is a separate path and doesn't matter.

$$V_{R2.Vs} := \frac{R_2}{R_2 + R_3} \cdot V_S \qquad V_{R2.Vs} = 4.8 \cdot V$$

$$I_{R3.Vs} := -\frac{V_S}{R_2 + R_3} \qquad I_{R3.Vs} = -2.4 \cdot mA$$

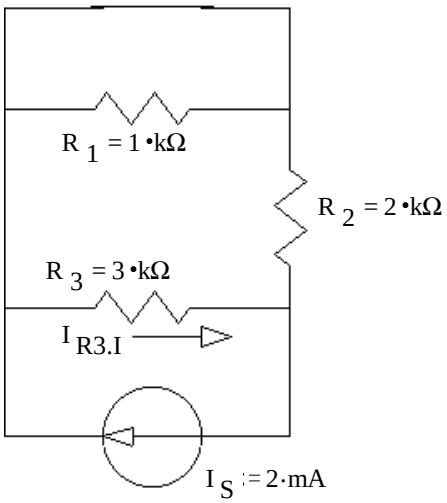


Eliminate voltage source

R_1 is shorted and doesn't matter.

$$V_{R2.Is} := I_S \cdot \frac{1}{\frac{1}{R_2} + \frac{1}{R_3}} \qquad V_{R2.Is} = 2.4 \cdot V$$

$$I_{R3.Is} := \frac{\frac{1}{R_3}}{\frac{1}{R_2} + \frac{1}{R_3}} \cdot I_S \qquad I_{R3.Is} = 0.8 \cdot mA$$



Add results

$$V_{R2} := V_{R2.Vs} + V_{R2.Is} \qquad V_{R2} = 7.2 \cdot V$$

$$I_{R3} := I_{R3.Vs} + I_{R3.Is} \qquad I_{R3} = -1.6 \cdot mA$$