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CSE250 – Circuits and Electronics

Ideal & non-ideal sources, Source transformation

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Circuit laws, method of analysis, & theorems

Laws

- Ohm's Law
- Kirchhoff's current law
- Kirchhoff's voltage law

Method of analysis

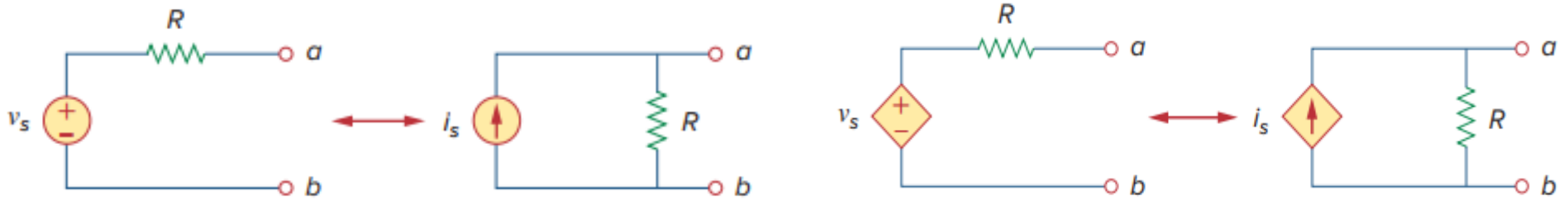
- Nodal analysis
- Mesh analysis

Theorems

- Source transformation
- Superposition theorem
- Thevenin's theorem
- Norton's theorem
- Maximum power transfer theorem

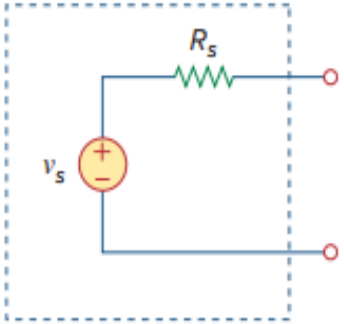
Source transformation

- A source transformation is the process of replacing a voltage source vs in series with a resistor R by a current source is in parallel with a resistor R, or vice versa.

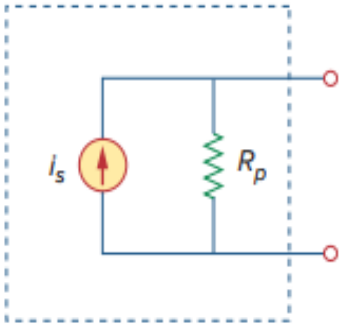


- Note that the arrow of the current source is directed toward the positive terminal of the voltage source.
- Note that source transformation is not possible when $R = 0$, which is the case with an ideal voltage source. However, for a practical, nonideal voltage source, $R \neq 0$. Similarly, an ideal current source with $R = \infty$ cannot be replaced by a finite voltage source.

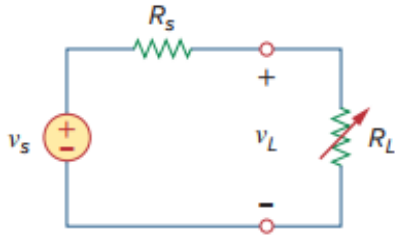
Ideal and non-ideal sources

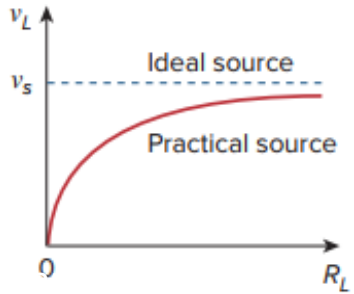


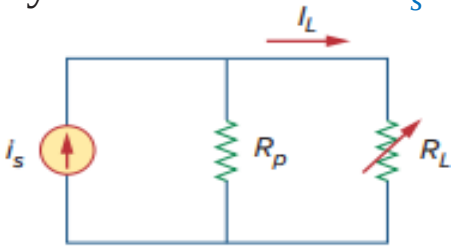
(a)

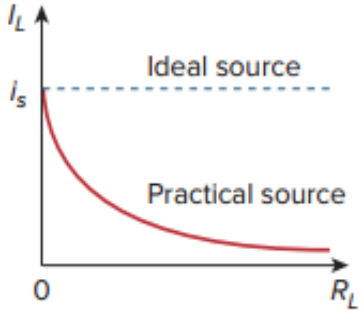


- An ideal voltage source provides a constant voltage irrespective of the current drawn by the load, while an ideal current source supplies a constant current regardless of the load voltage.
- Practical voltage and current sources are not ideal, due to their *internal resistances* or *source resistances* R_s and R_p. They become ideal as $R_s \rightarrow 0$ and $R_p \rightarrow \infty$.



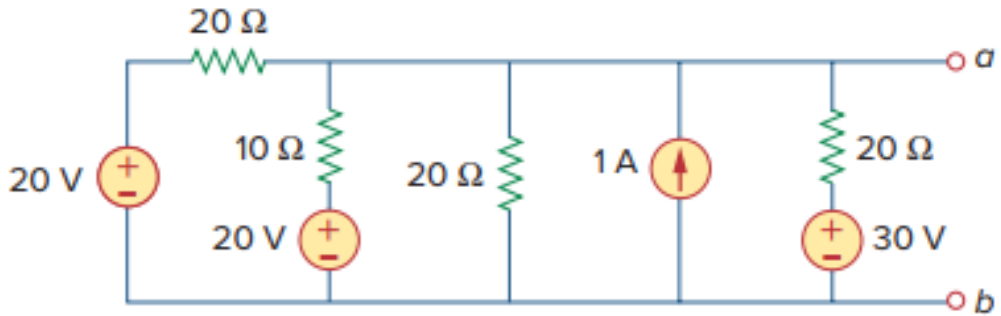




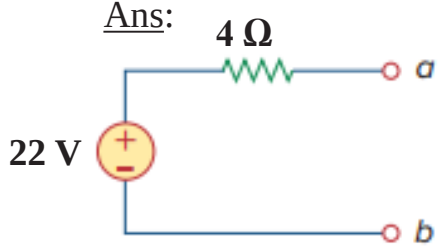


Example 1

- Use source transformation to reduce the circuit between terminals *a* and *b* shown to a single voltage source in series with a single resistor.

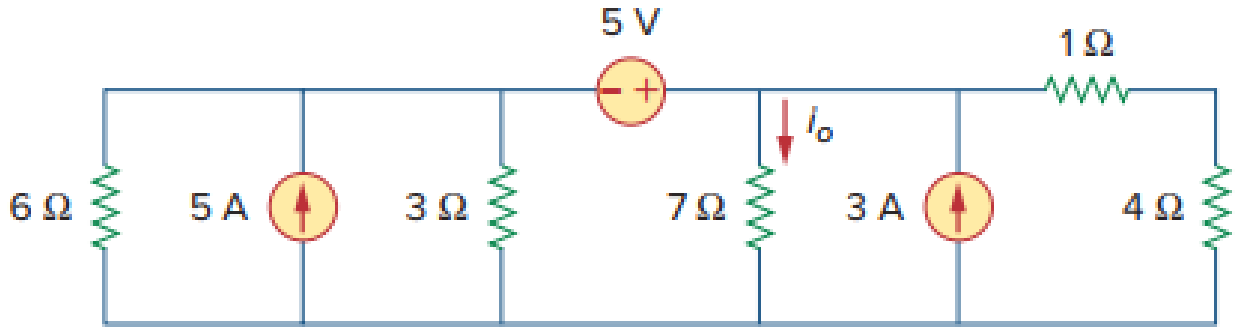


Ans:



Example 2

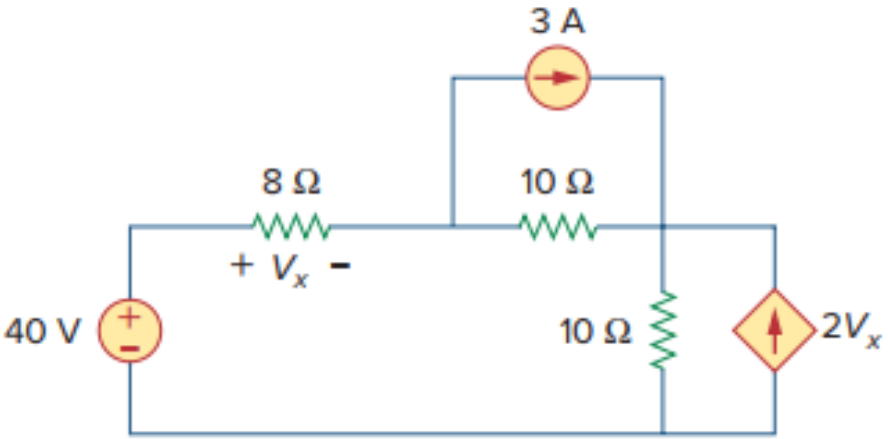
- Find i_o in the circuit using source transformation.



Ans: $\mathbf{i_0 = 1.78\ A}$

Example 3

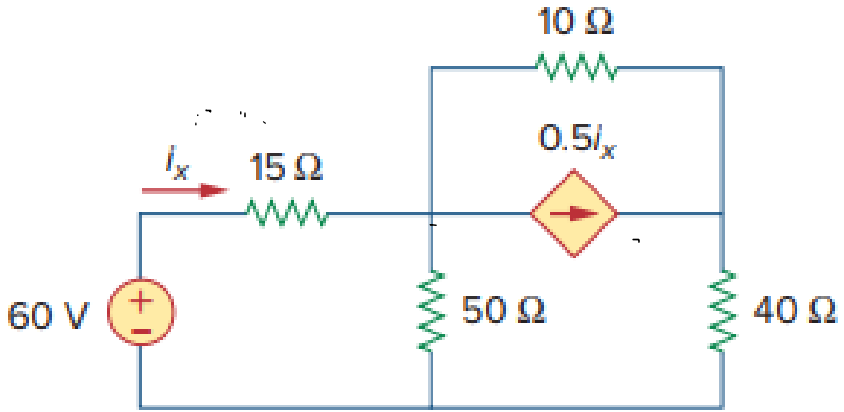
- Use source transformation to find $\mathbf{V_x}$



Ans: $\mathbf{V_x = 2.98\ V}$

Example 4

- Use source transformation to find $\mathbf{i_x}$ in the following circuit.



Ans: $\mathbf{i_x = 1.6\ A}$

Thank you for your attention