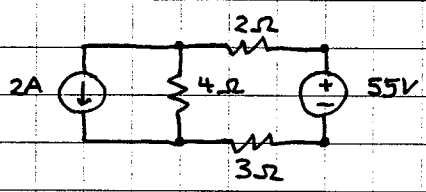
ex:



Use Node-Voltage method to find how much power the 2A source extracts from circuit.

First we use terminology:

nodes = 4 (two or more circuit elements join)

essential nodes = 2 (three or more circuit elements join; they are nodes for 4Ω resistor, top & bottom)

paths: 2A → 4Ω, 4Ω → 2Ω → 55V → 3Ω, 2Ω → 55V, 2A → 2Ω → 55V are a few examples (trace of connected circuit elements without passing thru any element twice)

branch: (path that connect 2 nodes) 2A, 4Ω, 2Ω, 3Ω, 2Ω → 55V, 55V → 3Ω, 3Ω → 55V (either direction ok), 55V, 2Ω → 55V → 3Ω

essential branch: (path connecting essential node w/o passing thru essential node) 2A, 4Ω, 2Ω → 55V → 3Ω, or 3Ω → 55V → 2Ω

loops: (path with last node = start node) 2A → 4Ω, 2A → 2Ω → 55V → 3Ω, 4Ω → 2Ω → 55V → 3Ω

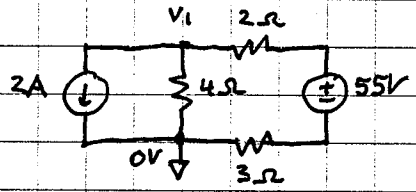
mesh: (loop not enclosing any other loop) 2A → 4Ω, 4Ω → 2Ω → 55V → 3Ω but not 2A → 2Ω → 55V → 3Ω

planar circuit: (can draw circuit w/o crossover branches) is planar

For Node-V method, we use all but 1 essential nodes after we define a ref node.

Choose node at bottom of 4Ω as ref node (i.e. 0V.)

↓ symbol ≡ 0V



Node at top of 4Ω is the other essential node. Label it V_1

Although we call it the Node-V method, (because we get an equation that we solve for voltage), we are writing an equation for sum of currents out of node = 0.

$$2A + \frac{V_1 - 0V}{4\Omega} + \frac{V_1 - 55V}{2\Omega + 3\Omega} = 0A$$

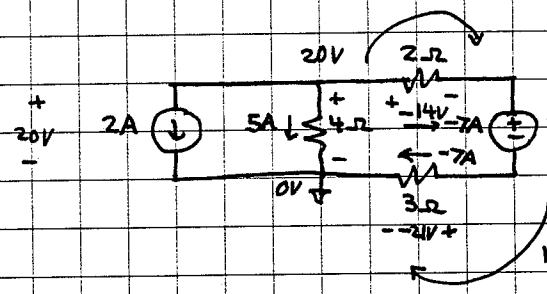
Note that current thru 2Ω is equal to total V-drop (i.e. $V_1 - 55V$) across the 2Ω and 3Ω R's.

$$\text{or } V_1\left(\frac{1}{4\Omega} + \frac{1}{5\Omega}\right) = -2A + \frac{55V}{5\Omega}$$

$$\text{or } \frac{V_1}{4\Omega \| 5\Omega} = 11A - 2A = 9A$$

$$\text{or } V_1 = 9A \cdot 4\Omega \| 5\Omega = \cancel{9A} \cdot \frac{4\Omega \cdot 5\Omega}{\cancel{9\Omega}} = 20\ V$$

check: $\frac{V_1}{4\Omega} = \frac{20V}{4\Omega} = 5A$ $\qquad \frac{V_1 - 55V}{2\Omega + 3\Omega} = -\frac{35V}{5\Omega} = -7A$



$-55V - -21V + 20V - -14V$
$= -55V + (21 + 20 + 14)V$
$= 0V$ ✓

Kirchoff V Loop

check: current out of top node for 4Ω is $2A + 5A - 7A = 0$ ✓

Calculate power for 2A source: $p = i \cdot v = 2A \cdot 2V = 40W$

$p > 0 \Rightarrow$ power absorbed.