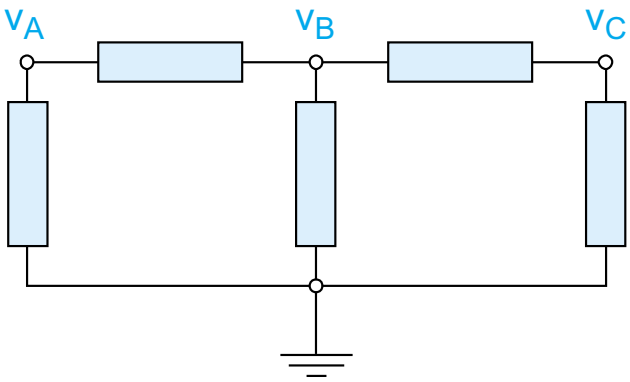
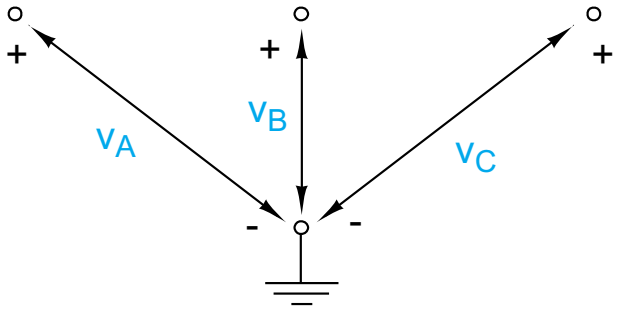
Node voltages:



Notation

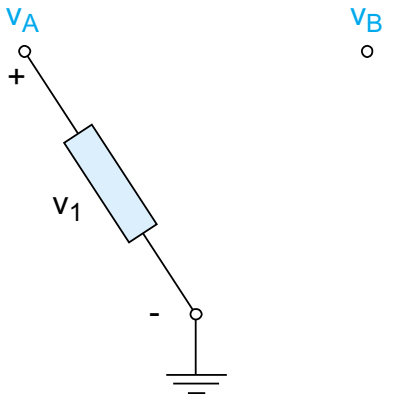


Interpretation

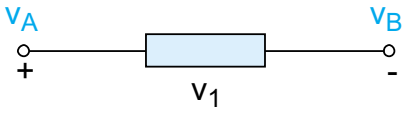
If the Kth two-terminal element is connected between nodes X and Y, then the element voltage can be expressed in terms of the two node voltages as

$$v_k = v_x - v_y$$

where X is the node connected to the positive reference for element voltage v_k



Case A

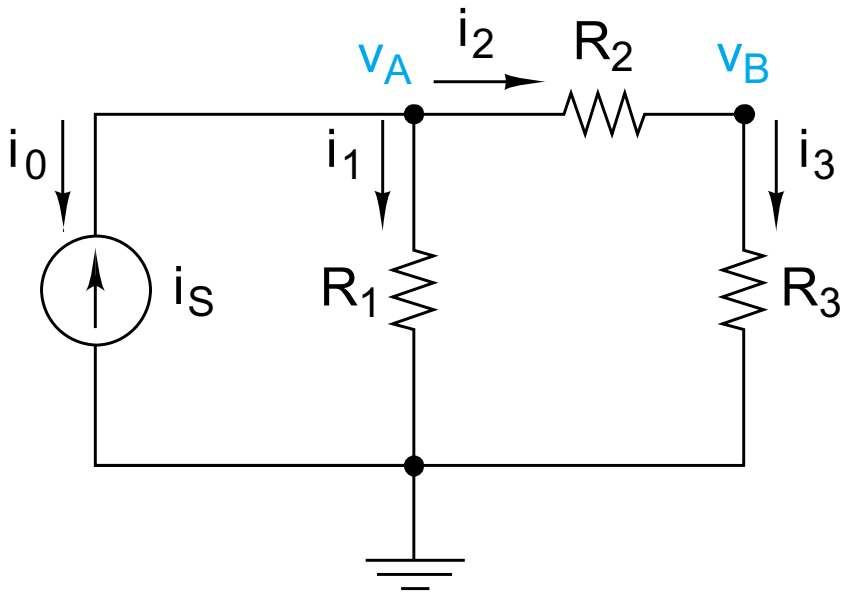


Case B

Node Voltage Method

1) select a reference node for ground, assign a node voltage to all other nodes and a current through every element.
2) write node equations via KCL
3) element equations (using conductance)
4) combine steps 2 & 3 to eliminate (non-source) element currents. In the process, reorder node equations to put all dependent values on LHS and independent values on RHS
5) solve for node voltages using linear algebra (you should know how to do this, see appendix B for a refresher)

Did somebody say example?



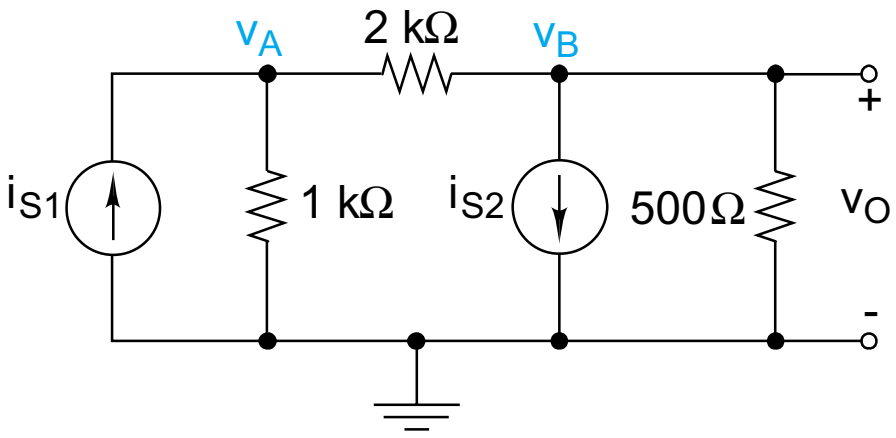
Making things quicker...

Replace steps 2-4 with modified step 2:

$v_X \bullet$(sum of all conductances entering node X) -
Σ(conductance i entering node X)$\bullet v_i$ + other currents = 0

where v_i is the node voltage on the opposite side of the i-th resistor entering node X

Oh what I'd give for an example...



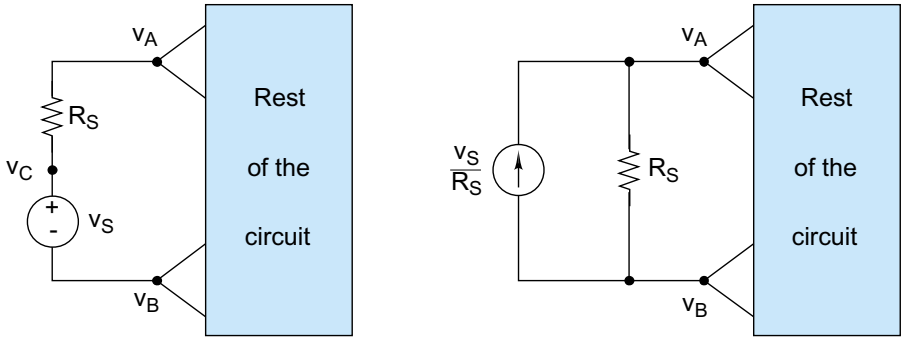
But what about voltage sources?

method 1: convert to current source

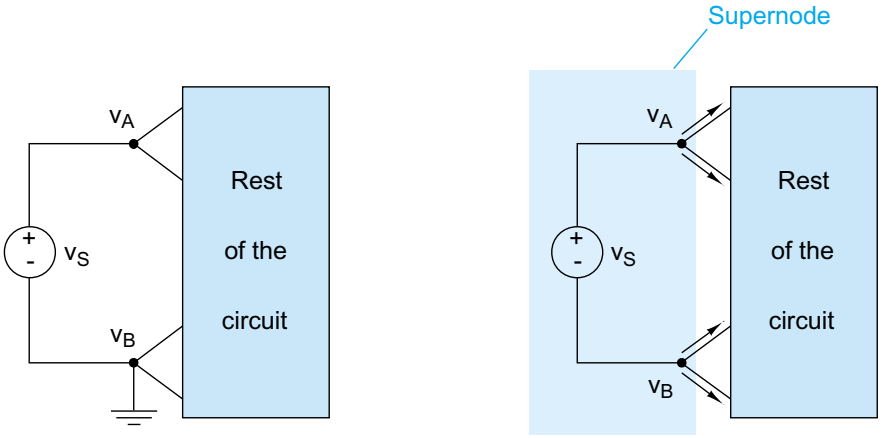
method 2: set ground at one end of voltage source. Now $v_A \equiv v_S$

may not be able to do this for all voltage sources in a circuit

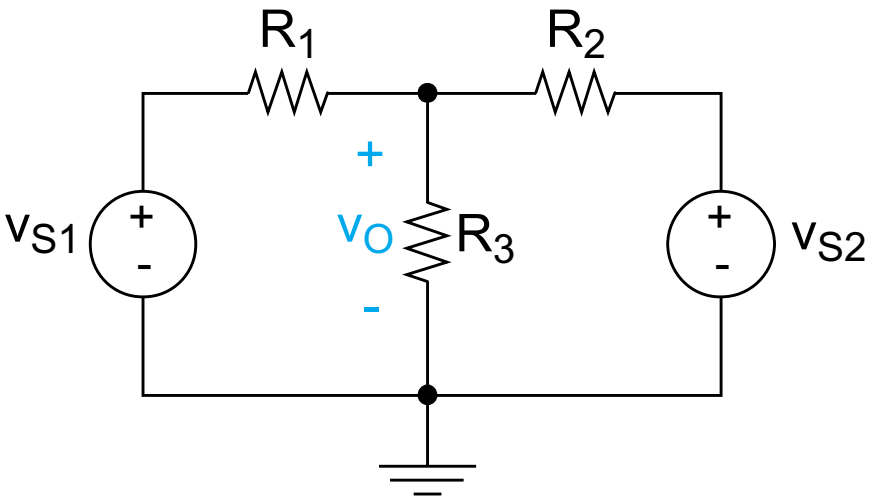
method 3: Super node: apply KCL to region and note that $v_A - v_B = v_S$

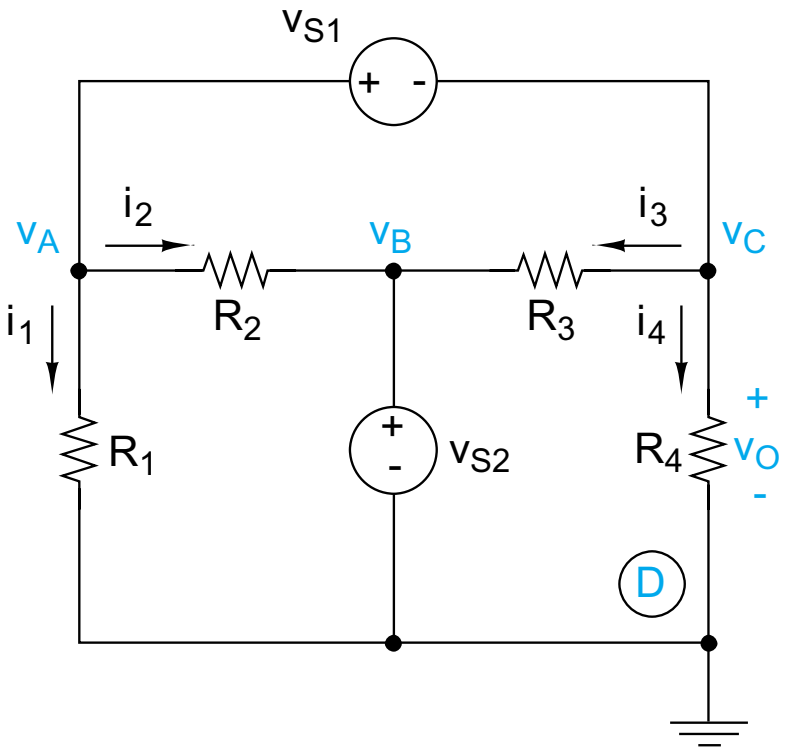


Method 1



Method 2 Method 3


R1
R2
+
vO
R3
-
vS1
+
-
+
-
vS2


vS1
+ -
i2
vA
vB
i3
vC
i1
R2
R3
i4
+
R1
+
-
vS2
R4
vO
-
D