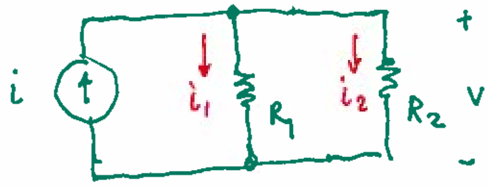
Current division (continued)

Wednesday, January 27, 2016



We have $R_{eq} = \dfrac{R_1 R_2}{R_1 + R_2}$

$$V = i\left(\frac{R_1 R_2}{R_1 + R_2}\right)$$

Individual currents are: $i_1 = \dfrac{V}{R_1} = \dfrac{i}{R_1}\left(\dfrac{R_1 R_2}{R_1 + R_2}\right)$

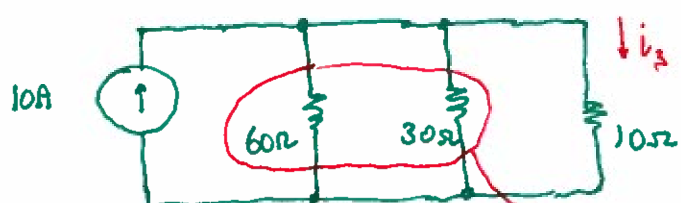
$$= i\left(\frac{R_2}{R_1 + R_2}\right)$$

note similarity to voltage divider, except it's the other branch's resistor (R_2)

Not as straightforward as voltage division when more than two resistors

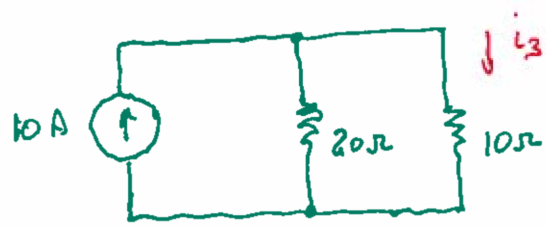
- when more than two resistors in parallel, we may group them.

Example 1: Find i_3



$$\frac{60 \times 30}{60 + 30} = 20\,\Omega$$

⇓

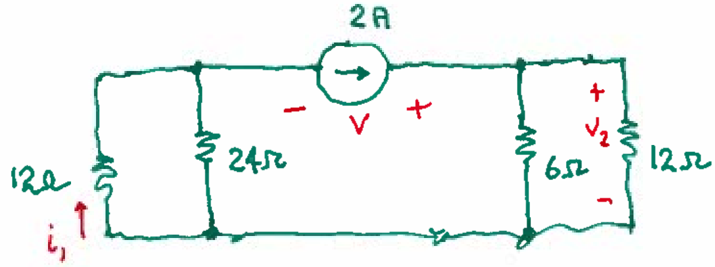


note the other branch's resistance.

Current division by inspection gives $i_3 = \dfrac{20}{20+10} \times 10$

$$= 6.67\,A$$

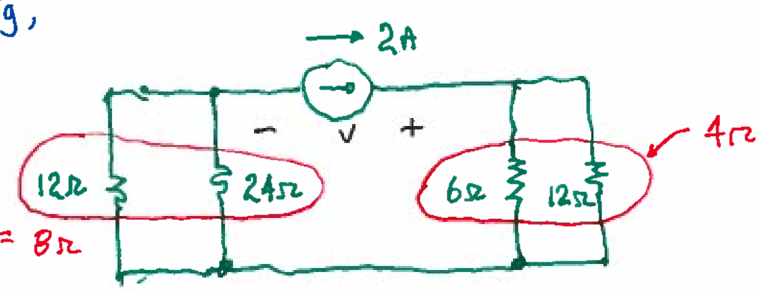
Example 2: Find v, i_1 and v_2 in the following



Many ways to proceed.

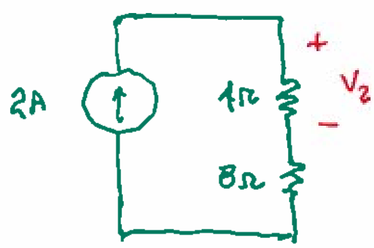
Strategy:
- Find to total resistance connected to the source; then find v
- Use voltage division to find v_2
- Use current division to find i_1

Simplifying,



$$\frac{12 \times 24}{12+24} = 8\Omega$$

Redraw:



$R_{eq} = 4 + 8 = 12\Omega$

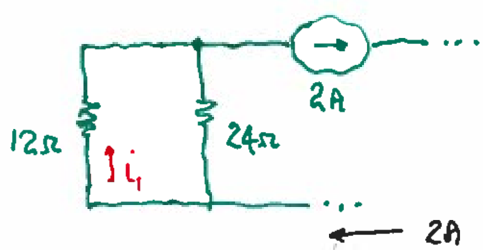
Hence, $v = 2 \times R_{eq}$

$= 24\,v$

By voltage division, we may write by inspection

$$v_2 = \frac{4}{4+8} \times v = \frac{1}{3} \times 24 = 8\,v$$

On the left side of the circuit



By current division, we may write by inspection

$$i_1 = \frac{24}{24+12} \times 2A = 4/3\ A$$

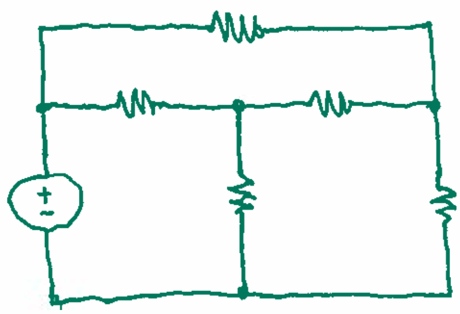
the other branch's resistance.

Node-voltage analysis

The previous method of circuit analysis by series/parallel circuit manipulation works well for many circuits, but ...

- it's an "ad-hoc" method; depends on circuit
- doesn't apply to all circuits

E.g.,



Yikes!

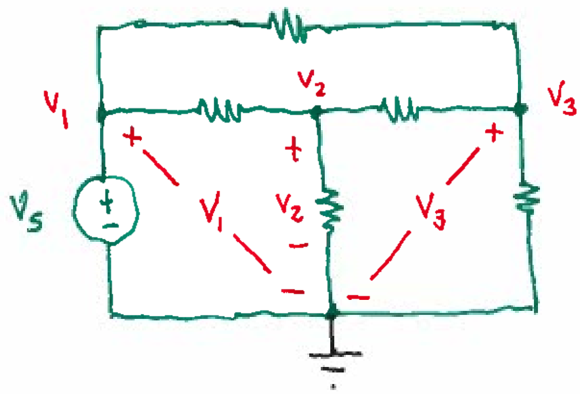
- nothing in series
- nothing in parallel.

Node-voltage analysis works for any circuit.

Basic steps:

1. Identify nodes, and decide on a reference node.
2. Apply KCL at nodes; develop a system of equations in terms of node voltages.
3. Solve for node voltages

Step 1: Identify nodes and node voltages



V_1
V_2
V_3
V_s
+
−
V_1
+
−
V_2
+
−
V_3
+
−