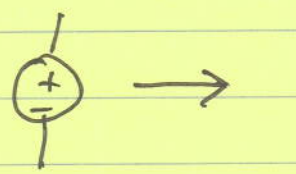
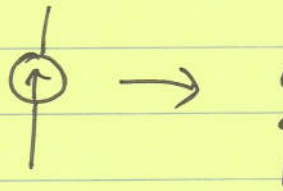
Method of Superposition

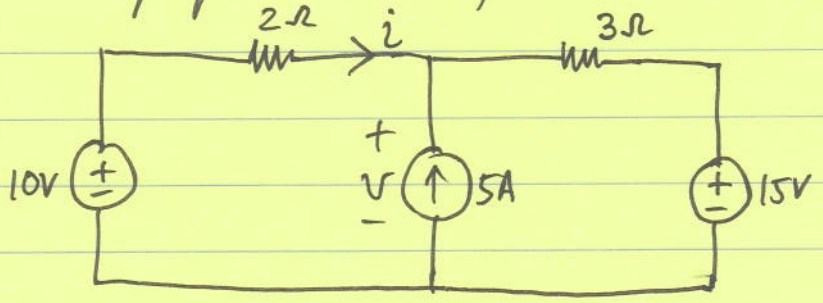
If circuit has more than one independent source, then any voltage or current can be found by summing the responses due to each independent source acting alone.

"acting alone" ⇒ we need to know how to suppress independent sources

voltage source  short.

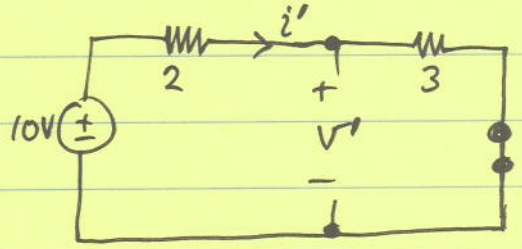
current source  open.

Ex Use superposition to find v and i:



3 dependent sources so we make 3 circuits: ~~with~~

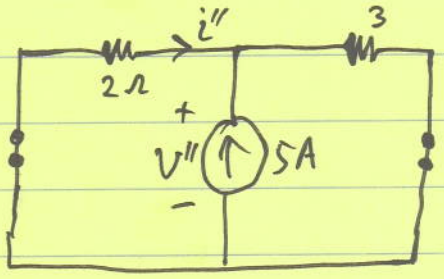
10V acting alone:



$$i' = \frac{10V}{2+3\Omega} = 2A$$

$$v' = 10V \times \frac{3}{3+2} = 6V \quad \text{(using voltage divider rule)}$$

5A acting alone:

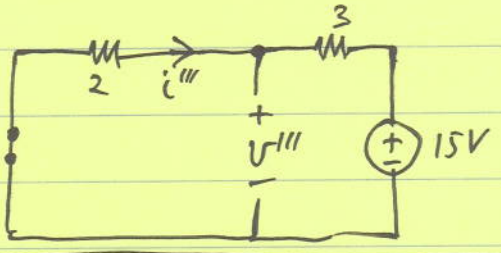


$$2\Omega \| 3\Omega = \frac{2\times 3}{2+3} = 1.2\Omega$$

$$v'' = 5A \times 1.2\Omega = 6V$$

$$i'' = \frac{(-6V)}{2\Omega} = -3A$$

15V acting alone:



$$i''' = -\frac{15V}{2+3\Omega} = -3A$$

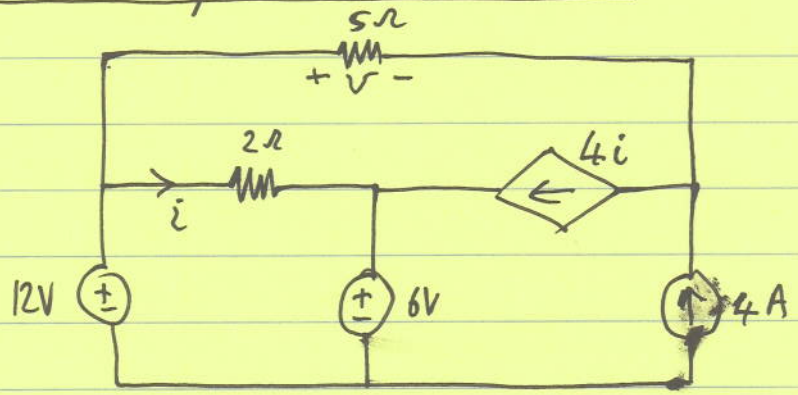
$$v''' = 3A \times 2\Omega = 6V$$

Add contributions $v = v' + v'' + v''' = 6 + 6 + 6 = 18V$

$i = i' + i'' + i''' = 2 + (-3) + (-3) = -4A$.

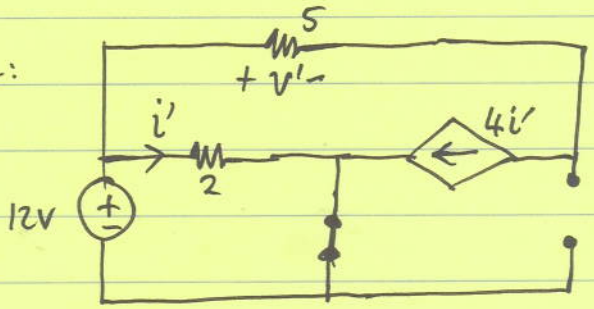
Unfortunately, dependent sources ◇→ ◇−+ do not suppress;

Ex with a dependent source



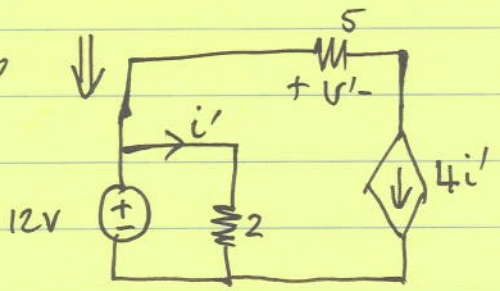
Find i & v using superposition.

Soln 12V acting alone:



Note the dependent source 4i' does not suppress!!

redraw ⇓

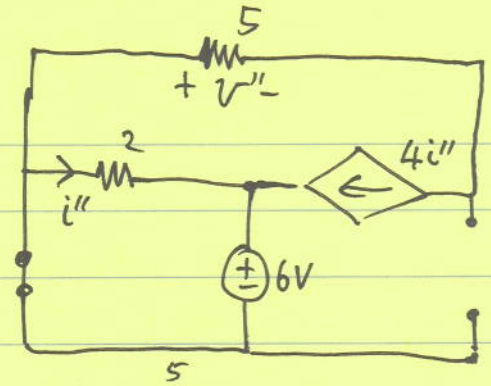


$$\Rightarrow i' = \frac{12V}{2\Omega} = 6A$$

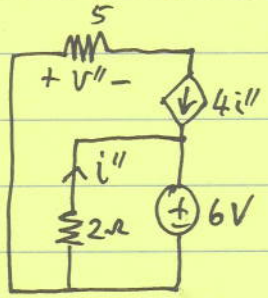
$$v' = (4i')(5\Omega) \quad \text{ohms law}$$

$$= 4 \times 6 \times 5 = 120V.$$

6V acting alone:



redraw ⇓

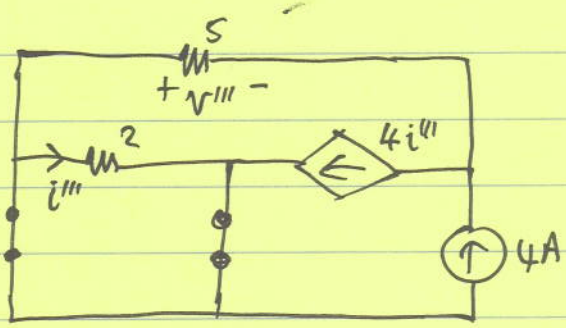


$\Rightarrow i'' = -\frac{6V}{2\Omega} = -3A$

$v'' = (4i'')(5\Omega)$ ohms law

$= 4(-3)5 = 60V$

4A acting alone:



Note: 2Ω is shorted $\Rightarrow i''' = \frac{0V}{2\Omega} = 0A$

$\Rightarrow 4i''' = 4 \times 0 = 0A$

So all of the 4A passes thru the 5Ω

$\Rightarrow v''' = -(4A)(5\Omega) = -20V.$

Add contributions $v = v' + v'' + v''' = 120 + 60 + (-20) = 160V$

$i = i' + i'' + i''' = 6 + (-3) + 0 = 3A.$