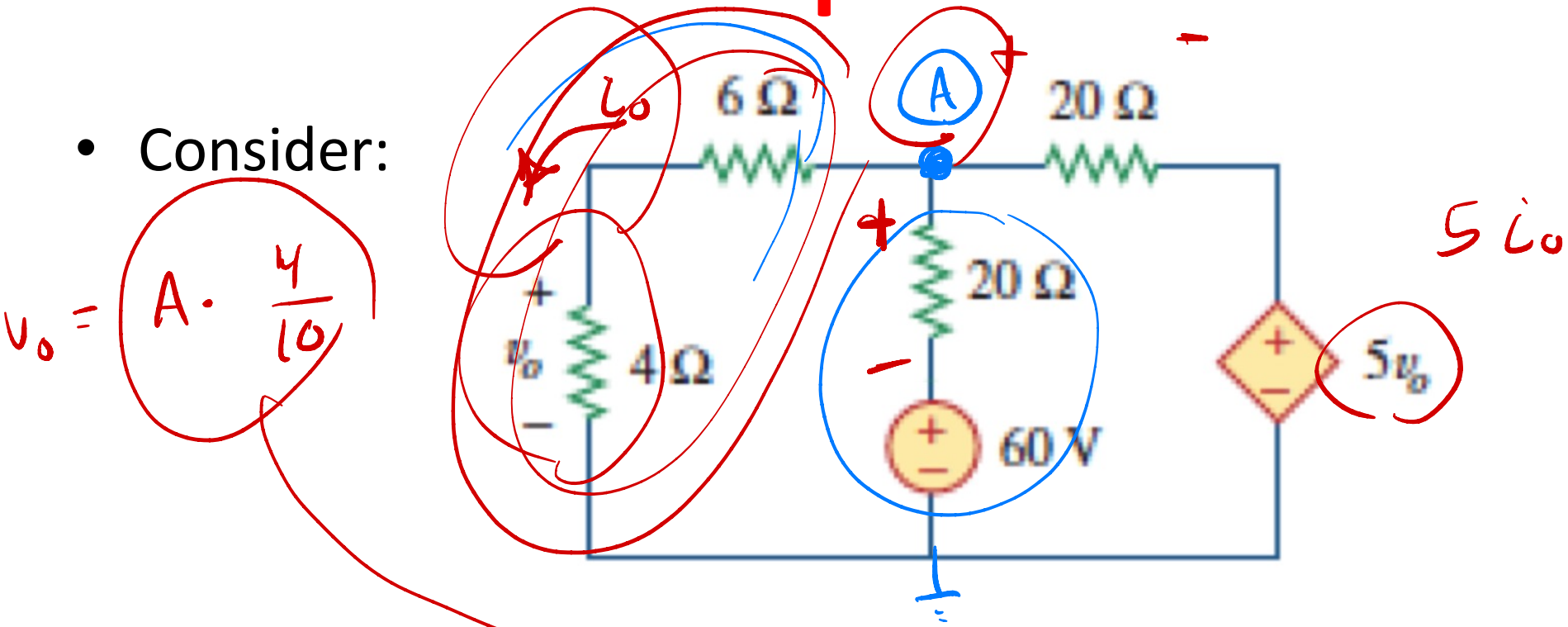
Node – 4

dependent sources

Extension #3 – dependent sources

- Consider:



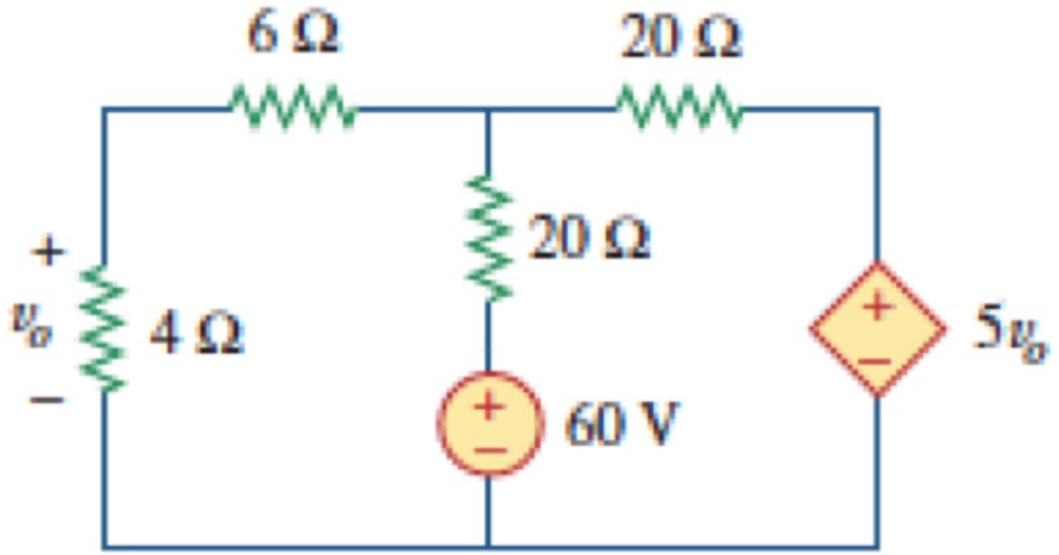
$v_o = A \cdot \frac{4}{10}$

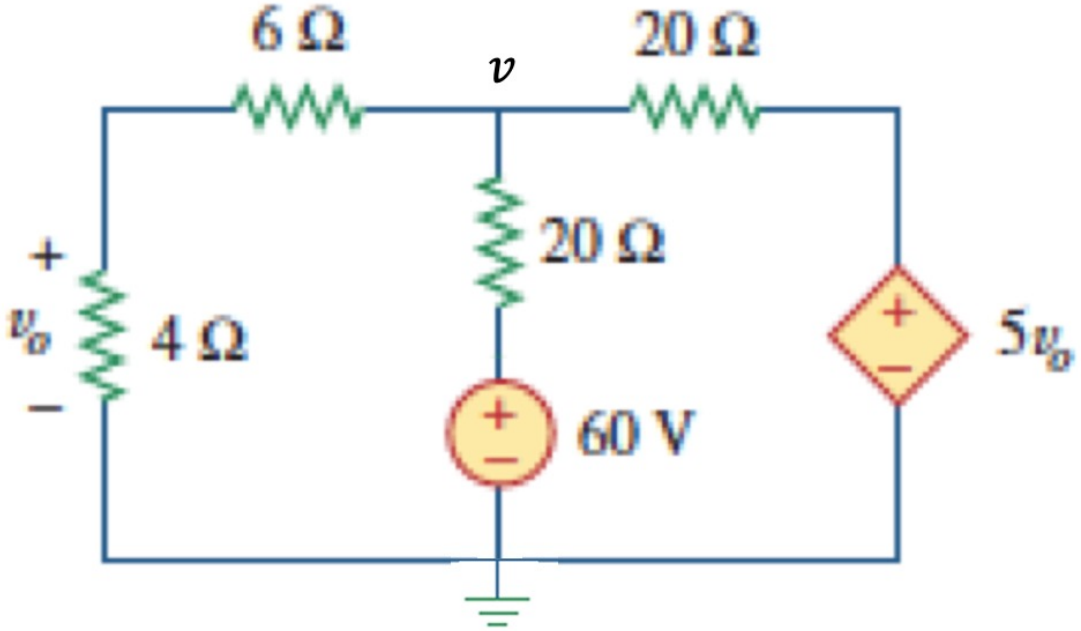
$5 i_o$

  - Write node equations as usual,
  - Add an equation "defining" the controlling variable in terms of the node voltages

$$\frac{A}{6+4} + \frac{A-60}{20} + \frac{A-5v_o}{20} = 0$$

Example (solved on next slide)





Node equation:

$$\frac{v}{10} + \frac{v - 60}{20} + \frac{v_1 - 5v_0}{20} = 0$$

Relate v_0 to the node:

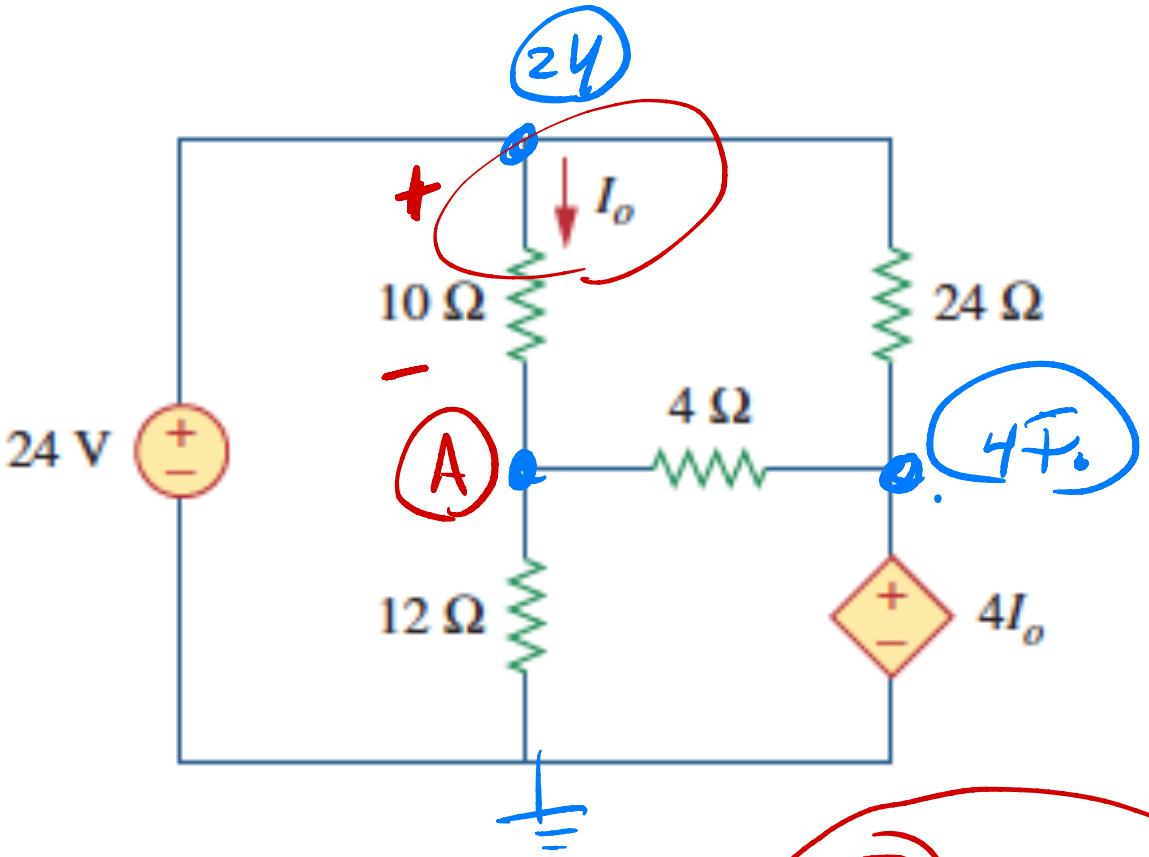
$$v_0 = \frac{4}{10} v$$

$$4v - 5v_0 = 60$$

$$4v - 5\frac{4}{10}v = 60$$

$$v = 30\ volts$$

Example:

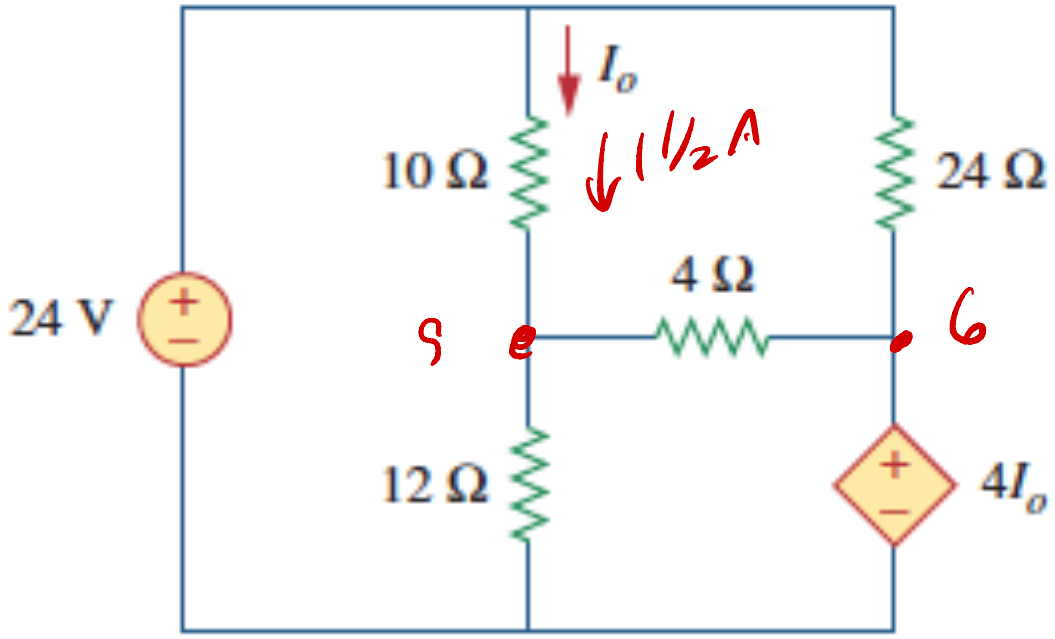


KCL at A:

$$\frac{A}{12} + \frac{A-24}{10} + \frac{A-4I_o}{4} = 0$$

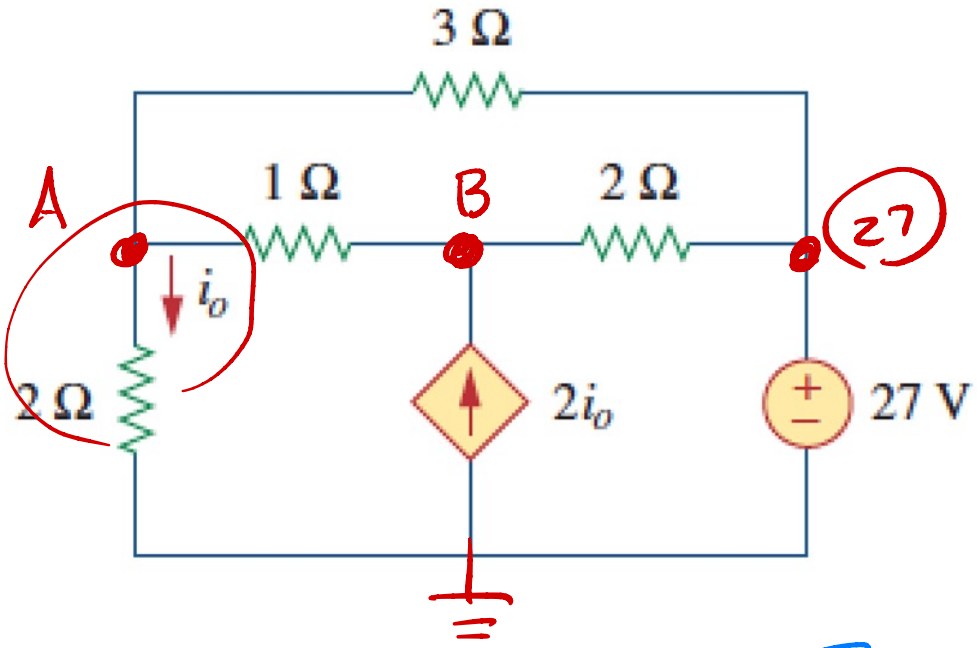
$$I_o = \frac{24-A}{10}$$

$$4I_o = \frac{96-4A}{10}$$



$v_L = 9\ V,$
$i_0 = 1.5\ A$
$v_R = 6\ V$

Example:



$i_o = \frac{A}{2}$

node A : $\frac{A}{2} + \frac{A-B}{1} + \frac{A-27}{3} = 0$] 6

" B : $\frac{B-A}{1} + \frac{B-27}{2} - 2i_o = 0$] 2

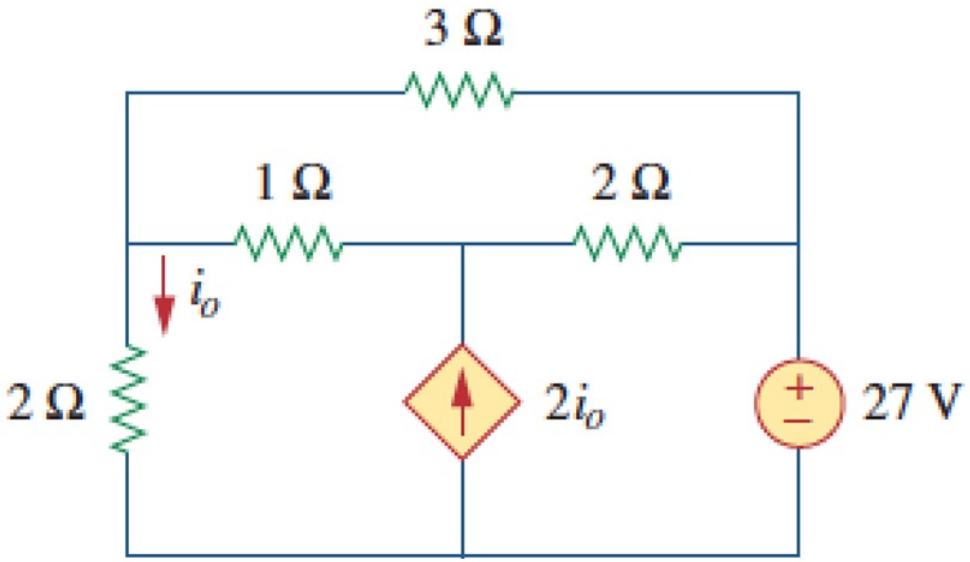
A

$3A + 6A - 6B + 2A = 54$

$2B - 2A + B - 2A = 27$

$11A - 6B = 54$

$-4A + 3B = 27$

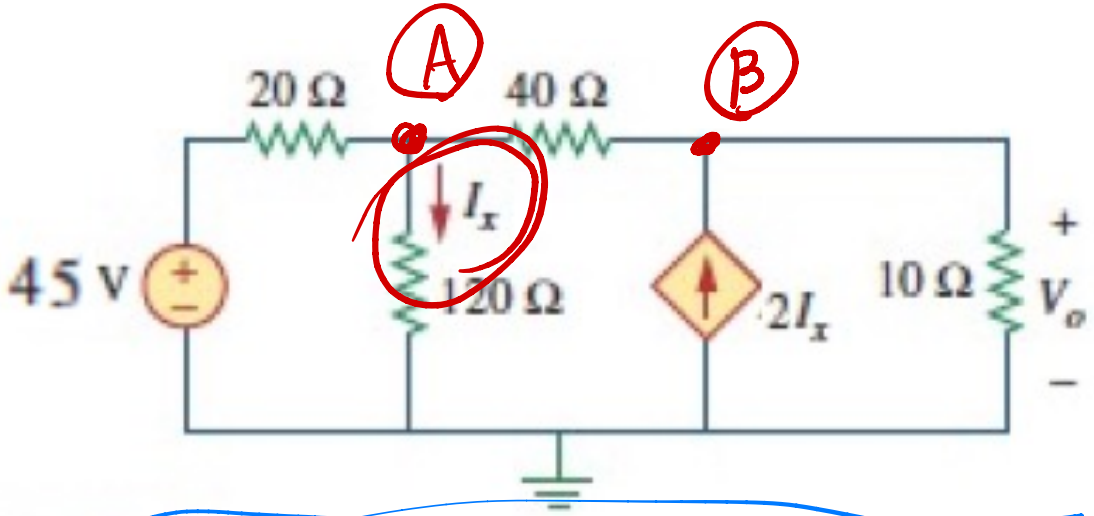


$v_L = 36\ V$

$v_R = 57\ V$

$V_o = 10\ V$

Practice problem: find V_0



$I_x = \frac{A}{120}$

$2I_x = \frac{A}{60}$

node A:

$$\frac{A-45}{20} + \frac{A}{120} + \frac{A-B}{40} = 0 \quad \text{(120)}$$

node B:

$$\frac{B-A}{40} + \frac{B}{10} - 2I_x = 0 \quad \text{(120)}$$

$$- \frac{A}{60}$$

$6A - 270$

$+A + 3A - 3B = 0$

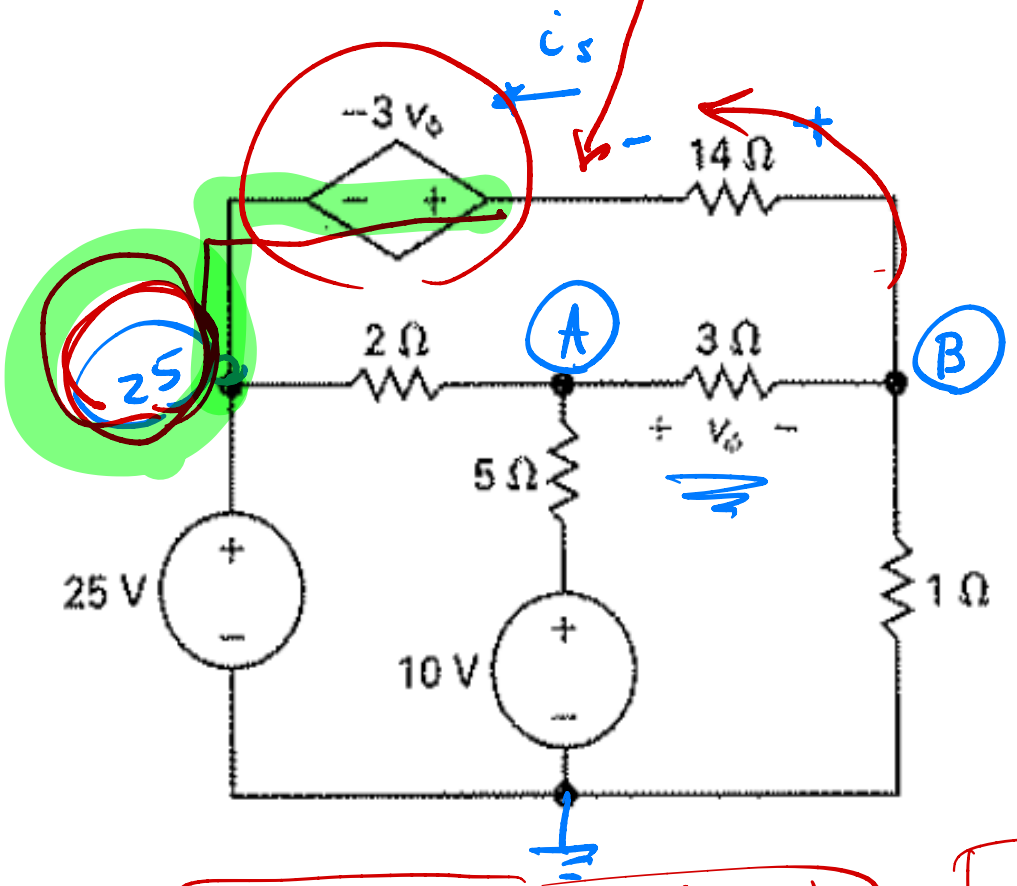
$10A - 3B = 270$

$3B - 3A + 12B$

$-2A = 0$

$-5A + 15B = 0$

Practice problem: find the power of the dependent source



$25 + (-3v_o) = 25 - 3(A-B)$

P = −36 W

$V_\phi = A - B$

node A:

$$\frac{A-25}{2} + \frac{A-B}{3} + \frac{A-10}{5} = 0$$

node B:

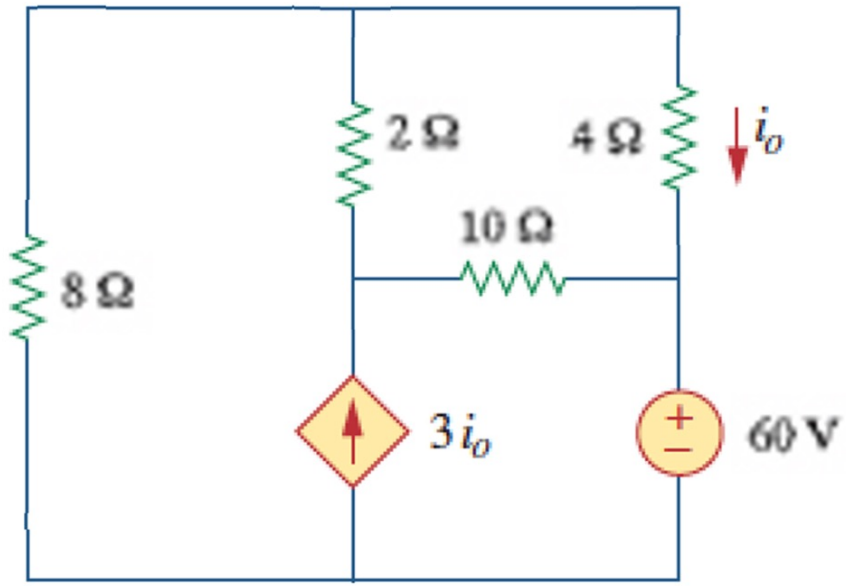
$$\frac{B}{1} + \frac{B-A}{3} + \frac{B-25+3(A-B)}{14} = 0$$

$$i_s = \frac{B-25+3(A-B)}{14}$$

$$v_s = -3(A-B)$$

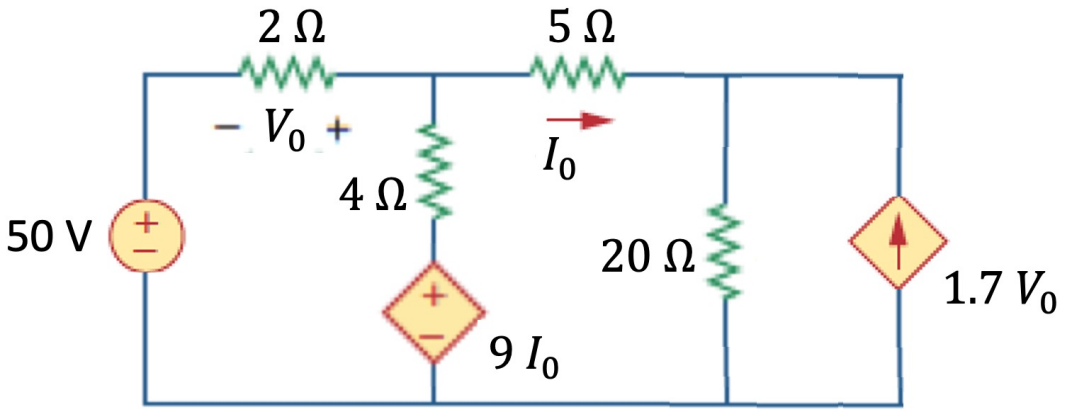
$i_0 = 11.25\ A$

Practice problem: find i_0

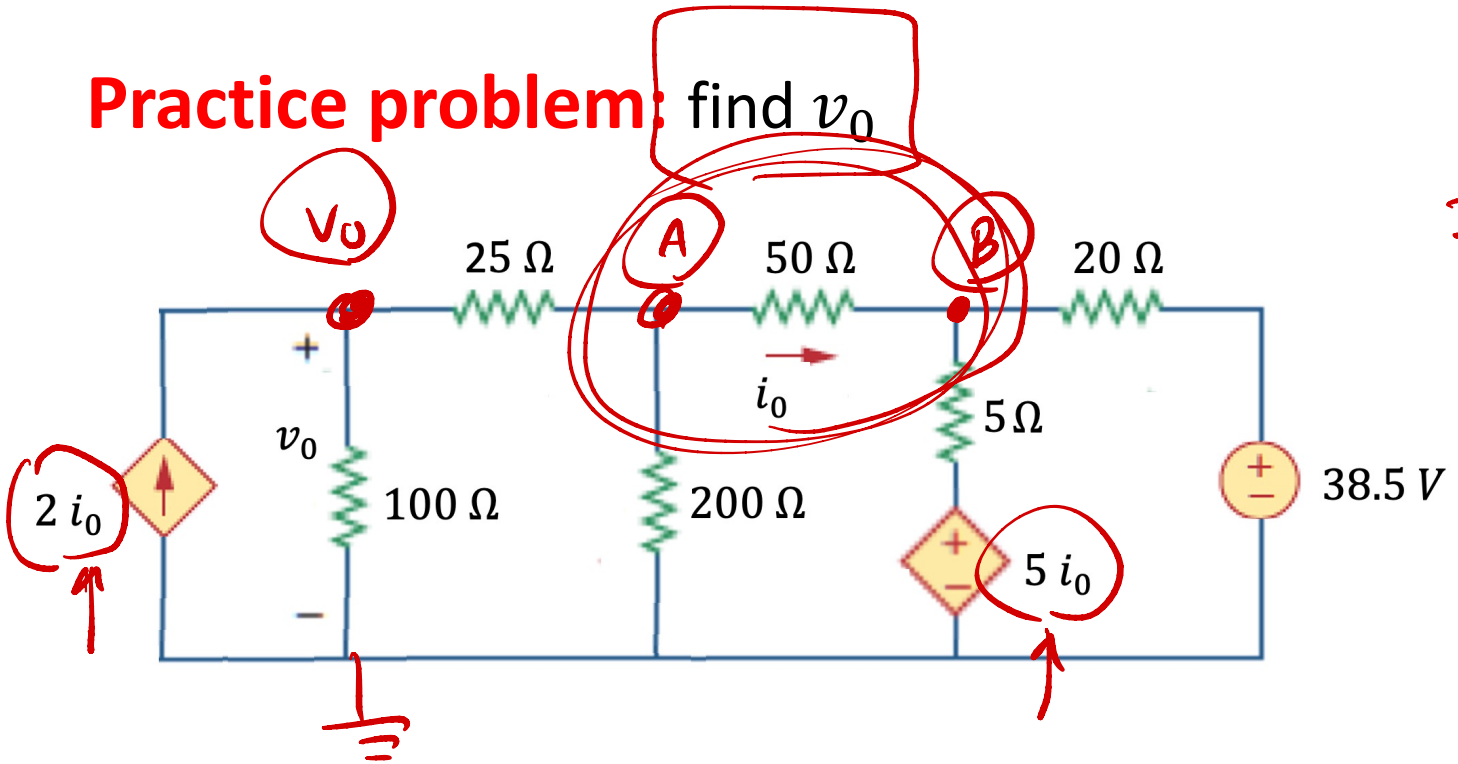


I_0=7.5 A

Practice problem: find I_0



Practice problem: find v_0



$v_o = -50\ V$

KCL

3 eqs at v_o, A, B

one eqn

$i_o = \frac{A - B}{50}$