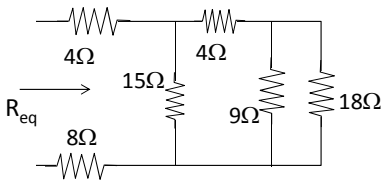
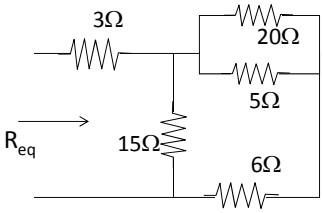
Practice 6: Find R_{eq}



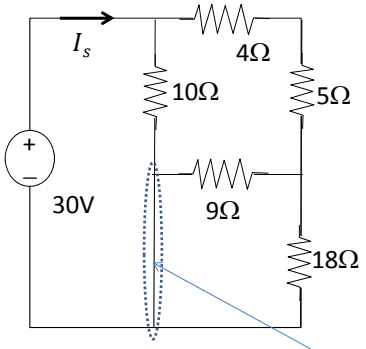


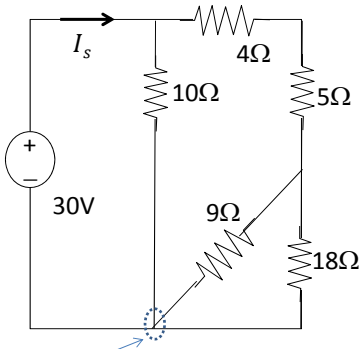
Solution:

R_{eq}=(9//18+4)//15+4+8 Ω
=10//15+12 Ω
=18Ω

R_{eq}=(20//5+6)//15+3 Ω
=10//15+3 Ω
=9 Ω

Practice 7: Find I_s

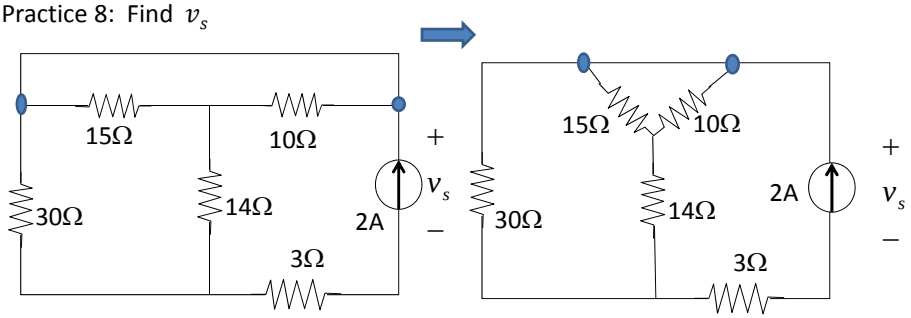




Solution: Shrink the wire to one point

R_{eq}=(9//18+4+5)//10 Ω
=15//10 Ω = 6 Ω
I_s = 30/6 A = 5A

Practice 8: Find v_s

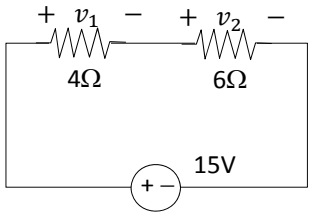


Solution:

$R_{eq} = (10//15+14)//30+3\ \Omega = 15\ \Omega$

$V_s = 2\times 15 = 30\ V$

Practice 9: Find v_1, v_2

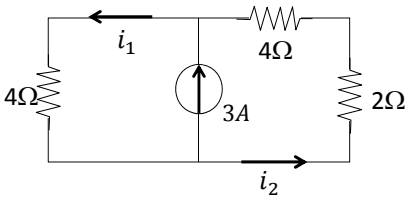


Solution:

$$v_1 = \frac{4}{4+6}\times 15V = 6V$$

$$v_2 = \frac{6}{4+6}\times 15V = 9V$$

Practice 10: Find i_1, i_2

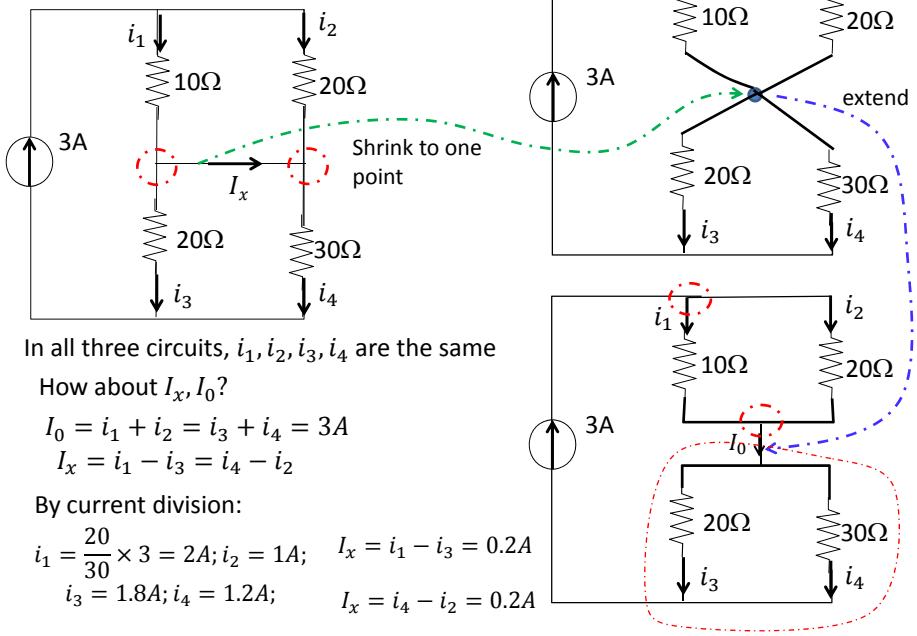


Solution:

$$i_1 = \frac{6}{4+6}\times 3A = 1.8A$$

$$i_2 = -\frac{4}{4+6}\times 3A = -1.2A$$

Practice 11: Find i_1, i_2, i_3, i_4, I_x



In all three circuits, i_1, i_2, i_3, i_4 are the same

How about I_x, I_0?

$I_0 = i_1 + i_2 = i_3 + i_4 = 3A$

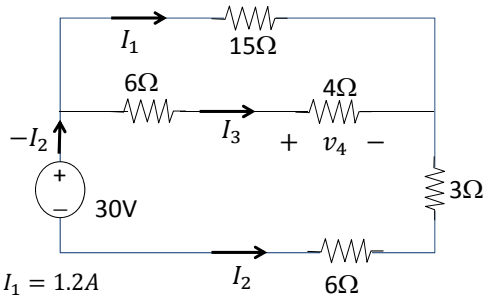
$I_x = i_1 - i_3 = i_4 - i_2$

By current division:

$i_1 = \frac{20}{30} \times 3 = 2A; i_2 = 1A;$ $\quad I_x = i_1 - i_3 = 0.2A$

$i_3 = 1.8A; i_4 = 1.2A;$ $\quad I_x = i_4 - i_2 = 0.2A$

Practice 12: Find I_1, I_2, v_4



Solution: equivalent R_{eq} w.r.t. 30V,

R_{eq}=15//10+3+6 Ω =15 Ω

The current should leave the positive terminal of a voltage source

Thus I_2 must be negative:

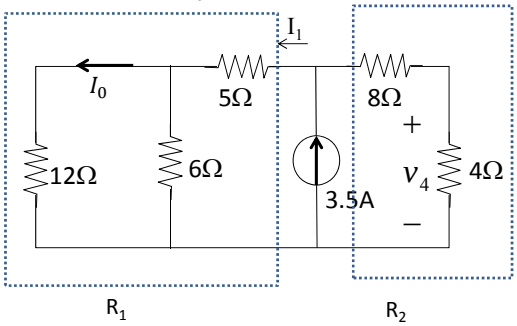
$I_2 = -30/15\ \text{A} = -2\ \text{A}$

By current division:

$I_1 = \frac{10}{10+15} \times (-I_2) = 0.8A,\ I_3 = -I_2 - I_1 = 1.2A$

$v_4 = 4I_3 = 4.8V$

Practice 13: Find I_0, v_4



Solution:

R_1=12//6+5 Ω=9Ω

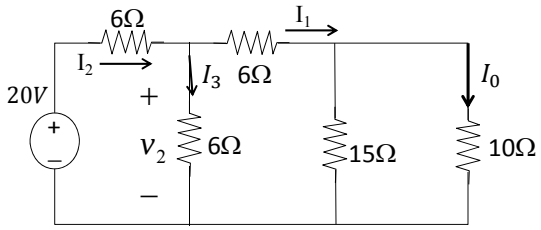
R_2=4+8 Ω=12Ω

$I_1 = 3.5 \times \frac{R_2}{R_1 + R_2} = 2A$

$I_0 = \frac{6}{12+6} \times I_1 = 0.667A$

$v_4 = (3.5 - I_1) \times 4V = 6V$

Practice 14: Find I_0, v_2



Solution: Equivalent resistance w.r.t. 20V:

$R_{eq}=(15//10+6)//6+6\Omega=10\Omega$

$I_2 = \frac{20}{10}A = 2A$, by ohms Law

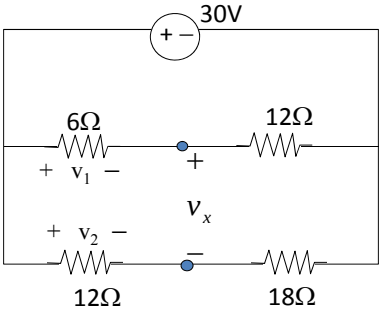
$I_1 = 2 \times \frac{6}{6+6+6}A = \frac{2}{3}A$, by current division

$I_0 = \frac{2}{3} \times \frac{15}{15+10}A = 0.4A$, also by current division

By KCL, $I_3 = I_2 - I_1 = 2 - \frac{2}{3} = \frac{4}{3}A$

$v_2 = 6I_3 = 8V$

Practice 15: Find the voltage v_x



Solution:

By voltage division:

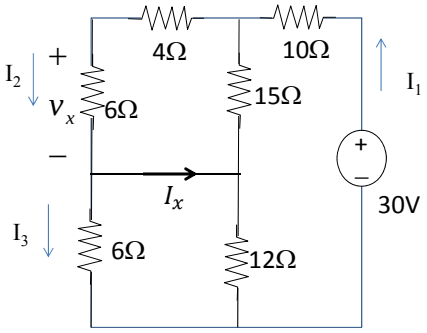
$v_1 = 30 \times \frac{6}{12+6}V = 10V$,

$v_2 = 30 \times \frac{12}{12+18}V = 12V$,

By KVL, $v_1 + v_x - v_2 = 0$

$v_x = v_2 - v_1 = 12 - 10V = 2V$

Practice 16: Find v_0, I_x,



Solution:

R_{eq}=10+10//15+6//12Ω=20Ω

$$I_1 = \frac{30}{20}A = 1.5A$$

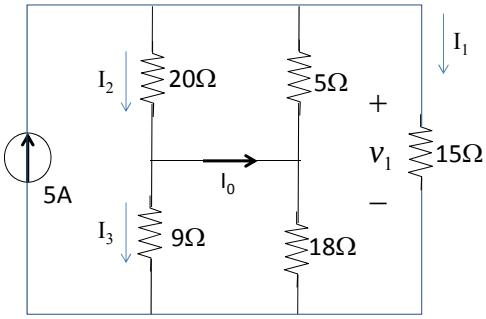
$$I_2 = 1.5 \times \frac{15}{15+10}A = 0.9A$$

$$I_3 = 1.5 \times \frac{12}{6+12}A = 1A$$

$$I_x = I_2 - I_3 = -0.1A$$

$$v_x = 0.9 \times 6V = 5.4V$$

Practice 16a: Find v_1, I_0,



Solution:

$$I_1 = 5 \times \frac{20||5+9||18}{20||5+9||18+15}A = 2A$$

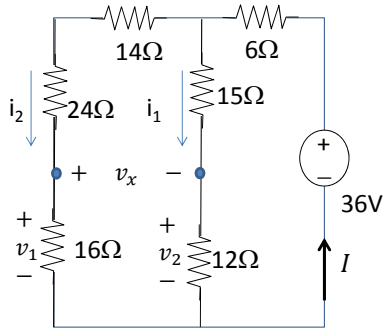
$$I_2 = (5-2) \times \frac{5}{20+5}A = 0.6A$$

$$I_3 = (5-2) \times \frac{18}{9+18}A = 2A$$

$$I_0 = I_2 - I_3 = 0.6 - 2A = -1.4A$$

$$v_1 = 2 \times 15V = 30V$$

Practice 17: Find v_x, I,



Solution:

Equivalent resistance w.r.t. 36V:

R_{eq}=6+(15+12)//(14+24+16)Ω=24Ω

I=36/24 A = 1.5A

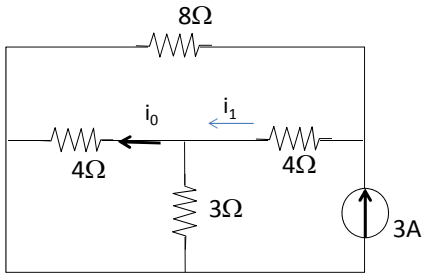
By current division and KCL:

$$i_1 = 1.5 \times \frac{54}{54+27} A = 1A$$

$$i_2 = 1.5 - 1A = 0.5A$$

$$v_x = v_1 - v_2 = 16i_2 - 12i_1 = -4V$$

Practice 18: Find i_0

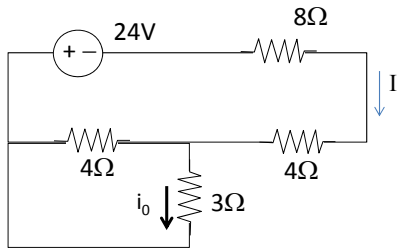


Solution:

$$i_1 = 3 \times \frac{8}{8+4+4||3} A = 1.75A$$

$$i_0 = 1.75 \times \frac{3}{3+4} A = 0.75A$$

Practice 19: Find i_0

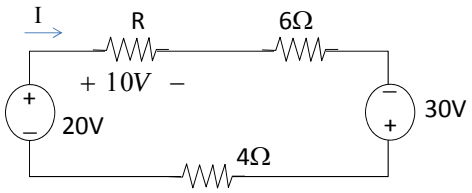


Solution:

$$I = -\frac{24}{8+4+3||4}A = -1.75A$$

$$i_0 = -1.75 \times \frac{4}{3+4}A = -1A$$

Practice 20: Find R for the circuit

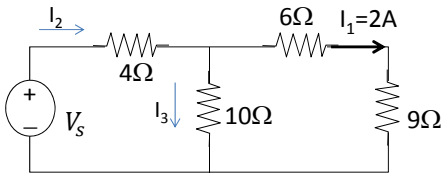


Solution:

$$I = \frac{10}{R} \quad \Rightarrow \quad R=2.5\Omega$$

$$(R+6+4)I - 30 - 20 = 0$$

Practice 21: Find V_s for the circuit



Solution:

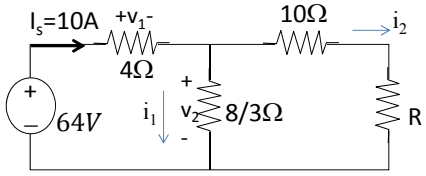
$R_{eq}=(6+9)//10+4\Omega=10\Omega$

$$I_3 = \frac{2 \times (6+9)}{10} A = 3A$$

$$I_2 = I_1 + I_3 = 2 + 3A = 5A$$

$$V_s = 5 \times 10V = 50V$$

Practice 22: Find R so that I_s is 10A



Solution:

$$v_1 = 4 \times 10V = 40V$$

$$v_2 = 64 - 40V = 24V$$

$$i_1 = \frac{24}{8/3} A = 9A$$

$$i_2 = 10 - 9A = 1A$$

$$(10 + R) \times 1 = 24 \quad \Rightarrow \quad R = 14\Omega$$