Tutorial EE201: Fundamentals Of Electric Circuits

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Tutorial 1: Voltage, Current, Resistance, Power and Energy

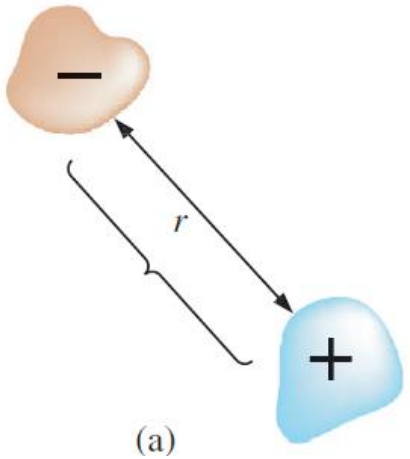
(a) $V = \frac{W}{Q}$

(b) $I = \frac{Q}{t}$

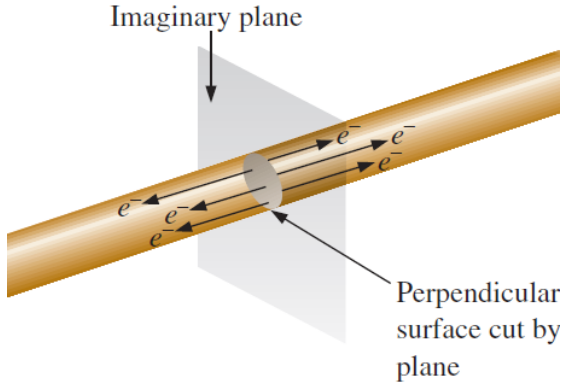
(c) $P = \frac{w}{t}$

(d) $R = \frac{V}{I}$

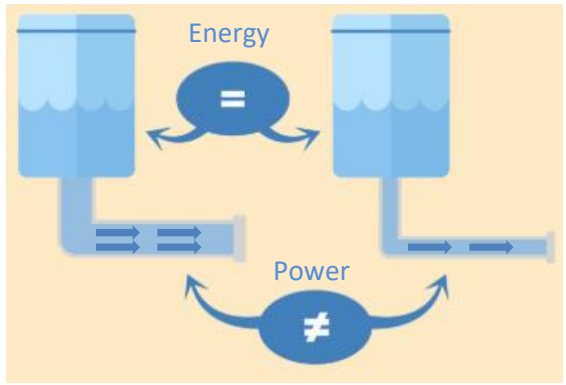
(e) $Life(h) = \frac{Ah}{A}$



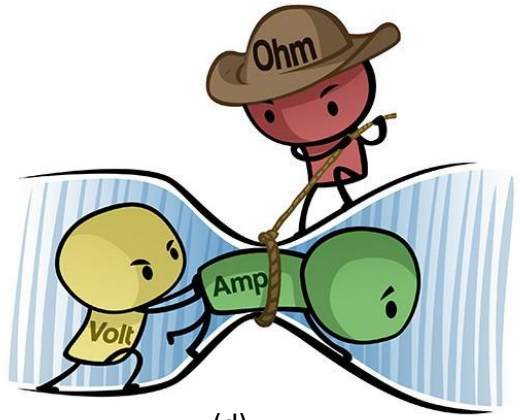
(a)



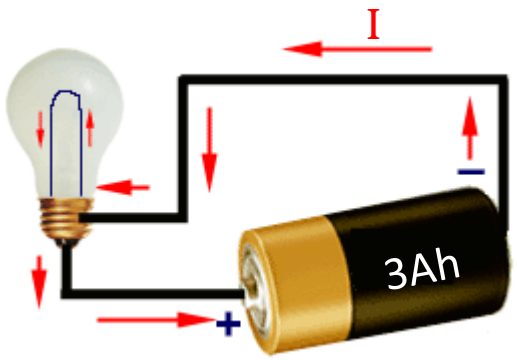
(b)



(c)



(d)



(e)

Problem 8, page 61

What is the voltage between two points if 1.2 J of energy are required to move 20 μC between the two points?

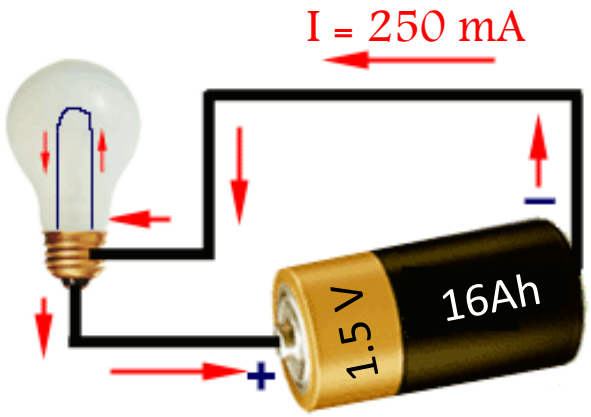
$$V = \frac{W}{Q} = \frac{1.2\text{J}}{20\mu C} = 60\text{ kV}$$

60 kV, Set San Luis - Set Central - Set San Isidro Peru

Example 6, page 51

How long can a 1.5 V flashlight battery provide a current of 250 mA to light the bulb if the ampere-hour rating is 16 Ah?

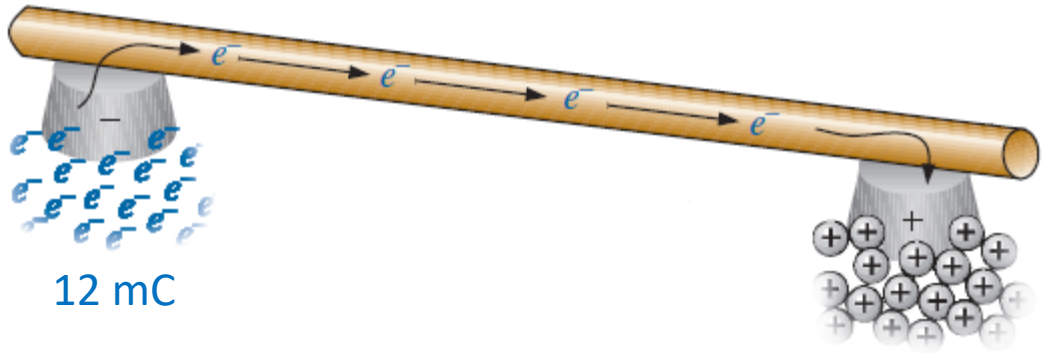
$$Life(h) = \frac{Ah}{A} = \frac{16\ Ah}{250\ \text{mA}} = 64\ \text{hours}$$



Problem 13, page 61

Find the current in amperes if 12 mC of charge pass through a wire in 2.8 s.

$$I = \frac{Q}{t} = \frac{12\ \text{mC}}{2.8\ \text{s}} = 4.286\ \text{mA}$$



12 mC

*Problem 14, page 61

if 312 C in 2 minutes ?

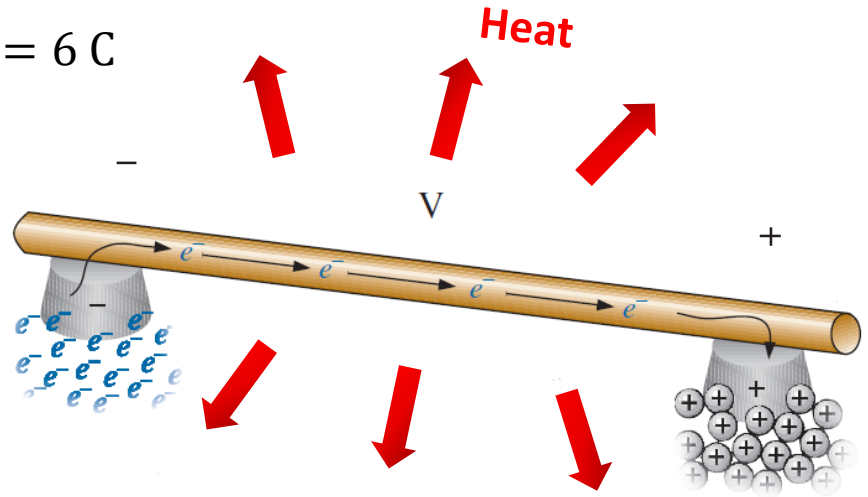
$$I = \frac{Q}{t} = \frac{312\ \text{C}}{2\text{x}60\ \text{s}} = 2.6\ \text{A}$$

Problem 23, page 61

If a conductor with a current of 200 mA passing through it converts 40 J of electrical energy into heat in 30 s, what is the potential drop across the conductor?

$$V = \frac{W}{Q} \quad \Longrightarrow \quad Q = \mathrm{I} * \mathrm{t} = 200\ \mathrm{mA} * 30\ \mathrm{s} = 6\ \mathrm{C}$$

$$V = \frac{W}{Q} = \frac{40J}{6\ C} = 6.667\ V$$



Made up Problem

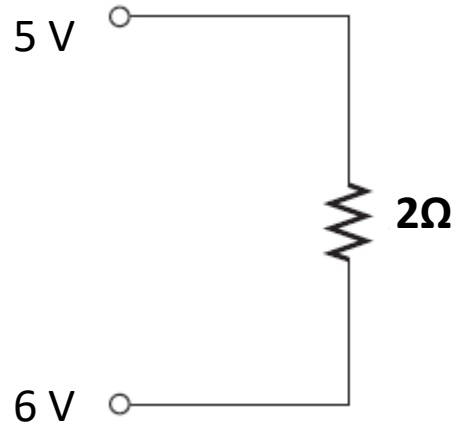
Find the current, power, energy observed over 6s, and battery rating to supply the load for 2h?

$$I = \frac{V}{R} = \frac{6-5}{2} = 0.5\ A$$

$$P = V * I = (6-5) * 0.5 = 0.5\ Watt$$

$$Energy = P\ * t = 0.5\ * 6 = 3J$$

Capacity $= current\ *\ time\ = 0.5\ * 2 = 1\ Ah$

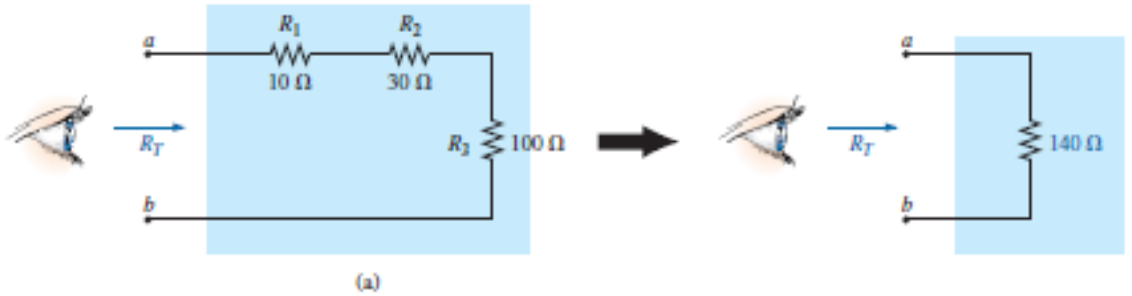


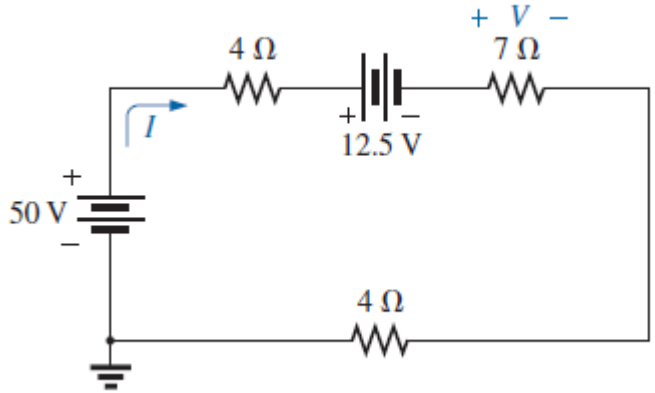
Tutorial 2: Series dc Circuits

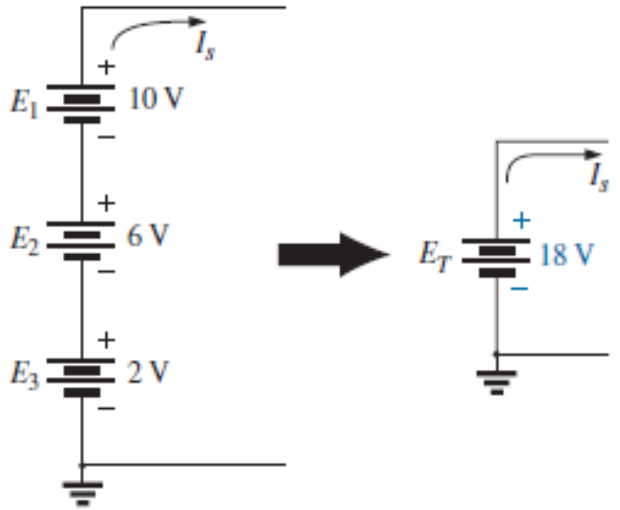
(a) $R_T = \sum_1^\infty R_n$ series

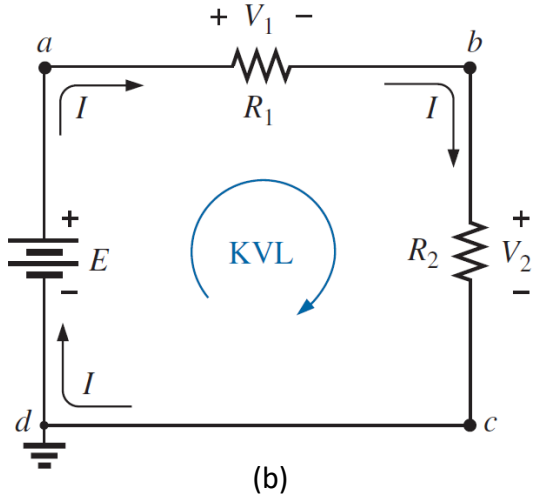
(b) $\sum_{close-loop} V_{rises} = \sum_{close-loop} V_{drop}$

(c) $V_x = R_x \frac{E}{R_T}$







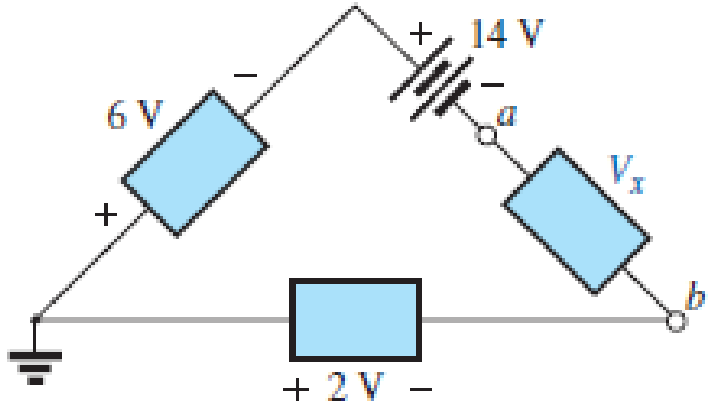


Example 12, page 152

Determine the voltage Vx for the circuit in shown. Note that the polarity of Vx was not provided.

$-6\ V - 14\ V - Vx + 2\ V = 0$ Assuming a is positive

$Vx = -18\ V$



Example 3.5, page 141

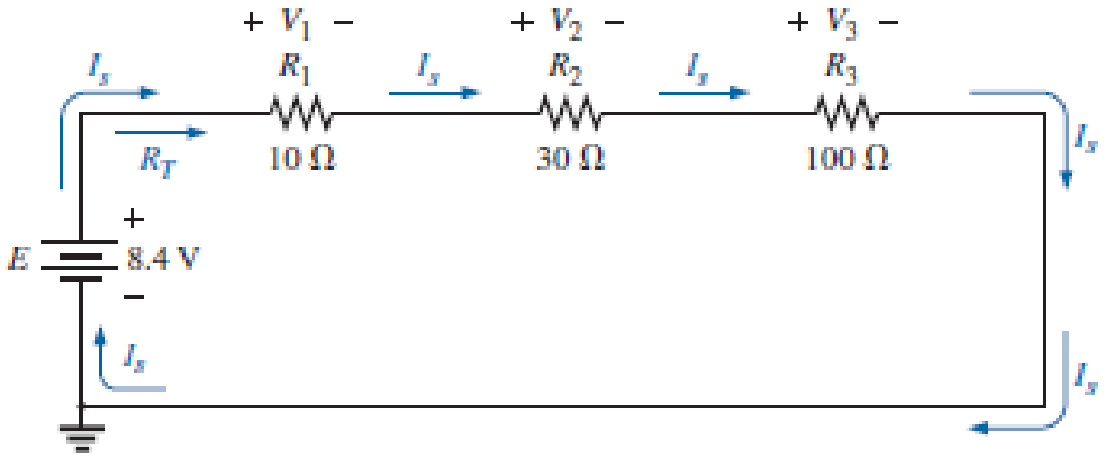
Determine the total resistance, the source current, and all the voltage drops.

KVL

$$E - R_1 I - R_2 I - R_3 I = 0$$
$$8.4 - 10xI - 30xI - 100xI = 0$$
$$I = 60\ mA$$

VDL

$$V_1 = R_1 \frac{E}{R_T} = 10 * \frac{8.4}{10 + 30 + 100} = 0.6\ V$$
$$V_2 = R_2 \frac{E}{R_T} = 30 * \frac{8.4}{10 + 30 + 100} = 1.8\ V$$
$$V_3 = R_3 \frac{E}{R_T} = 100 * \frac{8.4}{10 + 30 + 100} = 6\ V$$

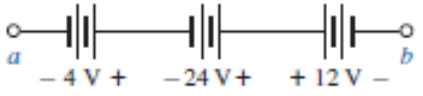


$$E = V_1 + V_2 + V_3$$

$$E = 0.6 + 1.8 + 6 = 8.4$$

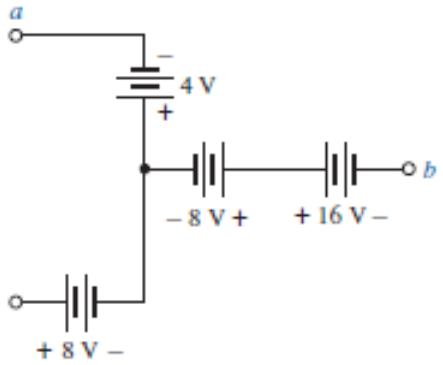
Example 18, page 182

Combine the series voltage sources into a single voltage source between points a and b find Vab.



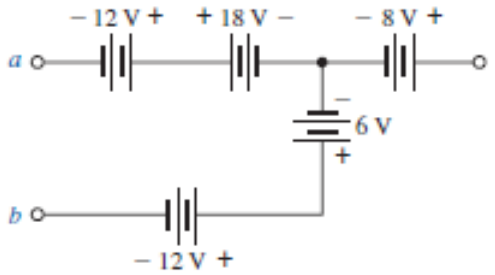
(a)

$V_{ab} = -16\ \text{V}$



(b)

$V_{ab} = 4\ \text{V}$



(c)

$V_{ab} = 12\ \text{V}$

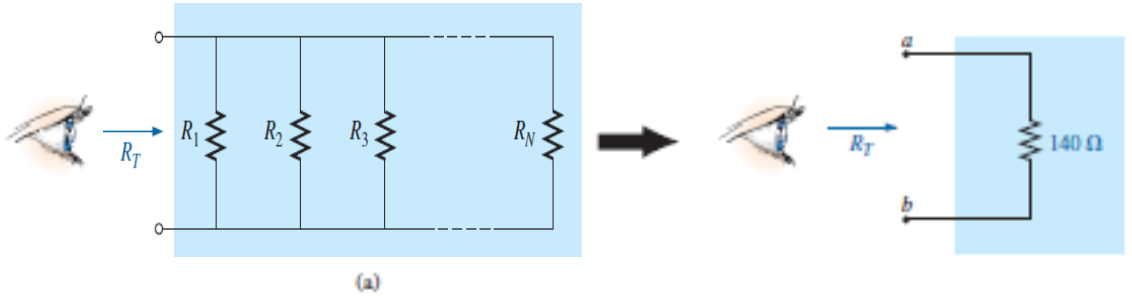
Tutorial 2: parallel dc Circuits

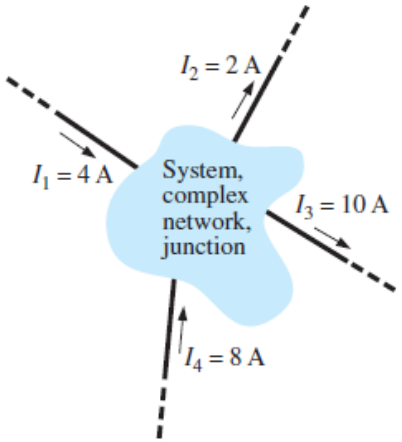
$$\frac{1}{R_T} = \sum_1^\infty \frac{1}{R_n}$$ parallel

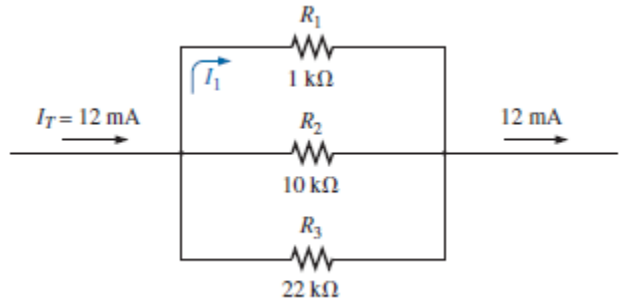
$$R_T = \frac{R_1 R_2}{R_1 + R_2}$$

$$\sum I_{in} = \sum I_{out}$$

$$I_x = I_T \frac{R_T}{R_X}$$







(b)

Example 15, page 207

For the parallel network, Determine the total resistance RT, Find the source current and the current through each resistor, Calculate the power delivered by the source , and Determine the power absorbed by each parallel resistor.

$$\frac{1}{R_T} = \frac{1}{1.6k} + \frac{1}{20k} + \frac{1}{56k} \qquad R_T = 1.4433\ k\Omega$$

$$I_s = \frac{E}{R_T} = \frac{28}{1.4433k} = 19.4\ mA$$

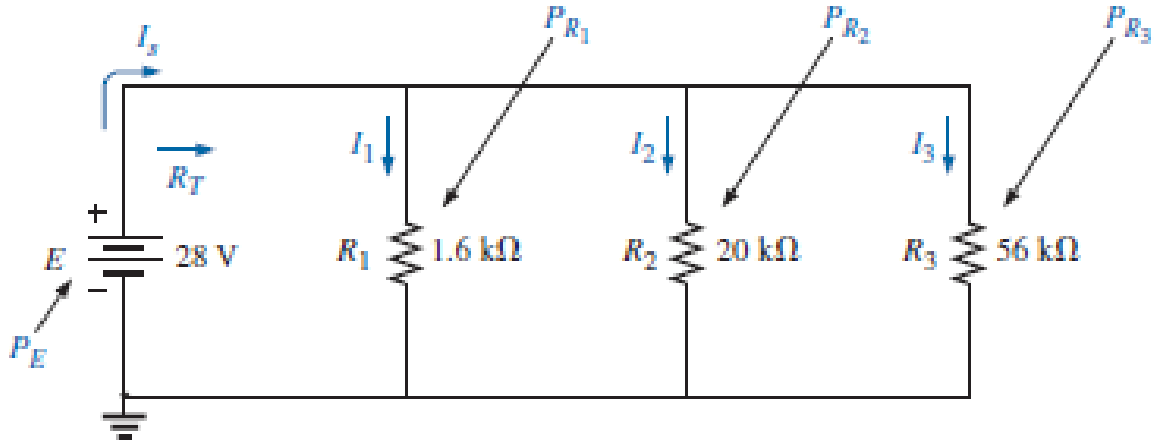
$$I_1 = (19.4\ mA)\frac{1.4433\ k}{1.6\ k} = 17.5\ mA$$

$$I_2 = 1.4\ mA \qquad I_3 = 0.5\ mA$$

$$P_T = V\ * I_s = 28\ * 19.4m = 543.2\ mW$$

$$P_1 = R_1\ * {I_1}^2 = 1.6k\ * (17.4m)^2 = 490\ mW$$

$P_2 = 39.2$ mW $\qquad P_3 = 14$ mW



Example 18, page 216

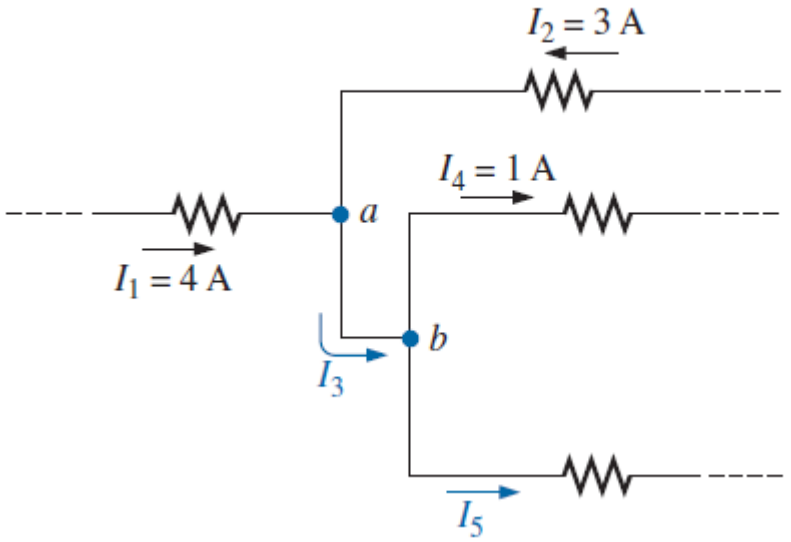
Determine currents I3 and I5 through applications of Kirchhoff's current law.

$$I_1 + I_3 = I_3$$

$$I_3 = 4 + 3 = 7 \text{ A}$$

$$I_3 = I_4 + I_5$$

$$I_5 = I_3 - I_4 = 7 - 1 = 6\ A$$



Example 18, page 252

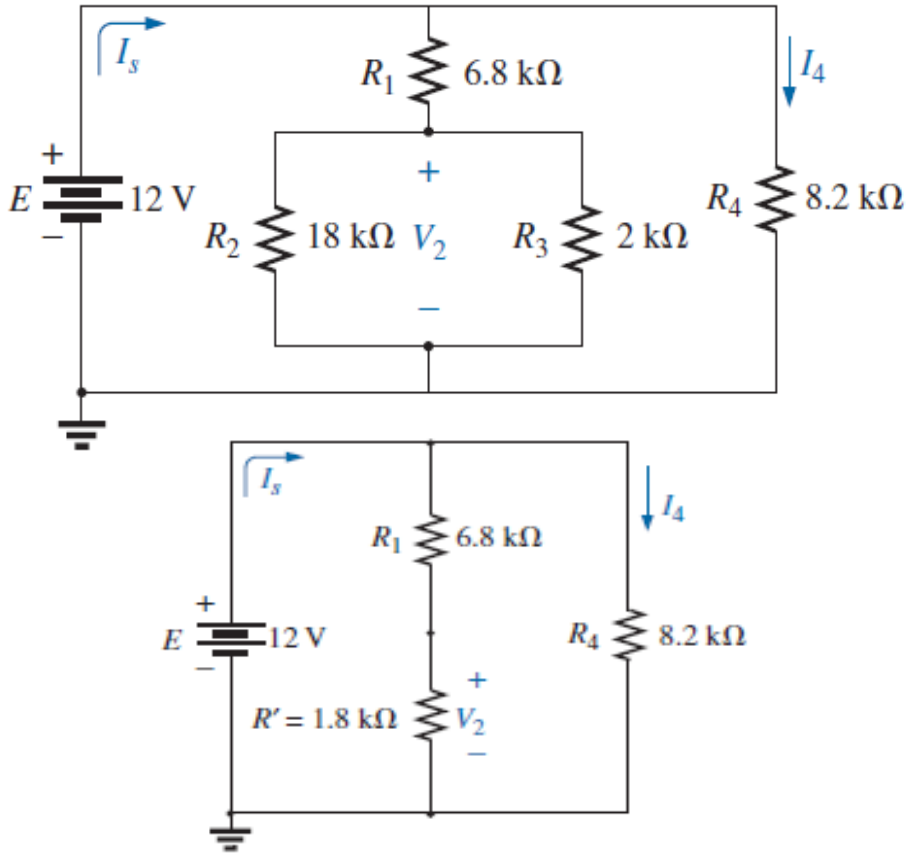
Determine All unknowns

$$\frac{1}{R'} = \frac{1}{18k} + \frac{1}{2k} \qquad R' = 1.8\ k\Omega$$

$$I_s = \frac{12}{6.8k + 1.8k} + \frac{12}{8.2k} = 2.859\ mA$$

$$I_4 = \frac{12}{8.2k} = 1.463\ mA$$

$$V_2 = \left(\frac{12}{6.8k + 1.8k}\right) * (1.8k) = 2.511\ V$$



Example 10, page 261

Calculate the indicated currents and voltage

$$R' = ((R_8 + R_9)||R_7) + R_6$$

$$R' = ((3k+6k)||9k)+12k = 16.5\ k\Omega$$

$$I' = \frac{E}{R'} = \frac{72}{16.5k} = 4.364\ \text{mA}$$

$$R'' = ((R_1 + R_2 + R_3)||\ R_4) + R_5$$

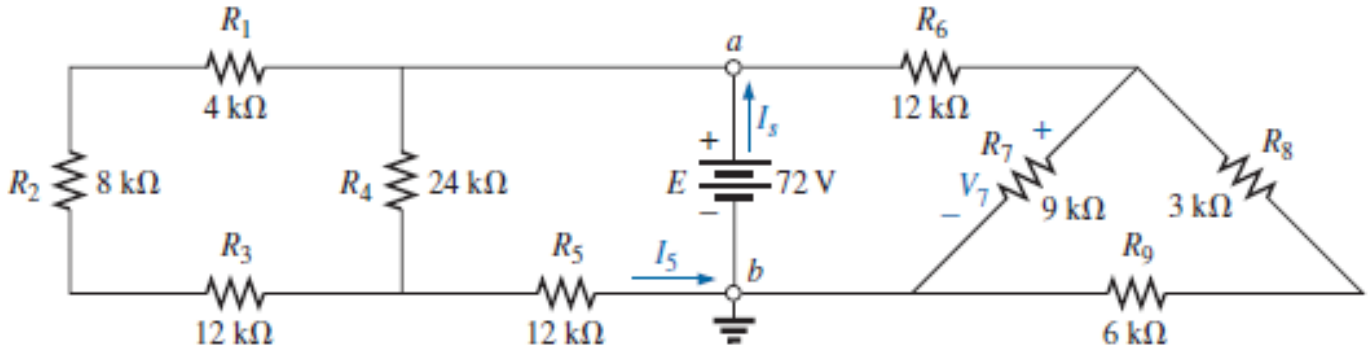
$$R'' = ((4k + 8k + 12k)||\ 24k) + 12k = 24k\Omega$$

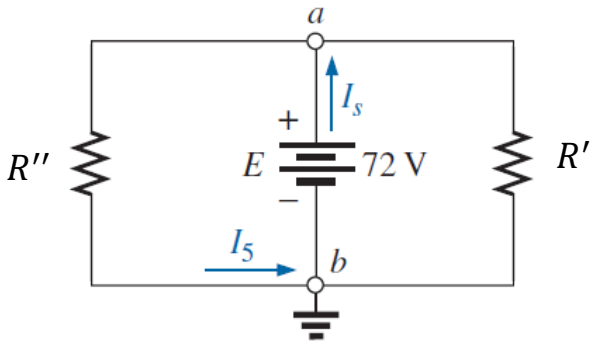
$$I' = \frac{E}{R''} = \frac{72}{24k} = 3\ \text{mA}$$

$$I_S = I' + I'' \qquad I_S = 4.364 + 3 = 7.364\ mA$$

$$R_x = (R_8 + R_9)||R_7 = (3k+6k)||9k = 4.5k\ \Omega$$

$$V_7 = R_x \times I' = 4.5k \times 4.364\ \text{mA} = 19.638\ \text{V}$$





$$I_5 = I''$$

Example 11, page 262

Determine all unknowns including Vac, and Vbc.

$V_a = E_1 = 20\ V \qquad V_c = E_3 = 8\ V$

$V_b = E_1 - E_2 = 20 - 5 = 15\ V$

$V_{ac} = V_a - V_c = 20 - 8 = 12\ V$

$V_{bc} = V_b - V_c = 15 - 8 = 7\ V$

$$I_2 = \frac{V_{bc}}{R_2} = \frac{7}{4} A = 1.75\ A$$

$$I_{ac} = \frac{V_{ac}}{R_1} = \frac{12}{10} A = 1.2\ A$$

$I_2 + I_{ac} + I_{s3} = 0$

$1.75 + 1.2 + I_{s3} = 0 \qquad I_{s3} = -2.95\ A$