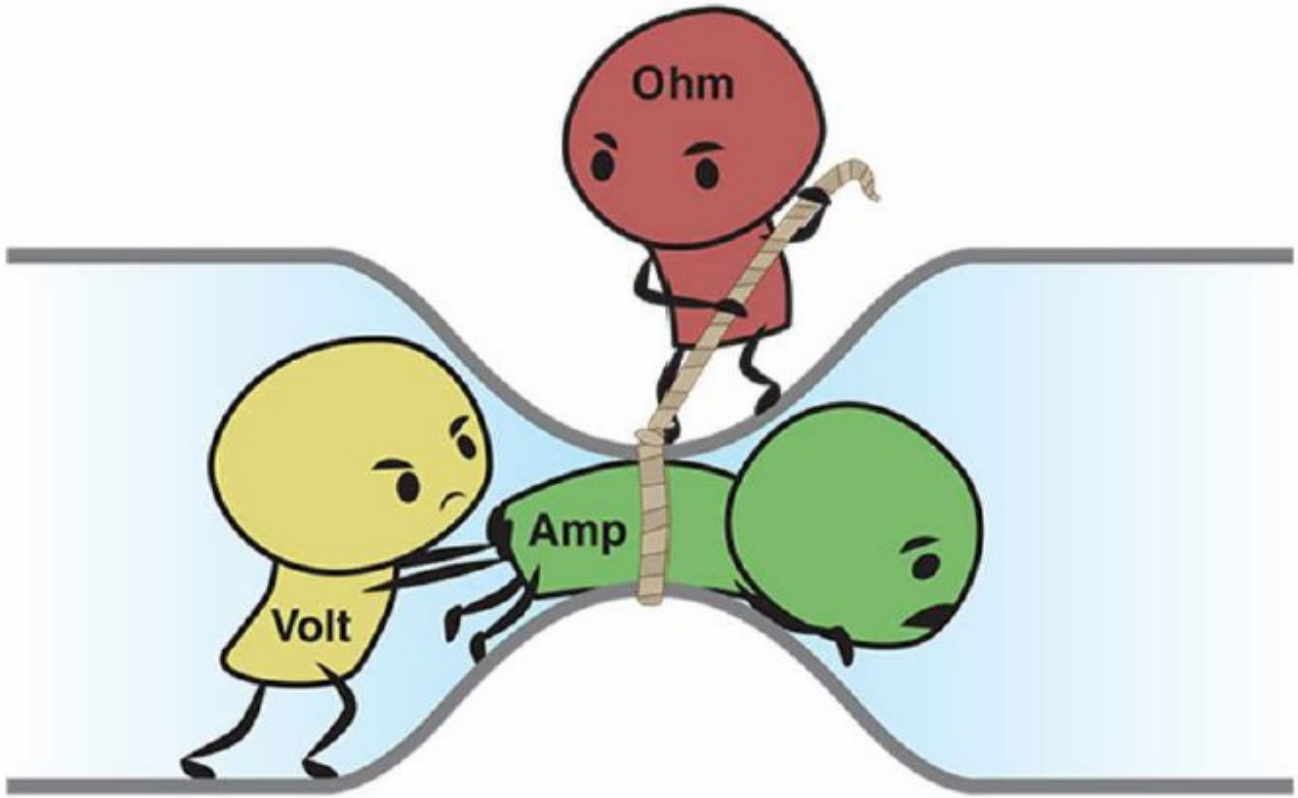
BASIC ELECTRONICS



Basic Circuit Analysis

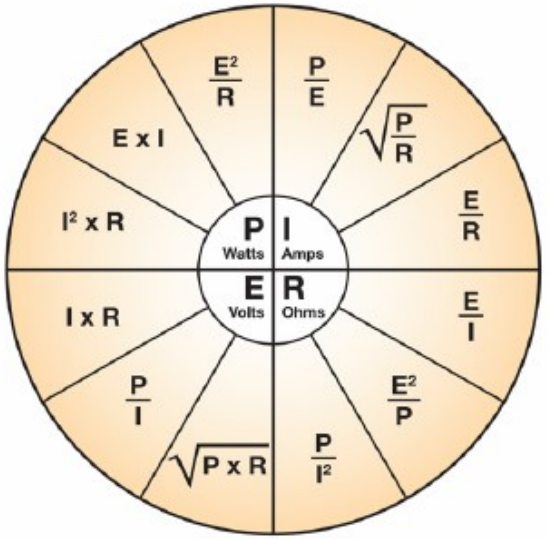
Ohm's Law:

E = Potential (Volts) I = Current (Amps) R = Resistance (Ohms)

$E = I\,R$ Algebraicly $I = E/R$ and $R = E/I$

Series Resistance: $R_{eff} = R_1 + R_2 + ... + R_n$

Parallel Resistence: $$R_{eff} := \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + ... + \frac{1}{R_n}}$$



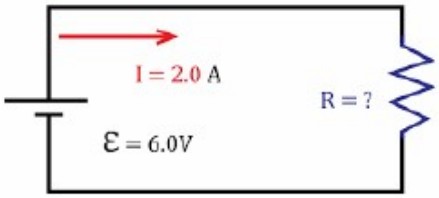
Kirchhoff's Voltage Law:

The sum of all the voltages around any closed loop in a circuit is equal to zero.

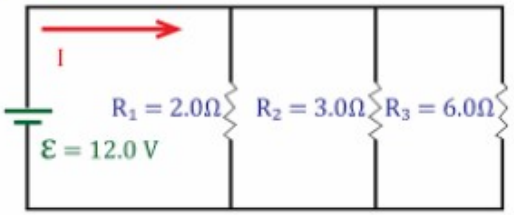
Kirchhoff's Current Law:

The sum of all currents flowing into a node equals the sum of currents flowing out of the node.

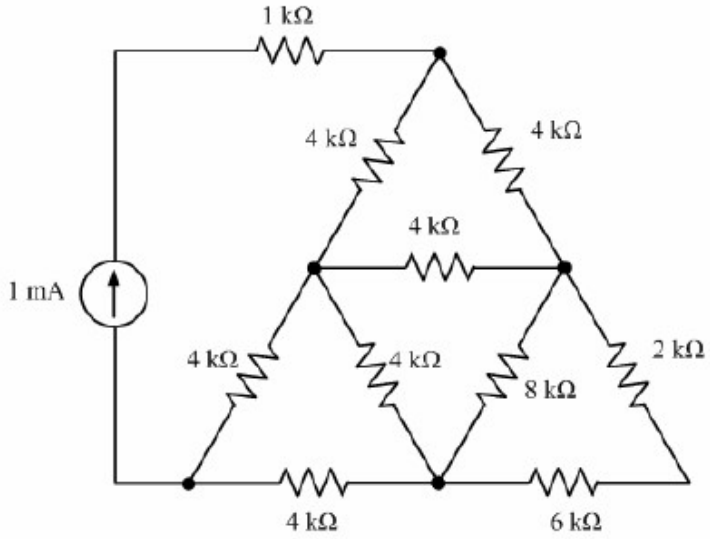
1.



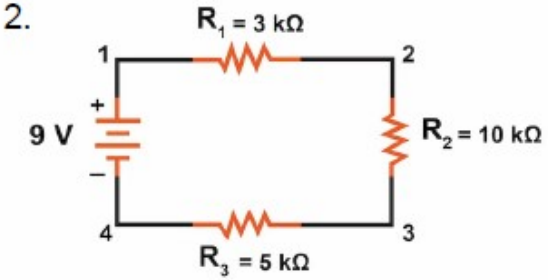
3.



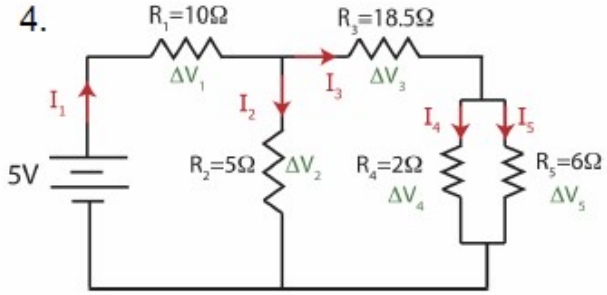
Extra Credit



2.



4.

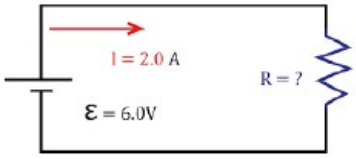


Conversion Factors: $k\Omega := 1000\Omega$ $mW := .001W$ $mV := .001V$

Problem 1.

$E := 6V$ $I := 2A$

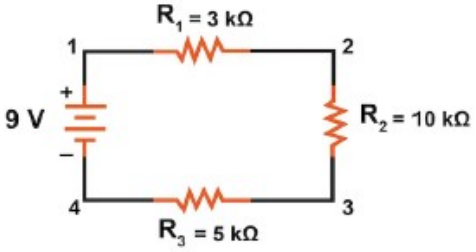
$R := \frac{E}{I}$ $R = 3\,\Omega$



Additionally: $P := E \cdot I$ $P = 12\,W$

Problem 2.

$E := 9V$ $R_1 := 3k\Omega$ $R_2 := 10k\Omega$ $R_3 := 5k\Omega$



$R_{eff} := R_1 + R_2 + R_3$ $R_{eff} = 18\,k\Omega$

$I := \frac{E}{R_{eff}}$ $I = 0.5\,mA$

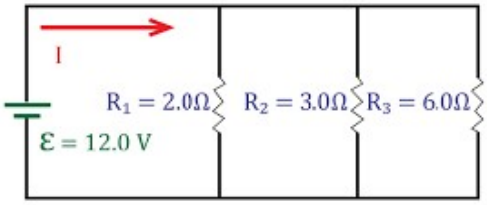
$E_{R1} := I \cdot R_1$ $E_{R1} = 1.5\,V$ $P_{R1} := I^2 \cdot R_1$ $P_{R1} = 0.75\,mW$

$E_{R2} := I \cdot R_2$ $E_{R2} = 5\,V$ $P_{R2} := I^2 \cdot R_2$ $P_{R2} = 2.5\,mW$

$E_{R3} := I \cdot R_3$ $E_{R3} = 2.5\,V$ $P_{R3} := I^2 \cdot R_3$ $P_{R3} = 1.25\,mW$

Problem 3.

$E := 12V$ $R_1 := 2\Omega$ $R_2 := 3\Omega$ $R_3 := 6\Omega$



$R_{eff} := \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$ $R_{eff} = 1\,\Omega$

$I := \frac{E}{R_{eff}}$ $I = 12\,A$

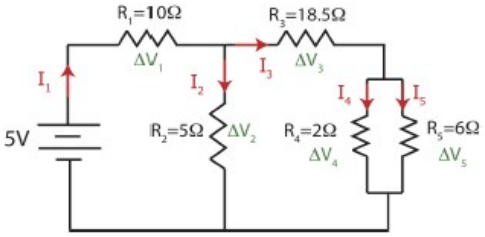
$I_{R1} := \frac{E}{R_1}$ $I_{R1} = 6\,A$ $P_{R1} := E \cdot I_{R1}$ $P_{R1} = 72\,W$

$I_{R2} := \frac{E}{R_2}$ $I_{R2} = 4\,A$ $P_{R2} := E \cdot I_{R2}$ $P_{R2} = 48\,W$

$I_{R3} := \frac{E}{R_3}$ $I_{R3} = 2\,A$ $P_{R3} := E \cdot I_{R3}$ $P_{R3} = 24\,W$

Problem 4.

$E := 5V \quad R_1 := 10\Omega \quad R_2 := 5\Omega \quad R_3 := 18.5\Omega \quad R_4 := 2\Omega \quad R_5 := 6\Omega$



$$R_{eff} := \frac{1}{\frac{1}{\frac{1}{\frac{1}{R_4}+\frac{1}{R_5}}+R_3}+\frac{1}{R_2}} + R_1 \qquad R_{eff} = 14\,\Omega$$

$I_1 := \frac{E}{R_{eff}} \qquad I_1 = 0.357\,A \qquad I_1 = 357.143\,mA \qquad E_{R1} := I_1 \cdot R_1 \qquad E_{R1} = 3.571\,V$

$I_2 := \frac{E - E_{R1}}{R_2} \qquad I_2 = 285.714\,mA \qquad E_{R2} := I_2 \cdot R_2 \qquad E_{R2} = 1.429\,V \qquad E_{loop1} := E - E_{R1} - E_{R2} \qquad E_{loop1} = 0\,V$

$$R_{loop2} := \frac{1}{\frac{1}{\frac{1}{R_4}+\frac{1}{R_5}}+R_3} \qquad R_{loop2} = 20\,\Omega$$

$I_3 := \frac{E - E_{R1}}{R_{loop2}} \qquad I_3 = 71.429\,mA \qquad E_{R3} := I_3 \cdot R_3 \qquad E_{R3} = 1.321\,V$

$E_{loop3} := E - E_{R1} - E_{R3} \qquad E_{loop3} = 107.143\,mV$

$I_4 := \frac{E_{loop3}}{R_4} \qquad I_4 = 53.571\,mA \qquad I_5 := \frac{E_{loop3}}{R_5} \qquad I_5 = 17.857\,mA$

$I_1 - I_2 - I_3 = 0\,A \qquad I_3 - I_4 - I_5 = 0\,A \qquad I_1 - I_2 - I_4 - I_5 = 0\,A$

$P_{R1} := I_1 \cdot E_{R1} \qquad P_{R1} = 1.276 \times 10^3\,mW$

$P_{R1} := I_1^2 \cdot R_1 \qquad P_{R1} = 1.276 \times 10^3\,mW$

$P_{R1} := \frac{E_{R1}^2}{R_1} \qquad P_{R1} = 1.276 \times 10^3\,mW$

$P_{R2} := I_2 \cdot E_{R2} \qquad P_{R2} = 408.163\,mW$

$P_{R3} := I_3 \cdot E_{R3} \qquad P_{R3} = 94.388\,mW$

$P_{R4} := I_4 \cdot E_{loop3} \qquad P_{R4} = 5.74\,mW$

$P_{R5} := I_5 \cdot E_{loop3} \qquad P_{R5} = 1.913\,mW$