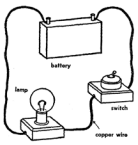
31/03/2020

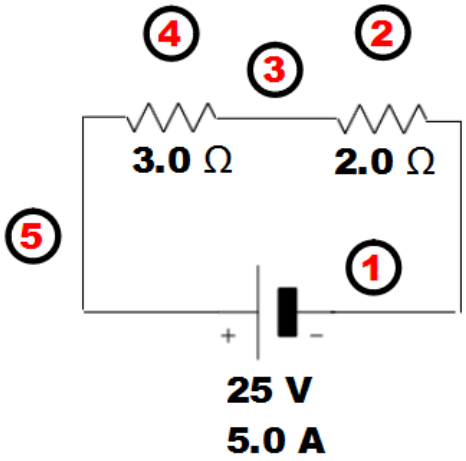


S30 Unit C: Physics - Circuit Analysis

Name: Key!

Date: _____

Review: The electron's energy adventure through a circuit.



1. A Series Circuit

In a series circuit, current is the same everywhere and voltage changes.

a) Electrons come from the battery and pass through point 1.

- The voltage of the electrons here is 25 V.
- The current in the circuit here is 5.0 A.

b) Electrons pass through the resistor at point 2.

- The current in the circuit here is 5.0 A.
- How much voltage does the resistor take from the electrons? *(Hint: do a calculation.)*

$V = IR$
$= (5.0A)(2.0\Omega)$
$V = 10V$

c) Electrons pass through point 3.

- The voltage of the electrons here is 15 V.
- The current in the circuit here is 5.0 A.

→ The electron started with 25V, but lost 10V to the first resistor.
25V − 10V = 15V

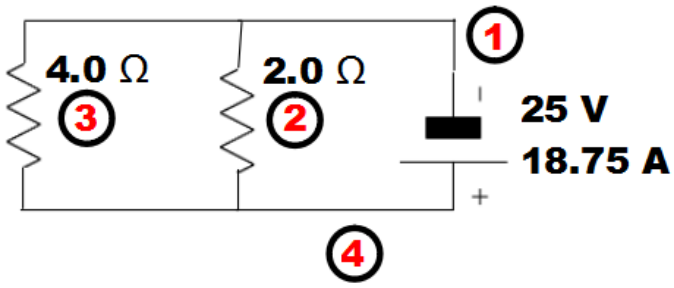
d) Electrons pass through the resistor at point 4.

- The current in the circuit here is 5.0 A.
- How much voltage does the resistor take from the electrons? *(Hint: do a calculation.)*

$V = (5.0A)(3.0\Omega)$
$V = 15V$

e) Electrons pass through point 5.

- The voltage of the electrons here is 0 V.
- The current in the circuit here is 5.0 A.



2. A Parallel Circuit

In a parallel circuit, voltage is the same everywhere and current changes.

a) Electrons come from the battery and pass through point 1.

- The voltage of the electrons here is 25 V.
- The current in the circuit here is 18.75 A.

b) Electrons pass through the resistor at point 2.

- The voltage of the electrons here is 25 V.
- The current in the circuit here is 12.5 A.
  (Hint: do a calculation.)

$V = IR$
$25\ V = I(2.0\ \Omega)$
$I = 12.5\ A$

c) Electrons pass through point 3.

- The voltage of the electrons here is 25 V.
- The current in the circuit here is 6.25 A.

The total current going into both resistors is 18.75A. If the first resistor takes 12.5A, that leaves 6.25A left for the other resistor.

d) Electrons pass through the resistor at point 4.

- The current in the circuit here is 18.75 A.
- How much voltage does the resistor take from the electrons? *(Hint: do a calculation.)*

Hmmm... we can't do this because we don't know the total resistance, we need to learn about

Total Resistance

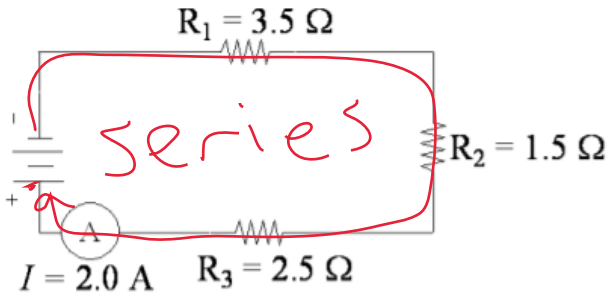
It is possible to find the total resistance of a circuit using the following two formulas:

For resistors in: series $R_T = R_1 + R_2 + R_3 + \ldots R_n$

For resistors in: parallel $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots \frac{1}{R_n}$

Pro Tip: to add the reciprocal fractions from the last formula on your calculator, use the x^{-1} key.

ex 1) Determine the total resistance of the circuit below.

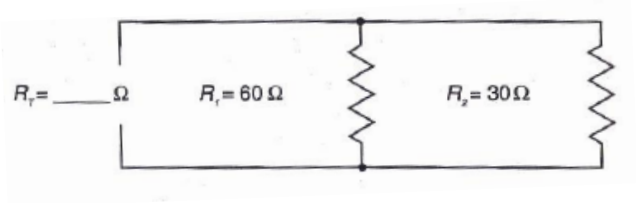


$$R_T = R_1 + R_2 + R_3 + \dots R_n$$

$R = 3.5\Omega + 1.5\Omega + 2.5\Omega$

$R = 7.5\Omega$

ex 2) Determine the total resistance of the circuit below.

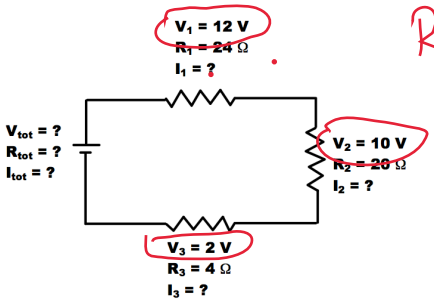


$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots \frac{1}{R_n}$$

$\frac{1}{R_T} = \frac{1}{60\Omega} + \frac{1}{30\Omega}$

$R_T = 20\Omega$

ex 3) First, determine the total resistance of the circuit below. Then, determine the total voltage of the circuit by adding each individual voltage. Finally, determine the current at each resistor by using Ohm's Law. *(Remember: the current is the same everywhere in a series circuit.)*



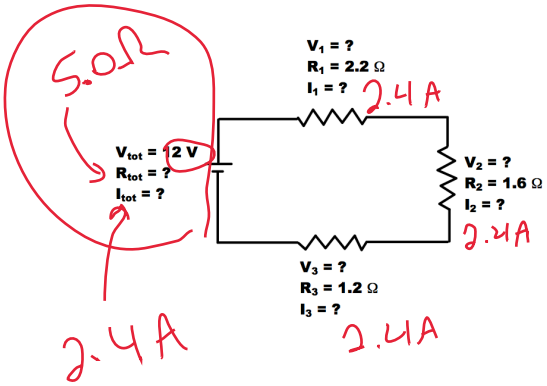
$R_{Tot} = 48\Omega$ $V_{Tot} = 24V$

$V = IR$

$12V = I(24\Omega)$

$I = 0.50A$

ex 4) First, determine the total resistance of the circuit below. Then, determine the current at each resistor. Finally, determine the voltage at each resistor using Ohm's Law.



$R_{Tot} = 5.0\Omega$

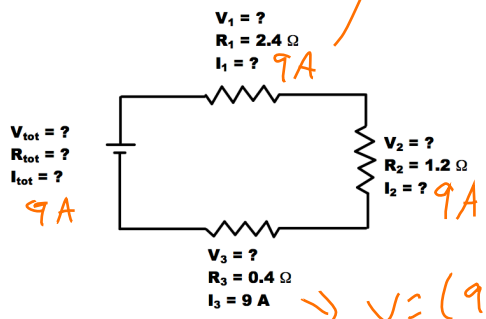
$V = IR$

$12V = I(5.0\Omega)$

$I = 2.4A$

$V = (9A)(2.4\Omega) = 22V$

ex 5) First, determine the total resistance of the circuit. Then, determine the current at each resistor. Finally. determine the voltage at each resistor using Ohm's Law.



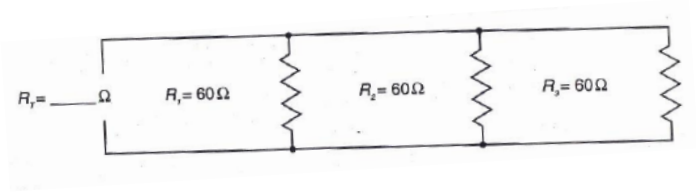
$R_{TOT} = 4.0\Omega$

$V = IR$

$\rightarrow V = (9A)(1.2\Omega) = 11V$

$\rightarrow V = (9A)(0.4\Omega) = 3.6V$

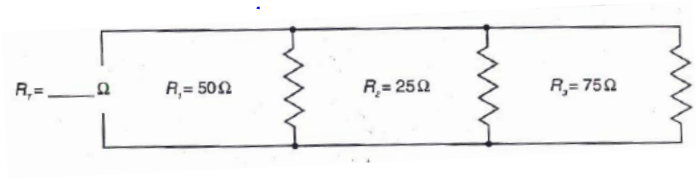
ex 6) Determine the total resistance of the circuit.



$\frac{1}{R_{TOT}} = \frac{1}{60\Omega} + \frac{1}{60\Omega} + \frac{1}{60\Omega}$

$R_{TOT} = 20\Omega$

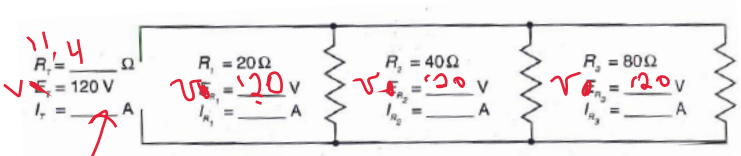
ex 7) Determine the total resistance of the circuit.



$\frac{1}{R_{TOT}} = \frac{1}{50\Omega} + \frac{1}{25\Omega} + \frac{1}{75\Omega}$

$R_{TOT} = 14\Omega$

ex 8) First, determine the total resistance of the circuit. Then, determine the voltage of each resistor. Finally, determine the current at each resistor by using Ohm's Law. *(Remember: the voltage is the same across each resistor in a parallel circuit.)*



10.5A

$R_{TOT} = \frac{1}{20\Omega} + \frac{1}{40\Omega} + \frac{1}{80\Omega}$

$R_{TOT} = 11.4\Omega$

$V = IR$

$120V = I(11.4\Omega)$

$I = 10.5A$

$I_1 = \frac{120V}{20\Omega} = 6.0A$

$I_2 = 3.0A$ $I_3 = 1.5A$