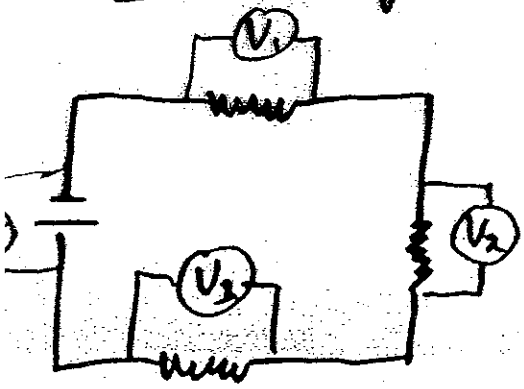
Calculating V_T I_T + R_T in Series + Parallel Circuits

* There are 3 variables in Ohm's Law, and two types of circuits (series + parallel)
∴ there are 6 rules for calculating V_T (total voltage), I_T (total current), and R_T (total resista

Calculating V_T in Series Circuit.

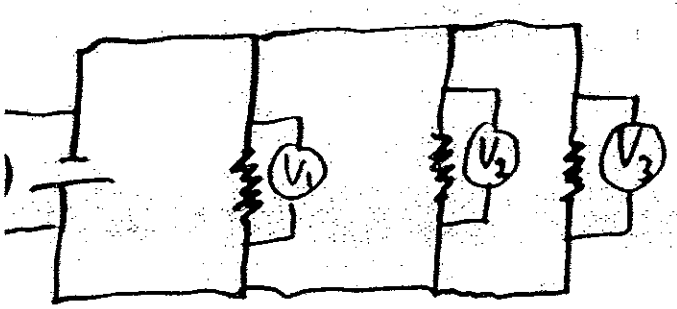


The total voltage in a series circuit is the sum of each voltage drop at each device.

eg: If $V_1 = 25V$, $V_2 = 15V$ and $V_3 = 10V$. Then V_T is $25V + 15V + 10V = 50V$

$$V_T = V_1 + V_2 + V_3 + \text{etc}$$

2) Calculating V_T in Parallel Circuit

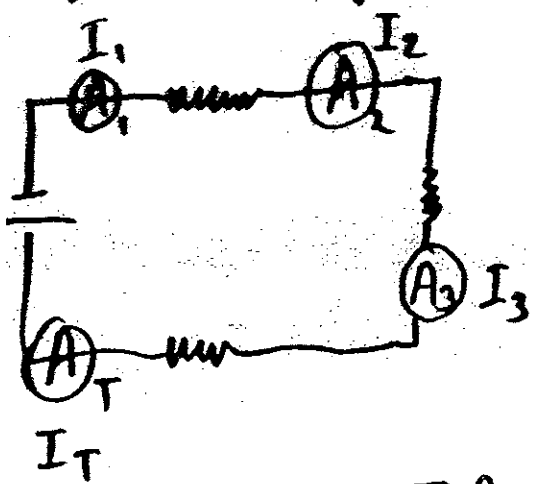


Voltage is the <u>same</u> everywhere in a parallel circuit.

eg: If $V_T = 15V$ the $V_1 = 15V$ and $V_2 = 15V$ and $V_3 = 15V$

$$V_T = V_1 = V_2 = V_3 = \text{etc}$$

3) Calculating I_T in Series Circuit.

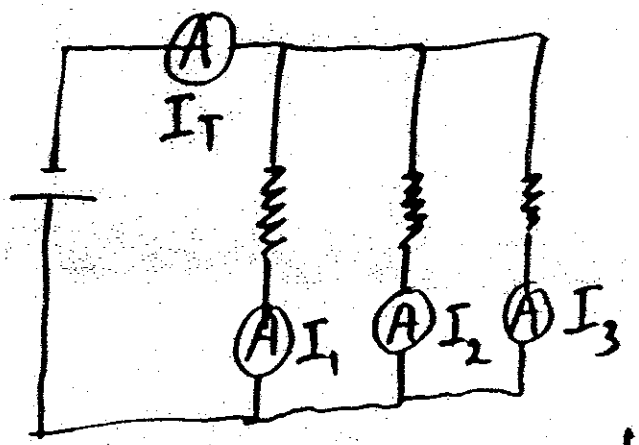


Current is <u>same</u> everywhere in a series circuit, regardless of the number of resistors, light bulbs, etc.

eg: If $I_T = 4A$, the $I_1 = 4A$ and $I_2 = 4A$ and $I_3 = 4A$.

$$I_T = I_1 = I_2 = I_3 = \text{etc.}$$

6. Calculating I_T in Parallel Circuit



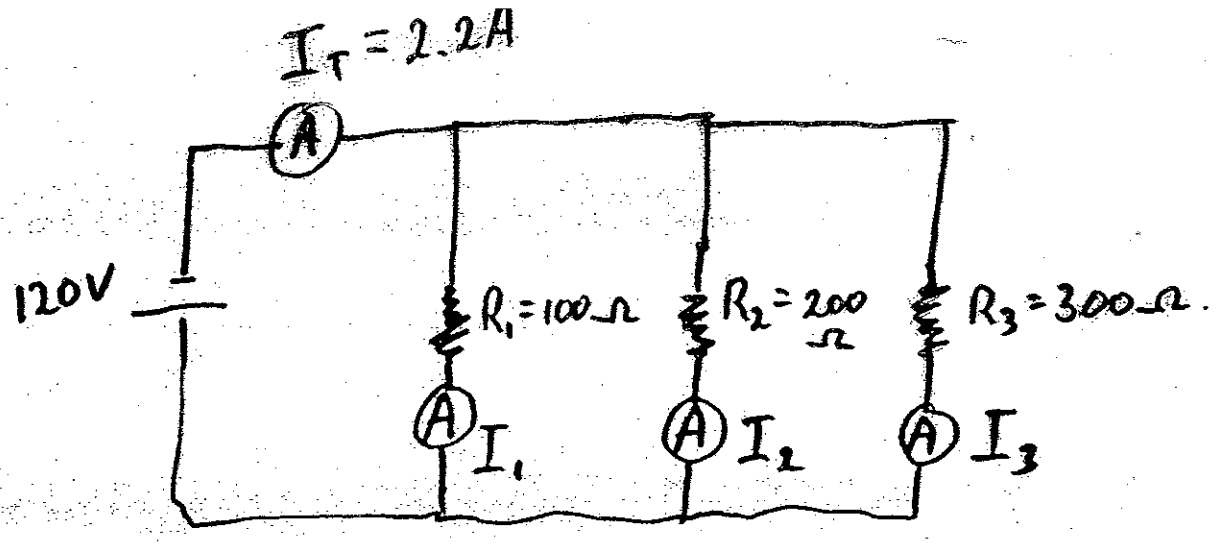
- In this example, the total current has 3 paths to follow

If all resistors in the circuit are of the same resistance, then the current will split up evenly down each path.

eg: If $I_T = 15A$, the $I_1 = 5A$ and $I_2 = 5A$ and $I_3 = 5A$.

But; when the resistors are of different values, the current will not split evenly through each path. The amount of current that flows through each path will depend on the size of the resistor in that path, and the current can be calculated using Ohm's Law.

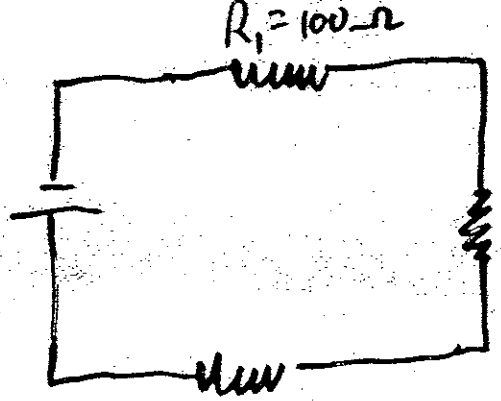
eg:



- To calculate the current flowing through the path with R_1, use this formula; $I_1 = \frac{V}{R_1} = \frac{120}{100} = 1.2A$
- To calculate the current flowing through the path with R_2, use this formula; $I_2 = \frac{V}{R_2} = \frac{120}{200} = .6A$
- To calculate the current flowing through the path with R_3, use this formula; $I_3 = \frac{V}{R_3} = \frac{120}{300} = .4A$.
- You can check your work, b/c I_T must equal $I_1 + I_2 + I_3$

$$I_T = I_1 + I_2 + I_3 + \text{etc}$$

C Calculating R_T in Series Circuit.

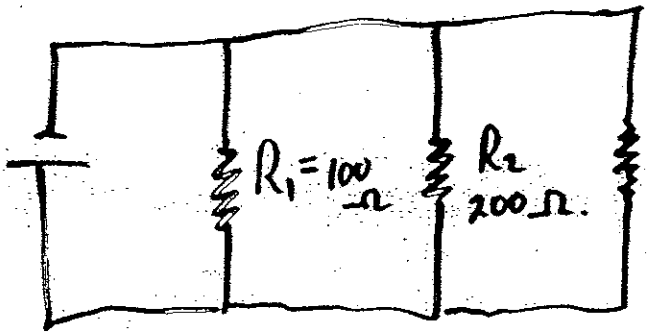


- To calculate R_T in series, you add up the values of all the resistors.

$$R_T = R_1 + R_2 + R_3 + \text{etc.}$$

$R_T = 100\ \Omega + 200\ \Omega + 300\ \Omega = 600\ \Omega$.

6) Calculating R_T in Parallel Circuit.



- To calculate R_T in a parallel circuit, the calculation is a bit "Tricky". You must add up the inverse of each resistor, flip, and reduce.

Using the above example of 3 resistors →

connected in parallel, here is how you calculate R_T!

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{100} + \frac{1}{200} + \frac{1}{300}$$ find a common denominator

$$\frac{1}{R_T} = \frac{6}{600} + \frac{3}{600} + \frac{2}{600}$$

$$\frac{1}{R_T} = \frac{11}{600}$$ then flip $R_T = \frac{600}{11} = \underline{54.5\ \Omega}$.

R_T in parallel $= \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ ↕ flip + reduce

<u>another example:</u> Calculate R_T for 3 resistors connected in parallel with values of 20 Ω, 30 Ω + 40 Ω

$R_T = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$ ↕ flip + reduce.

* The answer is: $R_T = 9.2\ \Omega$. You do the calculation!

Summary Chart of the Six Rules.

	Series	Parallel
V_T		
I_T		
R_T		