Properties of resistors in series and parallel

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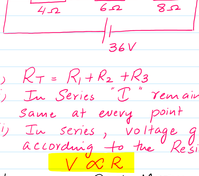
Resistors in Series.



(i) $R_T = R_1 + R_2 + R_3$

(ii) In Series "I" remains the same at every point

(iii) In series, voltage gets divided according to the Resistor

$V \propto R$

We can use RATIO METHOD to calculate Voltage in Series

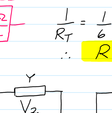
$R_1 \rightarrow \frac{4}{4+6+8} \times 36 = 8V$

$R_2 \rightarrow \frac{6}{4+6+8} \times 36 = 12V$

$R_3 \rightarrow \frac{8}{4+6+8} \times 36 = 16V$

(iv) If resistance of any one resistor increases, its corresponding voltage will also increase & the voltage across other resistors will decrease

Resistors in Parallel



① $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

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

$R_T = 2\Omega$.

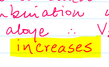
* If only 2 resistors than total Resistance can also be obtained using

$R_T = \frac{\text{Product}}{\text{Sum}}$

$R_T = \frac{6 \times 3}{6+3} = \frac{18}{9}$

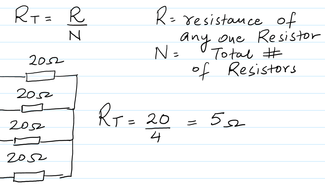
$R_T = 2\Omega$

② If you keep adding more Resistors in parallel, the combined Resistance keeps decreasing eg



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

$\therefore R_T = 1\Omega$



Suggest what happens to V_1 & V_2 if an extra resistor Z is added to the combination

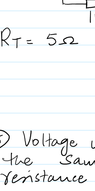
The combined resistance of parallel combination will be LESS than Y alone ∴ V_2 will decrease & V_1 increases

③ If there are many resistors (all identical) in a parallel combination, the total resistance can be worked out as follows

$R_T = \frac{R}{N}$

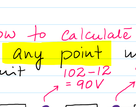
R = resistance of any one Resistor

N = Total # of Resistors



$R_T = \frac{20}{4} = 5\Omega$

④ If two resistors have a significant difference b/w them (i.e thousand times or more) than in parallel the total Resistance will always be equal to the resistor of the Lesser Value



$\frac{1}{R_T} = \frac{1}{5} + \frac{1}{10^6}$

$R_T = 5\Omega$

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$R_T = \frac{\text{Product}}{\text{Sum}}$

$R_T = \frac{5 \times 10^6}{5 + 10^6}$

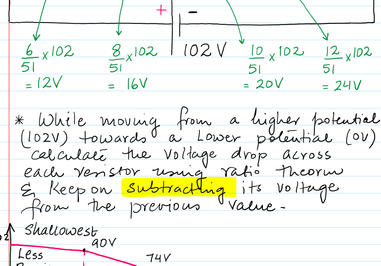
$R_T = 5\Omega$.

⑤ Voltage in Parallel remains the same irrespective of the resistance

⑥ Current in parallel get divided such that the branches containing higher resistance gets lesser Current

$I \propto \frac{1}{R}$.

* How to calculate Voltage/Potential at any point in an Electrical circuit



* While moving from a higher potential (102V) towards a lower potential (0V) calculate the voltage drop across each resistor using ratio theorem & keep on subtracting its voltage from the previous value.