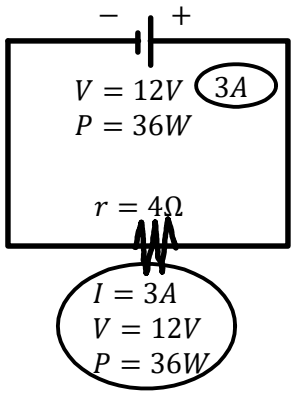
P12 - 9.1 - V=IR P=IV Q=I/T Series Parallel Circuits Notes



$V = IR$ $\quad I = \frac{12}{4}$ $\quad I = 3A$

$P = IV$ $\quad P = 3(12)$ $\quad P = 36W$

$P = I^2R$ $\quad P = 3^2(4)$ $\quad P = 36W$

$I = \frac{Q}{t}$ $\quad Q = It$ $\quad Q = 3(1)$ $\quad Q = 3C$

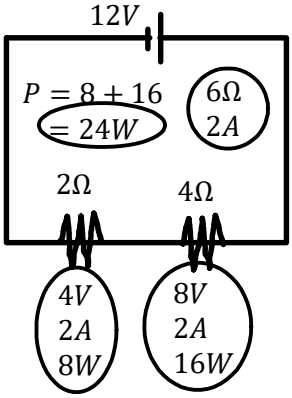
How many electrons in 1s?

$3\,C \times \frac{6.24E18e^-}{1C} = 1.87E19e^-$

$1e^- \times 1.9 \times 10^{-19}C$

Check: Ohm's Law/Series/Parallel/Loop/Junction Rules

Series $\quad I_T = I_1 = I_2$



R_T 1st

$R_T = R_1 + R_2$

$R_T = 2 + 4$

$R_T = 6\Omega$

2Ω $\quad V = IR$ $\quad V = 2(2)$ $\quad V = 4V$

4Ω $\quad V = IR$ $\quad V = 2(4)$ $\quad V = 8V$

Total

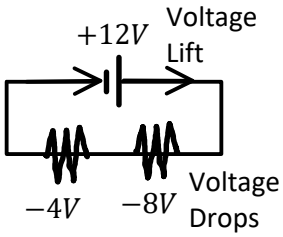
$V = IR$ $\quad I = \frac{12}{6}$ $\quad I = 2\,C$

Check $\quad V_T = V_1 + V_2$ $\quad 12 = 4 + 8$ ✓

$P = IV$ $\quad P = 2(4)$ $\quad P = 8W$

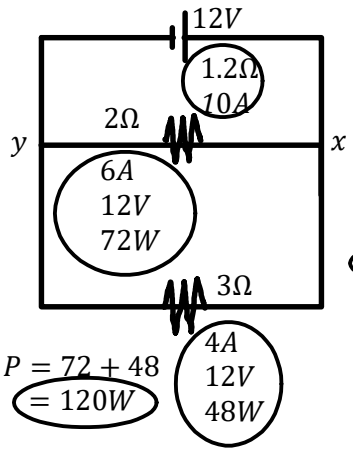
$P = IV$ $\quad P = 2(8)$ $\quad P = 16W$

Loop Rule: $\sum V = 0$



$-8V - 4V + 12V = 0$

Parallel $\quad V_T = V_1 = V_2$



R_T 1st

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

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

$\frac{1}{R_T} = \frac{5}{6}$

$R_T = 1.2\,\Omega$

2Ω $\quad V = IR$ $\quad I = \frac{12}{2}$ $\quad I = 6A$

3Ω $\quad V = IR$ $\quad I = \frac{12}{3}$ $\quad I = 4A$

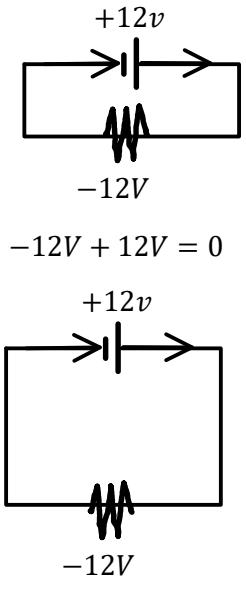
Check $\quad I_T = I_1 + I_2$ $\quad 10 = 6 + 4$ ✓

$V = IR$ $\quad I = \frac{12}{1.2}$ $\quad I = 10A$

$P = IV$ $\quad P = 6(12)$ $\quad P = 72W$

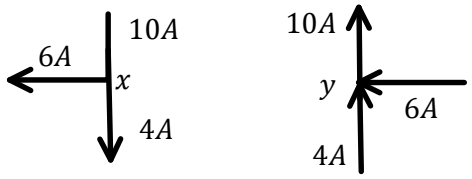
$P = IV$ $\quad P = 4(12)$ $\quad P = 48W$

Loop Rule: $\sum V = 0$



$-12V + 12V = 0$

Junction Rule: $\quad I_A + I_B + \cdots + I_n = I_C$



$10A = 6A + 4A$ $\qquad 6A + 4A = 10A$

*Two Resistors!

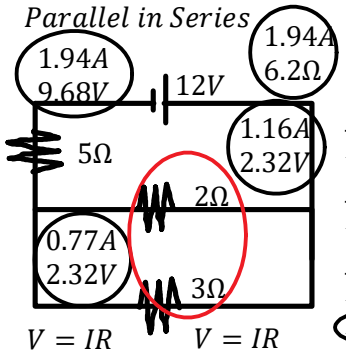
$R_T^* = \frac{R_1 R_2}{R_1 + R_2}$

$R_T^* = \frac{2(3)}{2 + 3}$

$R_T^* = 1.2\Omega$

P12 - 9.2 - Redraw Circuits Notes

Parallel in Series



R_T 1st

1

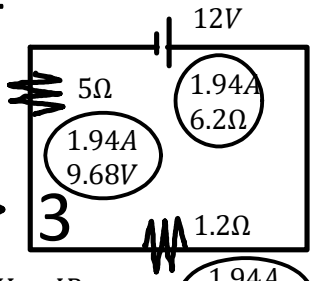
$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$

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

$$\frac{1}{R_T} = \frac{5}{6}$$

$$R_T = 1.2\,\Omega$$

1st Redraw



2

$$R_T = 5 + 1.2$$

$$R_T = 6.2\Omega$$

3

$$V = IR$$

$$I = \frac{V}{R}$$

$$I = \frac{12}{6.2}$$

$$I = 1.94A$$

4

$$V = IR$$

$$V = 1.94(5)$$

$$V = 9.68V$$

$$V = IR$$

$$V = 1.94(1.2)$$

$$V = 2.32V$$

$$I_T = I_1 = I_2$$

5

$$V = IR$$

$$I = \frac{V}{R}$$

$$I = \frac{2.32}{2}$$

$$I = 1.16A$$

$$V = IR$$

$$I = \frac{V}{R}$$

$$I = \frac{2.32}{3}$$

$$I = 0.77A$$

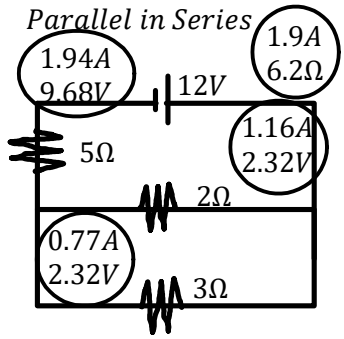
$$V_T = V_1 = V_2$$

Check

$$V_T = V_1 + V_2$$

$$12 = 2.32 + 9.68$$ ✓

Parallel in Series



Parallel/Series

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

$$R_T = R_1 + R_2$$

Total

$$V = IR$$

Parallel

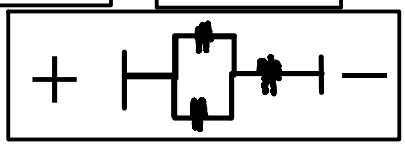
$$V_T = V_1 = V_2$$

$$I_T = I_1 + I_2$$

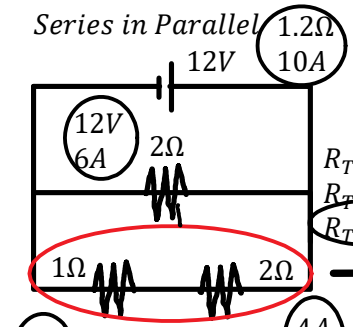
Series

$$I_T = I_1 = I_2$$

$$V_T = V_1 + V_2$$



Series in Parallel



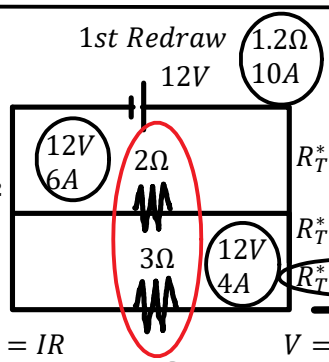
1

$$R_T = R_1 + R_2$$

$$R_T = 1 + 2$$

$$R_T = 3\Omega$$

1st Redraw



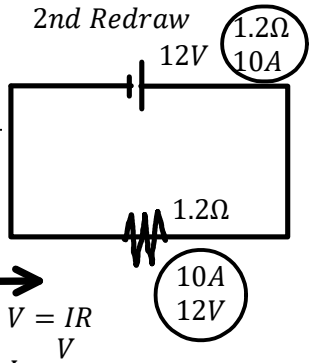
2

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

$$R_T^* = \frac{2(3)}{2+3}$$

$$R_T^* = 1.2\Omega$$

2nd Redraw



3

$$V = IR$$

$$I = \frac{V}{R}$$

$$I = \frac{12}{1.2}$$

$$I = 10A$$

4

$$V = IR$$

$$I = \frac{V}{R}$$

$$I = \frac{12}{3}$$

$$I = 4A$$

$$V_T = V_1 = V_2$$

5

$$V = IR$$

$$I = \frac{V}{R}$$

$$I = \frac{12}{2}$$

$$I = 6A$$

$$V = IR$$

$$V = 4(2)$$

$$V = 8V$$ ✓

$$I_T = I_1 = I_2$$

Check

$$V = IR$$

$$12 = 10(1.2)$$ ✓

$$V = IR$$

$$V = 4(1)$$

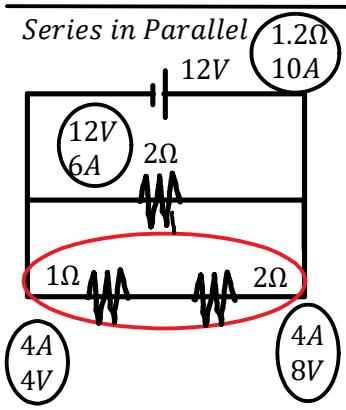
$$V = 4V$$

Check

$$V_T = V_1 + V_2$$

$$12 = 4 + 8$$

Series in Parallel



Series/Parallel

$$R_T = R_1 + R_2$$

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

Total

$$V = IR$$

Series

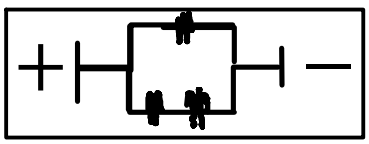
$$I_T = I_1 = I_2$$

$$V_T = V_1 + V_2$$

Parallel

$$V_T = V_1 = V_2$$

$$I_T = I_1 + I_2$$



P12 - 9.3 - Add R Bulb/Switch Circuits Notes

$V = IR \qquad P = IV$

Series

$I_T = I_1 = I_2 = I_3 \ldots$

$V_T = V_1 + V_2 + V_3 \ldots$

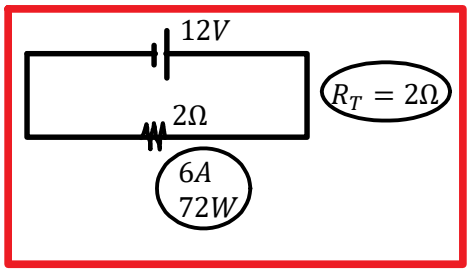
$R_T = R_1 + R_2 + R_3 \ldots$

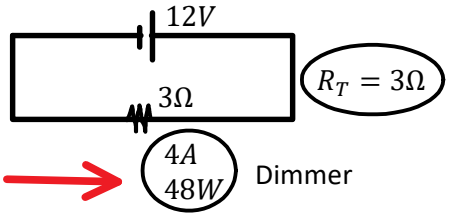
Parallel

$V_T = V_1 = V_2 = V_3 \ldots$

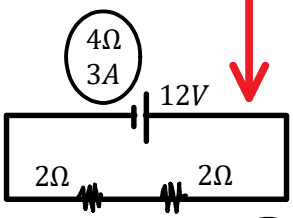
$I_T = I_1 + I_2 + I_3 \ldots$

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





Inc R → I Dec , P Dec



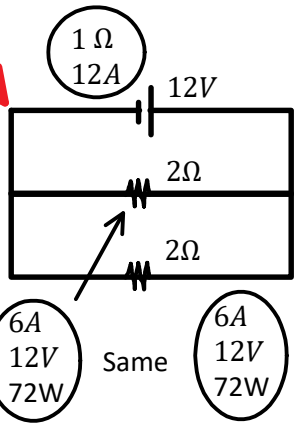
$R_T = R_1 + R_2$

$R_T = 2\Omega + 2\Omega$

$R_T = 4\Omega$

3A 6V 18W Dimmer 3A 6V 18W

Add resisters in Series → R_T increases



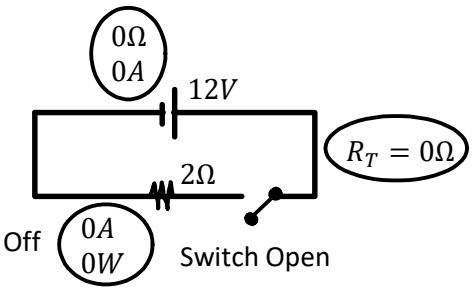
$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

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

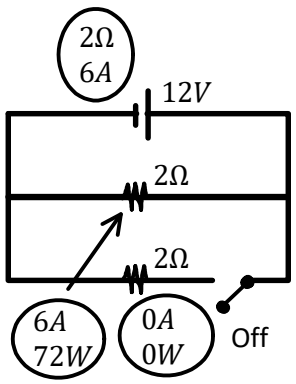
$\frac{1}{R_T} = 1$

$R_T = 1\ \Omega$

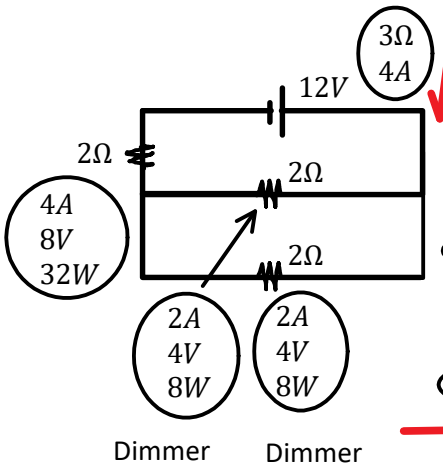
Add resisters in Parallel → R_T decreases



No Current!



$R_T = 2\Omega$



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

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

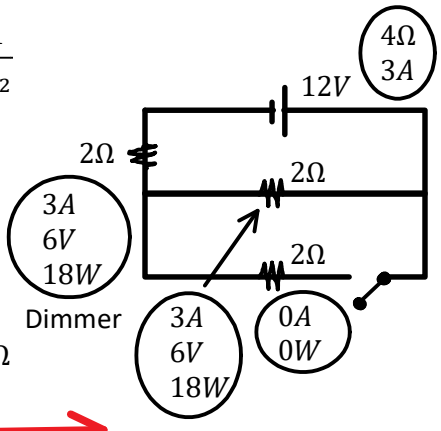
$\frac{1}{R_T} = 1$

$R_T = 1\ \Omega$

$R_T = R_1 + R_2$

$R_T = 2\Omega + 1\Omega$

$R_T = 3\Omega$

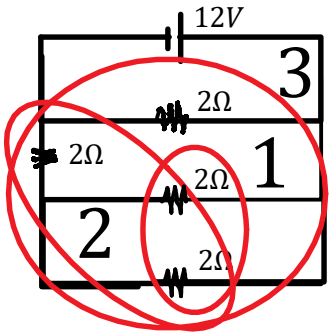


$R_T = R_1 + R_2$

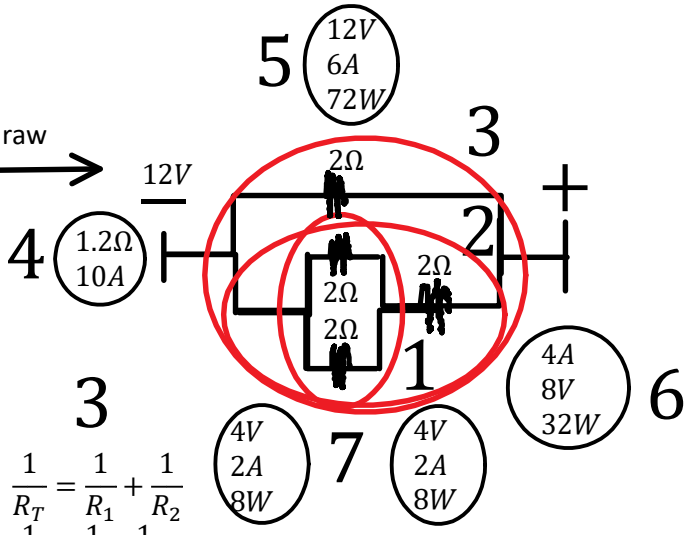
$R_T = 2\Omega + 2\Omega$

$R_T = 4\Omega$

P12 - 9.3 - Add R Bulb/Switch Circuits Notes



Redraw



1

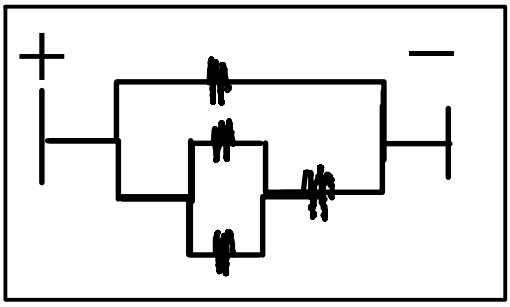
$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$
$$\frac{1}{R_T} = \frac{1}{2} + \frac{1}{2}$$
$$\frac{1}{R_T} = 1$$
$$R_T = 1\,\Omega$$

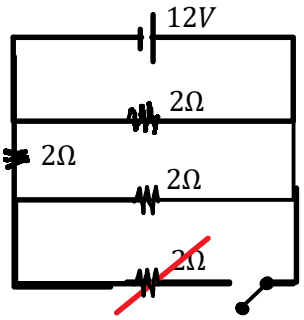
2

$$R_T = R_1 + R_2$$
$$R_T = 2\Omega + 1\Omega$$
$$R_T = 3\Omega$$

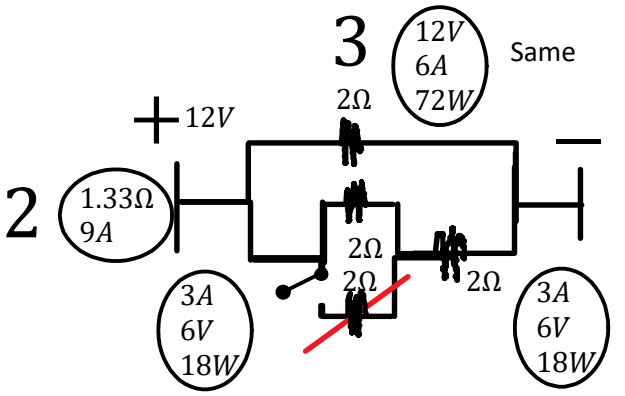
3

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$
$$\frac{1}{R_T} = \frac{1}{2} + \frac{1}{3}$$
$$\frac{1}{R_T} = \frac{5}{6}$$
$$R_T = 1.2\Omega$$





$$R_T = R_1 + R_2$$
$$R_T = 2\Omega + 2\Omega$$
$$R_T = 4\Omega$$

1

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$
$$\frac{1}{R_T} = \frac{1}{2} + \frac{1}{4}$$
$$\frac{1}{R_T} = \frac{3}{4}$$
$$R_T = 1.33\Omega$$