SPH3U 11.8 Resistors in Circuits

1. Series and parallel

Equivalent resistance:	the total resistance of a group of resistors.

Series:	$V_{series} = V_1 + V_2 + V_3 \rightarrow I_S R_S = I_1 R_1 + I_2 R_2 + I_3 R_3$. $(I_1 = I_2 = \ldots = I_S)$ $I_S R_S = I_S (R_1 + R_2 + R_3)$.
equation	$R_{series} = R_1 + R_2 + R_3 + \ldots$

Four resistors are connected in series in a circuit. The resistances are as follows: $R_1 = 41\ \Omega$, $R_2 = 51.75\ \Omega$, $R_3 = 11.1\ \Omega$, $R_4 = 102.008\ \Omega$. Calculate the equivalent resistance.

$R_S = R_1 + R_2 + R_3 + R_4$

$= 41 + 51.75 + 11.1 + 102.008$

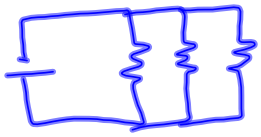
$= 206\ \Omega$.

$V = IR$

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

Parallel:	$I_P = I_1 + I_2 + I_3 \rightarrow \frac{V_P}{R_P} = \frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3}$ $(V_1 = V_2 = V_3 = V_P)$. $\frac{V_P}{R_P} = V_P \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)$
equation	$\frac{1}{R_{Parallel}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots \rightarrow R_P = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots}$

Three resistors are connected in parallel in a circuit. The resistances are as follows: $R_1 = 15\ \Omega$, $R_2 = 12\ \Omega$, $R_3 = 10\ \Omega$. Calculate the equivalent resistance.



$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$= \frac{1}{15} + \frac{1}{12} + \frac{1}{10}$

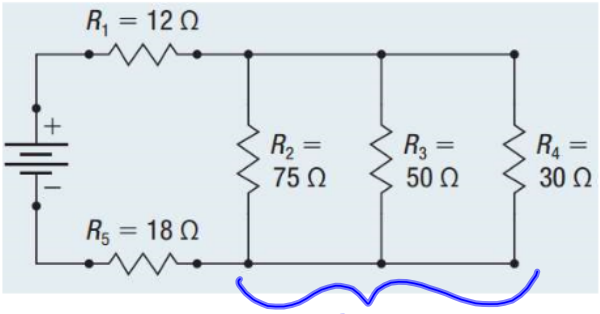
$= \frac{4}{60} + \frac{5}{60} + \frac{6}{60}$

$= \frac{15}{60} = \frac{1}{4}$.

$\therefore R_P = 4\ \Omega$.

2. Mixed circuits

Calculate the equivalent resistance for the circuit shown.



$\frac{1}{R_p} = \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}$

$= \frac{1}{45} + \frac{1}{50} + \frac{1}{30}$

$= 0.067$

$R_p = 15\ \Omega$.

$R_T = R_1 + R_p + R_5$

$= 12 + 15 + 18$

$= 45\ \Omega$.

$R_p = 15\ \Omega$.

Homework: page 530: #4-5