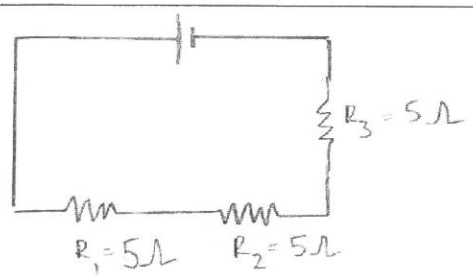
Resistance in Series and Parallel Worksheet



$R_{equivalent} = R_1 + R_2 + R_3 = 15\ \Omega$

Resistors in **parallel**

$R = \frac{5}{3} = 1.67\ \Omega$

$\frac{1}{R_{equivalent}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{5} + \frac{1}{5} + \frac{1}{5} = \frac{3}{5}$

1. Find the equivalent resistance of these <u>series</u> circuits (in Ω) :

a) $R_1 = 100\ \Omega$, $R_2 = 20\ \Omega$, $R_3 = 55\ \Omega$

$R = 100 + 20 + 55$
$= 175\ \Omega$

b) $R_1 = 7500\ \Omega$, $R_2 = 1.5\ k\Omega$, $R_3 = 25\ \Omega$

$R = 7500 + 1500 + 25$
$= 9025\ \Omega$

c) $R_1 = 0.1\ \Omega$, $R_2 = 0.2\ \Omega$, $R_3 = 50\ m\Omega$

$R = 0.1 + 0.2 + 0.05$
$= 0.35\ \Omega$

2. Find the equivalent resistance of these <u>parallel</u> circuits (in Ω) :

a) $R_1 = 100\ \Omega$, $R_2 = 20\ \Omega$, $R_3 = 55\ \Omega$

$\frac{1}{R} = \frac{1}{100} + \frac{1}{20} + \frac{1}{55} = \frac{43}{550}$

$R = \frac{550}{43} = 12.8\ \Omega$

b) $R_1 = 7500\ \Omega$, $R_2 = 1.5\ k\Omega$, $R_3 = 25\ \Omega$

$\frac{1}{R} = \frac{1}{7500} + \frac{1}{1500} + \frac{1}{25} = \frac{51}{1250}$

$R = \frac{1250}{51} = 24.5\ \Omega$

c) $R_1 = 0.1\ \Omega$, $R_2 = 0.2\ \Omega$, $R_3 = 50\ m\Omega$

$\frac{1}{R} = \frac{1}{0.1} + \frac{1}{0.2} + \frac{1}{0.05} = 35$

$R = \frac{1}{35} = 0.03\ \Omega$

3. The same two equations above work for any number of resistors in a circuit. If a fourth resistor is added ($R_4 = 85\ \Omega$), find the equivalent resistance in 1a) and 2a).

1a)

$175 + 85 = 260\ \Omega$

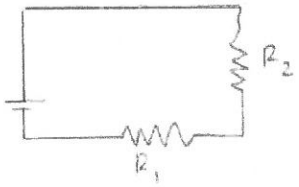
2a)

$\frac{1}{100} + \frac{1}{20} + \frac{1}{55} + \frac{1}{85} = \frac{841}{9350} = \frac{1}{R}$

$R = \frac{9350}{841} = 11.1\ \Omega$

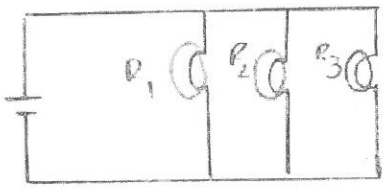
4. Calculate the equivalent resistance of the following circuits:

a) $R_1 = 5\ \Omega$ $R_2 = 10\ \Omega$



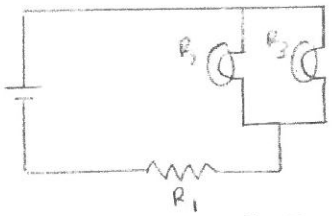
$R = R_1 + R_2 = 15\ \Omega$

b) $R_1 = R_2 = R_3 = 1.5\ \Omega$



$\frac{1}{R} = \frac{1}{1.5} + \frac{1}{1.5} + \frac{1}{1.5} = \frac{3}{1.5} = 2 \quad R = \frac{1}{2} = 0.5\ \Omega$

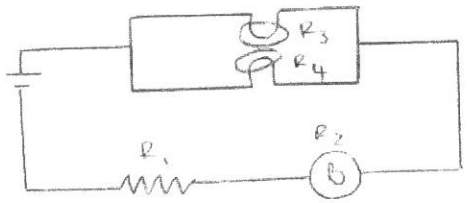
c) $R_1 = 12\ \Omega$ $R_2 = 5\ \Omega$ $R_3 = 8\ \Omega$



$\frac{1}{R} = \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{5} + \frac{1}{8} = \frac{13}{40} \quad R = \frac{40}{13} = 3.1\ \Omega$

$R_{total} = R_1 + R = 12 + 3.1 = 15.1\ \Omega$

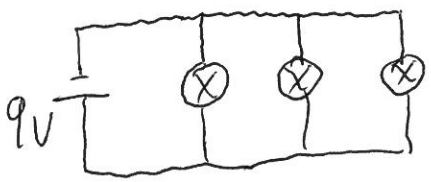
d) $R_1 = 1\ \Omega$ $R_2 = 2\ \Omega$ $R_3 = 3\ \Omega$ $R_4 = 4\ \Omega$



$\frac{1}{R} = \frac{1}{R_3} + \frac{1}{R_4} = \frac{1}{3} + \frac{1}{4} = \frac{7}{12} \quad R = \frac{12}{7} = 1.7\ \Omega$

$R_{total} = R_1 + R_2 + R = 1 + 2 + 1.7 = 4.7\ \Omega$

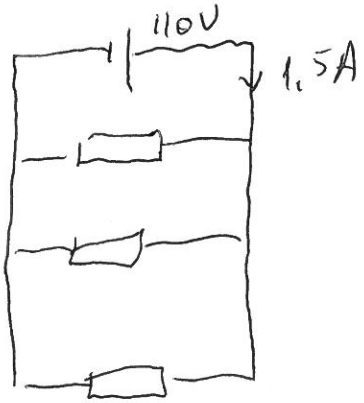
5. Three light bulbs of 4 Ω resistance each are in a parallel with a 9V power supply. Draw the circuit, and find the current.



$\frac{1}{R} = \frac{1}{4} + \frac{1}{4} + \frac{1}{4} = \frac{3}{4}$

$R = \frac{4}{3} = 1.3\ \Omega \quad I = \frac{V}{R} = \frac{9}{1.3} = 6.9\ A$

6. Three identical buzzers are in parallel with a 110 V power supply. The circuit has a current of 1.5 A. Draw the circuit. Find the resistance of one buzzer.



$R_{total} = \frac{V}{I} = \frac{110}{1.5} = 73.3\ \Omega$

$R = 3 \times R_t = 3 \times \frac{110}{1.5} = 220\ \Omega$