Resistance and Current

Tuesday, November 28, 2023 1:02 PM

Current in an object depends on how resistive a material is to charge passing thru it.

Objects that have little resistance are called good conductors, metal and certain carbon samples are good conductors. Current is high in good conductors.

Objects that have large resistance are called insulators. Materials include plastics, rubber, and typical non-metal compounds. These have covalent bonds.

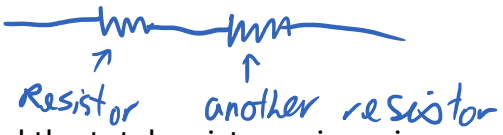
Resistance is the measure of how hard it is to move charge through a material. Metals have low resistance, non-metals have high resistance. Units are Ohms.

R in formulas

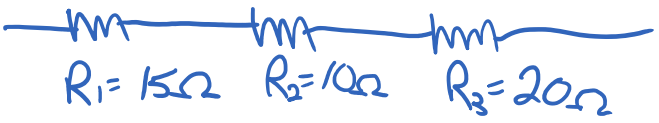
Ohms (Ω)

When resistors are connected one after the other we call this series:

$R_{series} = R_1 + R_2 + R_3 \ldots$



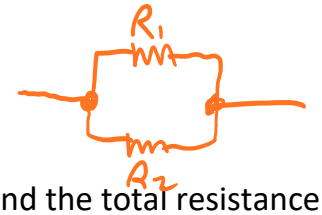
Find the total resistance in series:



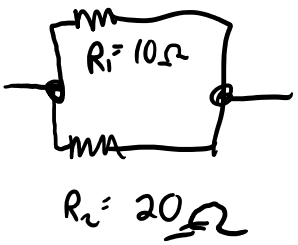
$R_{series} = R_1 + R_2 + R_3$
$= 15 + 10 + 20$
$= 45\Omega$

When resistors provide 2 routes between the same points we call this parallel. In parallel total resistance DROPS ← It's weird!

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



Find the total resistance in parallel:

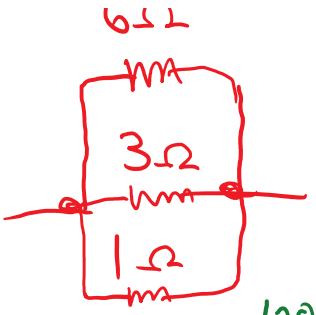


$\frac{1}{R_p} = \frac{1}{10} + \frac{1}{20} = 0.15$ ← That is $\frac{1}{R_p}$

$R_p = (0.15)^{-1} = 6.67\Omega$

less than the 10!

6Ω

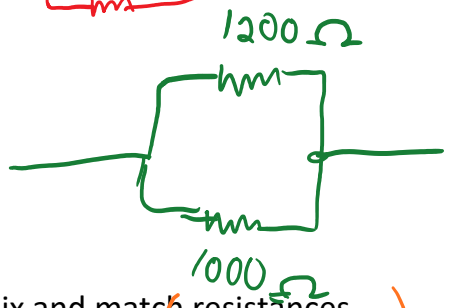


less than the 10!

$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{3} + \frac{1}{1} = 1.5 \leftarrow \frac{1}{R_p}$

$R_p = (1.5)^{-1} = 0.67\,\Omega$

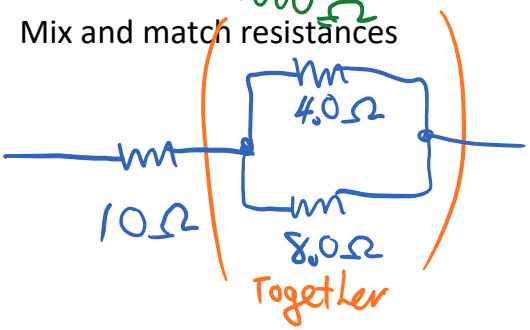
less than $1\,\Omega$



$\frac{1}{R_p} = \frac{1}{1200} + \frac{1}{1000} = 1.83 \times 10^{-3}$

$R_p = (1.83 \times 10^{-3})^{-1} = 545\,\Omega$

Mix and match resistances

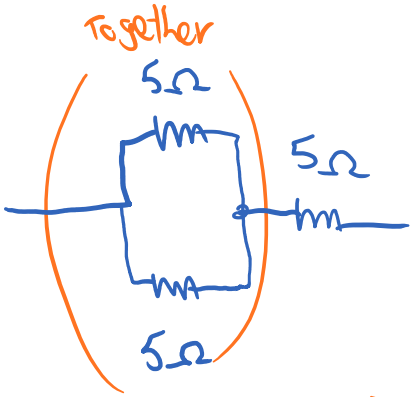


$\frac{1}{R_p} = \frac{1}{4} + \frac{1}{8} = .375$ $\quad R_p = 2.67\,\Omega$

then the 2.67 is series with 10

so

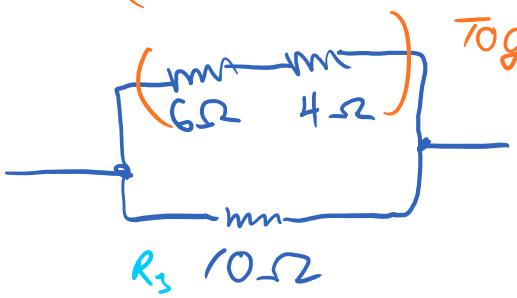
$10 + 2.67 = 12.7\,\Omega$



$\frac{1}{R_p} = \frac{1}{5} + \frac{1}{5} = \frac{2}{5}\Omega = 2.5\,\Omega$

then series

$2.5 + 5 = 7.5\,\Omega$

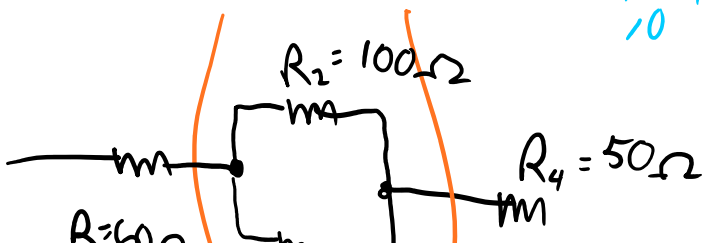


$R_s = 6 + 4 = 10 \leftarrow$

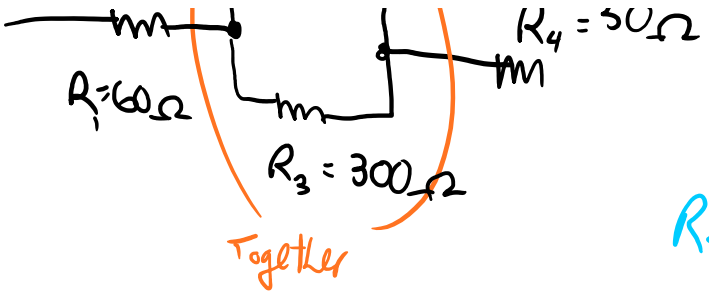
now

$\frac{1}{R_p} = \frac{1}{R_3} + \frac{1}{R_s}$

$= \frac{1}{10} + \frac{1}{10} = \frac{2}{10} \rightarrow \frac{10}{2} = 5.0\,\Omega$



$\frac{1}{6} = \frac{1}{\quad} + \frac{1}{\quad} = \frac{4}{\quad} \rightarrow = 75\,\Omega$



$\frac{1}{R_p} = \frac{1}{100} + \frac{1}{300} = \frac{4}{300}$ ↺ $= 75\Omega$

$R_s = 60 + 75 + 50 = 185\Omega$

Current is caused to flow by a voltage difference between 2 points in a conductor. The current is slowed or reduced by the resistance between the points.

$I = \Delta V / R$ this is called Ohm's Law

A cat is connected to a household supply and draws 0.480 A, find the resistance of the cat.

Find the current in 12W lightbulb connected to a household supply, use that to find the resistance of the bulb.

A 10 W bulb is connected in series to a 5.0 W bulb and a 6.0 V supply, find the current. Find the total power.

A 6.0 V supply is 10 W bulb and connected in parallel to a 5.0 W bulb. Find the current. Find the total power.

300 W are used to power the circuit at the right, find the current flowing from the source.