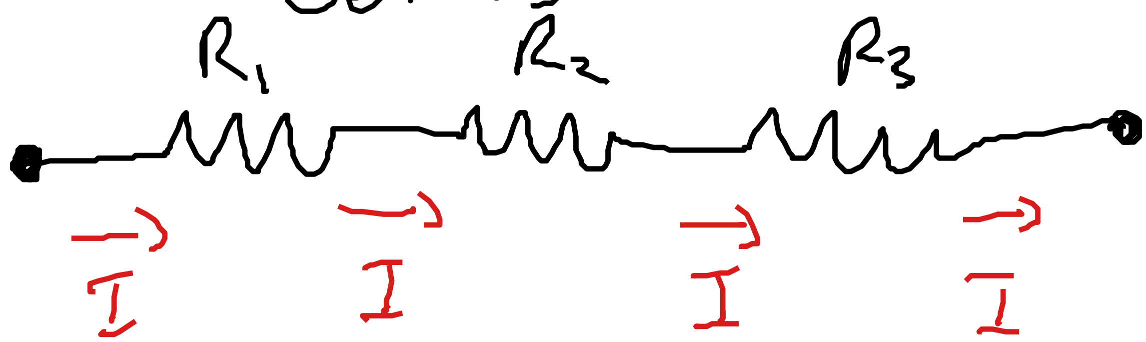
Series

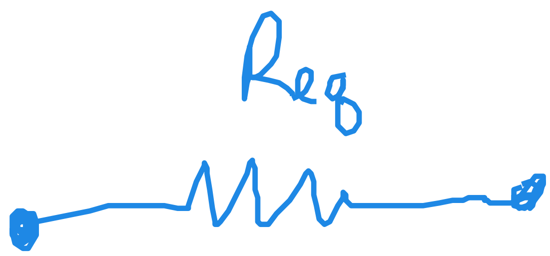


We can replace these with a single resistor having the same equivalent resistance:

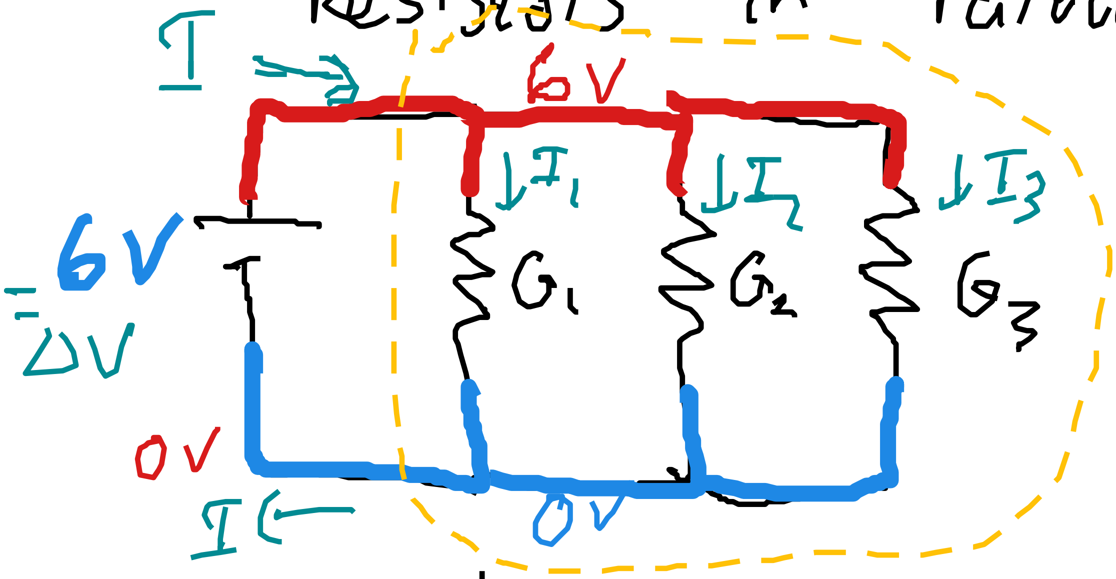
series

$$R_{eq} = R_1 + R_2 + R_3 + \cdots$$

same as



Resistors in Parallel



$$G = \frac{1}{R}$$

All have identical potential drops ΔV.

$$I = G\Delta V$$

$$I = I_1 + I_2 + I_3$$

$$G_{eq}\Delta V = G_1\Delta V + G_2\Delta V + G_3\Delta V$$

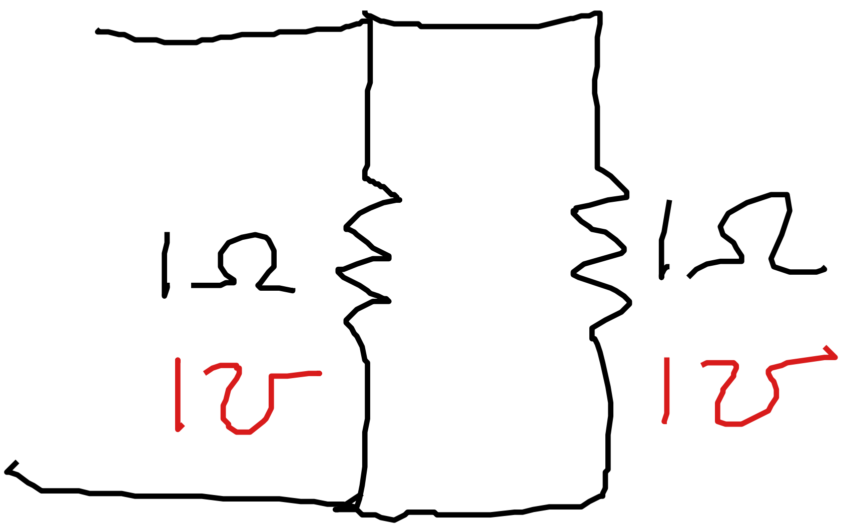
$$(G_1 + G_2 + G_3)\Delta V$$

$$G_{eq} = G_1 + G_2 + G_3$$

Series: resistances add

Parallel: conductances add

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$



R_{eq} is

$< 1\Omega$

$= 1\Omega$

$1 - 2\Omega$

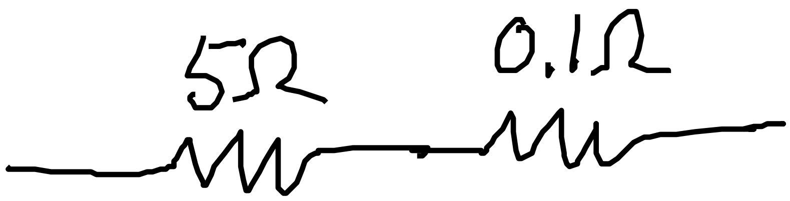
$= 2\Omega$

$> 2\Omega$

$G_{eq} = 2℧$

$R_{eq} = \frac{1}{2℧} = \frac{1}{2}\Omega$

$\frac{1}{R_{eq}} = \frac{1}{1} + \frac{1}{1} = 2 \rightarrow R_{eq} = \frac{1}{2}$

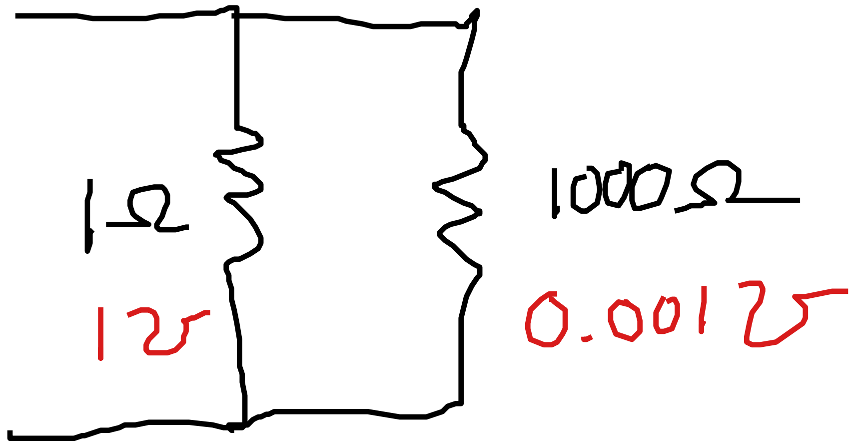


$R_{eq} = 5 + 0.1 = 5.1$

R_{eq} is larger than any one resistance in series

like security line at airport

even a quick additional stop will slow down the line.

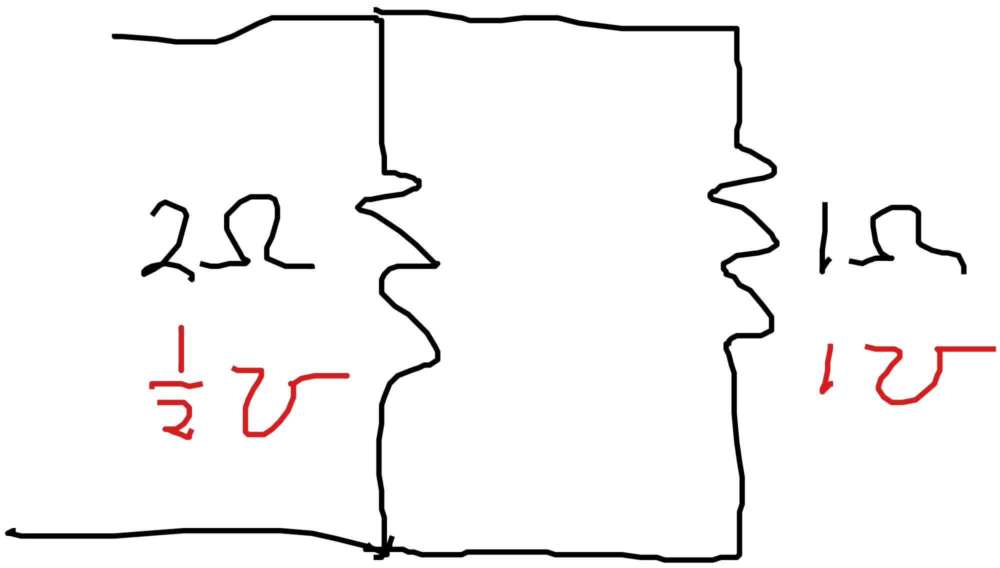


$$G_{eq} = 1.001\ ℧$$

$$R_{eq} = \frac{1}{1.001\ ℧} = 0.999\ \Omega$$

for resistors in parallel,

R_{eq} is <u>smaller</u> than all individual resistors



R_{eq} ?

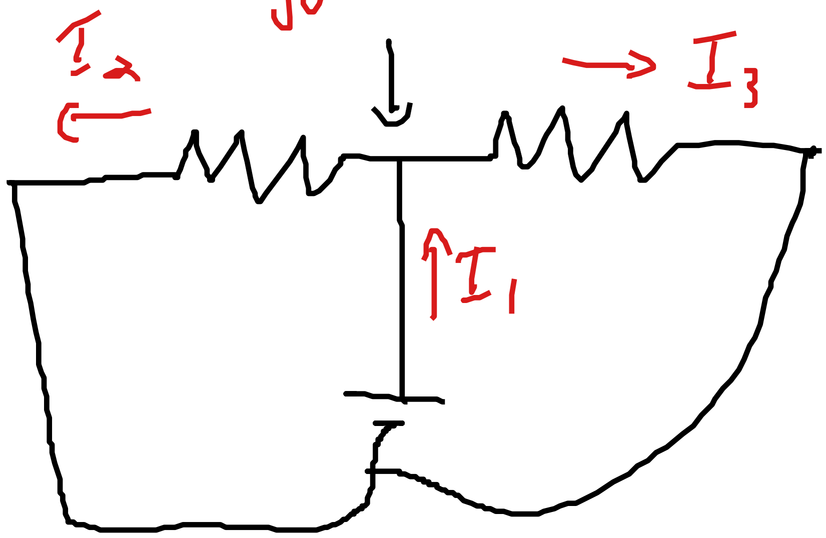
$$G_{eq} = \tfrac{1}{2}\,\mho + 1\,\mho$$

$$= \tfrac{3}{2}\,\mho = 1.5\,\mho$$

$$R_{eq} = \frac{1}{\tfrac{3}{2}\,\mho} = \boxed{\tfrac{2}{3}\,\Omega}$$

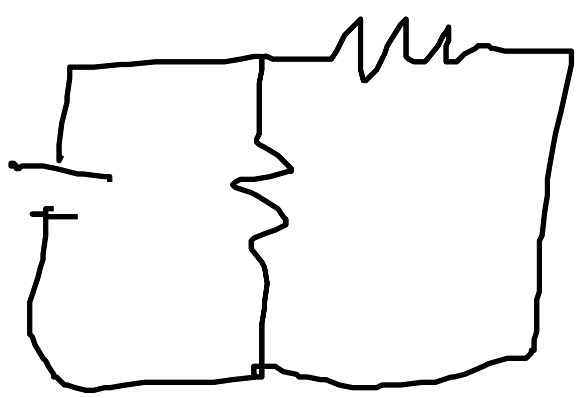
Identifying Series and parallel

junction changes current



Series? parallel? neither?

because they have the same potential drop across them



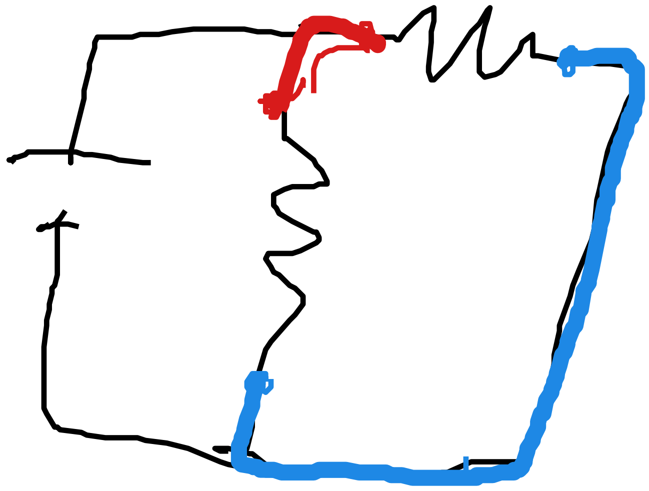
Also in parallel

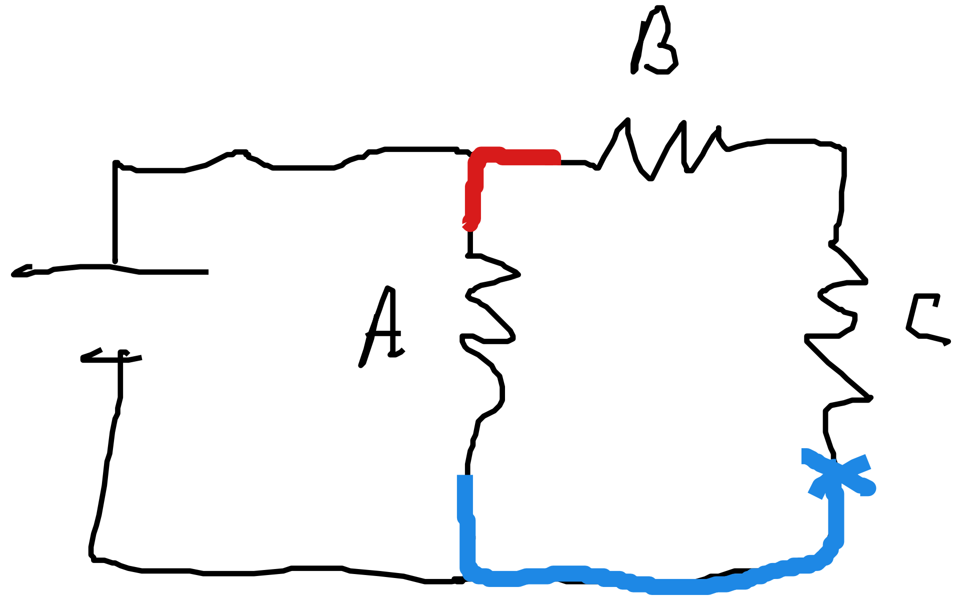
- Series: if you can draw a path from one resistor to the other without crossing a junction they are is series

A, B, C are in series with each other

D is not

- Parallel: if you can connect the leads of two resistors & their tails with paths that do not cross another circuit element (junctions don't count) then they are in parallel





Are any of these in parallel?

A & B are not in parallel

A & C are not in parallel

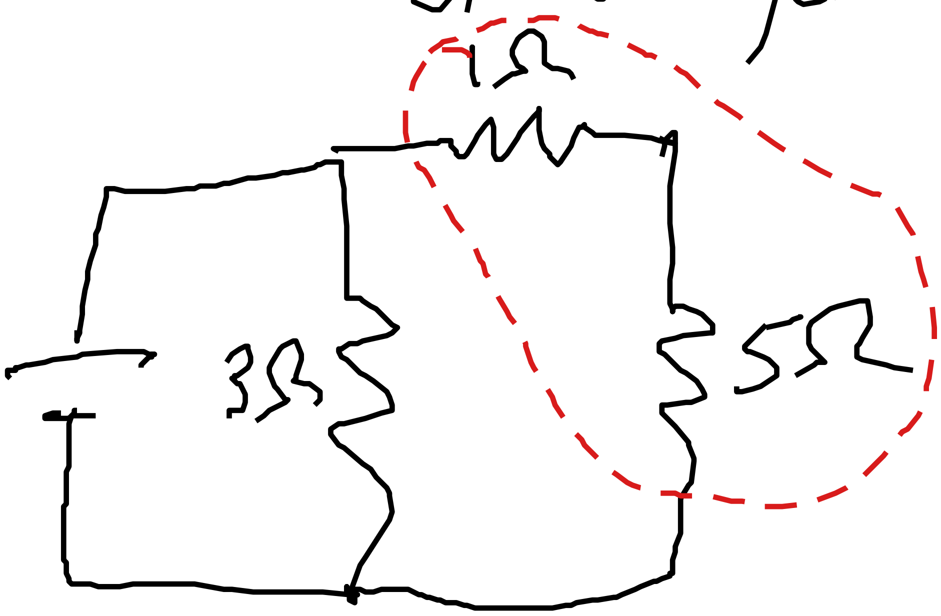
B & C are ~~in~~ series
not parallel

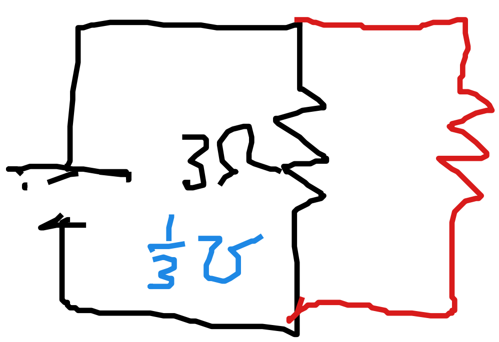
So NO

$$G_{eq} = G_1 + G_2 + G_3 \ldots$$

Resistance Reduction

- Find resistors in series or parallel.
- Replace with R_{eq}.
- Continue until 1 resistor or as far as you can.

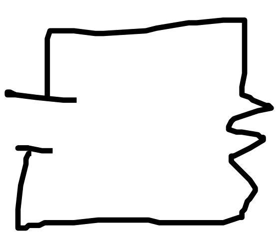




$1\Omega + 5\Omega$

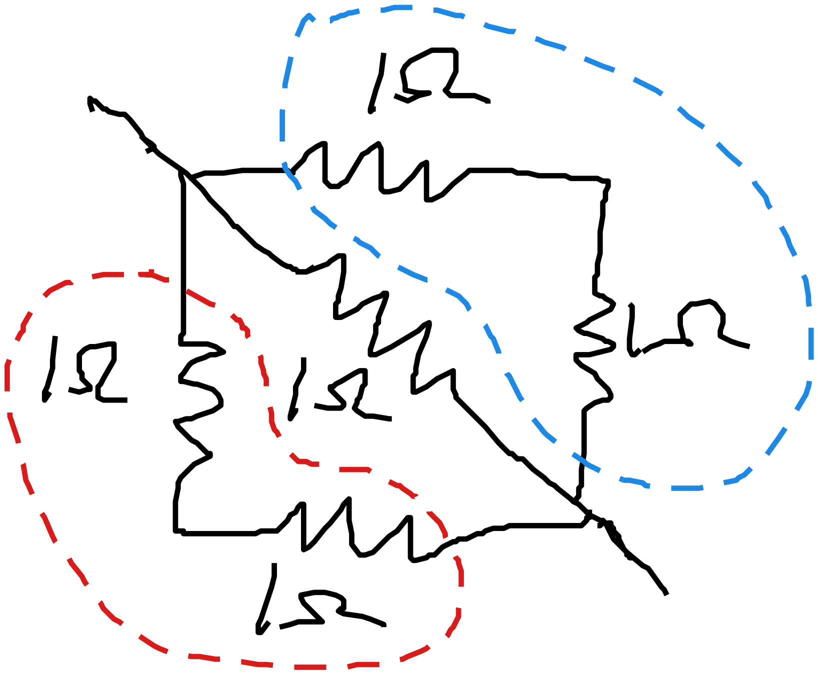
6Ω

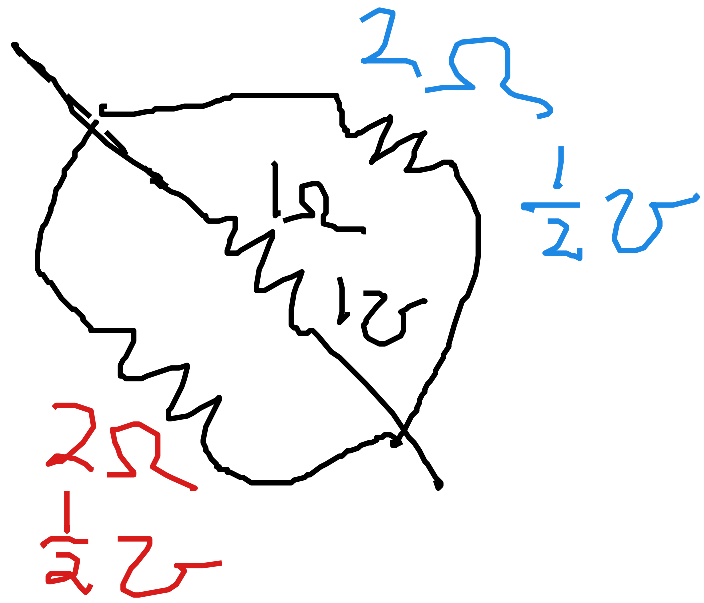
$\frac{1}{6}$ ℧



2Ω

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





$\Downarrow$

$R_{eq} = \frac{1}{2}\,\Omega$