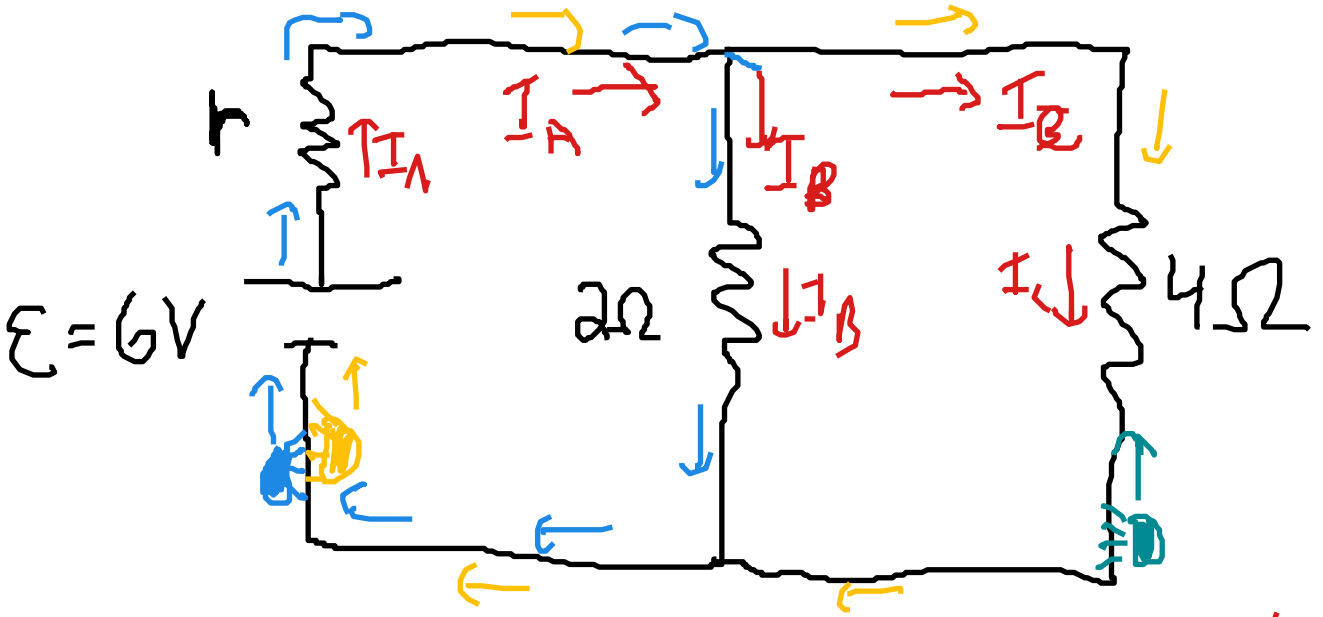
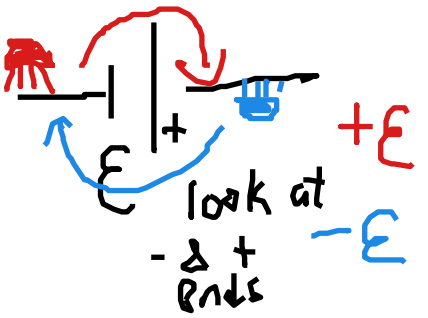
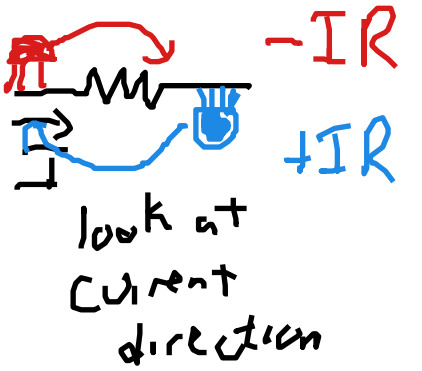
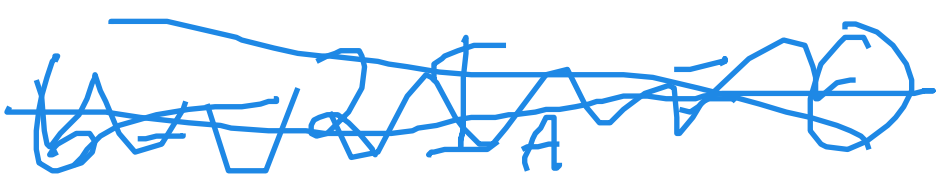






Current in = current out

$$I_A = I_B + I_C$$



$$6 - rI_A - 2I_B = 0$$

$$+rI_A - 6 + 2I_B = 0$$

(wp)

different start & direction - same loop, same eqns

$$+4I_C - 2I_B = 0$$

$$6 - rI_A - 4I_C = 0$$

Solve for I_A, I_B, I_C.

1) Choose one unknown.
2) Write the other unknowns in terms of it.
3) Solve for that choice.
4) Solve for the others

1) Choose I_C.

$$4I_C - 2I_B = 0$$

$$\rightarrow 4I_C = 2I_B$$

$$\rightarrow I_B = 2I_C$$

2) Write I_B in terms of I_C.

2) Write I_A in terms of I_C.

$$I_A = I_B + I_C = (2I_C) + I_C = 3I_C$$

3) Solve for I_C

$$6 - rI_A - 2I_B = 0$$

$$6 - r(3I_C) - 2(2I_C) = 0$$

$$6 = 3rI_C + 4I_C$$

$$6 = (3r + 4)I_C$$

$$I_C = \frac{6}{3r+4}$$

4) Solve for $I_A + I_B$

$$I_A = 3I_C = \frac{18}{3r+4}$$

$$I_B = 2I_C = \frac{12}{3r+4}$$

If r is small,
(compared to 2Ω & 4Ω)

$3r + 4 \approx 4$

if $r = 0.1$

$3r + 4 = 4.3 \approx 4$

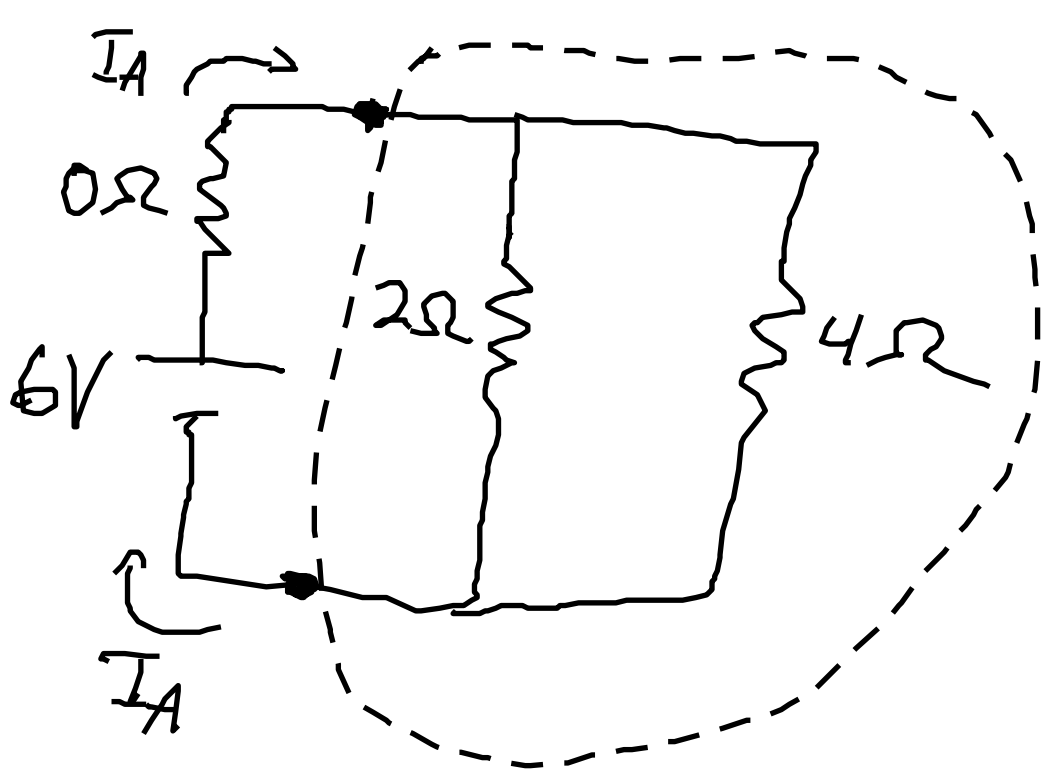
$r = 0.01$

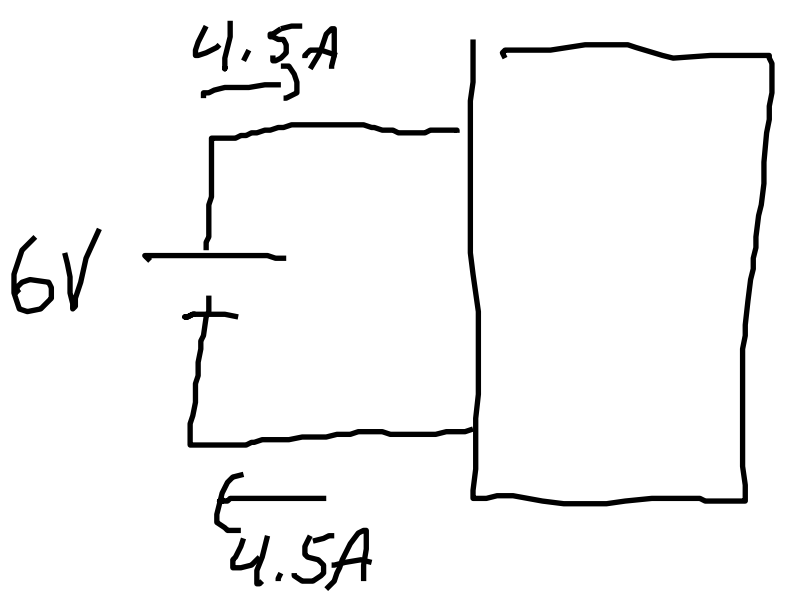
$3r + 4 = 4.03 \approx 4$

$I_C \approx \frac{6}{4} = 1.5A$

$I_A \approx \frac{18}{4} = 4.5A$

$I_B \approx \frac{12}{4} = 3A$





What is resistance of this box?

$$R = \frac{\Delta V}{I} = \frac{6V}{4.5A} = \frac{4}{3}\Omega$$

Combinations of resistors with two terminals have an equivalent resistance R_{eq}

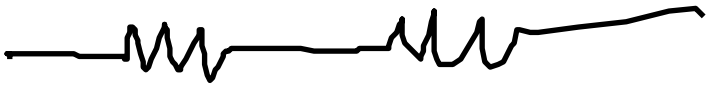
$$R_{eq} = \frac{\Delta V_{terminals}}{I_{into/out\ of\ system}}$$

As far as the rest of circuit is concerned, you can replace combo of resistors with its Req & nothing changes

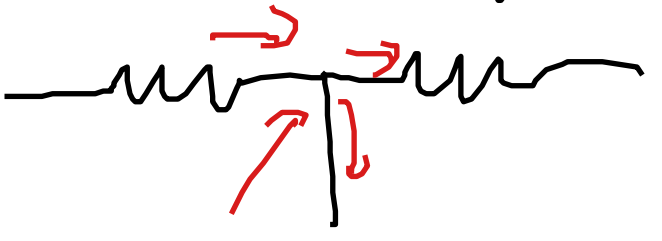
Resistors in Series

- experience the same current

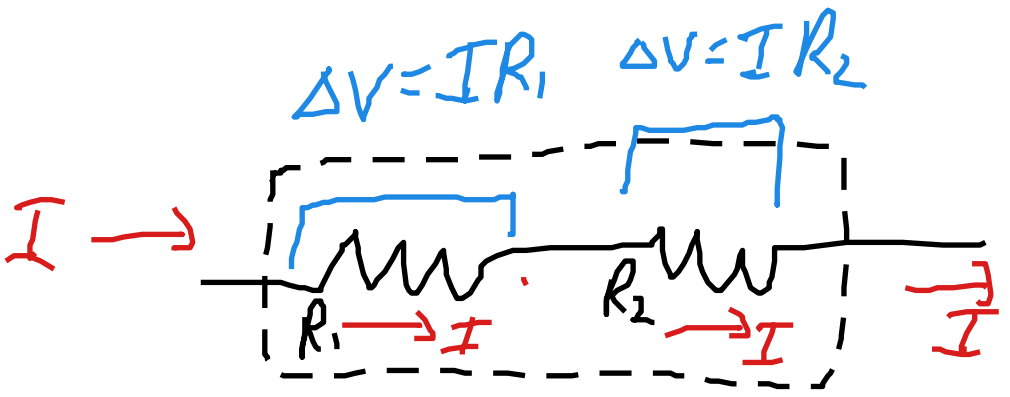
series



not in series



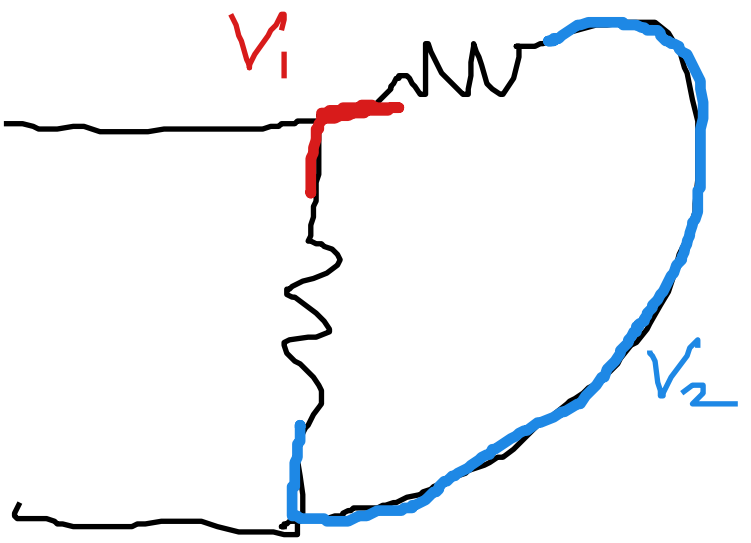
Junctions break "series"



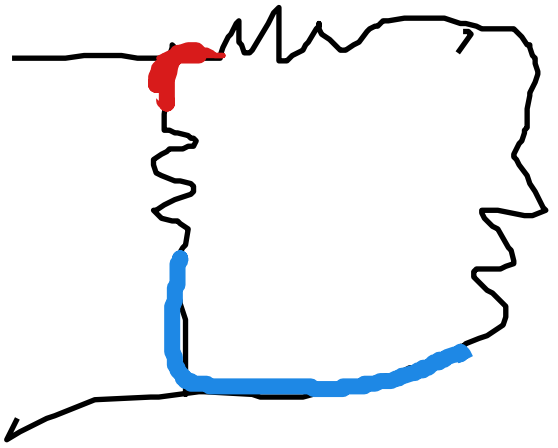
$$R_{eq} = \frac{\Delta V}{I} = \frac{IR_1 + IR_2}{I} = R_1 + R_2$$

Series: $R_{eq} = R_1 + R_2 + \cdots$

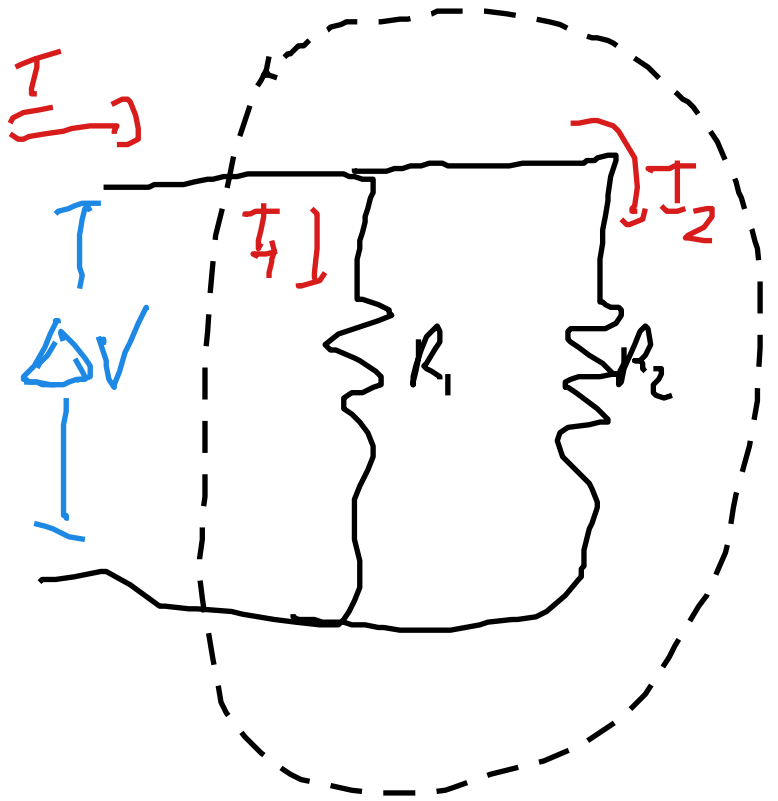
Resistors in Parallel



Both resistors have same ΔV.



other resistors & batteries block parallel



$$\Delta V = I_1 R_1 \rightarrow I_1 = \frac{\Delta V}{R_1}$$

$$\Delta V = I_2 R_2 \rightarrow I_2 = \frac{\Delta V}{R_2}$$

$$I = I_1 + I_2$$

$$I = \frac{\Delta V}{R_1} + \frac{\Delta V}{R_2} = \frac{\Delta V}{R_{eq}}$$

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