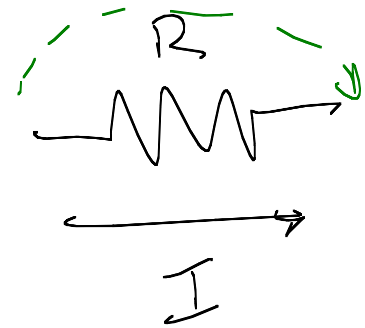
Phys 2120-4 9/28/12

Note Title 9/28/2012

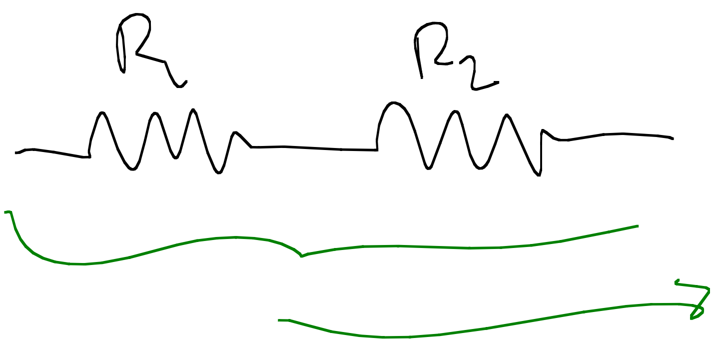
Electric Circuits

$V = IR$

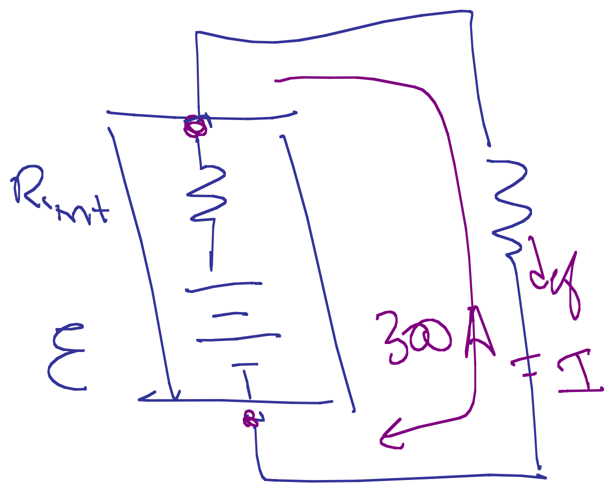


Voltage drop

V



$R_{eq} = R_1 + R_2$



25.21 A defective starting motor draws 300 A from car's 12 V battery, dropping the terminal voltage to 6 V. A good starter would draw only 100 A. What is terminal voltage with a good starter?

Terminal volatage is 6 V

$\mathcal{E} - I R_{int} = 6\,V$

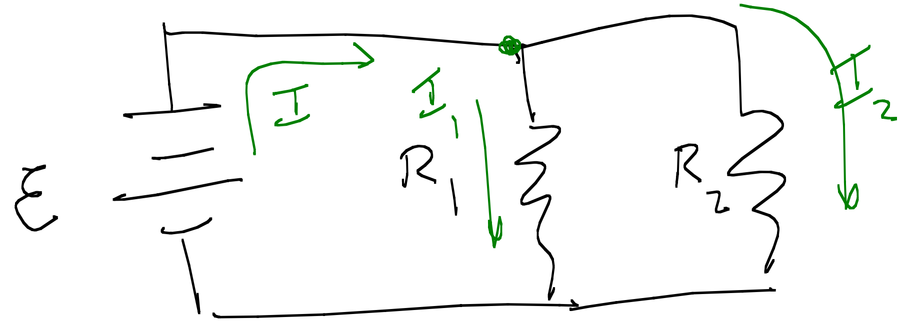
$\mathcal{E} = 12\,V$

$R_{int} = \frac{6\,V}{300\,A} = 0.020\,\Omega$

with 100 A $V_{tm} = 12 - I R_{int}$

$= 10\,V$

Resistors in Parallel!



$$I = I_1 + I_2$$

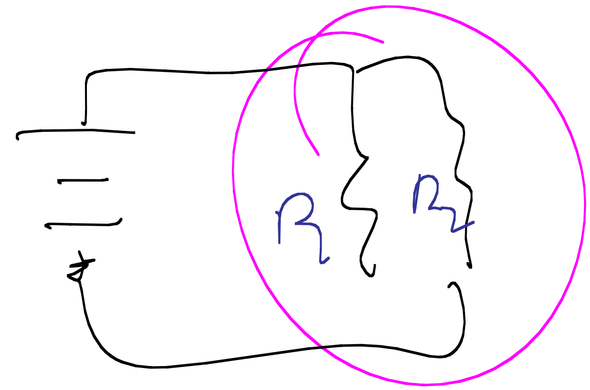
Voltage drop across either is $\mathcal{E}$

$$\mathcal{E} = I_1 R_1 \qquad \mathcal{E} = I_2 R_2$$

$$I_1 = \mathcal{E}/R_1 \qquad I_2 = \mathcal{E}/R_2$$

$$I = \mathcal{E}/R_1 + \mathcal{E}/R_2 = \mathcal{E}\left(\frac{1}{R_1} + \frac{1}{R_2}\right) = \mathcal{E}\left(\frac{R_1+R_2}{R_1 R_2}\right)$$

$$\mathcal{E} = I\left(\frac{R_1 R_2}{R_1+R_2}\right) = I R_{eq}$$



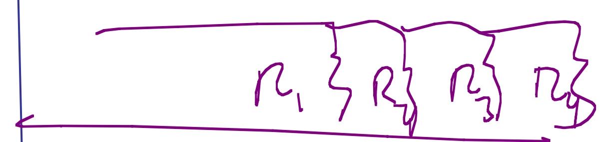
$$\left(\frac{1}{R_1}+\frac{1}{R_2}\right)^{-1}$$

$$R_{eq} = \left(\frac{R_1 R_2}{R_1+R_2}\right) = \left(\frac{1}{R_1}+\frac{1}{R_2}\right)^{-1}$$

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

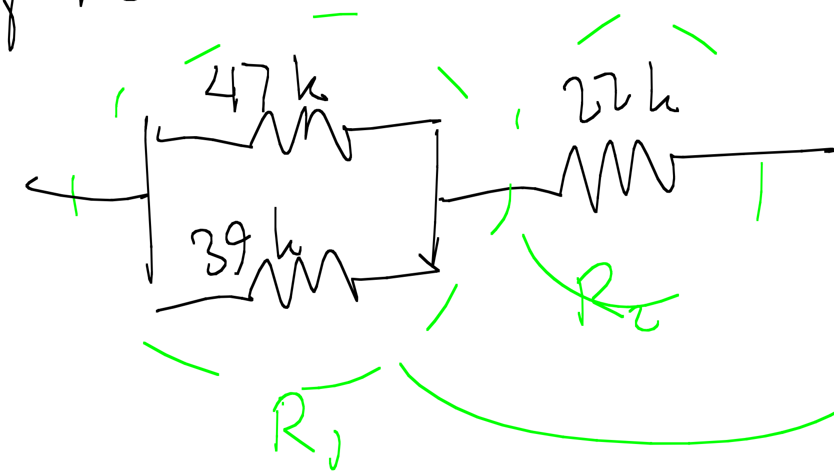
Add reciprocals

In general,



$$\frac{1}{R_{eq}} = \left(\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}+\dots\right)$$

25.19 A 47 kΩ and a 39 kΩ resistor are in parallel and the pair is in series with a 22 kΩ resistor. What's the resistance of the combination?



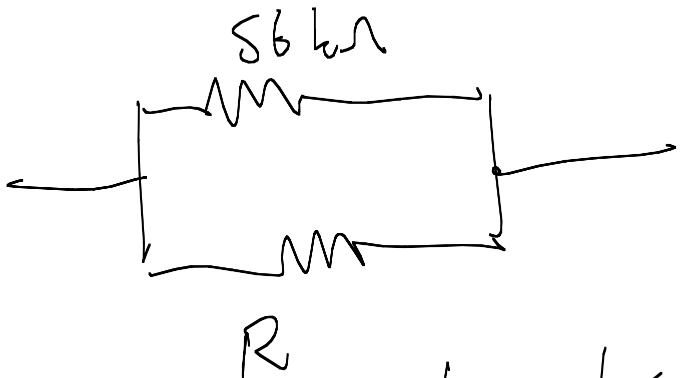
$$\frac{1}{R_1} = \frac{1}{47\,k\Omega} + \frac{1}{39\,k\Omega}$$

$$R_1 = 21.3\,k\Omega$$

$$R_1 + R_2 = 21.3\,k + 22\,k$$

$$= 43.3\,k\Omega$$

25.20 What resistance should you place in parallel with a 56 kΩ resistor to make an equivalent res. of 45 kΩ?

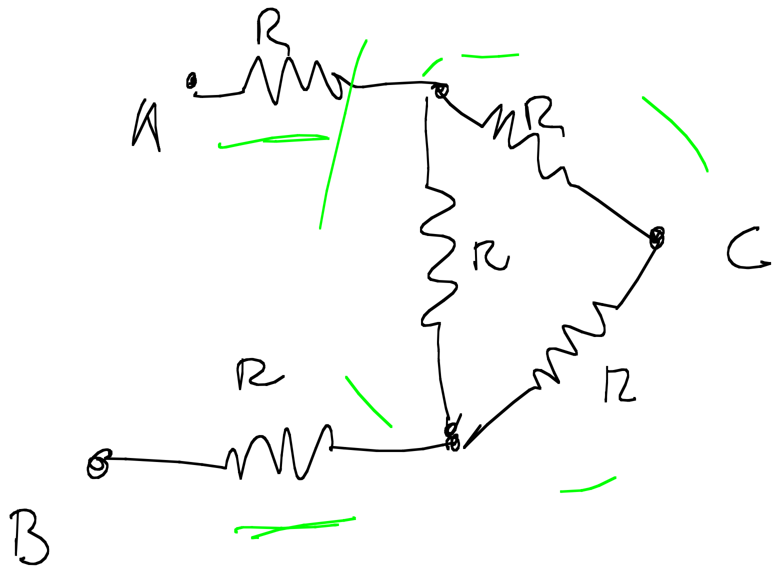


$= 45\ k\Omega = R_{eq}$

$R = 230\ k\Omega$

$$\frac{1}{R_{eq}} = \frac{1}{45\ k\Omega} = \left(\frac{1}{56\ k\Omega} + \frac{1}{R}\right)$$

25.36



All resistors have same value R

Find resistance

a) Between A and B

b) Between A and C

a) Series of 3 things

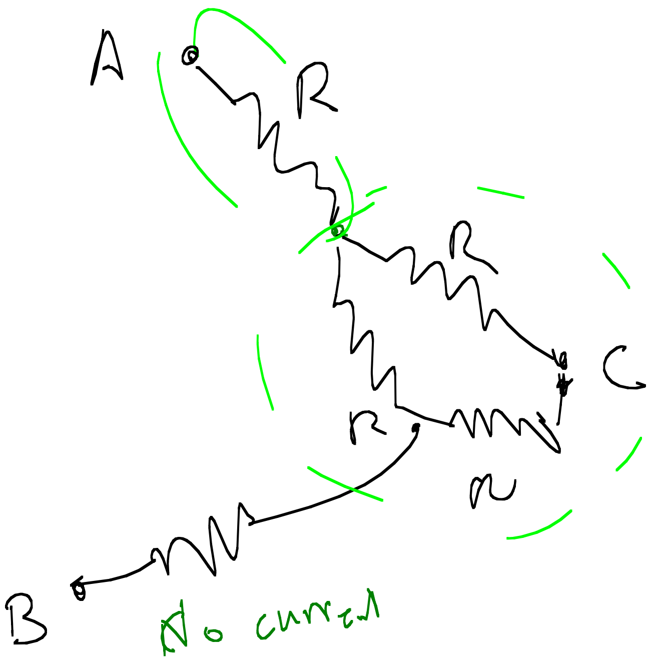
In middle

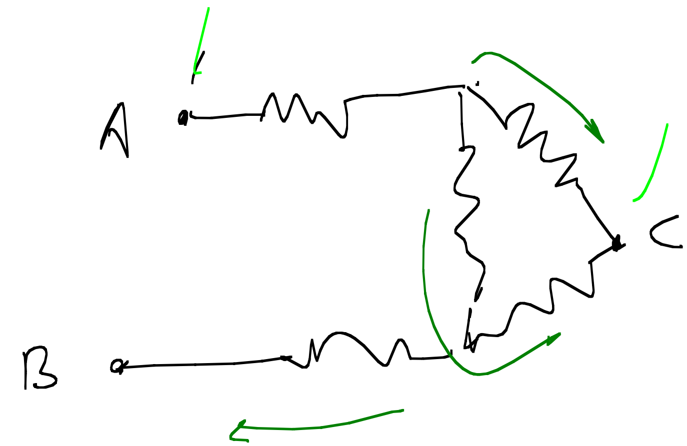
$$\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{2R} = \frac{3}{2R}$$

$$R_{eq} = \frac{2}{3}R = 0.669\,R$$

$$R_{Tot} = R + 0.667R + R = 2.667R$$

A to C





$$R_{eq} = R + 0.667R$$
$$= 1.667R$$

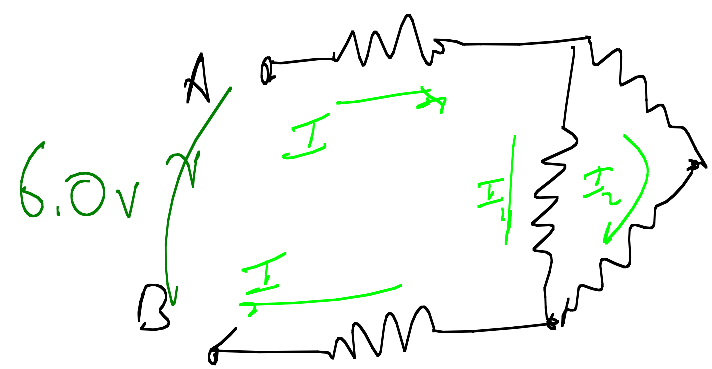
25.37 In last problem take R to be $1\,k\Omega$.
Find current in vertical resistor when
a 6.0 V battery is connected between A & B

In prev. prob.

$R_{Total} = 2.667\ k\Omega$

$I = \frac{\mathcal{E}}{R_{eq}} = \frac{6.0\,V}{2.667\,k\Omega} =$

$2.25 \times 10^{-3}\ A$



With I find drops across first & last resistor

Each is $V = (2.25 \times 10^{-3} A)(1 k\Omega) = 2.25 V$

So

$$V_{vert} = 6.0 V - 2.25 V - 2.25 V$$

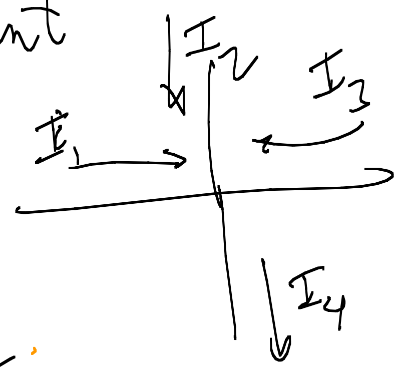
$$= 1.50 V$$

Current in vertical resis. is

$$I = \frac{1.50 V}{1 k\Omega} = 1.50 \times 10^{-3} A = 1.5 mA$$

For more complicated circuits, must use Kirchhoff's Laws.

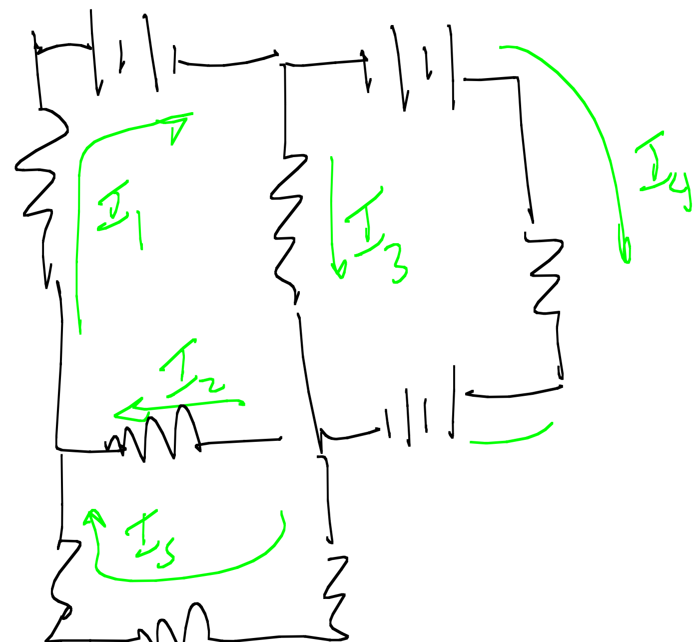
Solving for current



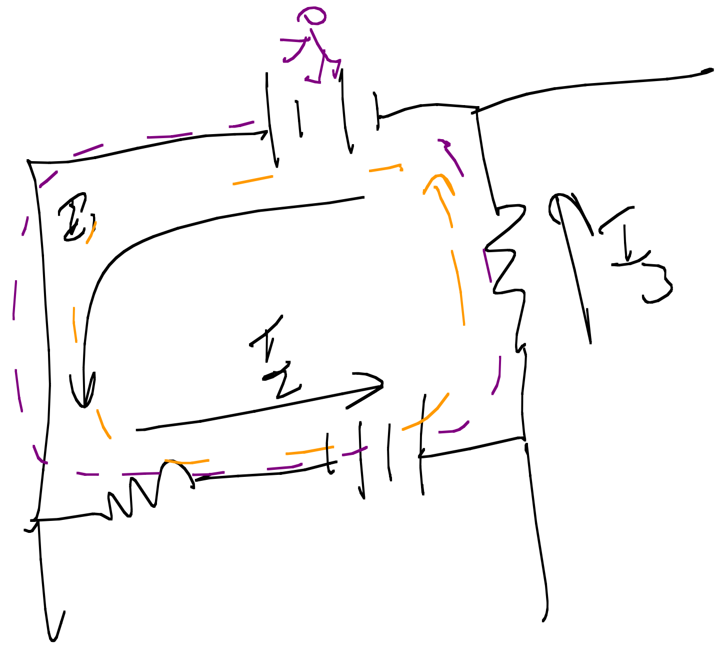
1) $I_1 + I_2 + I_3 = I_4$

Current:

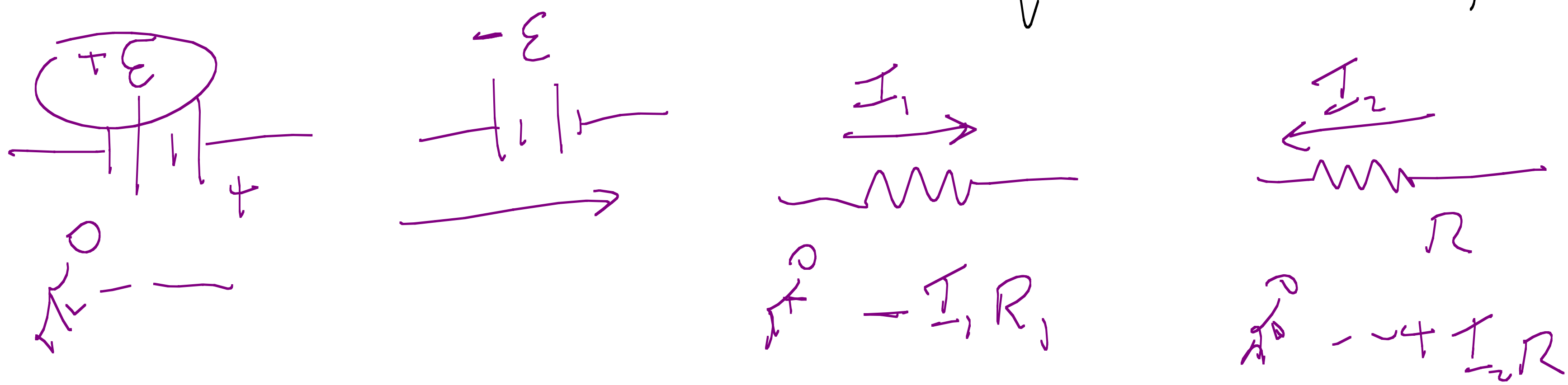
What goes in must come out.



Consider loops in circuit

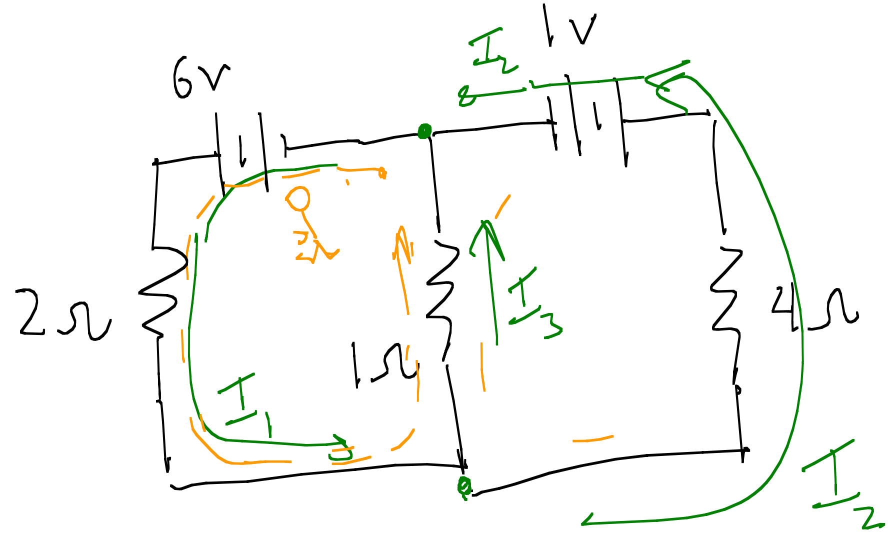


2) Voltage gains & drops seen by little man add up to zero.



25.25 Take Fig 25.13 replace: $\mathcal{E}_2 = 1.0\,V$

Solve it!



Top equation:

$$\boxed{I_1 = I_2 + I_3}$$

Loop 1 little man sees

$$\boxed{+6V - I_1(2\Omega) - I_3(1\Omega)} = 0$$

Loop 2:

$$1V + 4\Omega I_2 - I_3(1\Omega) = 0$$