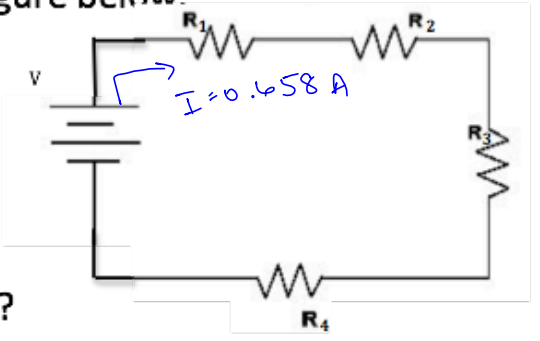
Example 5

Two batteries (each battery containing 24.0 v) are connected together to four resistors as shown in the figure below.



The values for the resistors are as follows:

$R_1 = 23.0\ \Omega$ $R_3 = 13.0\ \Omega$

$R_2 = 17.0\ \Omega$ $R_4 = 20.0\ \Omega$

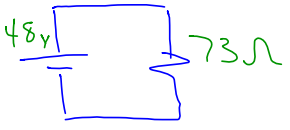
Find the following:

A. What is the equivalent resistance?

B. What is the total current at the battery?

C. What are the individual voltage drops across each resistor?

A.) $R_{eq} = 23 + 17 + 13 + 20 = 73\ \Omega$

B.) 

$V = IR$

$I = \frac{48}{73} = 0.658\ A$

C.) $V_1 = (0.658)(23) = 15.1\ v$

$V_2 = (0.658)(17) = 11.2\ v$

$V_3 = (0.658)(13) = 8.55\ v$

$V_4 = (0.658)(20) = 13.2\ v$

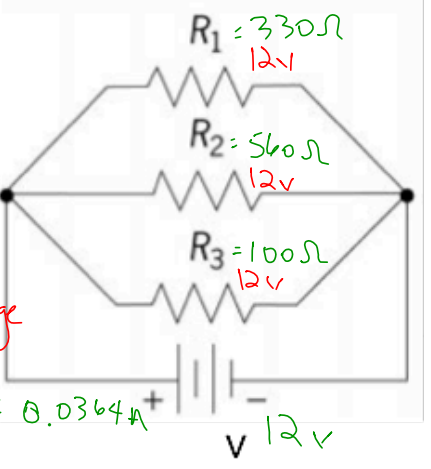
Example 6

A parallel circuit with three resistors is shown below. The resistors are connected to a double emf for a **total** voltage of 12.0 v. The resistors have values $R_1 = 330.0\ \Omega$, $R_2 = 560.0\ \Omega$, and $R_3 = 100.0\ \Omega$.

A. What is the equivalent resistance?

B. What is the total current at the battery?

C. What is the current through each resistor?

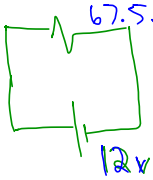


A.) $\frac{1}{R_{eq}} = \frac{1}{330} + \frac{1}{560} + \frac{1}{100}$

$R_{eq} = 67.5\ \Omega$

* Parallel - everyone gets the same voltage

B.)



$V = I \cdot R$

$I = \frac{V}{R} = \frac{12}{67.5}$

$I = 0.178\ A$

C.) $I_1 = \frac{V}{R} = \frac{12}{330} = 0.0364\ A$

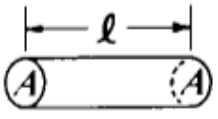
$I_2 = \frac{V}{R} = \frac{12}{560} = 0.0214\ A$

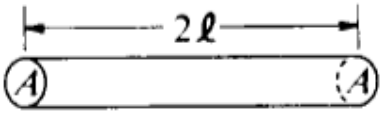
$I_3 = \frac{V}{R} = \frac{12}{100} = 0.12\ A$

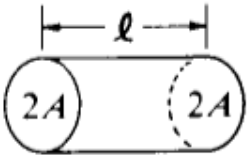
Warm-Up

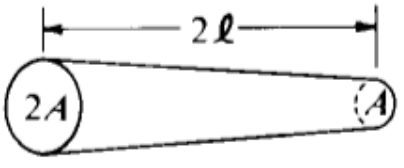
The five resistors shown below have the lengths and cross–sectional areas indicated and are made of material with the same resistivity. Which has the greatest resistance?

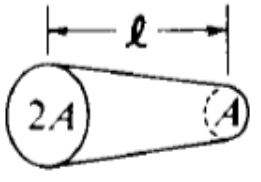
$R = \rho \frac{L}{A}$

(A) 

(B) 

(C) 

(D) 

(E) 

Simple Circuit

- Even the most efficient voltage source will have some internal resistance

$\mathcal{E}_g$

$$V = \xi - Ir$$

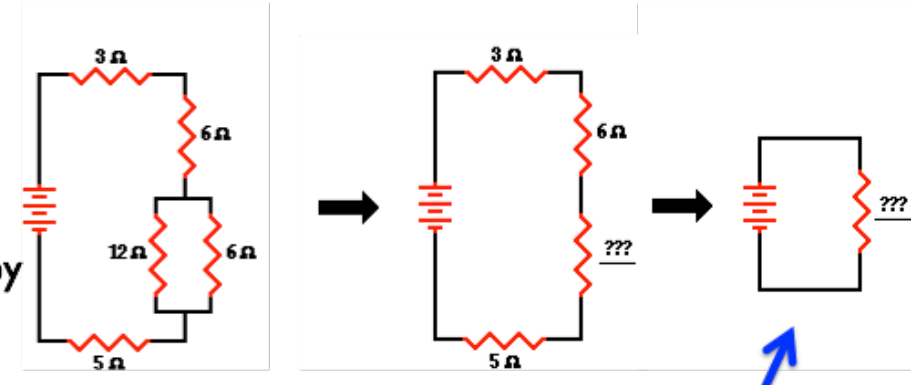
ξ: printed voltage 'emf'

Ir: voltage taken by internal resistance

V: available voltage

Combination Circuits

- **Main Goal** – To find the voltage drop and current through each device/resistor in a combo. circuit
- **Strategy:**
- Condense the circuit, making it as simple as possible by finding equivalent resistance.



Then work backwards, finding current and voltage as you go

Find as much as you can here

Combination Circuits

- Condensing a Circuit
  - Trace the current, look at all pathways
  - Resistors that current **must** pass through, save for last
  - Combine **simple series** and **simple parallel**
    (one pathway) (multiple pathways)
  - *Start from the 'back' and work your way towards the battery.

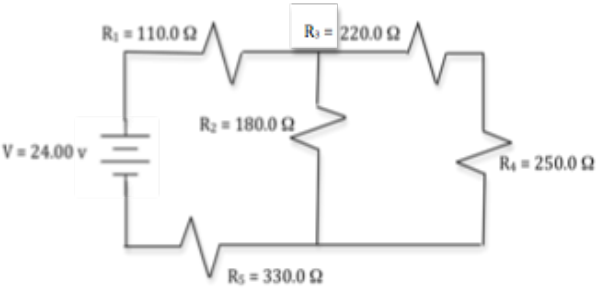
Example 9

For the circuit below:

A. Find the Equivalent Resistance (R_{eq})

B. Find the total current at the battery.

C. Find the current and voltage across each resistor.



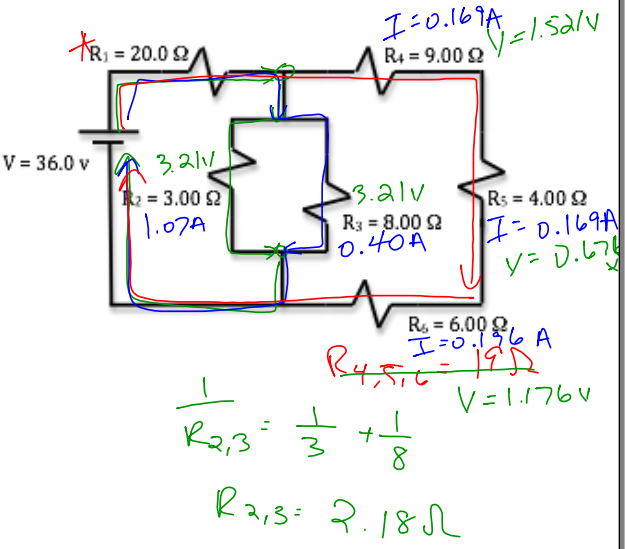
Example 10

For the circuit below:

A. Find the Equivalent Resistance (R_{eq})

B. Find the total current at the battery.

C. Find the current and voltage across each resistor.



$R_{4,5,6} = 19\,\Omega$

$\frac{1}{R_{2,3}} = \frac{1}{3} + \frac{1}{8}$

$R_{2,3} = 2.18\,\Omega$