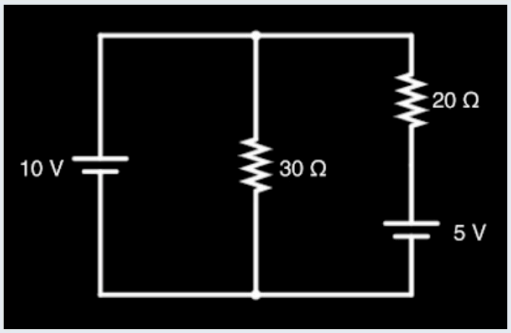
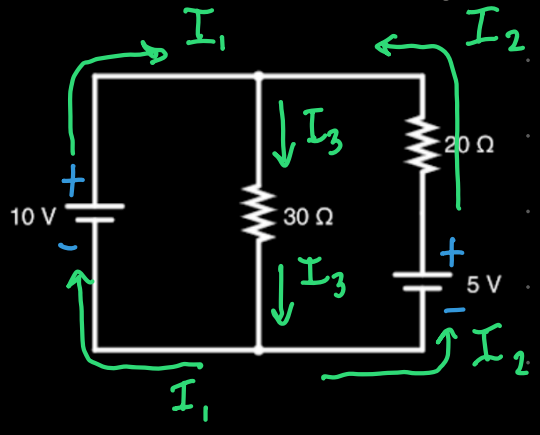


What is the current through the 30 Ω resistor?

This circuit cannot be simplified or reduced. The resistors are not connected in series (there's a junction and battery between them) and they're not connected in parallel either (they are not connected to the battery in the same way).

We need to apply Kirchhoff's rules here.



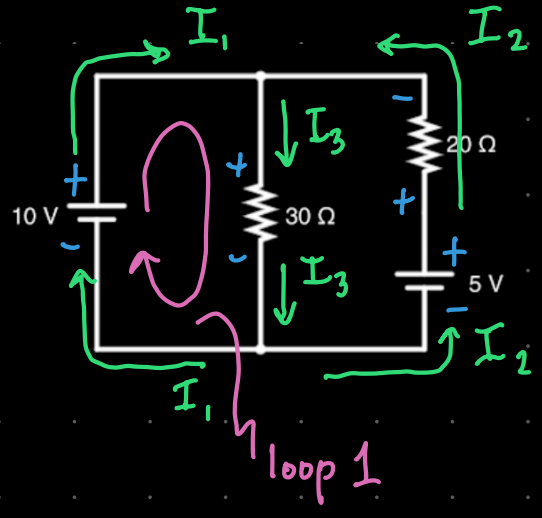
We know the emf of each battery and the resistance of each resistor. But we don't know anything about current yet.

I'll start by labeling the areas of high potential (+) and low potential (−) based on the polarity of the battery.

I'll define the currents in the three branches based on the battery polarity. I don't yet know for certain that the current will flow in the directions I defined, but the math will let us know. If, when I solve for the current, I get a negative value, then that tells

me the current flows opposite to the direction I defined.

Based on the current flow directions, and knowing that current spontaneously flows from high potential (+) to low potential (-), I'll label + and - around the resitors.



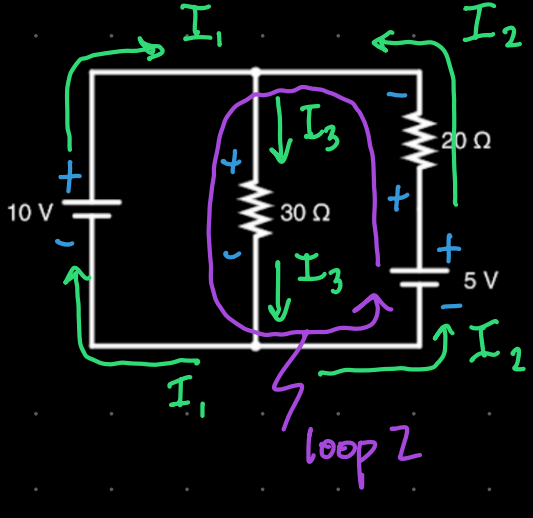
Now I'll define a closed loop around the circuit and apply the Loop Rule: $\sum \Delta V = 0$

Loop 1: $\sum \Delta V = \Delta V_{bat} - I_1 R_{30\Omega}$

$+10\,V - I_3(30\,\Omega) = 0$

$I_3 = \frac{10\,V}{30\,\Omega} = 0.33\,A$

From loop 1 we could find I_3 and since we got a positive value we know we guessed the direction correctly.

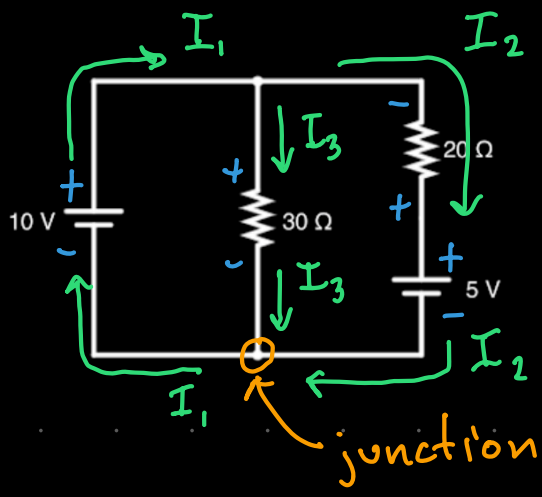


Loop 2: $\sum \Delta V = \Delta V_{bat} - I_2 R_{20\Omega} - I_3 R_{30\Omega}$

$+5\,V - I_2(20\,\Omega) - (0.33A)(30\,\Omega) = 0$

$I_2 = -0.25\,A$

I_2 flows opposite to the direction we guessed.



Now we know $I_3 = 0.33\,A$ and $I_2 = 0.25\,A$. I updated the diagram to show the correct direction of I_2.

Finally we can apply the junction rule to find I_1.

At the junction labelled, we see $I_2 + I_3$ flowing into the junction and I_1 flowing out. So we get

$$I_2 + I_3 = I_1$$

$$I_1 = 0.25\,A + 0.33\,A = 0.58\,A$$