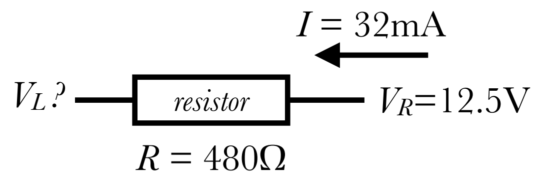
Physics 102 Homework #8

first draft due Wednesday, March 29th
final draft due Sunday, April 2nd

1a. This resistor has a resistance of 480Ω, and 32mA of current flows to the left into it. The right end of the resistor is at a potential of V_R = 12.5V. What is the potential difference ΔV across the resistor?



The potential difference across a resistor is given by Ohm's Law:
$\Delta V = IR = (32\text{mA})(480) =$ **15.4V.**

1b. What is the potential V_L of the left end of the resistor?

The potential on the left side must be smaller than 12.5V by that amount, or
12.5V – 15.4V = **−2.9V**.

1c. What is the power output by the resistor?

The power output by a resistor can be calculated several ways, all giving the same answer:
$P = I^2R = (32 \times 10^{-3}\text{A})^2(480\Omega) =$ **0.49W.**

$P = I\Delta V = (32 \times 10^{-3}\text{A})(15.4\text{V}) =$ **0.49W.**

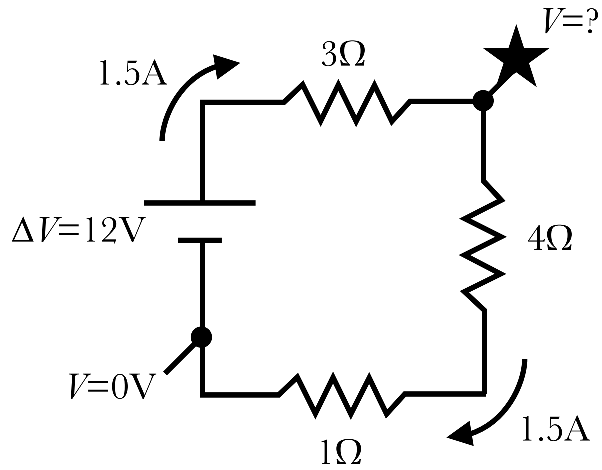
$P = \frac{(\Delta V)^2}{R} = \frac{(15.4\text{V})^2}{480\Omega} =$ **0.49W**.

1d. What is the current that flows out of the resistor?

The current that flows into the resistor is the same as the current that flows out of it: **32mA.**

2. A 12V battery makes 1.5A of current through a 4Ω, 3Ω, and a 1Ω resistor.

a. How much power does the battery supply?



The power supplied by a battery is $P = I\Delta V$ where I=1.5A and ΔV = 12V, the potential difference across the battery. Thus

$$P = (1.5\text{A})(12\text{V}) = \mathbf{18W}$$

2b. How much power is dissipated by the 4Ω resistor?

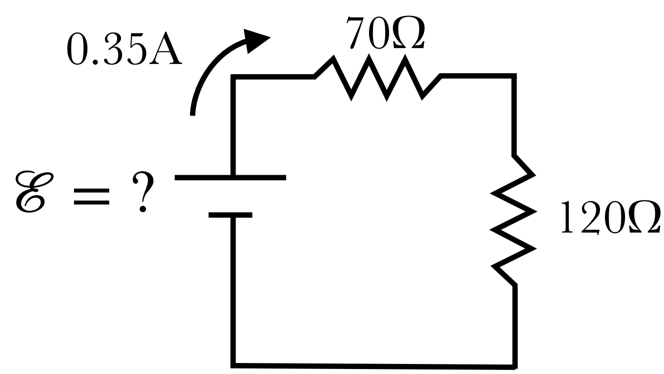
The power output by a resistor is given by the formulas $P = I\Delta V$, $P = I^2R$, or $P = \frac{(\Delta V)^2}{R}$. But we don't know the potential difference across the 4Ω resistor, but we do know the current. Thus we'll use the second equation:

$$P = I^2R = (1.5)^2(4) = \mathbf{9W}$$

2c. If the potential at the negative end of the battery is 0V, what is the potential V at the star?

The potential at the top-left corner of the circuit is 12V higher than 0V, so 12V.
The potential drop across the 3Ω resistor is $\Delta V = IR = (1.5)(3) = 4.5\text{V}$. Thus the potential at the star is 12V–4.5V = **7.5V.**

3. A battery causes 0.35A of current to flow through two resistors, 70Ω and 120Ω. What is the emf of the battery?



The potential drop across the 70Ω resistor is $\Delta V = (0.35\text{A})(70\Omega) = 24.5\text{V}$, and the potential drop across the 120Ω resistor is $\Delta V = (0.35\text{A})(120\Omega) = 42\text{V}$. The total drop across both resistors is 24.5 + 42 = **66.5V**, and so this must be equal to the <u>rise of the potential through the battery</u>: in other words, its **emf.**