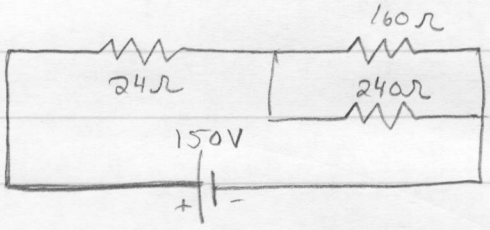
Physics 2b Quiz 5 Solutions #1



Note that the light bulbs are simply resistors and the orientation of the battery does not matter, since they only ask you how much current is flowing, and not in which direction.

This problem is easy to solve using circuit reduction.
First, find the equivalent resistance of the three resistors:

$$R_{parallel} = \left(\frac{1}{160\Omega} + \frac{1}{240\Omega}\right)^{-1} = 96\Omega$$

$$R_{total} = 24\Omega + 96\Omega = 120\Omega$$

Now find the total current being drawn from the battery:

$$I_{total} = \frac{V}{R_{total}} = \frac{150V}{120\Omega} = 1.25A$$

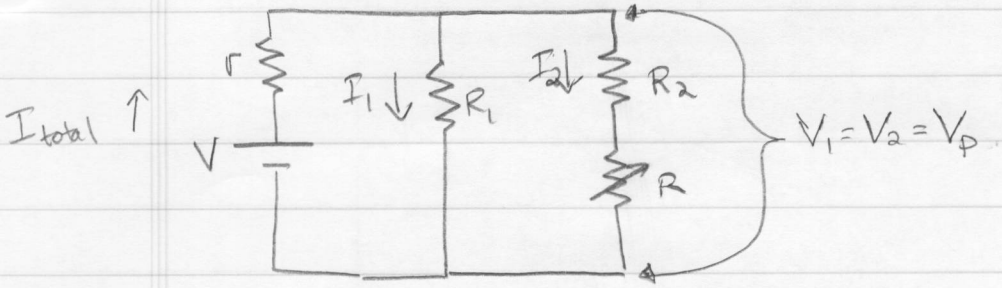
Find the voltage drop across the 24Ω resistor:

$$V = IR = (1.25A)(24\Omega) = 30V$$

We know that the remaining 150V - 30V = 120V must drop across both resistors in parallel, so you can find the current in the 240Ω resistor by Ohm's law:

$$I = \frac{V}{R} = \frac{120V}{160\Omega} = \boxed{0.75A}$$

Physics 2b Quiz 5 Solutions # 2



If the variable resistance in R is decreased, what happens to I_1 and I_2?

Let $V_1 = V_2 = V_p$ be the voltage across R_1 or R_2 and R, as indicated above.

Let I_{total} be the total current being drawn from the battery.

$$I_{total} = \frac{V}{R_{total}}, \quad R_{total} = r + \left(\frac{1}{R_1} + \frac{1}{R_2+R}\right)^{-1}$$

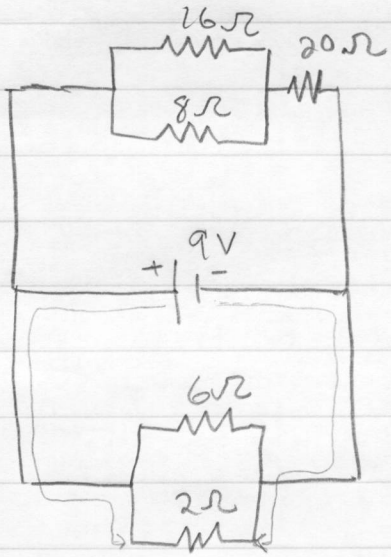
$$\Rightarrow I_{total} = \frac{V}{r + \left(\frac{1}{R_1} + \frac{1}{R_2+R}\right)^{-1}}$$

$$\Rightarrow V_p = V - I_{total}\, r = V - \left(\frac{V}{r + \left(\frac{1}{R_1} + \frac{1}{R_2+R}\right)^{-1}}\right) r$$

$$I_1 = \frac{V_p}{R_1}, \quad I_2 = \frac{V_p}{R_2+R} \Rightarrow I_1 \text{ decreases}, I_2 \text{ increases.}$$

This is the result you should expect intuitively because decreasing R will decrease the resistance in branch 2 and thereby increase its current. The resistance in branch 1 stays the same and so its current will decrease because it is "sharing current" with branch 2.

Physics 2b Solutions Quiz 5 # 3



Notice that the battery holds the potential difference across the 2Ω resistor at 9V, apply Ohm's law:

$$I = \frac{V}{R} = \frac{9V}{2\Omega} = \boxed{4.5A}$$

#4

RC Circuit, charging $\mathcal{E} = 60V$, $C = 50\mu F$, $R = 0.30M\Omega$

What is Q after 8 seconds?

$$Q(t) = C\mathcal{E}(1 - e^{-t/RC})$$

$$Q(8s) = (50\mu F)(60V)(1 - e^{-(8s/(0.3M\Omega)(50\mu F))})$$

$$= 1240\mu C$$

closest is $\boxed{1200\mu C}$