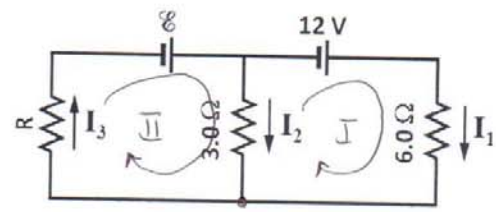
Physics 102Rec
Quiz #11
Chapter 27

Name: Key   Id#:   Sect#:

In the circuit shown in the figure, the current $I_1 = 3.0$ A.

(a) What is the value of current I_2?



loop I :

$$12 - 6 i_1 + 3 i_2 = 0$$

$$12 - 18 + 3 i_2 = 0$$

$$i_2 = \frac{18 - 12}{3} = \frac{6}{3} = \boxed{2\text{ A}}$$

(b) What is the value of the emf ε if R = 10 Ω?

loop II

$$-R i_3 + \mathcal{E} - 3 i_2 = 0 \qquad i_1 + i_2 = i_3$$

$$-10(i_1 + i_2) + \mathcal{E} - 3 \times i_2 = 0$$

$$-10 \times 5 - 6 + \mathcal{E} = 0$$

$$\boxed{\mathcal{E} = 56\text{ V}}$$

(c) What is the rate of energy supplied by the emf ε?

$$P_\mathcal{E} = i_3 \mathcal{E} = 5 \times 56 = \boxed{280\text{ W}}$$

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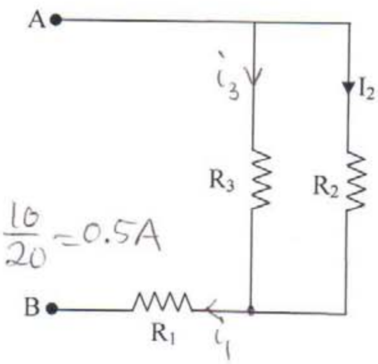
In the figure, $I_2 = 1.0$ A, $R_1 = 5.0\ \Omega$, $R_2 = 10\ \Omega$, and $R_3 = 20\ \Omega$.



(a) Calculate the current in R_1.

First calculate the current in R_3:

$$i_2 R_2 = R_3 i_3 \Rightarrow i_3 = \frac{i_2 R_2}{R_3} = \frac{10}{20} = 0.5\text{A}$$

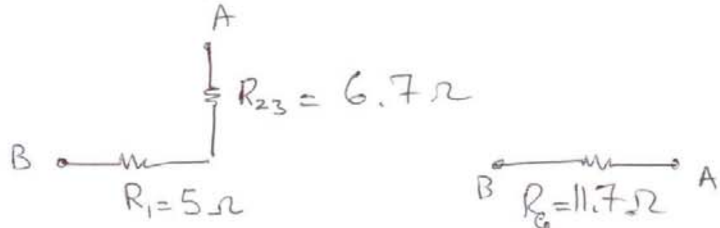
$$\Rightarrow i_1 = i_2 + i_3 = \boxed{1.5\text{ A}}$$

(b) Calculate the potential difference $V_A - V_B$.

$$V_A - V_B = i_1 R_1 + i_2 R_2 = 1.5 \times 5 + 1 \times 10$$

$$= \boxed{17.5\text{V}}$$

(c) Calculate the rate of thermal energy dissipated in the three resistors?



$$P = \frac{V^2}{R_{eq}} = \frac{(17.5)^2}{11.7} = \boxed{26.2\text{ W}}$$

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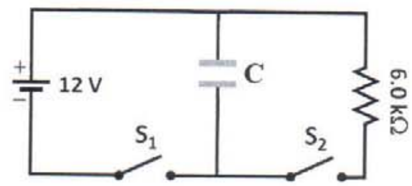
A capacitor of capacitance **C** is connected to a 12-V battery, as shown in the figure. First, switch **S2** is open, and switch **S1** is closed until the capacitor is fully charged. Then, **S1** is open and **S2** is closed. The voltage across the capacitor reaches 6.0 V after 0.10 s.



(a) What is the value of the capacitance **C?**

discharge $\Rightarrow$ $q(t) = C\mathcal{E}e^{-t/RC}$

$$|i| = \left|\frac{dq}{dt}\right| = \frac{C\mathcal{E}}{RC}e^{-t/RC} = \frac{\mathcal{E}}{R}e^{-t/RC}$$

$$V_R = iR = \frac{\mathcal{E}}{R}Re^{-t/RC} = \mathcal{E}e^{-t/RC}$$

$$6 = 12e^{-t/RC} \qquad \frac{1}{2} = e\left(-\frac{t}{RC}\right)$$

$$\ln\left(\frac{1}{2}\right) = -\frac{t}{RC}$$

$$-\ln(2) = -\frac{t}{RC} \Rightarrow C = \frac{t}{R\ln(2)} = \frac{0.1}{6000 \times 0.693}$$

$$\boxed{C = 2.4 \times 10^{-5}\,F}$$

(b) What is the charge on the capacitor at t =0.1 s?

$$q = C\mathcal{E}e^{-t/RC}$$

$$= (2.4 \times 10^{-5})(12)\,e^{-\frac{0.1}{6000 \times 2.4 \times 10^{-5}}}$$

$$\boxed{q = 1.4 \times 10^{-4}\,C}$$

Another way:

$$q = CV_c = 2.4 \times 10^{-5} \times 6 = \boxed{1.44 \times 10^{-4}\,C}$$