

FIFTH MIDTERM

2

Name: _____

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Discussion Section # _____

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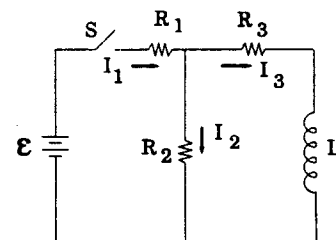
SHOW ALL WORK!!!!

REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!

Use the conversion constants and data given on the front page.

For the circuit shown, the switch S is closed at $t = 0$.

- (a) [5 pts.] Find the values of I_1 and I_3 at $t = 0$.
- (b) [5 pts.] Find the values of I_1 and I_3 at $t = \infty$.
- (c) [5 pts.] Find the value of I_2 immediately after the switch is opened.
- (d) [10 pts.] Using full loops and junctions, calculate both time constants for this circuit (charging and discharging).



$\epsilon = 150 \text{ V}; R_1 = 130 \Omega; R_2 = 250 \Omega; R_3 = 350 \Omega; L = 0.35 \text{ H}$

a). $I_1 = \frac{\epsilon}{R_1 + R_2} = \frac{150}{130 + 250} = 0.395 \text{ A} \quad I_3 = 0 \text{ A}$

b). $I_1 = \frac{\epsilon}{R_1 + \frac{R_2 R_3}{R_2 + R_3}} = 0.544 \text{ A} \quad I_3 = I_1 \times \frac{R_2}{R_2 + R_3} = 0.227 \text{ A}$

c) $I_2 = -I_3 = -0.227 \text{ A}$

d). charging time constant

$$\begin{cases} I_1 = I_2 + I_3 \\ \epsilon = I_1 R_1 + I_2 R_2 \\ \epsilon = I_1 R_1 + I_3 R_3 + L \frac{dI_3}{dt} \end{cases} \Rightarrow \tau_1 = \frac{L}{R_3 + \frac{R_1 R_2}{R_1 + R_2}} = 8.04 \times 10^{-4} \text{ s}$$

discharging time constant

$$+L \frac{dI}{dt} + I R_3 + I R_2 = 0 \Rightarrow \tau_2 = \frac{L}{R_2 + R_3} = 5.83 \times 10^{-4} \text{ s}$$