Physics 2220
Spring 2001
George A. Williams

FIFTH MIDTERM

3

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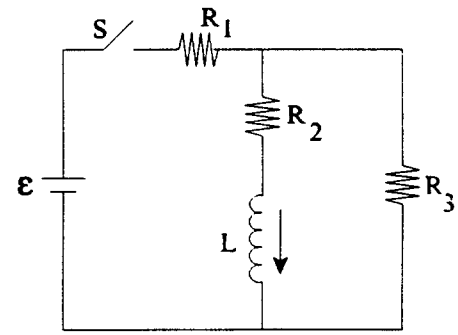
Discussion Section # _____ Student ID #: _____

SHOW ALL WORK!!!!!
REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

In the circuit shown, the switch is closed at t = 0 after being open for a long time.

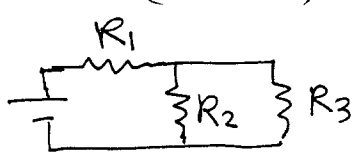


(a) Calculate the current in R_3 at t = 0
(b) Calculate the current in R_2 at t = ∞.
(c) Calculate the current in the inductance 1.5 time constants after t = 0.
(d) If the switch is opened 1.5 time constants after t = 0, write a complete expression for the current in the inductor as a function of time with all numerical quantities evaluated. Take the arrow as the positive direction.

ε = 175 V
R_1 = 100 Ω
R_2 = 150 Ω
R_3 = 250 Ω
L = 4.75 μH

(a) $t=0$ 

$$I = \frac{\varepsilon}{R_1+R_3} = \frac{170\,V}{(100+250)\,\Omega} = 0.500\,A$$

(b) $t=\infty$ 

$$I_{total} = \frac{\varepsilon}{R_1 + \frac{R_2R_3}{R_2+R_3}} = \frac{175}{100+\frac{150\times250}{150+250}}\,A$$

$$= 0.9032\,A$$

$$I_2 = I_{total} \times \frac{R_3}{R_2+R_3} = 0.9032 \times \frac{250}{150+250}\,A$$

$$= 0.565\,A$$

(c) $I_0 = I_2\left[1-e^{-t/\tau}\right]$

$$= 0.565\,A\left[1-e^{-1.5}\right] = 0.439\,A$$

(d) $I = I_0 e^{-t/\tau}$ $\quad \tau = \frac{L}{R_2+R_3} = \frac{4.75\times10^{-6}}{150+250}\,s = 1.19\times10^{-8}\,s$

$$\therefore I = 0.439 \times \exp\left[-t/1.19\times10^{-8}\,s\right]\,A$$

$$= 0.439 \times \exp\left[-8.42\times10^{7}\,t/s\right]\,A$$