Quiz for March 29, 2012

Problems 1 through 6 deal with the RL circuit of Fig. 3.7.7, a series circuit containing an inductor with an inductance of L henries, a resistor with a resistance of R ohms, and a source of electromotive force (emf), but no capacitor. In this case Eq. (2) reduces to the linear first-order equation
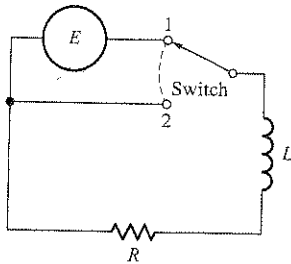
$$LI' + RI = E(t).$$

FIGURE 3.7.7. The circuit for Problems 1 through 6.

In the circuit of Fig. 3.7.7, suppose that $L = 5$ H, $R = 25$ Ω, and the source E of emf is a battery supplying 100 V to the circuit. Suppose also that the switch has been in position 1 for a long time, so that a steady current of 4 A is flowing in the circuit. At time $t = 0$, the switch is thrown to position 2, so that $I(0) = 4$ and $E = 0$ for $t \geq 0$. Find $I(t)$.

We must solve $5I' + 25I = 0$
$$I(0) = 4$$

Try $I(t) = e^{rt}$ get $5r + 25 = 0$
$$r = -5$$

So $I(t) = c e^{-5t}$
$$4 = I(0) = c$$
$$\boxed{I(t) = 4e^{-5t}}$$