Demonstration 72.57 – LR circuit rise time (L/R)

$$i = \frac{\varepsilon}{R}(1 - e^{-Rt/L}), \text{ or}$$

$$i = \frac{\varepsilon}{R}(1 - e^{-t/\tau}), \text{ where } \tau = L/R$$

R, of course, changes as the lamp heats up. (At 120 V and maximum current the resistances are about 360 Ω and 29 Ω for the 40-watt and 500-watt lamps, respectively.) Still, we can estimate the *L/R* time constants for the lamps when they are cold. They are about 0.273 H/28.5 Ω = 9.6 ms, and 0.273 H/1.6 Ω = 170 ms, for the 40-watt and 500-watt lamps, respectively. These differ by a factor of about 18.