1) The differential equation governing an RLC circuit is:
\[-Li/dt - Ri + q/C = 0.\]
Using \(i = -dq/dt\), we have,
\[Ld^2q/dt^2 + Rdq/dt + q/C = 0.\]
The differential equation governing a mass on a spring is (with velocity proportional viscous damping):
\[md^2x/dt^2 + bdx/dt + Kx = 0.\]
Here the mass is \(m\), \(K\) is the spring constant and \(b\) is the coefficient of proportionality between velocity and the viscous retarding force.

Thus: \(M\) and \(L\) play the same roles; \(b\) and \(R\) play the same roles; and, \(K\) plays the same role as \(1/C\).

\(Mv\) is the momentum that will persist unless changed by a force, and \(Li\) is the flux in an inductor that will persist unless changed by an external agent. The kinetic energy stored in motion is \((1/2)mv^2\), while energy is stored in the inductor as \((1/2)Li^2\). The resistor is an agent for energy loss at the rate \(i^2R\). Energy is lost to viscosity at the rate \(bv^2\). Energy is stored in a capacitor as \((1/2)q^2/C\) and energy is stored in the spring as \((1/2)Kx^2\).

2) The self-inductance of the circuit causes the current to persist until the voltage developed across the gap acting as a capacitor causes it to stop. Now this gap usually has a very small capacitance and the current, which we have assumed to be large, can charge the gap to a very large voltage. Thus the spark develops when the air brakes down. The energy for the spark comes from the energy stored in the self-inductance of the circuit, \((1/2)Li^2\).

The equilibrium current is \(i = V/R = 100/10 = 10\) amps. The energy stored in the inductor is \((1/2)Li^2 = (1/2)(1/1000)(100) = 1/20\) joule.

3) a. Compare figure 30.18 and fig 30.6b. Note that points a and b are reversed. Thus, according to equation 30.8, \(dI/dt = (Vb - Va)/L = -1.04V/0.260H = -4\) A/s. Thus, the current is decreasing.
b. From a. we know that \(di = (-4A/s)dt\). After integrating both sides of the expression with respect to \(t\), we obtain \(\Delta I = (-4A/s)\Delta t\) and so \(I = (12.0A) - 4A/s * 2s = 4A\).

4) a. \(U = P*t = (200W)(24h/dayx3600s/h) = 1.73x10^7\) J.
b. \(U = \frac{1}{2}LI^2\) and therefore \(L = 2U/I^2 = 2 (1.73x10^7J)/(80A^2) = 5406\) H.

5) When switch 1 is closed and switch 2 is open, the loop rule gives \(L\ dl/dt + IR = 0\) and therefore \(dl/dt = -I R/L\). Integrating from \(I_0\) to \(I\) on the LHS and 0 to \(t\) on the RHS gives \(ln(I/I_0) = -R/L\ t\) and therefore \(I(t) = I_0 \exp(-t/(L/R))\).