Prob 2.3

$$I(t) = I_o e^{-\frac{t}{RC}}$$

$$C_e = \frac{C_1 C_2}{C_1 + C_2} = \frac{(60\mu F)(40\mu F)}{60\mu F + 40\mu F} = 24\mu F$$ (Capacitors in Series)

$$RC_e = (5\Omega)(24\mu F) = 120\mu s$$

$$V_1(0) = \frac{Q_1}{C_1} = \frac{1C}{60\mu F} = 16.67\,KV$$

$$I_o = \frac{V_1(0) - V_2(0)}{R} = \frac{16.67\,KV}{5\Omega} = 3333\,A$$

The equation is: $I(t) = 3333\, e^{-\frac{t}{120\mu s}}$

ⓐ Peak Current $I_o = 3333\,[A]$; this is the in-rush current needed to charge the C_2.

ⓑ I @ 200μs after switch closes.

$$I(200\mu s) = 3333\, e^{-\frac{200}{120}} = 629.52\,[A]$$

ⓒ Ultimate energy stored in C_2

$V_F = ?$

$$Q_1(0) + Q_2(0) = Q_F$$

$$C_1 V_1(0) + C_2 \cancel{V_2(0)}^{0} = (C_1 + C_2) V_F$$

$$V_F = \frac{C_1}{C_1 + C_2} V_1(0) = \frac{60\mu F}{(60+40)\mu F}(16.67KV) = \underline{\underline{10\,KV}}$$

$$E_{2F} = \frac{1}{2} C_2 V_F^2 = \frac{1}{2}(40\mu F)(10KV)^2 = 2000\,[J]$$

ⓓ Ultimate Voltage at C_1

$$V_1(\infty) = V_F = 10[KV]$$