Current in a RC Circuit *The equation governing the amount of current I (in amperes) after time t (in microseconds) in a single RC circuit consisting of a resistance R (in ohms), a capacitance C (in microfarads), and an electromotive force E (in volts) is*[1]

$$I = \frac{E}{R}\mathrm{e}^{-t/(RC)}$$

(a) *If $E = 120$ volts, $R = 2000$ ohms, and $C = 1.0$ microfarad, how much current I_1 is flowing initially ($t = 0$)? After 1000 microseconds? After 3000 microseconds?*

We substitute into the given function.

$$\begin{aligned} I(t) &= \frac{120}{2000}\mathrm{e}^{-t/(2000\cdot 1.0)} \\ I(0) &= \frac{120}{2000}\mathrm{e}^{-0/(2000\cdot 1.0)} \\ I(0) &= 0.06 \end{aligned}$$

Thus, the initial current at time $t = 0$ microseconds is 0.06 amperes.

$$\begin{aligned} I(t) &= \frac{120}{2000}\mathrm{e}^{-t/(2000\cdot 1.0)} \\ I(1000) &= \frac{120}{2000}\mathrm{e}^{-1000/(2000\cdot 1.0)} \\ I(1000) &\approx 0.036 \end{aligned}$$

Thus, the current at time $t = 1000$ microseconds is 0.036 amperes.

$$\begin{aligned} I(t) &= \frac{120}{2000}\mathrm{e}^{-t/(2000\cdot 1.0)} \\ I(3000) &= \frac{120}{2000}\mathrm{e}^{-3000/(2000\cdot 1.0)} \\ I(3000) &\approx 0.013 \end{aligned}$$

Thus, the current at time $t = 3000$ microseconds is 0.036 amperes.

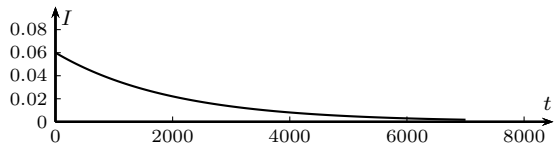
(b) *What is the maximum current?*

We graph the function $I(t) = \frac{120}{2000}\mathrm{e}^{-t/(2000\cdot 1.0)}$ on our graphing calculator. Let's use the domain $0 \le t \le 10000$ since the function seems to be decreasing, based on our work from part (a).

Thus the maximum current of 0.06 amperes occurs at $t = 0$ microseconds.

(c) *Graph the function $I = I_1(t)$, measuring I along the y-axis and t along the x-axis.*

See graph at right.



[1] Sullivan, *Precalculus: Enhanced with Graphing Utilities*, p. 287, #114.