Mathcad Solutions to Assesment Problems from Nilsson and Riedel
Electric Circuits 9th edition,
Chapter 1

AP 1.1 Assume a telephone signal travels through a cable at two-thirds the speed of light. How long does it take the signal to get from New York City to Miami if the distance is approximately 1100 miles?

$$1100\,\text{mile} \div \left(\frac{2}{3}c\right) = 8.858\cdot\text{ms}$$

AP 1.2 How many dollars per millisecond would the federal government have to collect to retire a deficit of $100 billion in one year?

$$\frac{100 \times 10^{9}}{yr} = 3.169 \cdot \frac{1}{ms} \qquad \$$$

AP 1.3 The current at the terminals of the element in Fig. 1.5 is

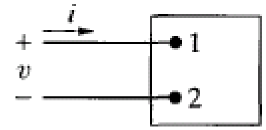
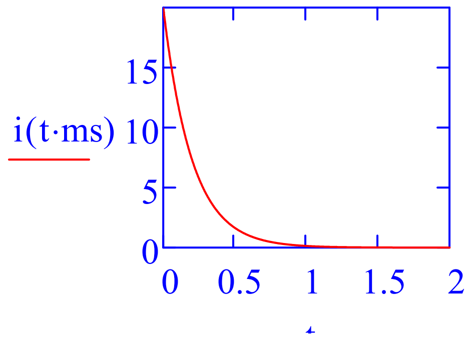


Figure 1.5 ▲ An ideal basic circuit element.

$$i(t) := \begin{cases} 0A & \text{if } t < 0 \\ 20e^{-5000\frac{t}{s}}A & \text{otherwise} \end{cases}$$

Calculate the total charge (in microcoulombs) entering the element at its upper terminal.



$$q := \int_0^{10ms} i(t)\,dt \qquad q = 4 \cdot mC$$

AP 1.4 The expression for the charge entering the upper terminal of Fig. 1.5 is

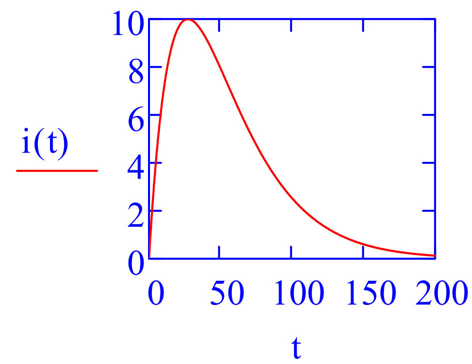
$$q(t) := \left[\frac{1}{\alpha^2} - \left(\frac{t}{\alpha} + \frac{1}{\alpha^2}\right)e^{-\alpha \cdot t}\right]C \qquad \frac{d}{dt}q(t) \rightarrow -C\cdot\left[\frac{e^{-\alpha\cdot t}}{\alpha} - \alpha\cdot e^{-\alpha\cdot t}\cdot\left(\frac{t}{\alpha} + \frac{1}{\alpha^2}\right)\right]$$

Find the maximum value of the current entering the terminal if α = 0.03679.

$$\alpha := 0.03679$$

$$i(t) := -A\cdot\left[\frac{e^{-\alpha\cdot t}}{\alpha} - \alpha\cdot e^{-\alpha\cdot t}\cdot\left(\frac{t}{\alpha} + \frac{1}{\alpha^2}\right)\right]$$

$$\text{Given} \quad \frac{d}{dt}i(t) = 0 \qquad t := \text{Find}(t) \rightarrow 27.18129926610491981 5$$



$$i(t) = 10\,A$$

AP 1.5 Assume that a 20 V voltage drop occurs across an element from terminal 2 to terminal 1 and that a current of 4 A enters terminal 2.

a) Specify the values of v and i for the polarity references shown in Fig. 1.6(a)-(d).

b) State whether the circuit inside the box is absorbing or delivering power.

c) How much power is the circuit absorbing?

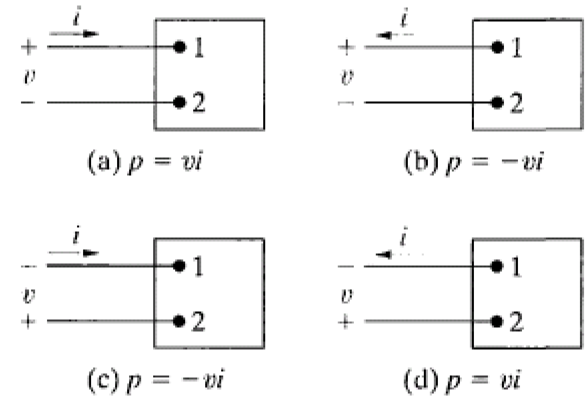


Figure 1.6 ▲ Polarity references and the expression for power.

a) (a) v= -20V i= -4A
   (b) v= -20V i= 4A
   (c) v= 20V i= -4A
   (d) v= 20V i= 4A

b) absorbing

c) $P := 20V \cdot 4A = 80\,W$

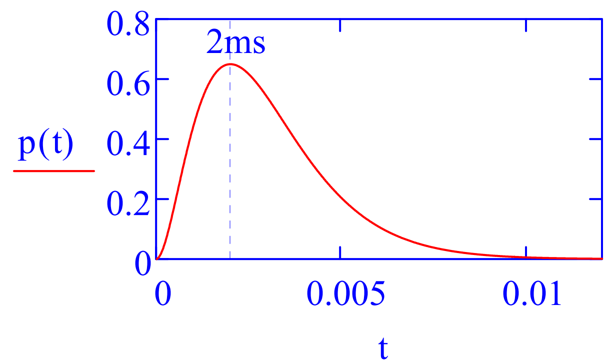
AP 1.6 The voltage and current at the terminals of the circuit element in Fig 1.5 are zero for t < 0. For $t \geq 0$,

$t := tt$

$$v(t) := 80000\frac{t}{s}\cdot e^{-500\frac{t}{s}}V \qquad i(t) := 15\frac{t}{s}\cdot e^{-500\frac{t}{s}}A$$

$$p(t) := i(t)\cdot v(t)$$

a) Find the time when the power delivered to the circuit element is maximum.
b) Find the maximum value of power.
c) Find the total energy delivered to the circuit element.

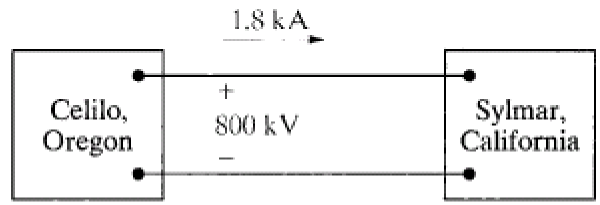


a) Given $t := 1ms$ $\frac{d}{dt}p(t) = 0$ $t_{maxP} := Find(t) = 2\cdot ms$

b) $p(t_{maxP}) = 649.6\cdot mW$

c) $Energy := \int_0^{15ms} p(t)\,dt = 2.4\cdot mJ$ $mJ \equiv 10^{-3}J$

AP 1.7 A high-voltage direct-current (dc) transmission line between Celilo, Oregon and Sylmar, California is operating at 800 kV and carrying 1800 A, as shown. Calculate the power (in megawatts) at the Oregon end of the line and state the direction of power flow.



$P := 800\text{kV}\cdot 1800\text{A} = 1440\cdot\text{MW}$ From Celilo to Sylmar.