EECS2200 Electric Circuits

Chapter 1

Activities

Activity 1

(a) Assume that 10 millions electrons are moving from left to right in a wire every microsecond, what is the value of the current flowing in the wire?

(b) What about direction?

Solution

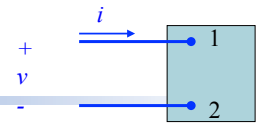
(a)

$$i = \frac{10 \times 10^{6} \times 1.6022 \times 10^{-19}}{10^{-6}} = 16.022 \times 10^{-7} \text{ Ampere}$$

$$= 1.6022 \times 10^{-6} = 1.6022 \mu\text{A}$$

(b) If we define the direction as the positive charge flow, then it is from right to left.

Activity 2



Assume the current and voltage are gives as

$$i(t) = \begin{cases} 0 & t < 0 \\ 20e^{-5000t} & t \geq 0 \end{cases} \qquad v(t) = \begin{cases} 0 & t < 0 \\ 10e^{-5000t}\, KV & t \geq 0 \end{cases}$$

(a) Find the total charge entering the element
(b) Max. value of the current entering the element
(c) Power supplied to the element at 1ms
(d) Total energy delivered to the circuit

Solution

(a)
$$q = \int_0^\infty 20e^{-5000t}dt = 20\left(\frac{e^{-5000t}}{-5000}\Big|_0^\infty\right) = 0.004C = 4000\mu C$$

(b) $$i = 20e^{-5000t} \rightarrow i_{\max} = 20A$$

(c) $$p = vi = 10000e^{-5000t} \times 20e^{-5000t} = 9.08W\ @\ t = 1ms$$

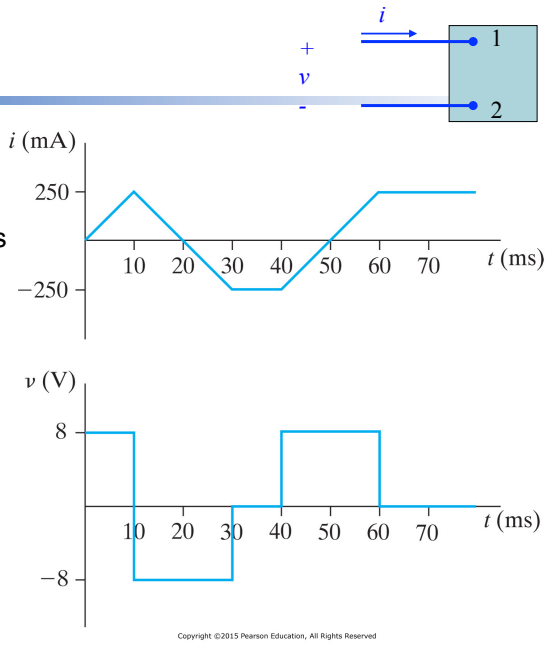
(d)
$$w = \int_0^\infty pdt = 200000\left(\frac{e^{-10000t}}{-10000}\Big|_0^\infty\right) = 20J$$

Activity 3

Voltage and current at the terminals of a circuit block are shown.

(1) Sketch the power versus t plot for 0 to 80ms.

(b) Calculate the energy delivered to the circuit element at t=10, 30 and 80ms.



Solution (a)

$0\ \text{s} \leq t < 10\ \text{ms}$:

$v = 8\ \text{V};\quad i = 25t\ \text{A};\quad p = 200t\ \text{W}$

$10\ \text{ms} < t \leq 30\ \text{ms}$:

$v = -8\ \text{V};\quad i = 0.5 - 25t\ \text{A};\quad p = 200t - 4\ \text{W}$

$30\ \text{ms} \leq t < 40\ \text{ms}$:

$v = 0\ \text{V};\quad i = -250\ \text{mA};\quad p = 0\ \text{W}$

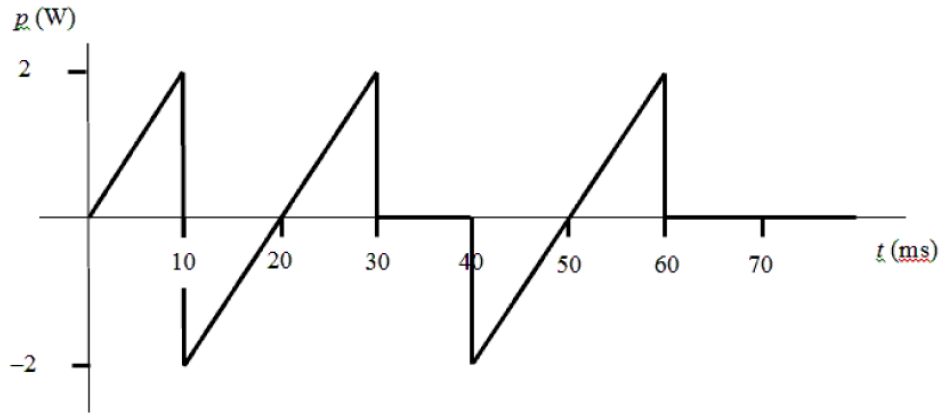
$40\ \text{ms} < t \leq 60\ \text{ms}$:

$v = 8\ \text{V};\quad i = 25t - 1.25\ \text{A};\quad p = 200t - 10\ \text{W}$

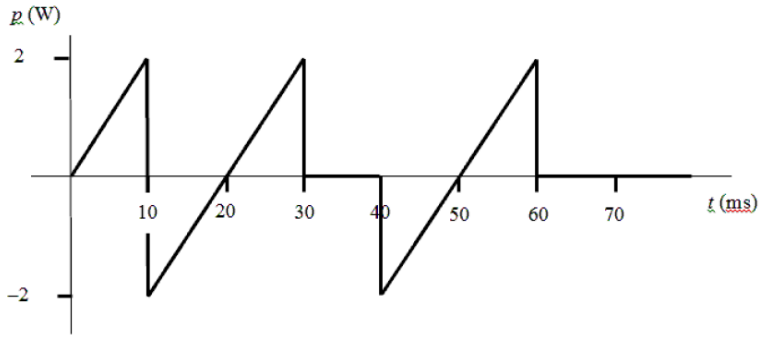
$t > 60\ \text{ms}$:

$v = 0\ \text{V};\quad i = 250\ \text{mA};\quad p = 0\ \text{W}$

Solution (a)



Solution (b)



Calculate the area under the curve from zero up to the desired time:

$$w(0.01) = \tfrac{1}{2}(2)(0.01) = 10 \text{ mJ}$$

$$w(0.03) = w(0.01) - \tfrac{1}{2}(2)(0.01) + \tfrac{1}{2}(2)(0.01) = 10 \text{ mJ}$$

$$w(0.08) = w(0.03) - \tfrac{1}{2}(2)(0.01) + \tfrac{1}{2}(2)(0.01) = 10 \text{ mJ}$$