

Chapter 1: Circuit Variables

Charges and Current Flow

1. Given the expression for the charge entering a positive terminal of a circuit element below, determine the current, $i(t)$, at any time.

$$q(t) = 10\cos(4t) + 8\sin(4t) \mu\text{C}$$

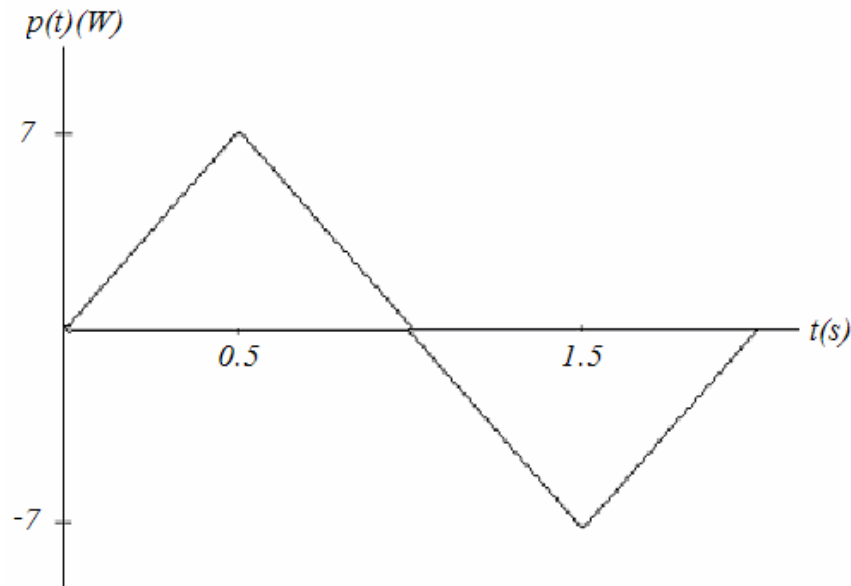
2. Given the following piecewise function describing a current $i(t)$ entering the positive terminal of the device,

$$i(t) = \begin{cases} 4 + 2t^2 & 0 \leq t < 1 \\ 4e^{3000t} & 1 \leq t \leq 3 \text{ A} \\ 20\sin(7t) & t > 3 \end{cases}$$

determine the charge entering the element in (a) the first 0.5s, (b) the first 3s, (c) from 2s to 4s, (d) from 4s to 6s, (e) sketch the graph of $q(t)$ for all time

Power & Energy

3. Given the following graph of power $p(t)$, during which intervals of time is power being absorbed and when is power being delivered?



4. The charge entering the positive terminal of a circuit element is given to be

$$q(t) = 10e^{-2t} \mu\text{C} . \text{ It is determined that } v(t) = 5 \frac{di(t)}{dt} \text{ V} .$$

- (a) Find the power $p(t)$ delivered/absorbed by the element for any time t .
- (b) Find a energy $w(t)$ supplied to the element at any time t .
- (c) How much energy is delivered/absorbed by the element between 0s and 2s.

5. Given the following functions of voltage across a circuit element and current through a circuit element,

$$v(t) = (200t + 5)e^{-400t} \text{ V}$$

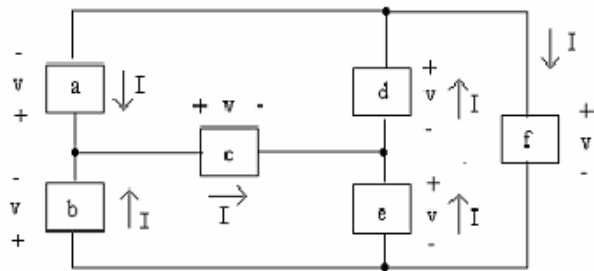
$$i(t) = (40t - 20)e^{-400t} \text{ A}$$

- (a) At what instant in time does the maximum value of power delivered to the element occur? What is the power in watts?
 (b) Find the total energy delivered to the circuit element in millijoules.

Basic Circuits, Energy Conservation, & Passive Sign Convention

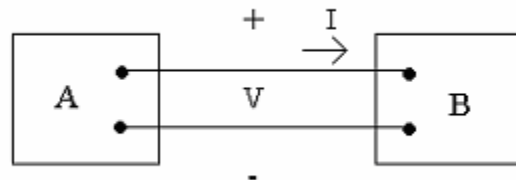
5. The numerical values for the current and voltages in the circuit below are given in the table, which is also below.

Element Name	Voltage (V)	Current (A)
a	-18	-51
b	-18	45
c	2	-6
d	20	-20
e	16	-14
f	36	31



- (a) What is the total power delivered by the circuit elements, and which elements deliver that power?
 (b) What is the total power absorbed by the circuit elements, and which elements absorb that power?
 (c) Is the power delivered equal the power absorbed? Why?
 (d) Based on the figure above, which elements follow the passive sign convention?
6. Two electric circuits, represented by block diagrams A and B, are connected as shown below. The reference direction for the current I in the interconnection and the reference polarity for the voltage V across the interconnection are shown in the figure. For each of the following sets of numerical values, calculate the power in the interconnection and state whether the power is flowing from A to B or vice-versa.

- (a) $I = 5 \text{ A}, V = 120 \text{ V}$
 (b) $I = -8 \text{ A}, V = 250 \text{ V}$
 (c) $I = 16 \text{ A}, V = -150 \text{ V}$
 (d) $I = -10 \text{ A}, V = -480 \text{ V}$



Design Problem(s)

1. The current entering the positive terminal of a circuit element is shown below along with the corresponding plot of the power absorbed.
 - a. Determine a suitable voltage given the waveforms below.
 - b. Sketch the resulting energy waveform

