Homework #1

MEMS 0031 - Electrical Circuits

Assigned January 12, 2018
Due January 19, 2018

Problem #1

- The total charge entering a circuit element is expressed as $q(t)=1(1\text{-}e^{-10t})$ for when $t \geq 0$. When $t<0$, $q(t)=0$. Determine the current in the circuit element for $t \geq 0$.

Problem #2

- The current in a circuit element is $i(t)=5(1\text{-}e^{-20t})$ [A] when $t \geq 0$. When $t<0$, $i(t)=0$. Determine the total charge that has entered the circuit element for $t \geq 0$.

Problem #3

- The time variation of current and voltage through and across an electrical circuit element is depicted in Fig. 1. The element current and voltage adhere to the passive sign convention. Sketch the power delivered to the element for the time interval between 0 and 25 seconds. What is the total energy delivered to the element for the time interval between 0 and 25 seconds?
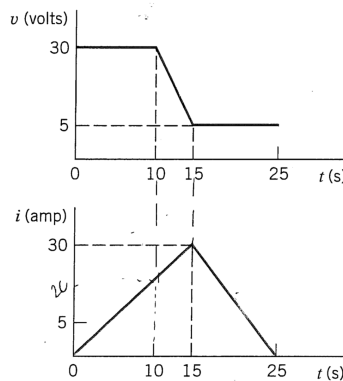

Figure 1: Schematic for Problem #3.

Problem #4

- Find the power, $p(t)$, supplied by the element shown Fig. 2 when $v(t)=4\cos(3t)$ [V] and $i(t)=\sin(3t)/12$ [A]. Determine $p(t)$ for when t=0.5 and 1 [s].
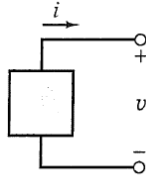

Figure 2: Schematic for Problem #4.

Problem #5

- A flashlight uses a 9 [V] battery and the bulb draws a current of 500 [mA]. What is the power absorbed by the bulb? What is the power absorbed by the bulb over a 10 minute period?

Problem #6

- There are prescribed currents through and voltages across circuits elements constituting a network as shown in Fig. 3. Determine the incorrect reference direction. Hint: apply the conservation of energy.
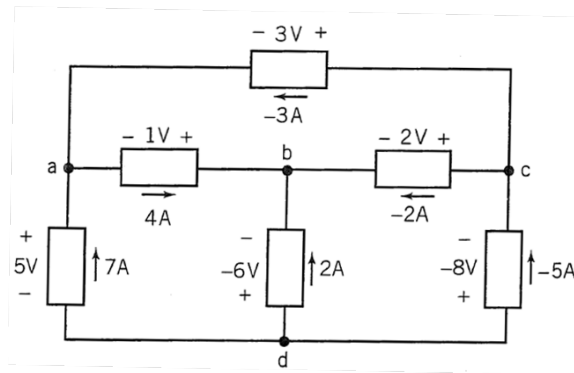

Figure 3: Schematic for Problem #6.

Problem #7

- An electrical circuit element has voltage and current values as shown in Fig. 4. Determine if this particular circuit element is linear.
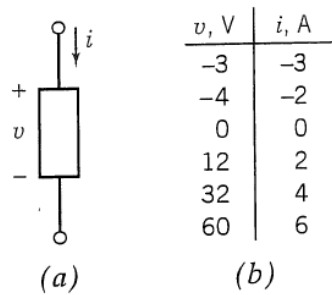

v, V	i, A
−3	−3
−4	−2
0	0
12	2
32	4
60	6

(a)   (b)

Figure 4: Schematic for Problem #7.

Problem #8

- A current source and resistor are connected in series as shown in Fig. 5, which means the same current provided by the source is that which goes through the resistor. If the current source is 3 [A] and the voltage drop across the resistor is 24 [V], calculate the resistance R of the resistor and the power absorbed.
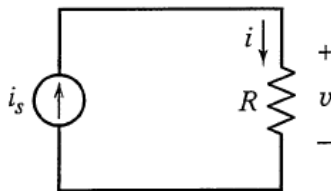

Figure 5: Schematic for Problem #8.

Problem #9

- A voltage source and resistor are connected in series as shown in Fig. 6, which means the same voltage potential provided by the source is the same across the resistor. If the voltage source is 15 [V] and the resistance of the resistor is 5 [Ω], determine the current through the resistor and the power absorbed.
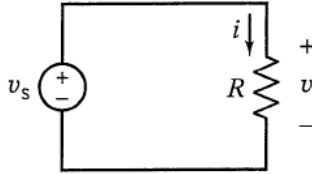

Figure 6: Schematic for Problem #9.