MEMS 0031 - Electrical Circuits
Quiz #1
May 15th, 2019
90 points

Name: Solutions

Problem #1

(5 pts.) Given that current is the time-rate-of-change of charge, and that $i(t)$=5·sin(3t) [A], determine the charge $q(t)$ for $t \geq 0$:

$$i = \frac{dq}{dt} \implies dq = i\,dt \implies q = \int_0^t i\,dt = \frac{5}{3}\Big(1 - \cos(3t)\Big)$$

Problem #2

(5 pts.) Given $q(t)$=e^{-10t}, determine the current $i(t)$ for $t \geq 0$:

$$i = \frac{dq}{dt} = \frac{d}{dt}(e^{-10t}) = -10e^{-10t}$$

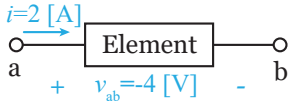
Problem #3

(5 pts.) Given $i(t)$=$3t^3$ and $V(t)$=$3t^{-2}$, determine $P(t)$ for $t \geq 0$:

$$P(t) = V(t)i(t) = (3t^3)(3t^{-2}) = 9t$$

Problem #4

(5 pts.) Given the schematic below, determined the power **supplied**:

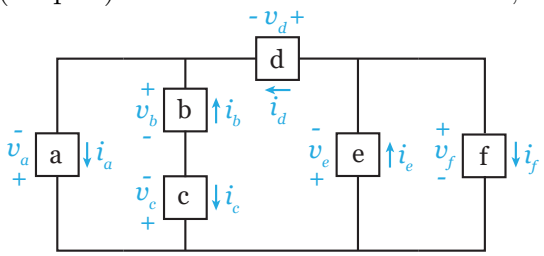


The circuit depicted adheres to the PSC, however, the voltage potential across terminals a and b is negative. Switching the polarity of the voltage potential, the circuit then adheres to the ASC

$$P = Vi = (4\,[\text{V}])(2\,[\text{A}]) = 8\,[\text{W}]$$

Problem #5

(40 pts.) Given the schematic below, does the circuit satisfy the Conservation of Power?

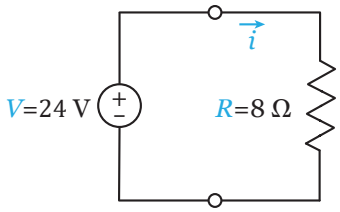


Element	Voltage [kV]	Current [mA]	Active or Passive?	Power Dissipated [W]
a	-3	-250	Active	-750
b	4	-400	Passive	1,600
c	1	400	Active	-400
d	1	150	Passive	150
e	-4	200	Active	-800
f	4	50	Passive	200
			Sum:	0

Yes, this circuit conserves power.

Problem #6

(15 pts.) Give the schematic below, determine a) the current flowing through the resistor and b) the power dissipated by the resistor.



The current is calculated via Ohm's law:

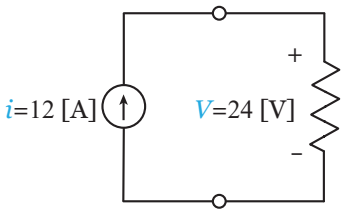
$$i = \frac{V}{R} = \frac{24\,[\mathrm{V}]}{8\,[\Omega]} = 3\,[\mathrm{A}]$$

The power dissipated is current-squared times resistance:

$$P_{diss} = i^2 R = (3\,[\mathrm{A}])^2 (8\,[\Omega]) = 72\,[\mathrm{W}]$$

Problem #7

(15 pts.) Give the schematic below, determine a) the resistance of the resistor and b) the power dissipated by the resistor.



The resistance is calculated via Ohm's law:

$$R = \frac{V}{i} = \frac{24\,[\mathrm{V}]}{12\,[\mathrm{A}]} = 2\,[\Omega]$$

The power dissipated is current-squared times resistance:

$$P_{diss} = i^2 R = (12\,[\mathrm{A}])^2 (2\,[\Omega]) = 288\,[\mathrm{W}]$$