ECSE-200 Electric Circuit 1
Quiz #1 (Jan. 18, 2019)

LAST NAME SOLUTIONS **MCGILL ID#** _____

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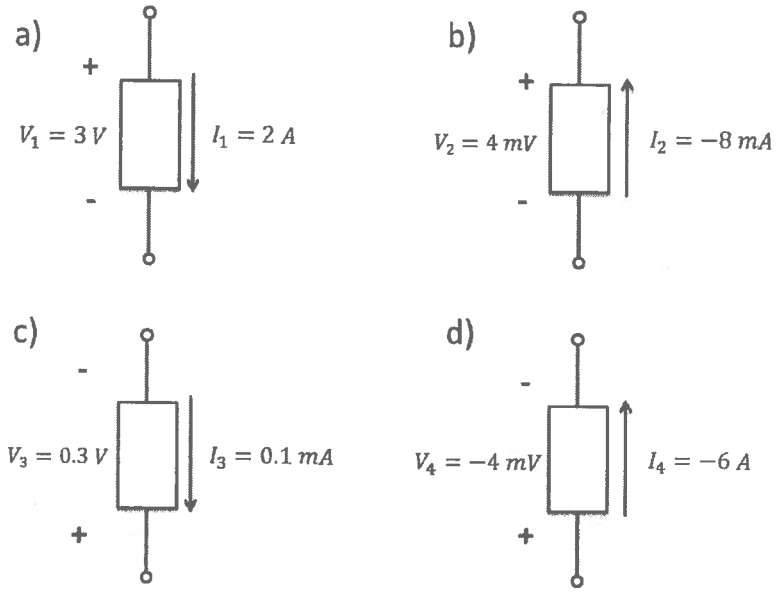
- ***Carefully read the questions***
- ***Show all your work***
- ***Clearly indicate your final answer***
- ***Plagiarism will have important consequences***
- ***Answer must provide the appropriate symbol for the multiplier and SI unit where applicable***
- ***Only Faculty standard calculators are accepted***
- ***You have 45 minutes to complete this quiz***

Question 1. Consider the four circuit elements below. For each circuit element, indicate the power that is being delivered or absorbed by the element. [2 pts / element × 3 elements = 6 pts].



a) (passive sign convention)

$P_1 = V_1 \cdot I_1 = 3V \cdot 2A = 6W$ [+1]

power is absorbed [+1]

b) $P_2 = V_2 \cdot I_2 = 4\times10^{-3}V \cdot (-8\times10^{-3}A)$

$= -32\times10^{-6}W$

$= -32\,\mu W$ [+1]

(not following passive sign convention)

$32\,\mu W$ power absorbed

[+1] [+1]

c) (not following passive sign conv.)

$P_3 = V_3 \cdot I_3 = 0.3V \cdot 0.1\times10^{-3}A$

$= 0.03\times10^{-3}W$

$= 30\,\mu W$

power is delivered [+1]

[+1]

d) (passive sign conv.)

$P_4 = (-4\times10^{-3}V)(-6A)$

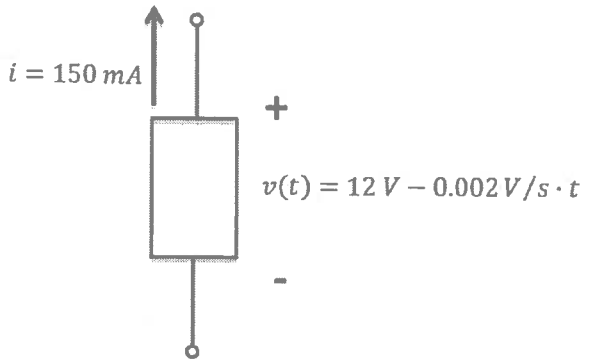
$= 24\times10^{-3}W$

$= 24\,mW$ power is

[+1] absorbed

[+1]

Ouestion 2. Consider the circuit element below which represents a battery. Answer the questions.



(a) What is the instantaneous power $p(t)$ delivered by the battery at time $t = 500\ s$? [2 pts]

(b) What is the energy delivered by the battery over the time interval $0\ s \leq t \leq 500\ s$? [3 pts]

(c) How much charges will exit the battery from the + terminal at the end of the time interval over the time interval $0\ s \leq t \leq 500\ s$? [2 pts]

a) $p(t) = i \cdot v(t) = 150\times10^{-3}\,A\,(12V - 0.002V/s \cdot t)$ [+1]

$= 1800\times10^{-3}\,W - 0.3\times10^{-3}\,\frac{W}{s} \cdot t$

$p(t=500s) = 1.8\,W - 0.3\,\frac{mW}{s} \cdot 500\,s$

$= 1.8\,W - 150\,mW = \boxed{1.65\,W}$ [+1]

b) $U(t_2) - U(t_1) = \int_{t_1}^{t_2} p(t)\,dt$ [+1] $= \int_{0s}^{500s} \left(1.8W - 0.3\,\frac{mW}{s} \cdot t\right) dt$

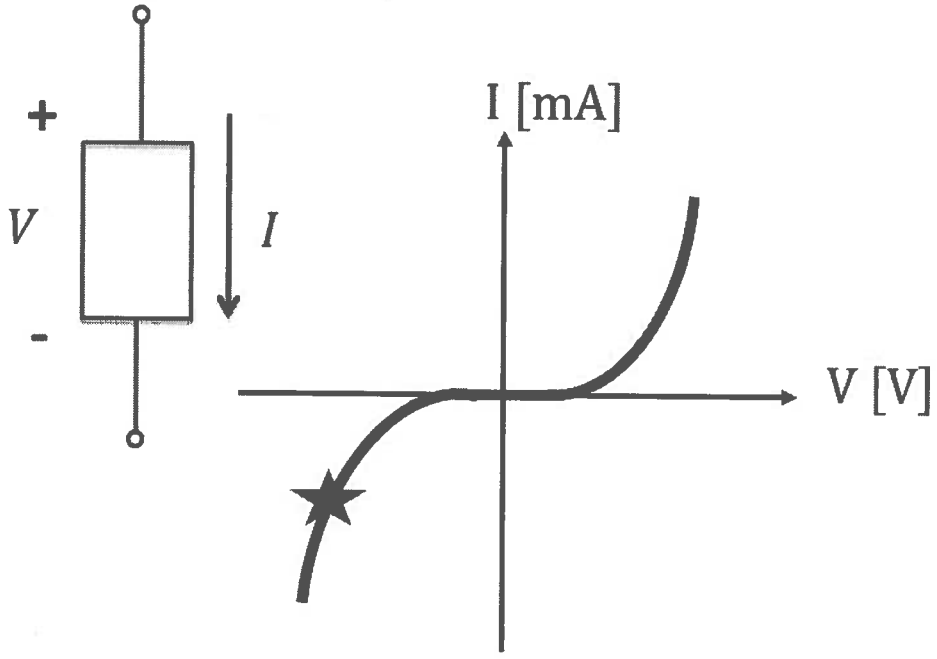
$U(500s) - U(0s) = \left(1.8W\,t - \frac{1}{2}\,0.3\,\frac{mW}{s} \cdot t^2\right)_0^{500s}$ [+1]

$= 900\,J - 37.5\,J = \boxed{862.5\,J}$ [+1]

c) $I = \frac{dQ}{dt}$ [+1] $= 150\,mA \qquad \Delta t = 500\,s$

$Q = 150\times10^{-3}\,A \cdot 500s = \boxed{75\,C}$ [+1]

Question 3. Consider the I-V diagram for the circuit element shown. Write if the statement is true or false.



a) The circuit element is not a linear circuit element [1 pt]. TRUE

b) The circuit element is a passive element. [1 pt] TRUE

c) The element delivers energy at the star, which indicates a measurement made. [1 pt] FALSE