Name: _____ (please print)

Signature: _____

ECE 2300 – Quiz #1
September 6, 2012

Keep this quiz closed and face up until you are told to begin.

1. This quiz is closed book, closed notes. You may use one 8.5" x 11" crib sheet, or its equivalent.
2. Show all work necessary to complete the problem. A solution without the appropriate work shown will receive no credit.
3. Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.
4. Do not use red ink. Do not use red pencil.
5. You will have 30 minutes to work on this quiz.

_____/20

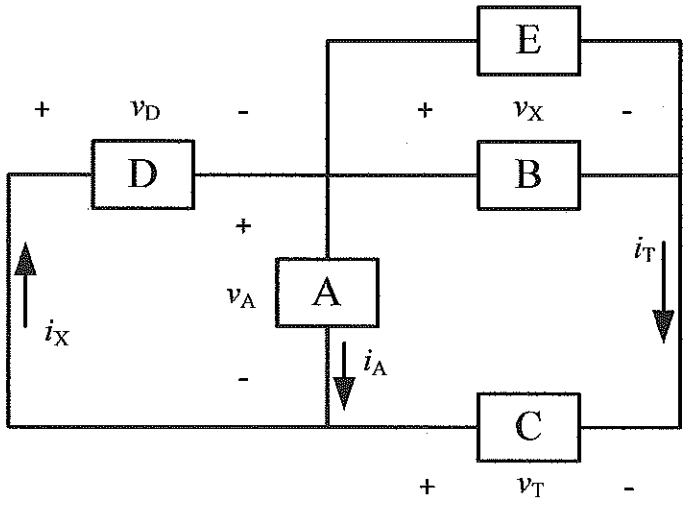
Devices A through E are interconnected as shown in the diagram below.

a) Assuming that current is carried by positive charge in this circuit, state whether the charge carriers are gaining or losing energy as they go through Device A at t = 0.5 [s].
b) State whether Device A is delivering energy or absorbing it at t = 0.5 [s].
c) Find the energy delivered by Device C from t = 0 to t = 1.5 [s].

$$i_T = \left(283.3 - 8.33e^{-2[s^{-1}]t}\right)[mA] \qquad i_A = -100[mA] \qquad i_X = \left(183.3 - 8.33e^{-2[s^{-1}]t}\right)[mA]$$

$$v_A = \left(-9.167 + 0.416e^{-2[s^{-1}]t}\right)[V] \qquad v_D = \left(9.165 - 0.416e^{-2[s^{-1}]t}\right)[V]$$

$$v_X = \left(2.833 - 0.083e^{-2[s^{-1}]t}\right)[V] \qquad v_T = \left(12 - 0.5e^{-2[s^{-1}]t}\right)[V]$$



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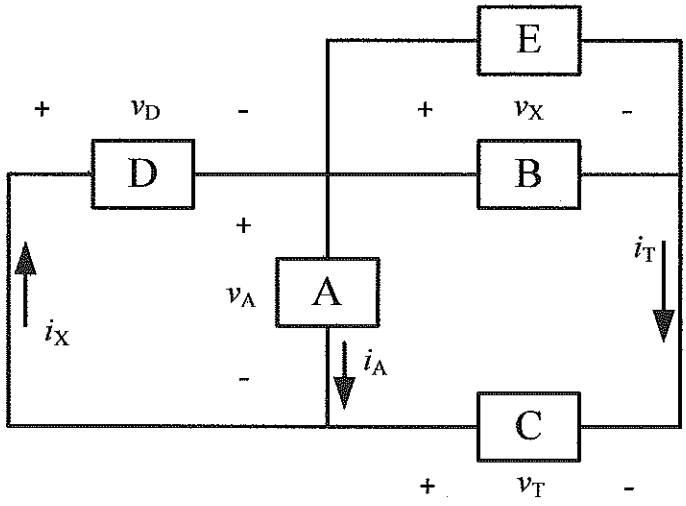
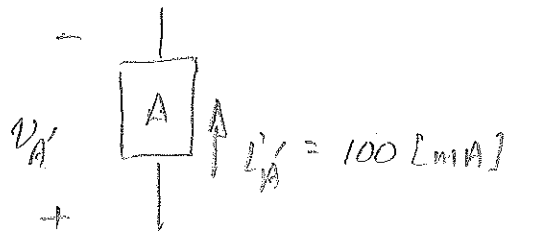


a) For this we need to know actual voltage and current polarities. Device A is redrawn showing actual polarities:



$v_A' = (9.176 - 0.416\,e^{-2t})\ [V]$

By inspection, v_A' is positive for all t. Further, this is passive sign convention, so the device is absorbing power. Therefore charge carriers (whether positive or negative) are losing energy as they go through A.

Room for extra work

b). From the argument given in a), Device A is absorbing energy (energy is being transferred to it) for all t, including $t = 0.5$ [s].

c) $p_{del,c} = v_T i_T$

$= (12 - 0.5e^{-2t})(283.3 - 8.33e^{-2t}) \times 10^{-3}$ [W]

$$w_{del,c} = \int_0^{1.5\,[s]} v_T i_t \, dt$$

$$= \int_0^{1.5\,[s]} (3.3996 - 0.2416e^{-2t} + 4.165 \times 10^{-3} e^{-4t}) \, dt$$

$= 4.986$ [J]

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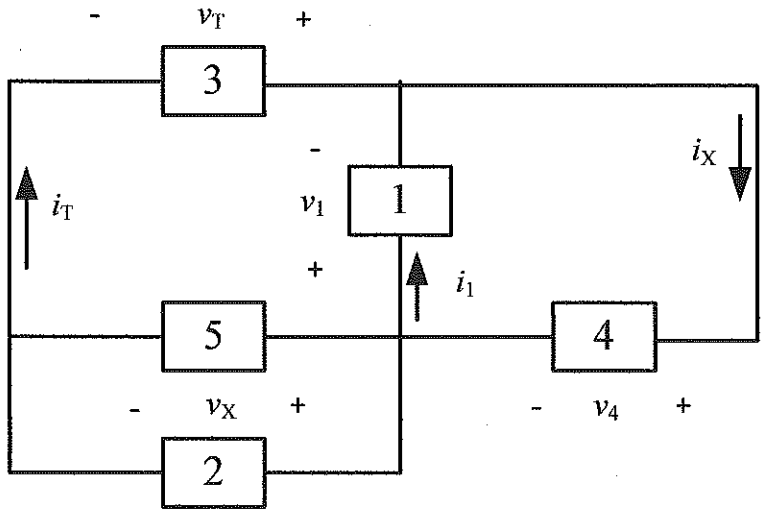
Devices 1 through 5 are interconnected as shown in the diagram below.

a) Assuming that current is carried by positive charge in this circuit, state whether the charge carriers are gaining or losing energy as they go through Device 1 at t = 0.5 [s].
b) State whether Device 1 is delivering energy or absorbing it at t = 0.5 [s].
c) Find the energy delivered by Device 3 from t = 0 to t = 2.5 [s].

$$i_T = \left(183.3 - 4.165e^{-2[s^{-1}]t}\right)[mA] \quad i_1 = -50[mA]] \quad i_X = \left(133.3 - 4.16e^{-2[s^{-1}]t}\right)[mA]$$

$$v_1 = \left(-4.165 + 0.208e^{-2[s^{-1}]t}\right)[V] \quad v_4 = \left(6.665 - 0.208e^{-2[s^{-1}]t}\right)[V]$$

$$v_X = \left(1.833 - 0.0416e^{-2[s^{-1}]t}\right)[V] \quad v_T = \left(6 - 0.25e^{-2[s^{-1}]t}\right)[V]$$



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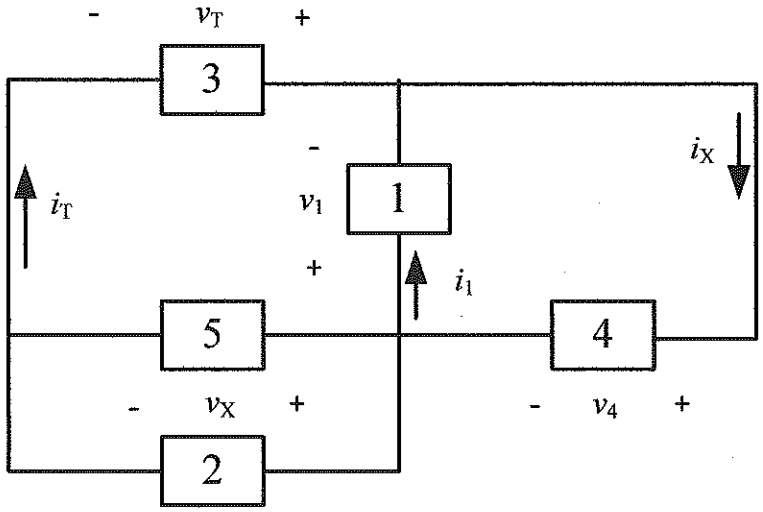
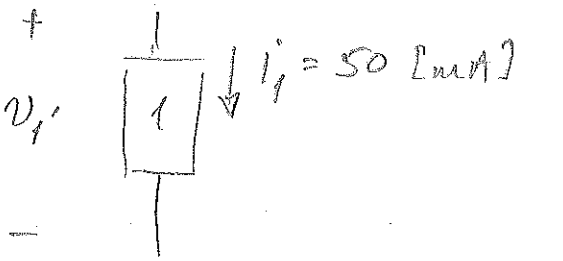


a) For this we need to know actual voltage and current polarities. Device 1 is redrawn showing actual polarities:



$v_1' = (4.165 - 0.208e^{-2t})$ [V]

By inspection, v_1' is positive for all t. Further, this is the passive sign convention, so the device is absorbing power. Therefore charge carriers, positive or negative, are losing energy as they go through Device 1.

Room for extra work

b) From the argument given in a), Device 1 is absorbing energy (energy is being transferred to it) for all t, including $t = 0.5$ [s]

c)

$$p_{del,3} = v_T i_T$$

$$= (6 - 0.25e^{-2t})(183.3 - 4.165e^{-2t}) \times 10^{-3} \text{ [W]}$$

$$w_{del,3} = \int_0^{2.5\,[s]} v_T i_T \, dt$$

$$= \int_0^{2.5\,[s]} (1.0998 - 0.07082e^{-2t} + 1.0412 \times 10^{-3} e^{-4t}) \, dt$$

$$= 2.7146 \text{ [J]}$$