Name: ~~Solution!~~ (please print)

Signature: ____________________________

ECE 2300 – Quiz #1
January 28, 2013

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 on these pages. Show all work necessary to complete the problem. A solution without the appropriate work shown will receive no credit. A solution which is not given in a reasonable order will lose credit.
3. It is assumed that your work will begin on the same page as the problem statement. If you choose to begin your work on another page, you must indicate this on the page with the problem statement, with a clear indication of where the work can be found. **If your work continues on to another page, indicate clearly where your work can be found. Failure to indicate this clearly will result in a loss of credit.**
4. Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.
5. Do not use red ink. Do not use red pencil.
6. You will have 30 minutes to work on this quiz.

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There were 2 versions of the quiz - both are presented here along with a blank...

For the devices A and B shown in the diagram below, do the following.

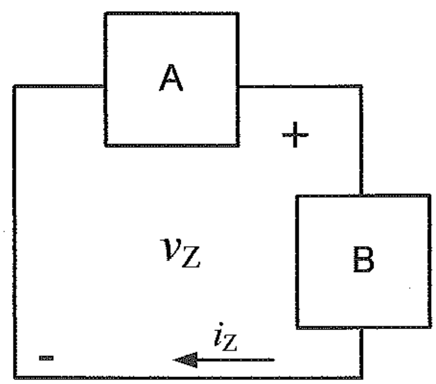
a) Find a simplified algebraic expression for the energy delivered by Device A as a function of time t after t = 0. Your expression should not contain integrals.

b) Find a numerical value for the energy delivered by Device A in the first 250[ms] after $t = 0$.

c) Find the time at which the power delivered to Device B is 0. If no such time exists, state that this is the case.

$$v_Z(t) = -12 + 20e^{(-200[\mathrm{ms}^{-1}]t)}[\mathrm{V}];\ \text{for } t \geq 0.$$

$$i_Z(t) = 750[mA] \text{ for } t \geq 0.$$

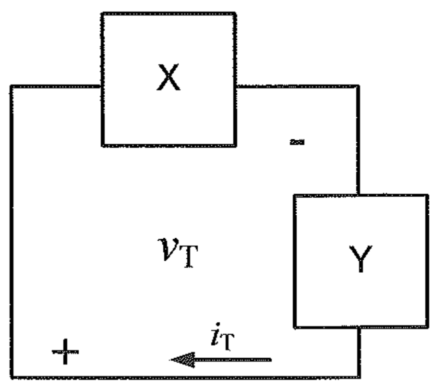


Room for extra work

For the devices X and Y shown in the diagram below, do the following.

a) Find a simplified algebraic expression for the energy delivered by Device X as a function of time t after t = 0. Your expression should not contain integrals.
b) Find a numerical value for the energy delivered by Device X in the first 300[ms] after $t = 0$.
c) Find the time at which the power delivered to Device Y is 0. If no such time exists, state that this is the case.

$$v_T(t) = -8 + 16e^{(-250[\text{ms}^{-1}]t)}[\text{V}];\ \text{for } t \geq 0.$$
$$i_T(t) = -250[mA] \text{ for } t \geq 0.$$



Room for extra work

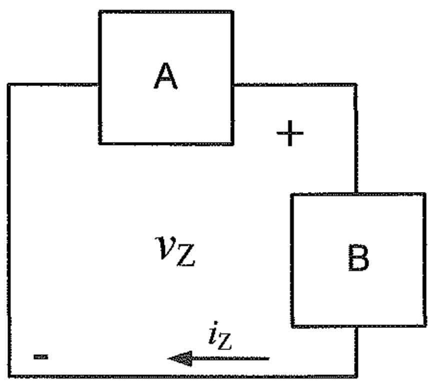
For the devices A and B shown in the diagram below, do the following.

a) Find a simplified algebraic expression for the energy delivered by Device A as a function of time t after t = 0. Your expression should not contain integrals.

b) Find a numerical value for the energy delivered by Device A in the first 250[ms] after $t = 0$.

c) Find the time at which the power delivered to Device B is 0. If no such time exists, state that this is the case.

$$v_Z(t) = -12 + 20e^{(-200[\text{ms}^{-1}]t)}[\text{V}];\ \text{for } t \geq 0.$$
$$i_Z(t) = 750[mA]\ \text{for } t \geq 0.$$



a) At A, current is in the direction of voltage rise, so...

$$w_{\text{del by }A}(t) = \int_0^t p_{\text{del by }A}(t)\,dt = \int_0^t v_Z(t)\, i_Z(t)\,dt$$

$$= \int_0^t \left(-12[V] + 20[V]e^{-200[\text{ms}^{-1}]t}\right)(750[mA])\,dt$$

I like to convert to [V], [A], [s]:

$$= \int_0^t \left(-12 + 20e^{-200\times10^3[s^{-1}]t}\right)(0.750)\,dt \qquad [J] \qquad t \text{ in } [s]$$

$$= \left[-9t + \frac{15}{-200\times10^3} e^{-200\times10^3[s^{-1}]t}\right]_0^t$$

$$w_{\text{del by }A}(t) = -9t - 7.5\times10^{-5} e^{-200\times10^3[s^{-1}]t} + 7.5\times10^{-5} \qquad [J] \quad t \text{ in } [s]$$

Room for extra work

b) We evaluate $w_{del\ by\ A}$ at $t = 0{,}250$ [s], by plugging in to the last expression, or by changing the integration limit to 0.250 [s]. In either case...

$$w_{del\ by\ A}(t = 0.250\,[s]) = -2.2499\ [J]$$

c) power will be 0 when $v_2(t) = 0$...

$$-12 + 20e^{-200\times10^3\,[s^{-1}]t} = 0$$

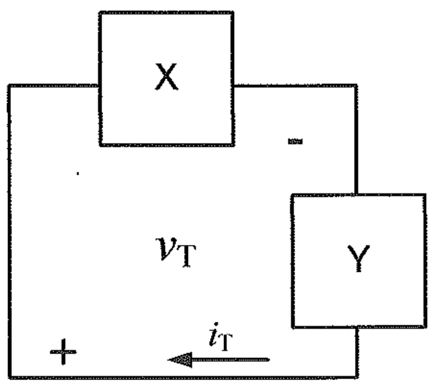
$$e^{-200\times10^3\,[s^{-1}]t} = \frac{12}{20}$$

$$t = \frac{-1}{200\times10^3}\ln\frac{12}{20} = 2{,}55\ [\mu s]$$

For the devices X and Y shown in the diagram below, do the following.

a) Find a simplified algebraic expression for the energy delivered by Device X as a function of time t after t = 0. Your expression should not contain integrals.
b) Find a numerical value for the energy delivered by Device X in the first 300[ms] after $t = 0$.
c) Find the time at which the power delivered to Device Y is 0. If no such time exists, state that this is the case.

$$v_T(t) = -8 + 16e^{(-250[\text{ms}^{-1}]t)}[\text{V}];\ \text{for } t \geq 0.$$
$$i_T(t) = -250[mA] \text{ for } t \geq 0.$$



a) At X, current is in the direction of voltage drop, so...

$$w_{del\,by\,X}(t) = \int_0^t p_{del\,by\,X}(t)\,dt = -\int_0^t v_T(t)\,i_T(t)\,dt$$

$$w_{del\,by\,X}(t) = -\int_0^t (-8[V] + 16[V]e^{-250[ms^{-1}]t})(-250[mA])\,dt$$

I like to convert to [V], [A], [s]:

$$= +\int_0^t (-8 + 16e^{-250\times10^3[s^{-1}]t})(0.250)\,dt \quad [J]$$

t in [s]

$$= \left[-2t + \frac{4}{-250\times10^3} e^{-250\times10^3[s^{-1}]t}\right]_0^t$$

$$w_{del\,by\,X}(t) = -2t - 1.6\times10^{-5} e^{-250\times10^3[s^{-1}]t} + 1.6\times10^{-5} \quad [J]\ t \text{ in } [s]$$

Room for extra work

b) We evaluate $w_{del\ by\ x}$ at 0,3 [s] either by substituting the 0,3 [s] into the expression above, or by changing the integration limit to 0,3 [s]. In either case...

$$w_{del\ by\ x}(t = 0{,}3\ [s]) = -0.599984\ [J]$$

c) power will be 0 when $v_T = 0$...

$$-8 + 16\, e^{-250\times10^{3}[s^{-1}]t} = 0$$

$$t = \frac{-1}{250\times10^{3}} \ln\left(\frac{8}{16}\right) = 2{,}77\ [\mu s]$$