

Name: Solution (please print)

Signature: _____

ECE 2201 – Quiz #1
September 10, 2019

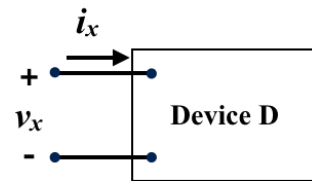
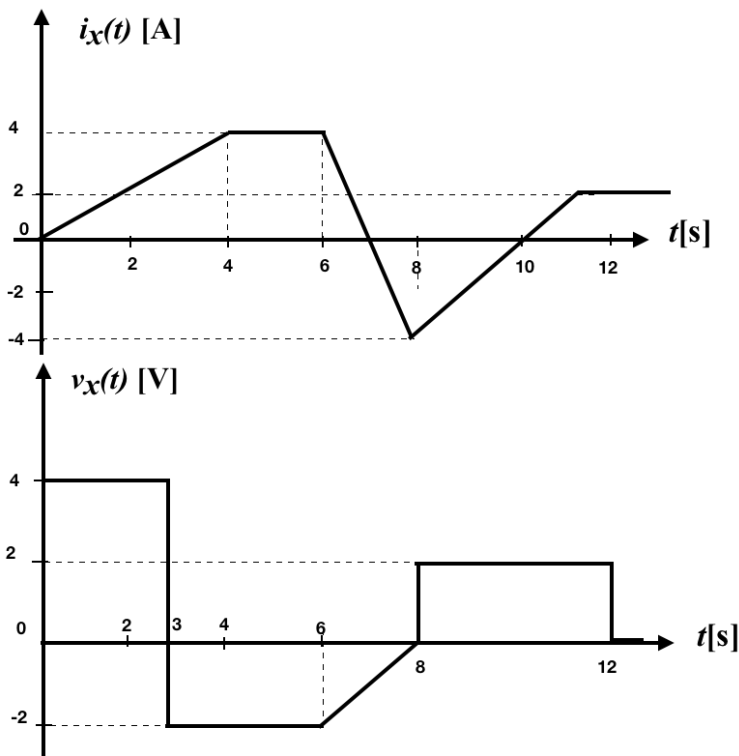
**Keep this quiz closed and
face up until you are told to
begin.**

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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The device shown below has the current $i_x(t)$ and voltage $v_x(t)$ plotted for $0 [s] < t < 12 [s]$.

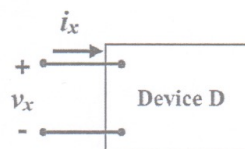
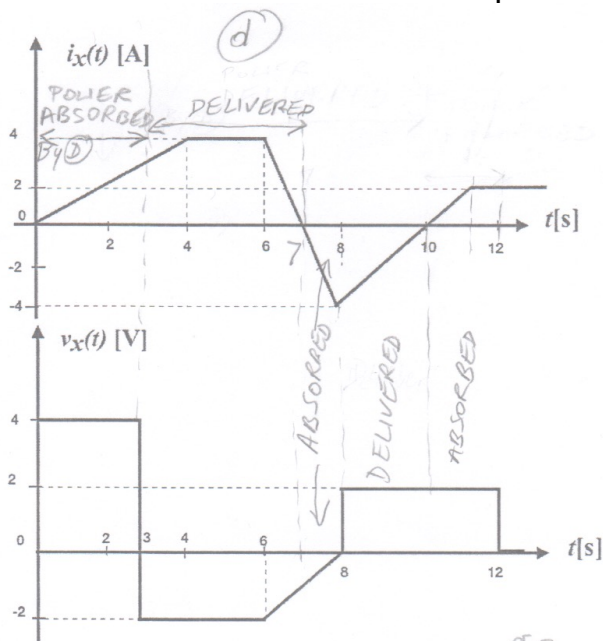
- Determine the direction (right or left) of the electrons' flows in the time interval $8 [s] < t < 12 [s]$
- Find charge $q(t)$ flowing through the device from 0 to 8 seconds.
- Find the numerical expressions for power absorbed by this device and make a plot $p_{\text{ABS,D}}(t)$ for $8 [s] < t < 12 [s]$.
- Determine time intervals when the power is absorbed and when the power is delivered by Device D.
- Determine time interval(s) when electrons in Device D gain energy.



Room for extra work

The device shown below has the current $i_x(t)$ and voltage $v_x(t)$ plotted for $0 [s] < t < 12 [s]$.

- Determine the direction (right or left) of the electrons' flows in the time interval $8 [s] < t < 12 [s]$
- Find charge $q(t)$ flowing through the device from 0 to 8 seconds.
- Find the numerical expressions for power absorbed by this device and make a plot $p_{\text{ABS,D}}(t)$ for $8 [s] < t < 12 [s]$.
- Determine time intervals when the power is absorbed and when the power is



- i_x is negative for $8 [s] < t < 10 [s]$ so electrons flow: \rightarrow (right)
 - for $10 [s] < t < 12 [s]$ i_x is positive so electrons flow: \leftarrow (left)

b) $t \in [0, 8]$ $q(t) = \int_0^{8[s]} i_x(t) dt$ or area under the $i_x(t)$ plot.

$$t \in [0, 4] \quad i_x(t) = t$$

$$t \in [4, 6] \quad i_x(t) = 4 [A]$$

$$t \in [6, 8] \quad i_x(t) = -\frac{8}{2}t + 28 [A] = -4t + 28 [A]$$

$$q(t) = \int_0^4 t dt + \int_4^6 4 dt + \int_6^8 (-4t + 28) dt = \frac{t^2}{2} \Big|_0^4 + 4t \Big|_4^6$$

$$+ (-2t^2) \Big|_6^8 + 28t \Big|_6^8 = 16 [C] \text{ (total charge)}$$

$$q(t) = \frac{1}{2} 4 \cdot 4 + 4 \cdot 2 + \frac{4 \cdot 1}{2} - \frac{4 \cdot 1}{2} = 16 [C]$$

c) We need to find expression for $i_x(t)$ for $8[s] < t$ & t_0 for $i_x(t) = 2[A]$

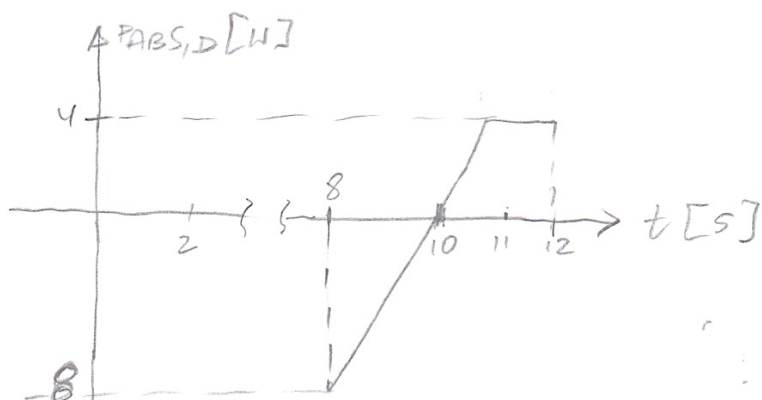
$$i_x(t) = \frac{4}{2}t - 20[A] \rightarrow i_x(t_0) = 2 \rightarrow t_0 = 11[s]$$

$$P_{ABS,D}(t) = i_x(t) \cdot v_x(t) \quad t \in [8, 12]$$

the same functions $P_{ABS,D} = (2t - 20[A]) \cdot 2[V] = 4t - 40 [W] \quad t \in [8, 10]$

$$P_{ABS,D} = (2t - 20[A]) \cdot 2[V] = 4t - 40 [W] \quad t \in [10, 11]$$

$$P_{ABS,D} = 2[A] \cdot 2[V] = 4[W] \quad t \in [11, 12]$$



e) electrons gain energy when power is delivered by dev. D_j i.e. in the intervals $3[s] < t < 7[s]$ and $8[s] < t < 10[s]$