Name: Solution (please print)

Signature: _____

ECE 2201 – Quiz #1
February 6, 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.

_____/20

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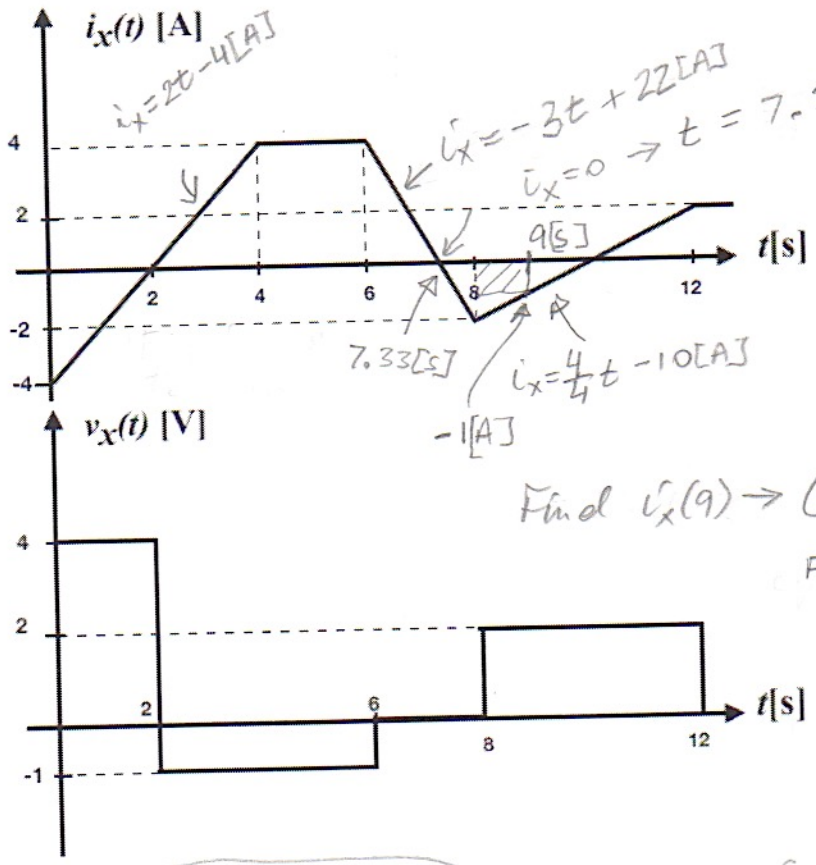
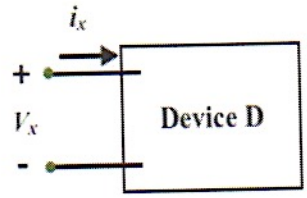
The device shown below has the current $i_x(t)$ and voltage $v_x(t)$ plotted for $0\ [s] < t < 12\ [s]$.

a) Find charge q(t) flowing through the device from 2 to 9 seconds.
b) Find the numerical expressions for power absorbed by this device and make a plot $p_{ABS.D}(t)$.
c) Determine time intervals when the power is absorbed and when it is delivered by device D.
d) Determine in which time interval(s) electrons gain energy.





a) $q(t) = \int_2^9 i_x(t)\,dt$ [C]

It is equivelent to calculated area defined by $i_x(t)$.

Find $i_x(9) \rightarrow$ @ $t = 9$[s] $\quad i_x(9) = 9 - 10 = \boxed{-1[A]}$

For $2[s] < t < 9[s]$

$$q[C] = \frac{1}{2}\,2 \cdot 4 + 4 \cdot 2 + \frac{1}{2}\,4 \cdot (7.33 - 6) - \frac{1}{2}(8 - 7.33) \cdot 2 - 1 \cdot 1 - \frac{1}{2}(1 \cdot 1) = \boxed{12.49\ [C] \sim 12.5\ [C]}$$

→ or integral (easier in this case)

$$q(t) = \int_2^4 (2t-4)\,dt + \int_4^6 4\,dt + \int_6^8 (-3t+22)\,dt + \int_8^9 (t-10)\,dt =$$

$$= 4 + 8 + 2 - \frac{3}{2} = 12.5\ [C]$$

b) $v_x(t)$

$0 < t < 2[s] \quad v_x(t) = 4\ [v]$

$2[s] \le t < 6[s] \quad v_x(t) = -1\ [v]$

$6[s] \le t < 8\ [s] \quad v_x(t) = 0\ [v]$

$8[s] \le t < 12\ [s] \quad v_x(t) = 2\ [v]$

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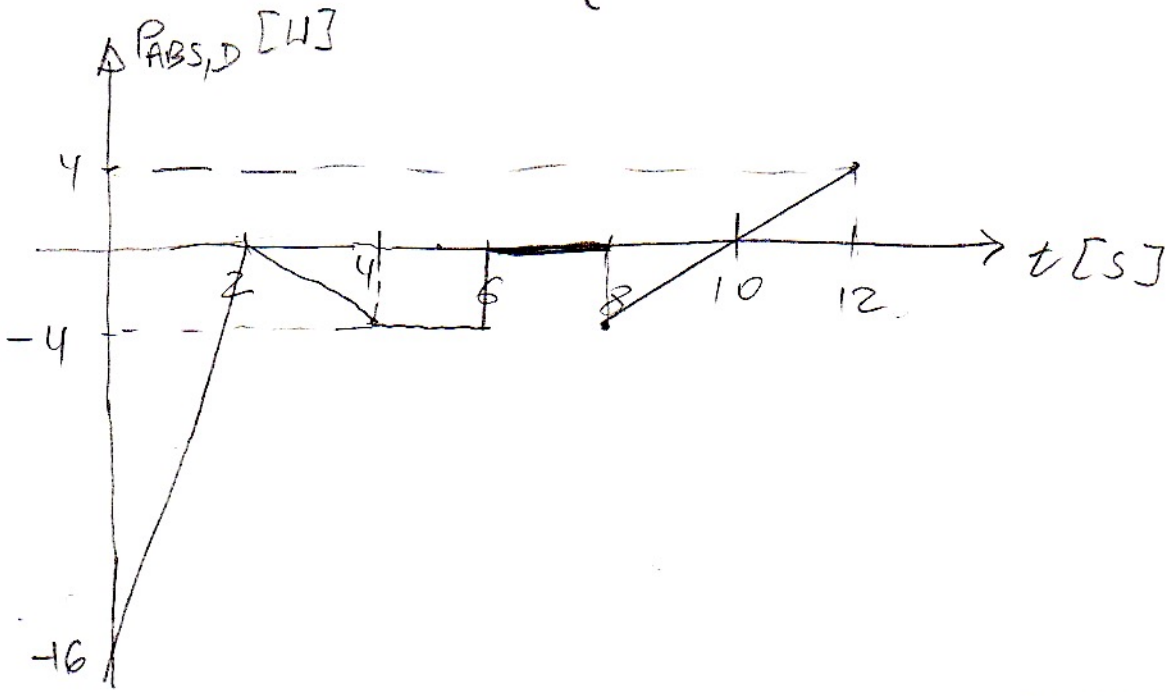
Room for extra work

b) Power absorbed: power in [W]; time in [s]

$$P_{ABS,D} = v_x(t) \cdot i_x(t) = \begin{cases} 4 \cdot (2t-4) & 0 < t < 2 \\ -(2t-4) & 2 \leq t < 4 \\ -4 & 4 \leq t < 6 \\ 0 & 6 \leq t < 8 \\ 2(t-10) & 8 \leq t < 12 \end{cases} \quad [W]$$



c) Power is absorbed for $10\,[s] < t < 12\,[s]$
In the remaining intervals $0 < t < 6s$ & $8 < t < 10$ power is delivered. From 6 to 8 seconds power is zero.

d) Electrons gain energy when power is delivered i.e. when $t = (0,6) \cup (8,10)$.

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