Name: ______________________________ (please print)

Signature: ___________________________

ECE 2201 – Quiz #1
June 7, 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. Show all units in solutions, intermediate results, and figures. Units in the quiz will be included between square brackets.
4. If the grader has difficulty following your work because it is messy or disorganized, you will lose credit.
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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Room for extra work

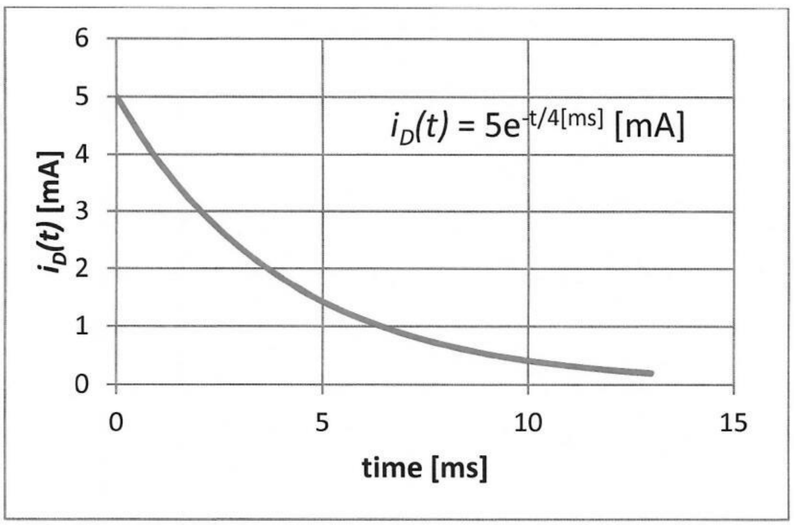
The current $i_D(t)$ for device D is plotted in the graph below. The voltage v_D is known to be constant, but its value is unknown.

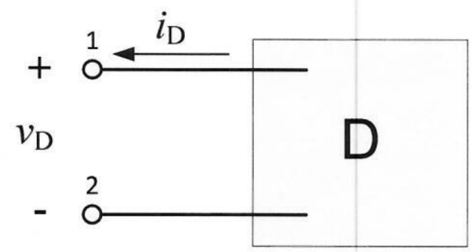
a) The energy delivered by device D in the time interval 10 [ms] to 20 [ms] is 200 [mJ]. What is the voltage v_D?

b) What is the power delivered to D at t = 20 [ms]?

c) Assuming charge carriers entering D are positive, at which terminal do they enter at t = 20 [ms]?

d) Are positive charge carriers gaining or losing energy at t = 20 [ms]?





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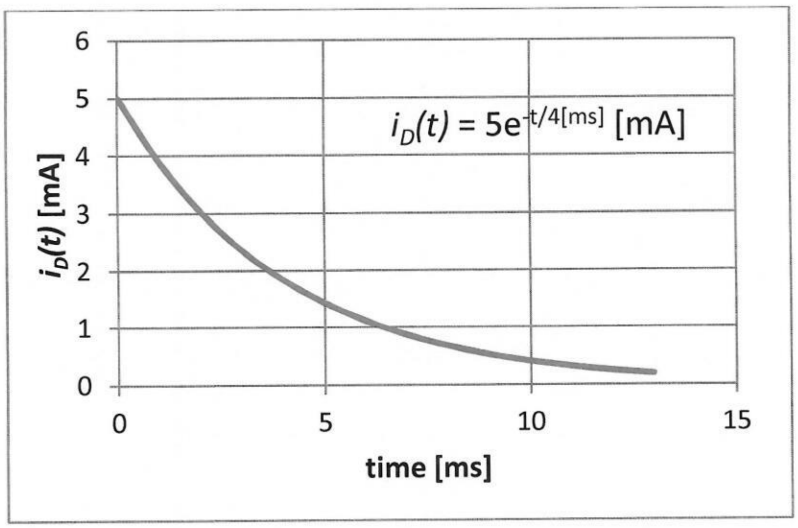

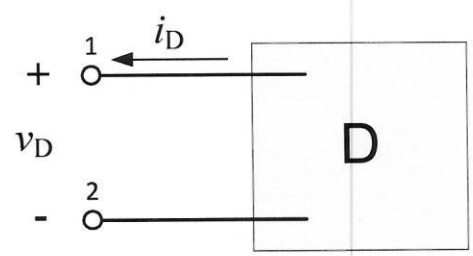

a) $P_{del\ by\ D} = +\, v_D \cdot i_D(t)$

$$w_{del\ by\ D} = \int_{10[ms]}^{20[ms]} 5[mA]\cdot v_D[V]\, e^{-t/4[ms]}\, dt$$

t in [ms], v_D in [V], 5 in [mA] $\Rightarrow$ w in [μJ]

$$= 5 v_D \left(-4[ms]\right) e^{-t/4[ms]} \Big|_{10[ms]}^{20[ms]}$$

$$= -20\,[ms\cdot mA]\, v_D \left(e^{-5} - e^{-2.5}\right) = 1.507\, v_D\ [\mu J]$$

Room for extra work

$\therefore \quad 1.507\, v_D = 200\,000\ [\mu J]$

$v_D = 1.327 \times 10^5\ [V] = 0.1327\ [MV]$

b) $P_{del\ to\ D} = -v_D \cdot i_D(t = 20[ms])$

$= -(0.1327 \times 10^6)(5 \times 10^{-3})e^{-5} = -4.471\ [W]$

c) i_D is positive for all t, so positive charge carriers are in the direction indicated in the diagram for i_D. So positive charge carriers are entering D at terminal 2.

d) Since D is delivering power, charge carriers are gaining energy.

Alternatively, $v_D > 0$ so positive carriers moving from $1 \rightarrow 2$ are gaining energy.