Signature

Name (print, please)

ECE 2300 Circuit Analysis

Summer 2011
Quiz 1

DO NOT OPEN THIS QUIZ BOOKLET UNTIL INSTRUCTED TO DO SO

This quiz has 3 pages including this cover page. If you are missing any pages, raise your hand. You have 30 minutes to complete the quiz.

Notes

1. Be sure your name and signature appear above.
2. The quiz is closed-book. You may have a calculator and one 8 ½ " x 11" crib sheet.
3. To receive full credit for a problem, you must:

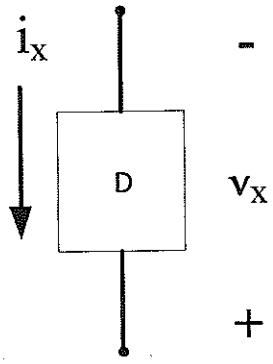
- Show all work necessary to solve the problem;
- Define all variables and parameters and label them on circuit diagrams;
- Use the proper notation for all variables.
- Show all units explicitly in intermediate and final results;
- Indicate clearly whether power being calculated is absorbed or delivered;

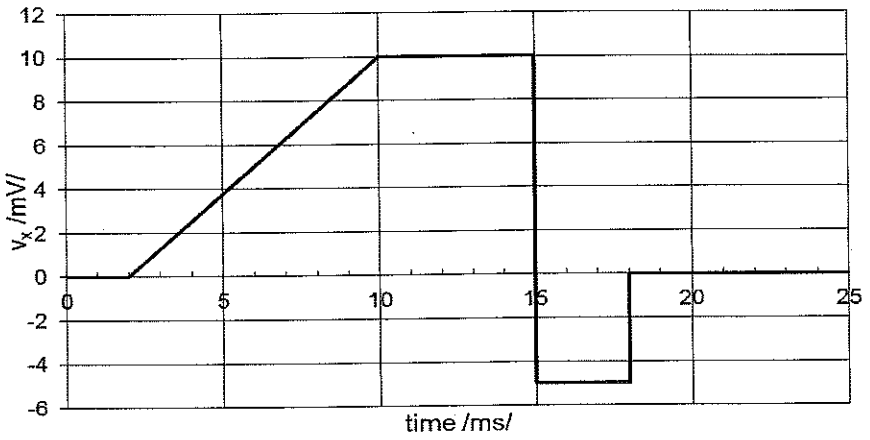
_____/50

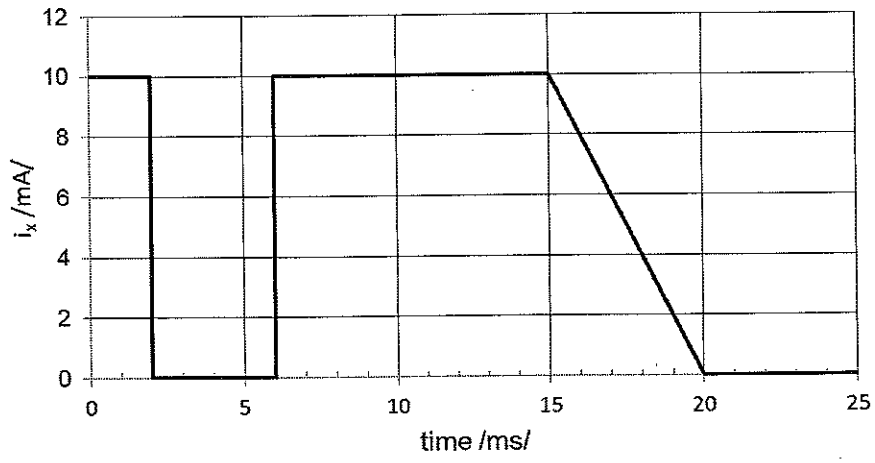
The plots in the figures below show the voltage v_x across and the current i_x through the device D.

+30 i. Find the energy absorbed by the device over the time period 0 to 10 /ms/.

+20 ii. Find the power delivered by the device at 17 /ms/.







2) Energy absorbed by D: $W_{abs,D} = \int_0^{10\,/ms/} P_{abs,D}\, dt$

$P_{abs,D} = -i_x v_x$ so we need an equation for $v_x(t)$. Since $v_x = 0$ for $0 \le t \le 2$ /ms/, we need $v_x(t)$ for $2 \le t \le 10$ /ms/.

I will convert everything to /s/ and /V/ and /A/ to reduce errors in units.

Room for Extra Work

$v_x(t) = a + bt$

$t = 0.002\ [s] \Rightarrow v_x = 0 \quad \therefore \quad 0 = a + 0.002b \qquad (1)$

$t = 0.010\ [s] \Rightarrow v_x = 0.01\ [V] \quad \therefore \quad 0.01 = a + 0.010b \qquad (2)$

Solving these eqns. together gives $a = -0.0025\ [V]$ $b = 1.25\ [\frac{V}{s}]$

+10 $v_x(t) = 1.25t - 0.0025\ [V] \qquad 0.002 \le t \le 0.010\ [s]$

Now $i_x'(t) = 0$ until $t = 0.006\ [s]$ so...

+15 $$W_{abs,D} = -\int_{0.006\ [s]}^{0.010\ [s]} (0.010)(-0.0025 + 1.25t)\,dt$$

$$= \left(2.5\times10^{-5}\,t - \tfrac{1}{2}\,1.25\times10^{-2}\,t^2\right)\Big|_{0.006\ [s]}^{0.010\ [s]}$$

+5 $$\underline{W_{abs,D} = -3\times10^{-7}\ [J] = -0.3\ [\mu J]}$$

ii $P_{del,D} = -P_{abs,D} = -(-i_x')(v_x)$

We could find a general expression for $P_{del,D}$ if we had $i_x'(t)$. Alternatively we can try to read a value for i_x' at $t = 17\ [ms]$ but this invites error... So...

$i_x'(t) = c + dt \qquad t = 0.015\ [s] \Rightarrow i_x' = 0.010\ [A]$

$\therefore \quad 0.01 = c + 0.015d \qquad (1)$

$t = 0.020\ [s] \Rightarrow i_x' = 0 \quad \therefore \quad 0 = c + 0.020d \qquad (2)$

+10 $\Rightarrow \quad i_x'(t) = 0.04 - 2.0t\ [A] \qquad 0.015 \le t \le 0.020\ [s]$

→

$$P_{del,D}\Big|_{t=0,017\,[s]} = i_x\Big|_{t=0,017\,[s]} * v_x\Big|_{t=0,017\,[s]}$$

$$= [0,04 - 2,0(0,017)][-5\times10^{-3}]$$

$\times 10$

$$P_{del,D}\Big|_{t=0,017\,[s]} = -0,03\times10^{-3}\,[W] = -30\,[\mu W].$$
