Name: _____ (please print)

Signature: _____

ECE 3455
Quiz 4
October 28, 2010

Quiz duration: 30 minutes

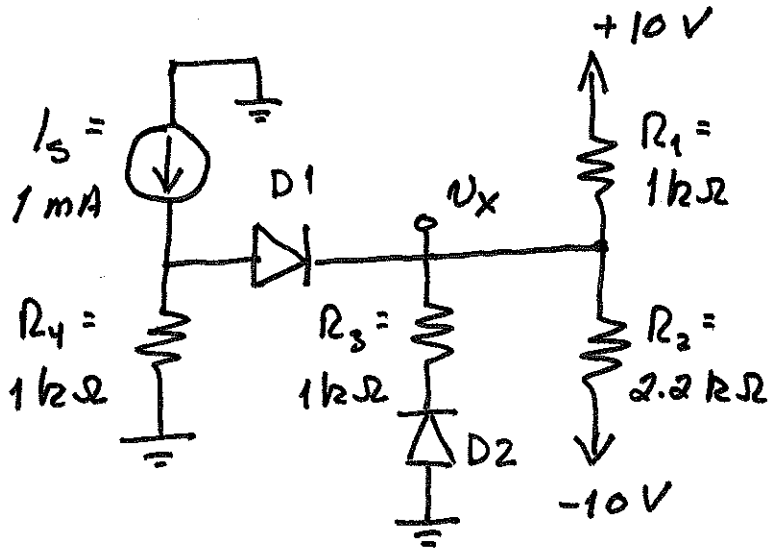
1. You may have one 8 ½ x 11 in. "crib" sheet, written on both sides, during the quiz. You may have any calculator you choose, but no computers. No other notes or materials will be allowed.
2. Show all work necessary to complete the problem on these pages. A solution without the work shown will receive no credit.
3. Show units in intermediate and final results, and in figures.
4. If your work is sloppy or difficult to follow, points will be subtracted.

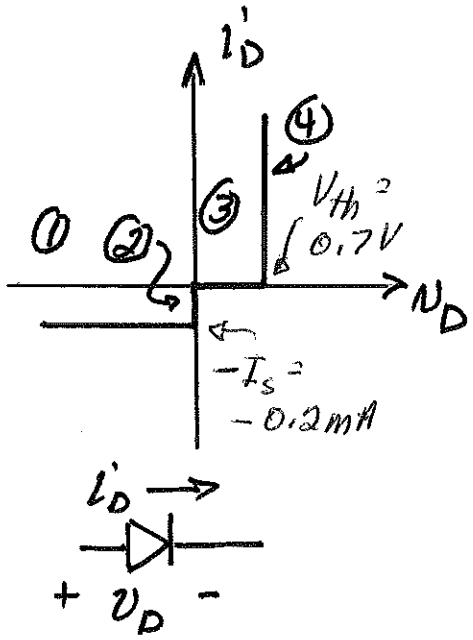
_____/20

The diodes in the circuit below can be represented by a piecewise linear model with $V_{th} = 0.7$ V, $r_D = 0\ \Omega$, and $I_s = 0.2$ mA. This model is shown in the figure.

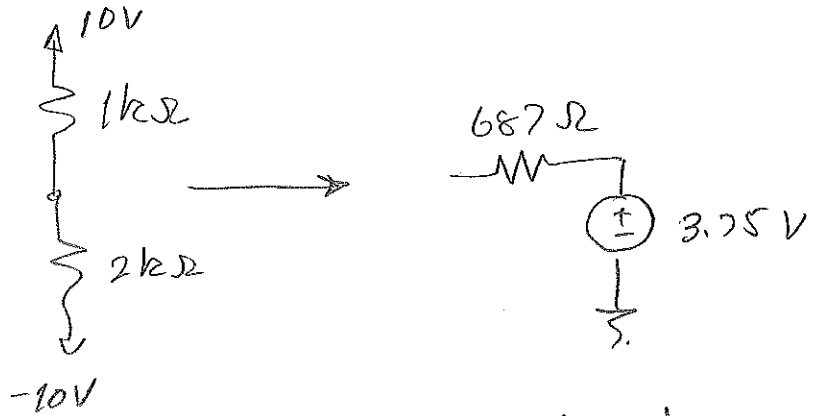
Find v_x. Be sure to prove any assumptions you make about the state of the diodes.

To receive full credit, you must:
(i) Clearly state the assumptions you are making about each diode, and what you will test to prove the assumptions;
(ii) Clearly indicate the results of your test, or else that you are abandoning the current approach and trying again.





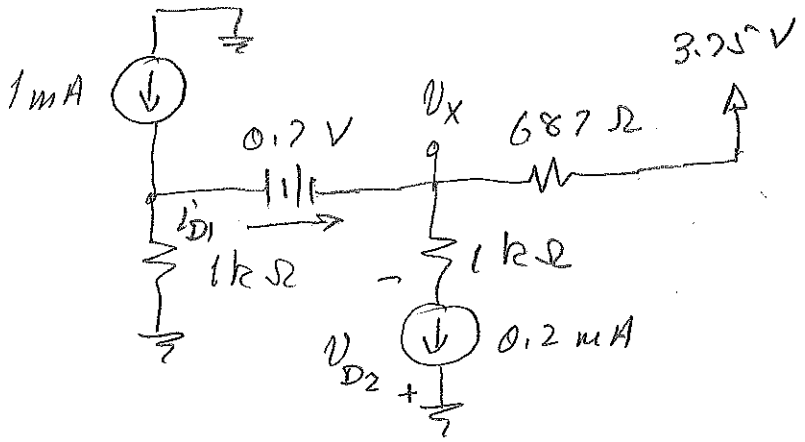
Let's Thevenize the right hand source and resistors:



Based on this, we will guess that $v_x > 0$, and D2 is in reverse bias ①.

We will also assume D_1 is in ④.

Room for Extra Work



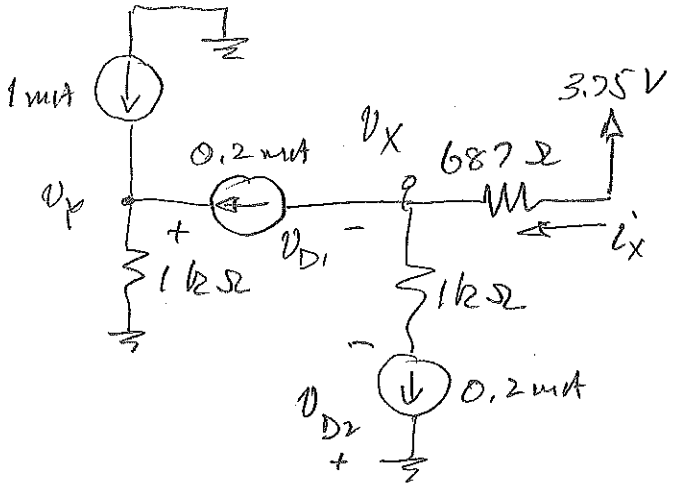
TEST: $v_{D2} \leq 0$? $\quad i_{D1} \geq 0$

$$0.2\times10^{-3} - 1\times10^{-3} + \frac{v_x + 0.7}{1000} + \frac{v_x - 3.75}{687} = 0 \quad \Rightarrow v_x = 2.26\ V.$$

$$v_x = (0.2\times10^{-3})(1000) - v_{D2} \quad \Rightarrow \quad v_{D2} = 0.2 - 2.26\ V < 0 \checkmark$$

$$i_{D1} = \frac{v_x - 3.75}{687} + 0.2\times10^{-3} = -2.37\ mA \quad ! \times \quad \text{no good.}$$

Since D2 was correct we will leave it alone and guess D1 also in (1).



$i_x = 0.4\ mA$

$v_x = 3.75 - 687(4\times10^{-4})$

$\boxed{v_x = 3.48\ V.}$

TEST: $v_{D2} \leq 0$? $\quad v_{D1} \leq 0$

$v_Y = (1.2\times10^{-3})(1000)$

$= 1.2\ V.$

$v_{D2} = 0.2 - 3.48\ V \checkmark$

$v_{D1} = v_Y - v_x = 1.2 - 3.48 = -2.28\ V \checkmark$