Name: _____ (please print)

Signature: _____

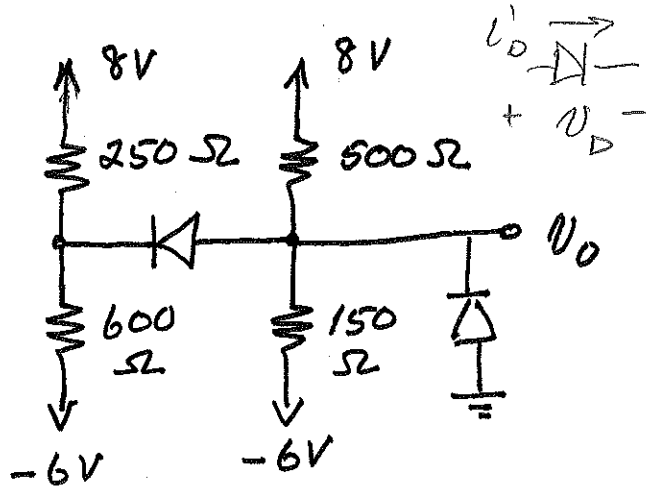
ECE 3455
Quiz #4
Summer 2010

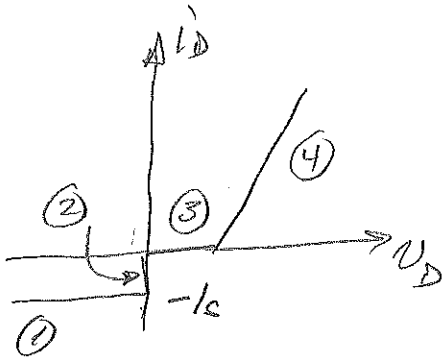
Quiz duration: 25 minutes

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.

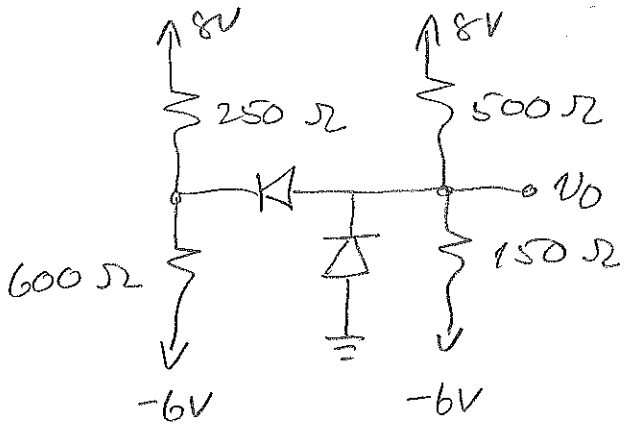
_____/20

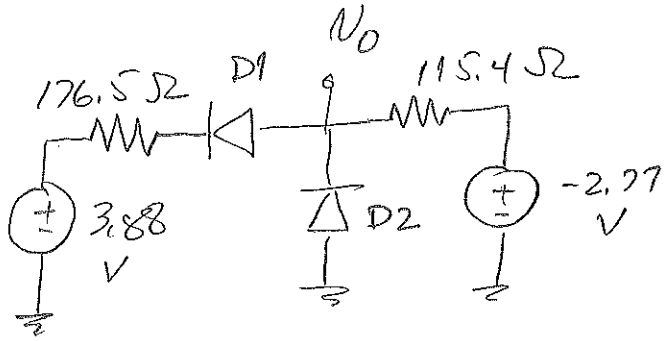
The diodes in the circuit below are characterized by a piecewise linear model in which the threshold voltage is $V_{th} = 0.8$ V, the series resistance is $r_d = 50\ \Omega$, and reverse saturation current is $I_S = 0.2$ mA. For the circuit shown, find v_O. Be sure to prove any assumptions you make about the diode operating regions.





Let's start by re-drawing and Theveninging:





LHS: $R_{Th} = 250 // 600 = 176.5\ \Omega$

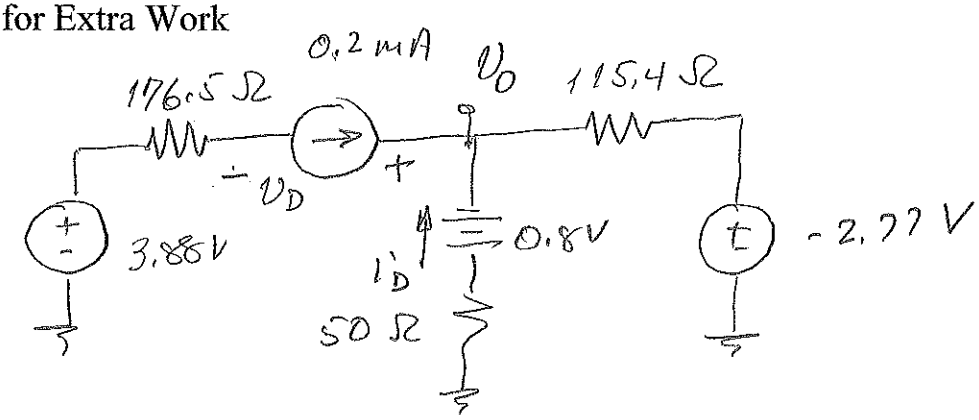
$V_{Th} = 14 \cdot \frac{600}{850} - 6 = 3.88$ V

RHS: $R_{Th} = 500 // 150 = 115.4\ \Omega$

$V_{Th} = 14 \cdot \frac{150}{650} - 6 = -2.77$ V

Guess: D1 in ①, D2 in ④:

Room for Extra Work



We need to prove that $v_D \leq 0$ and $i'_D \geq 0$.

$$\frac{v_O + 0.8}{50} - 2\times10^{-4} + \frac{v_O + 2.77}{115.4} = 0 \quad \Rightarrow \quad v_O = -1.39\ V$$

$$i'_D = \frac{0 - (-1.39) - 0.8}{50} = 11.8\ mA \quad \checkmark$$

$$-3.88 + 0.2\times10^{-3}\cdot 176.5 + v_O = v_D$$

$$v_D = -5.23\ V \quad \checkmark$$

So the diodes are in the regions indicated and

$$v_O = -1.39\ V$$