

Name: _____ (please print)

Signature: _____

ECE 3455
Quiz #4
April 13, 2009

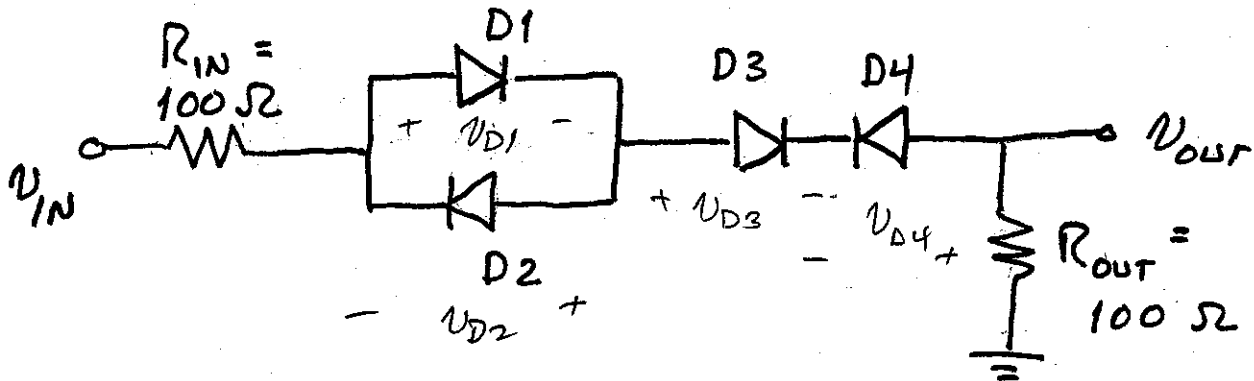
Quiz duration: 30 minutes

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.

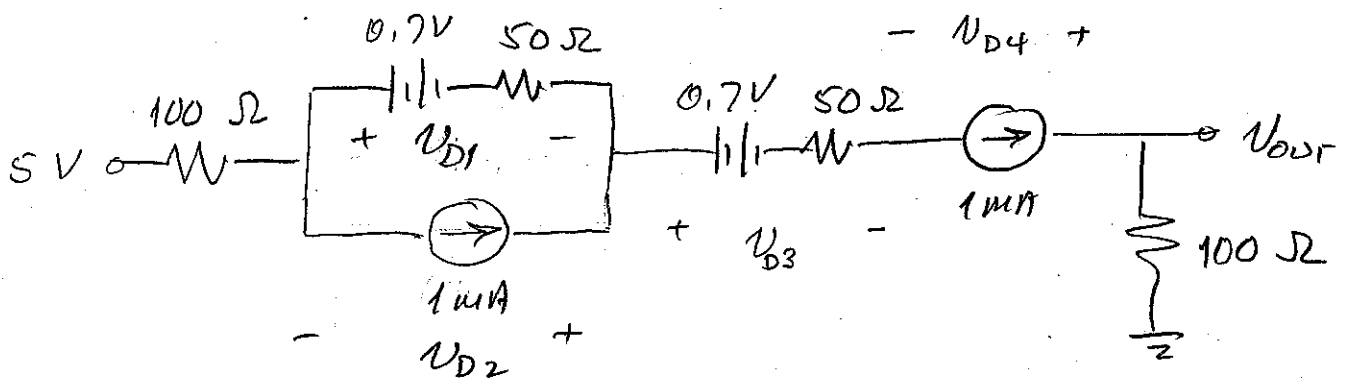
_____/20

In the circuit shown, the model for all diodes is $V_{th} = 0.7\text{ V}$; $r_D = 50\ \Omega$; $I_S = 1\text{ mA}$.

For $v_{IN} = 5\text{ V}$, find v_{OUT} . Your answer is not complete unless you prove that each diode is in the region you are assuming it to be in.

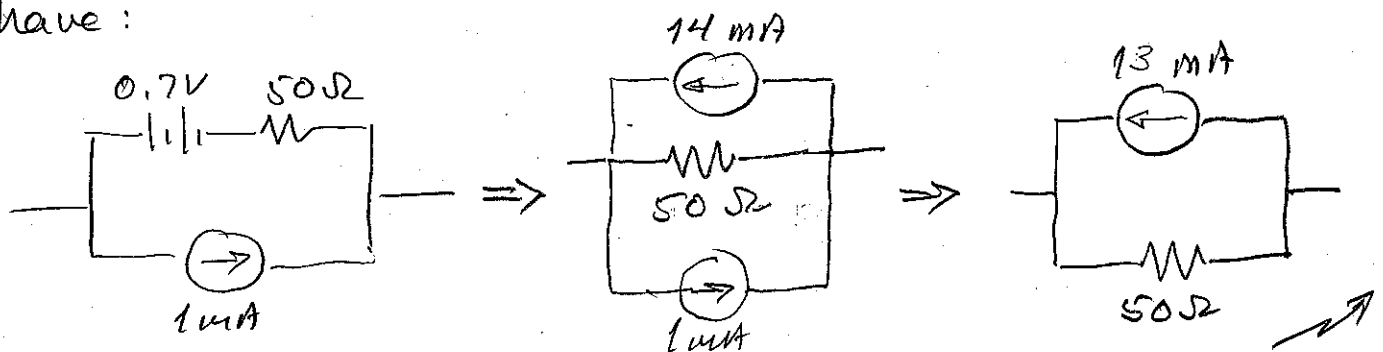


The obvious choice for $v_{IN} \gg 0.7\text{ V}$ is $D1$ and $D3$ in forward bias and $D2, D4$ in reverse bias.

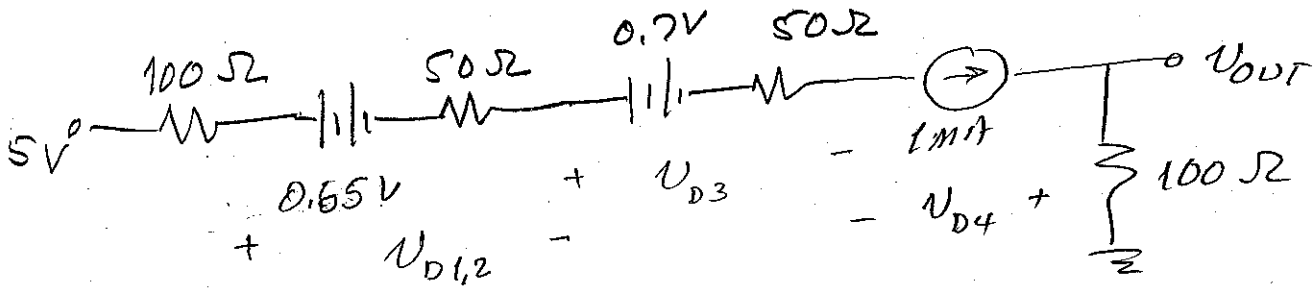


We need to show that $v_{D1} \geq 0.7\text{ V}$, $v_{D3} \geq 0.7\text{ V}$,
 $v_{D2} \leq 0$, $v_{D4} \leq 0$. Via source transformation

we have:



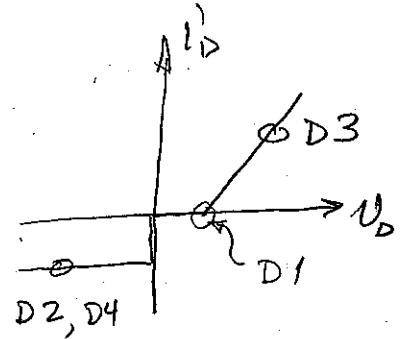
Room for Extra Work



$$V_{D1,2} = 0.65 + 50(0.001) = 0.70 \text{ V}$$

$$\therefore V_{D1} = V_{D1,2} = 0.70 \text{ V} \quad \checkmark$$

$$V_{D2} = -V_{D1,2} = -0.70 \text{ V} \quad \checkmark$$



$$\text{KVL: } -5 + 0.001 \times (100 + 50 + 50 + 100) + 0.65 + 0.7 - V_{D4} = 0$$

$$V_{D4} = -5 + 0.3 + 1.35 = -3.35 \text{ V} \quad \checkmark$$

$$V_{D3} = 0.7 + 50(0.001) = 0.80 \text{ V} \quad \checkmark$$

So all diode states check out OK, and ...

$$\underline{V_{OUT}} = 100 \cdot (0.001) = \underline{0.1 \text{ V}}$$

Note that D₁ is at the edge of the forward bias region, i.e., where $V_D = 0.7 \text{ V}$ and $I_D = 0$ (see figure above).