

Name: \_\_\_\_\_ (please print)

Signature: \_\_\_\_\_

ECE 3455  
Quiz 4  
April 7, 2008

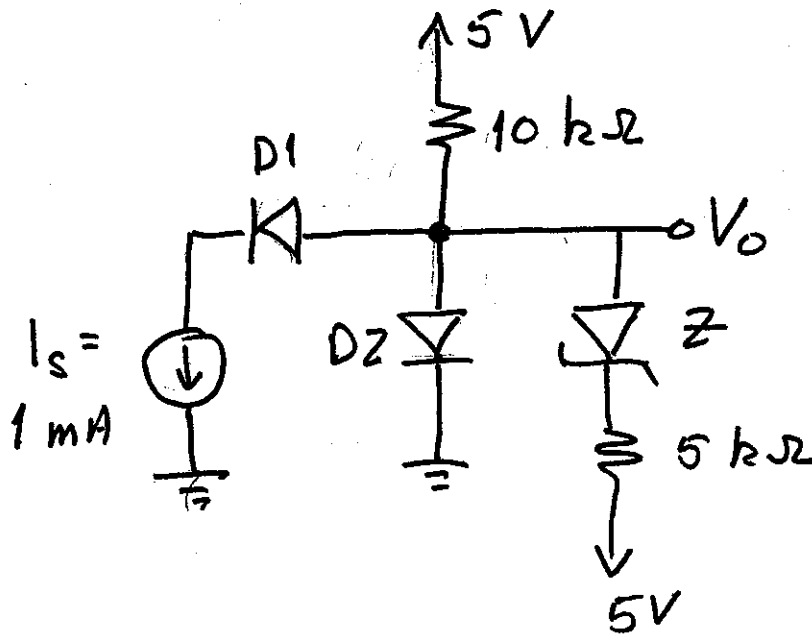
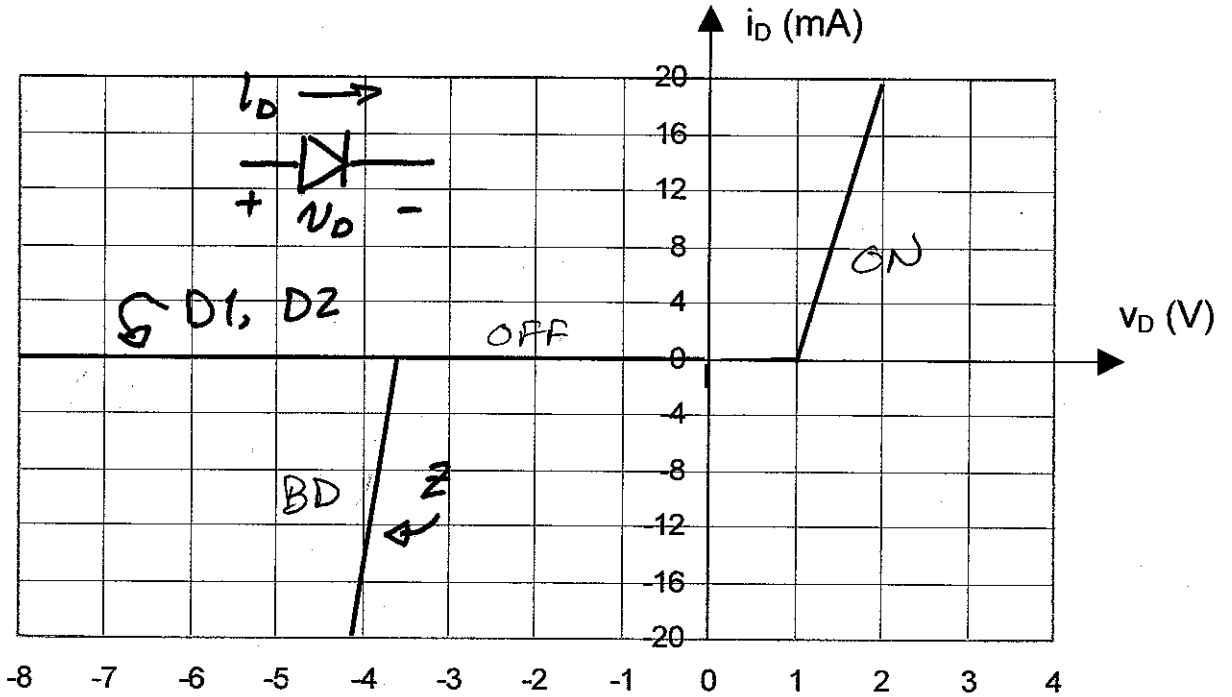
Quiz duration: 30 minutes

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 graph shows the current-voltage characteristics for the diodes in the circuit below. Diodes D1 and D2 and Zener Diode Z have the characteristics indicated.

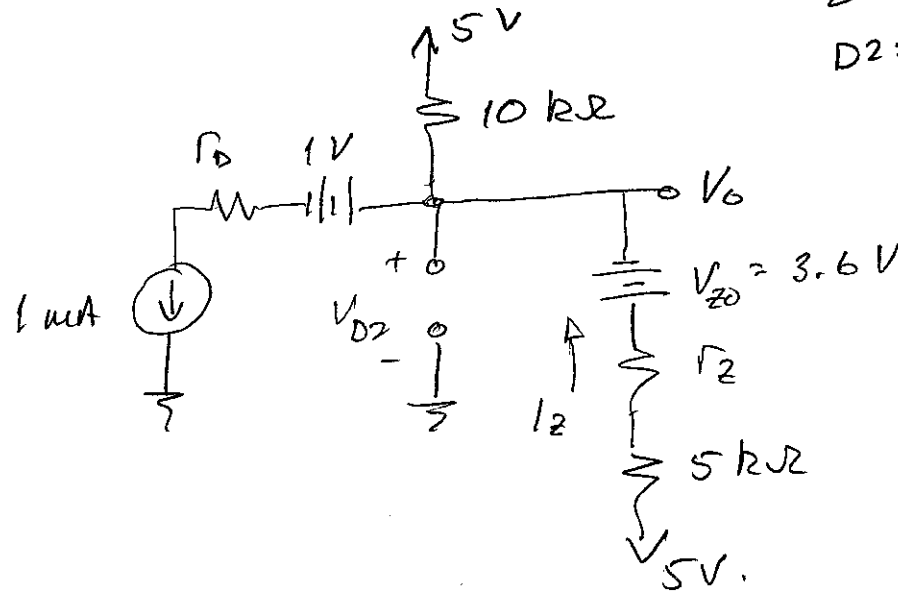
Find  $V_o$ . Be sure to prove that each of the diodes is in the region you assume it to be in. Partial credit can be obtained for incorrect guesses, as long as you demonstrate clearly that your guess is incorrect.



Room for Extra Work

The case for D1 is clear: It must be ON since there is 1 mA flowing through it. For D2 and Z we guess as follows.

Z: BD  
D2: OFF



We need to show that  $V_{D2} \leq 1V$  and  $I_2 \geq 0$ :

$$\frac{V_0 - 5}{10k\Omega} + 0.001 + \frac{V_0 - 5 + 3.6}{5000 + r_2} = 0$$

$$r_2 = \frac{\Delta V}{\Delta I} = \frac{0.5V}{20mA} = 25\Omega$$

So  $r_2$  is negligible. Let's assume it's 0 to keep the math simple - we can revisit this if our guess is wrong.

Room for Extra Work

With  $r_2 = 0$  we have

$$\frac{V_0 - 5}{10k} + \frac{V_0 - 5 + 3.6}{5k} + 0.001 = 0$$

$$\Rightarrow V_0 - 5 + 2V_0 - 10 + 7.2 + 10 = 0$$

$$\therefore V_0 = -0.733 \text{ V.}$$

Thus  $V_{D2} = V_0 \leq 1 \text{ V}$  ✓

$$I_Z = \frac{5 - V_0 - 3.6}{5k\Omega} = 0.427 \text{ mA} \geq 0 \quad \checkmark$$

So the guess is correct. With  $r_2 = 25 \Omega$ , we get  $V_0 = -0.7404 \text{ V}$  so this does not change the conclusion.