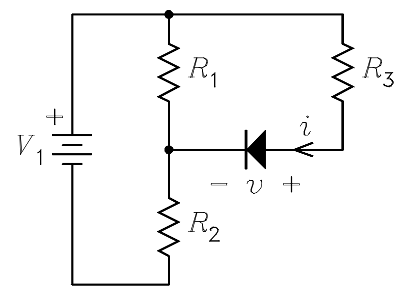
ECE 3040 Microelectronic Circuits Quiz 2
May 26, 2004

Professor Leach Name____________________________________

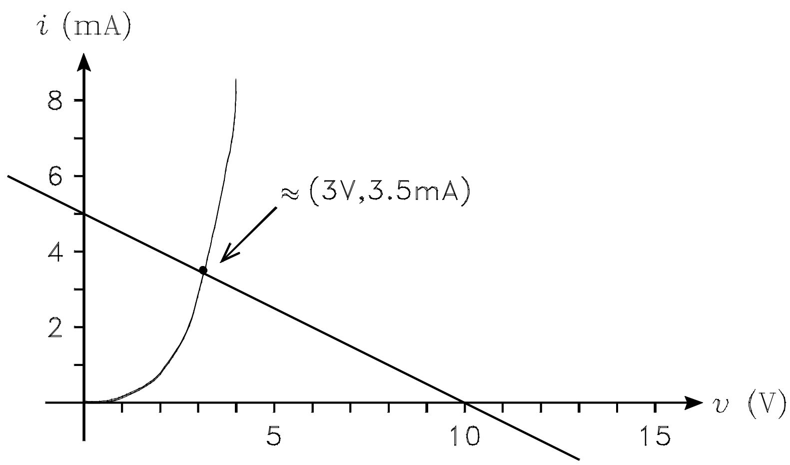
Instructions. Print your name in the space above. The quiz is closed-book and closed-notes. **Honor Code Statement:** *I have neither given nor received help on this quiz.* Initials ______________

1. It is given that $V_1 = 30\,\mathrm{V}$, $R_1 = 1.5\,\mathrm{k}\Omega$, $R_2 = 3\,\mathrm{k}\Omega$, and $R_3 = 1\,\mathrm{k}\Omega$. (An alternate version of the problem had $V_1 = 15\,\mathrm{V}$, $R_1 = 3\,\mathrm{k}\Omega$, $R_2 = 1.5\,\mathrm{k}\Omega$, and $R_3 = 1\,\mathrm{k}\Omega$.
(a) Solve for the Thévenin voltage V_S and Thévenin resistance R_S seen by the diode.



$$V_S = V_1 \frac{R_1}{R_1 + R_2} = 10\,\mathrm{V} \qquad R_S = R_1 \| R_2 + R_3 = 2\,\mathrm{k}\Omega$$

(b) Draw the load line for the diode on the characteristics given and estimate the diode voltage and current at the Q point.



2. (a) A diode is biased at a constant current. If the temperature changes in constant increments ΔT, describe the mathematical variation of the diode voltage. *Answer:* It changes by an additive amount, i.e. you add or subtract something each time the temperature increases by ΔT.
(b) If the temperature of a diode changes in constant increments ΔT, describe the mathematical variation of the saturation current of the diode. *Answer:* It changes by a multiplicitave factor, i.e. you multiply by something each time the temperature increases by ΔT.
(c) Represent the total voltage across a diode by $v_D = V_D + v_d$ and the total current through the diode by $i_D = I_D + i_d$, where V_D and I_D are the Q-point values and v_d and i_d are small-signal changes about the Q point. In deriving the small-signal model of the diode, what is the basic mathematical step that is used to relate i_d to v_d? *Answer:* You solve for the slope or derivative of the i_D versus v_D curve at the Q point and set this equal to the ratio i_d/v_d. Although not part of the answer, this slope is the reciprical of the small-signal resistance r_d.