

Test 1

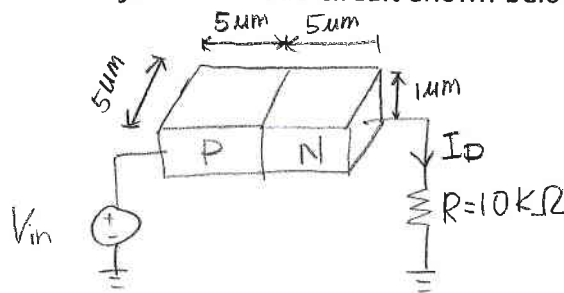
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Electronic Circuits 1

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Prob. 1(20)

Consider a PN junction diode circuit shown below.



$$N_A \text{ for P-side} : 10^{18} \text{ cm}^{-3}$$

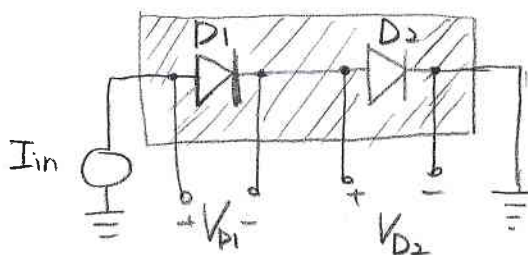
$$N_D \text{ for N-side} : 10^{15} \text{ cm}^{-3}$$

(a)(10) Determine the P-side resistance and the N-side resistance in ohm. Assume electron mobility is $1350 \text{ cm}^2/\text{V-sec}$ and hole mobility is $400 \text{ cm}^2/\text{V-sec}$.

(b)(10) Plot I_D vs V_{in} . Model the PN junction diode with a constant voltage source ($V_{D,on} = 0.8\text{V}$) and resistors for P-region and N-region whose values are determined in (a). In your plot, clearly indicate the value of the slope and where the slope changes.

Prob. 2(20)

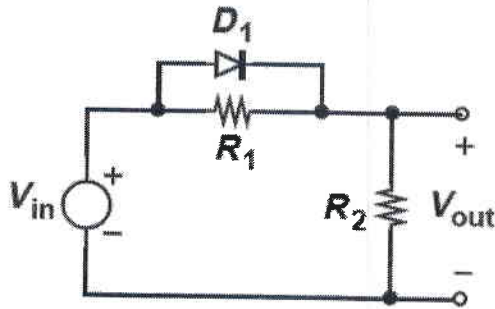
Two PN junction diodes are identical except one diode (D_1) is twice as large as the other diode (D_2). Two diodes are placed on a board and connected in series to a constant current source. When the voltage across each diode is measured, V_{D2} is 20mV larger than V_{D1} . What is the temperature of the board? Assume I_{in} is positive and much larger than the diode saturation current and the temperatures of two diodes are same as that of the board. Use $V_T = 25\text{mV}$ at $T=300\text{K}$.



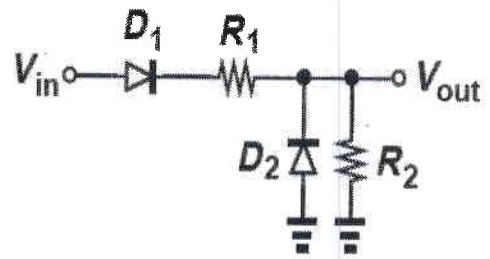
Prob. 3(20)

Plot V_{out} vs V_{in} for following PN junction circuits. Use the constant voltage drop model with $V_{D,on}$. Clearly indicate the value of the slope and where the slope changes.

(a)

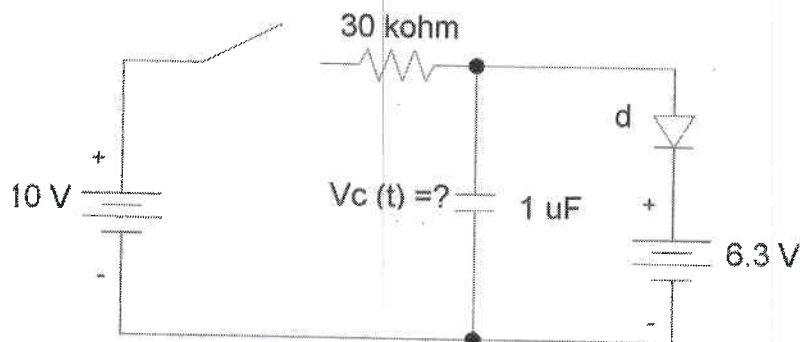


(b)



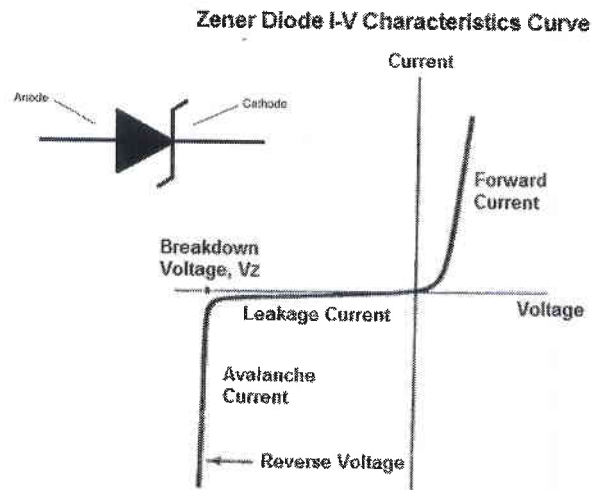
Prob. 4(20)

In the circuit shown below, the switch is closed at $t=0$. Assuming the capacitor has no initial charges, sketch the capacitor voltage $v_C(t)$ as a function of time. Your sketch should include any constant voltage values as well as time constants for exponential curves. Use the ideal diode model.



Prob. 5(20)

A Zener diode can turn on even in the reverse bias if the reverse bias voltage reaches a certain value (V_Z). With the forward bias voltage, it is just like the PN junction diode we discussed in the class. The current-voltage characteristics is shown along with its circuit symbol.



Plot V_{out} vs V_{in} for the following circuit. Use $V_{D,on,forward} = 0.8\text{ V}$ and $V_Z = -10\text{ V}$.

