1. The applied electric field in p-type silicon is E = 15 V/cm. The semiconductor conductivity is $\sigma = 2.2\ (\Omega - cm)^{-1}$ and the cross sectional area is $A = 10^{-4} cm^2$. Determine the drift current in the semiconductor.

2. The required conductivity of a semiconductor material must be $\sigma = 0.5\ (\Omega - cm)^{-1}$. What must be the concentration of donor impurities in the semiconductor?

3. The hole concentration in the semiconductor is given by

$$p(x) = 10^4 + 10^{15} \exp\left(-\frac{x}{L_p}\right) \qquad x \geq 0$$

The value of L_p is $10\ \mu m$. The hole diffusion coefficient is $D_p = 15\ cm^2/s$. Determine the hole diffusion current density at (a) $x = 0, (b) x = 10\ \mu m\ and\ (c)\ x = 30\ \mu m$.

4. The cut-in voltage of the diode shown in the circuit in the Figure 1 is $V_\gamma = 0.7\ V$. The diode is to remain biased "on" for a power supply voltage in the range $5 \leq V_{PS} \leq 10V$. The minimum diode current is to be $I_{D(min)} = 2\ mA$. The maximum power dissipated in the diode is to be no mere than $10\ mW$ . . Determine appropriate values of $R_1\ and\ R_2$.

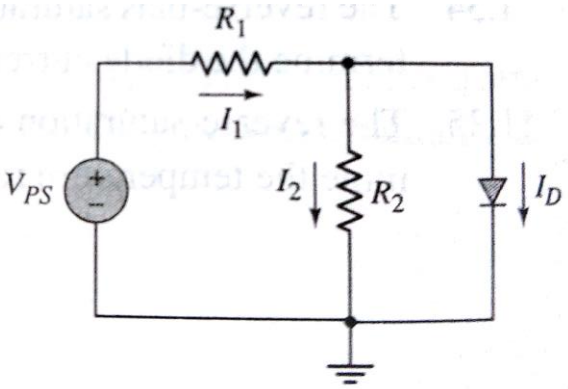

Fig.1

5. Assume each diode in the circuit shown in the Figure 2 has a cut-in voltage of $V_\gamma = 0.65\ V$. (a) The input voltage is $V_I = 5\ V$. Determine the value of R_1 required such that I_{D1} is one-half the value of I_{D2} . What are the values of I_{D1} and I_{D2} ? (b) If $V_1 = 8\ V$ and $R_1 = 2\ k\Omega$, determine I_{D1} and I_{D2} .

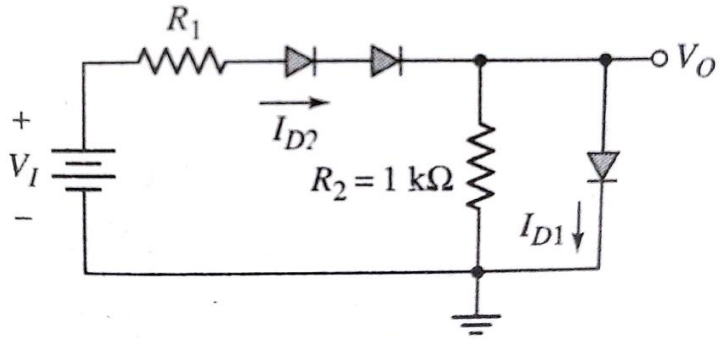

Fig.2

6. The diode in the circuit shown in the Figure 3 is biased with a constant current source I . A sinusoidal signal v_s is coupled through R_s and C. Assume that C is large so that it acts as a short circuit to the signal. (a) Show that the sinusoidal component of the diode voltage is given by $v_0 = v_s\left(\frac{V_T}{V_T+IR_s}\right)$.

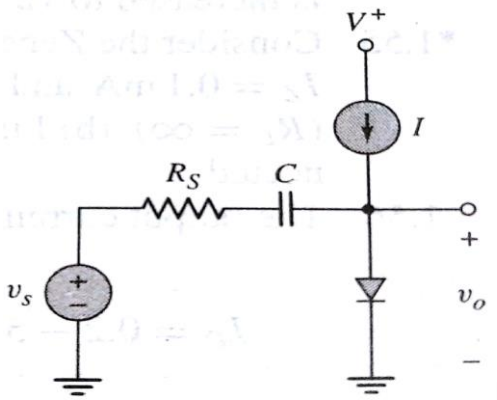

Fig.3

7. Consider the Zener diode circuit shown in Figure 4. The Zener breakdown voltage is $V_Z = 5.6\ V$ at $I_Z = 0.1\ mA$, and the incremental Zener resistance is $r_z = 10\ \Omega$. (a) Determine V_O with no load $(R_L = \infty)$ (b) Find the change in the output voltage if V_{PS} changes by $\pm 1V$. (c) Find V_O if $V_{PS} = 10\ V$ and $R_L = 2\ k\Omega$.

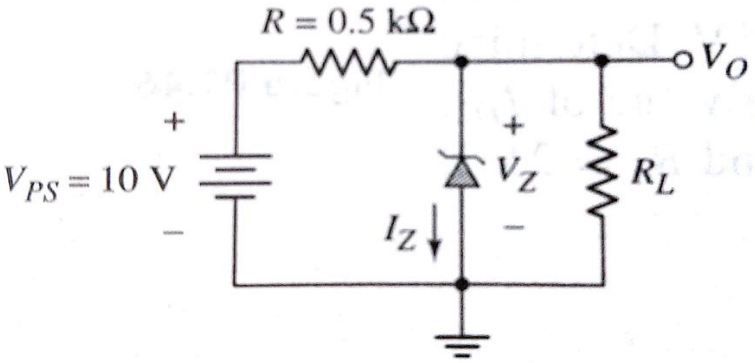

Fig.4

8. Design a circuit to produce the characteristics shown in figure, where v_O is an output voltage and v_I is the input voltage.