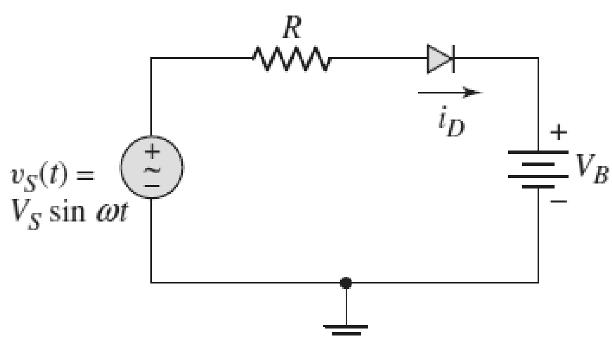
1. A sample of silicon at $T = 300$ K is doped to $N_d = 8 \times 10^{15}$ cm^{-3}. (a) Calculate n_o and p_o. (b) If excess holes and electrons are generated such that their respective concentrations are $\delta n = \delta p = 10^{14}$ cm^{-3}, determine the total concentrations of holes and electrons.

2. A silicon PN junction at T= 300K is doped at $N_d = 10^{16}$cm^{-3} and $N_a = 10^{17}$cm^{-3}. The junction capacitance is to be $C_j = 0.8$ pF when a reverse-bias voltage of $V_R = 5$V is applied. Find the zero-biased junction capacitance C_{j0}.

3. Consider the circuit shown below. Assume V_B =12V, R = 100Ω, and V_γ=0.6V. Also assume v_S(t)=24sin$w$t. Calculate the maximum reverse-bias voltage, the peak diode current and the fraction of the cycle over which the diode is conducting.



4. (a) At what reverse-bias voltage does the reverse-bias current in a silicon PN junction diode reach 90 percent of its saturation value? (b) What is the ratio of the current for a forward-bias voltage of 0.2 V to the current for a reverse-bias voltage of 0.2 V?

5. The reverse-saturation current of a silicon PN junction diode at T = 300K is $I_s = 10^{-12}$A. Determine the temperature range over which I_s varies from $0.5*10^{-12}$A to $50*10^{-12}$A.

   A silicon PN junction diode has an applied forward bias voltage of 0.6V. Determine the ratio of current at 100°C to that at -55°C.

6. A half-wave rectifier uses a diode with an equivalent forward resistance of 0.3Ω. If the input ac voltage is 10 V (rms) and the load is a resistance of 2.0Ω, calculate $\mathbf{I_{dc}}$ and $\mathbf{I_{rms}}$ in the load.
7. A half-wave rectifier uses a diode with a forward resistance of 100Ω. If the input ac voltage is 200 V (rms) and the load resistance is 2 kΩ, determine

   $\mathbf{a.\ I_{max}, I_{dc}\ and\ I_{rms}}$

   b. Peak inverse voltage when the diode is ideal

   c. Load output voltage

   d. dc output and ac input power

   e. Ripple factor

   f. Rectification efficiency

8. The load resistance of a centre-tapped full-wave rectifier is 500Ω and the necessary end to end voltage is 60 sin (100πt). Calculate

   a. Peak, average and rms values of current.
   b. Ripple factor
   c. Efficiency of the rectifier

   Each diode has an idealized I-V characteristics having slope corresponding to a resistance of 50Ω.

9. A centre-tapped transformer has a 220 V primary winding and a secondary winding rated at 12-0-12 V and is used in a full-wave rectifier circuit with a load of 100Ω. What is the dc output voltage, dc load current.

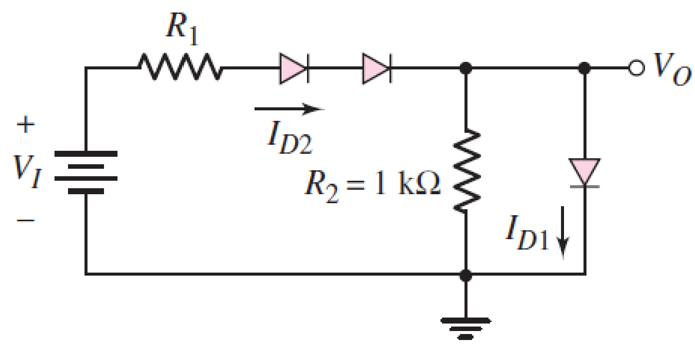
10. In a certain copper conductor, the current density is 2.4 A/$\boldsymbol{mm^2}$ and the electron density is $\mathbf{5 \times 10^{28}}$ free electrons per $\boldsymbol{m^3}$ of the copper. Determine the drift velocity of the electron.

11. A silicon sample is fabricated such that the hole concentration is $p_o = 2 \times 10^{17}$ cm^{-3}. (a) Should boron or arsenic atoms be added to the intrinsic silicon? (b) What

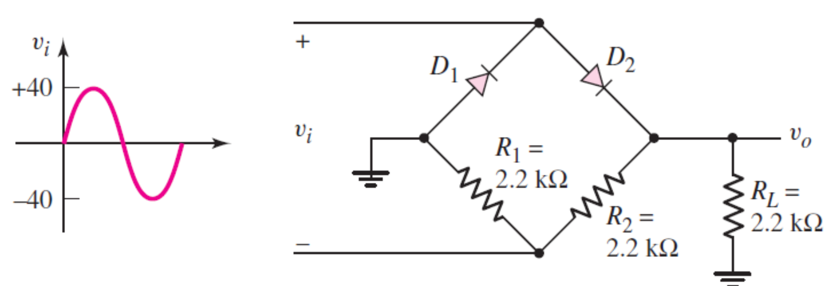
concentration of impurity atoms must be added? (c) What is the concentration of electrons?

12. (a) At what reverse-bias voltage does the reverse-bias current in a silicon pn junction diode reach 90 percent of its saturation value? (b) What is the ratio of the current for a forward-bias voltage of 0.2 V to the current for a reverse bias voltage of 0.2 V?

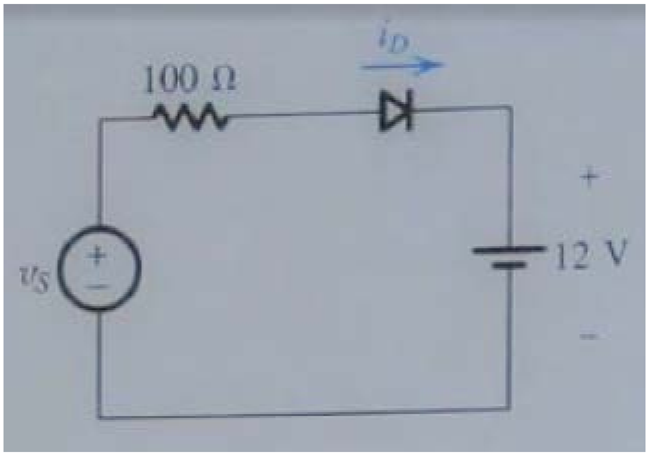
13. Assume each diode in the circuit shown in Figure has a cut-in voltage of V_γ = 0.65V. (a) The input voltage is V_I = 5V. Determine the value of R_1 required such that I_{D1} is one-half the value of I_{D2}. What are the values of I_{D1} and I_{D2}? (b) If V_I = 8V and R_1 = 2kΩ, determine I_{D1}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



14. Sketch v_o versus time for the circuit in Figure with the input shown. Assume V_γ = 0.



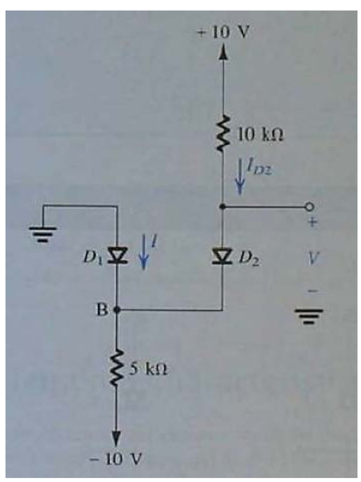
15. Figure shows a circuit for charging a 12V battery. If Vs is sinusoid with 24-V Peak amplitude, find the fraction of each cycle for which the diode conducts. Also find the peak values of the diode current and the maximum reverse bias voltage that appears across the diode?



16. A Silicon Diode said to be a 1mA device displays a forward voltage of 0.7V at a current of 1mA. Evaluate the junction scaling constant I_S. What scaling constant would apply for a 1-A Diode of the same manufacturer that conducts 1A at 0.7V?

17. Consider a PN junction T=300K with a P- Type doping concentration of $N_A = 10^{18} / cm^3$. Determine the N-type doping concentration such that the maximum electric field is | $E_{\max}$ | = $3*10^5 V/cm$ at a reverse bias voltage of $V_R = 25V$

18. Assume the Diode to be ideal, Find the values of I and V in the circuit



19. Calculate the intrinsic carrier concentration of pure Si at T= 300 k. When the pure si is doped with Arsenic (Nd) find the equilibrium electron and hole concentrations. Comment on the doped Si semiconductor based on the resulting equilibrium concentrations and find the resistivity of the resulted material. For this material find the required electric field which is to be applied in order to induce a drift current density of, 190 A/cm2

20. Calculate built in potential barrier of Si pn junction at room temperature and fora given Donor and acceptor concentrations. Find the junction capacitance for an applied reverse voltage of 2V

21. Assuming piece wise linear diode with parameters as given below, find the diode current and voltage and also the power dissipated in the diode When an ac signal of vi is applied in series with the supply voltage find the DC and ac component of output voltage

$$V_\gamma = 0{\cdot}6V;\quad r_f = 12\Omega;\quad V_S = 6V;\quad R = 4k\Omega$$
$$v_i = 0{\cdot}2 \sin \omega t \ (V)$$

22. A power supply A delivers 10 V dc with a ripple of 0.5 V r.m.s. while the power supply B delivers 25 V dc with a ripple of 1 mV r.m.s. Which is better power supply ?

23. Calculate the minority carrier hole concentration at the edge of the space charge region of a pn junction when a forward bias is applied.
Consider a silicon pn junction at T = 300 K so that ***n,*** = 1.5 x 10^{10} cm^{-3}. **Assume** the n-type doping is 1 x $10^{16}$$cm^{-3}$ and assume that a forward bias of 0.60 V is applied to **the** pn junction. Calculate the minority carrier hole concentration at the edge of the space charge region.