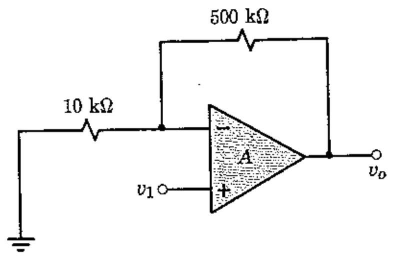

Figure P3.23

P3.24. In Fig. P3.24, $v = 10 \sin \omega t$ V and $V_B = 6$ V. Under what circumstances will current i flow? Sketch v and i as functions of time on the same axes.

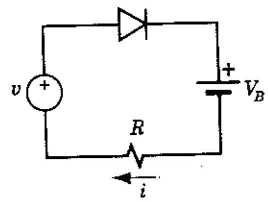

Figure P3.24

P3-25. Explaining your reasoning and stating any simplifying assumptions, predict current I in Fig. P3.25.

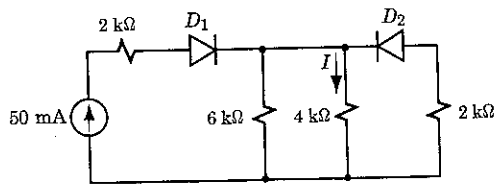

Figure P3.25

P3-26. Four ideal diodes are connected in the fullwave rectifier of Fig. 3.27 where R_L = 1000 Ω. Specify the amplitude of v so that the *average* current through R_L is 20 mA.

P3-27. An ideal diode is used in a half-wave rectifier with power supplied at 120 V (rms) and 60 Hz. For a load $R_L = 2000$ Ω, predict I_{dc}, V_{dc}, and the power delivered to the load.

P3-28. Repeat Problem 3-27 assuming a full-wave bridge rectifier circuit.

P3-29. A diode is connected in series with a 30-V rms source to charge a 12-V battery with an internal resistance of 0.1 Ω. Specify the series resistance necessary to limit the peak current to 2 A. Estimate the time required to recharge a 10-A·hr battery.

Answer: $R = 14.66$ Ω, time = 19.2 h

P3-30. In Fig. 3.30, $C = 100$ μF and $R_L = 10$ kΩ. For $V_m = 20$ V at 60 Hz, predict:

(a) The dc load current through R_L

(b) The percent ripple in v_L

(c) The reading of a dc ammeter in series with R_L if C is disconnected

P3-31. A "load" requires 10 mA at 30 V dc with no more than 0.5 V ripple.

(a) Draw the circuit of a power supply consisting of a transformer with 120-V 60-Hz input, half-wave rectifier, capacitor filter, and effective R_L; specify C and the turn ratio of the transformer.

(b) Repeat for a full-wave bridge rectifier circuit. Draw a conclusion.

P3-32. In Fig. 3.32b, $R = 1$ kΩ, $V_A = 2$ V, and $V_B = 5$ V. Sketch v_2 for $v_1 = 6 \sin \omega t$ V.

P3-33. In Fig. P3.33, $v_1 = 10 \sin \omega t$ V.

(a) Sketch $v_1(t)$ and $v_2(t)$ on the same graph.

(b) Draw the transfer characteristic v_2 versus v_1.

(c) What function is performed by this circuit?

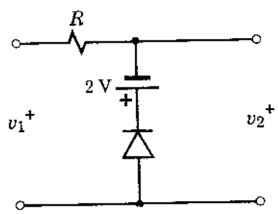

Figure P3.33

P3-34. For $v_1 = 10 \sin \omega t$ V, $R = 1$ kΩ, and $V = 4$ V in Fig. P3.34, sketch $v_2(t)$.

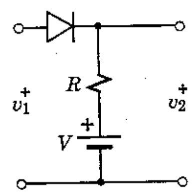

Figure P3.34

P3-35. For $v_1 = 10 \sin \omega t$ V, $R = 1$ kΩ, and $V = 4$ V in Fig. P3.35, sketch $v_2(t)$.

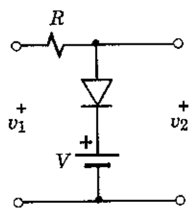

Figure P3.35

P3-36. The periodic voltage v_1 of Fig. P3.36 is applied to the input of Fig. P3.33. Show the input signal v_i and the output signal v_o on the same graph.

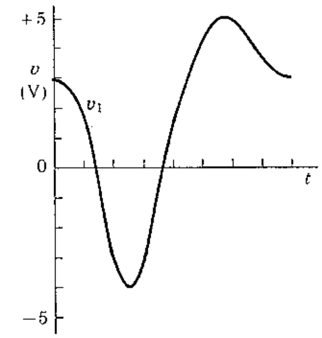

Figure P3.36

P3-37. Repeat Problem P3.36 for the circuit of Fig. P3.37.

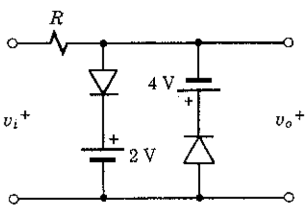

Figure P3.37

P3-38. The periodic voltage v_1 of Fig. P3.36 is applied to the input of Fig. P3.38. Show the input signal v_i and the output signal v_o on the same graph.

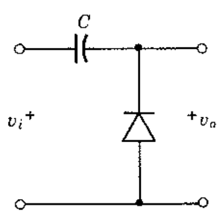

Figure P3.38

P3-39. Repeat Problem 3.38 for the circuit of Fig. P3.39 where $V_B = 2$ V.

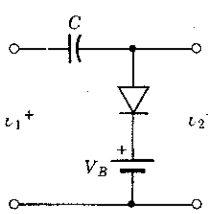

Figure P3.39

P3-40. In Fig. P3.39, $v_1 = 10 \sin \omega t$ V and $V_B = 4$ V. Assuming v_1 has been applied a "long" time, plot v_1, v_C, and v_2 on the same time axis.

P3-41. In Fig. P3.41, when voltage $v_1 = V_m(0.5 + \sin \omega t)$ V, the high-resistance dc voltmeter VM reads 70 V.

(a) What functions are performed by each section of the circuits?

(b) How is v_2 related to v_1? Show v_1, v_2, and v_3 on the same graph.

(c) Determine V_m and define the function of this instrument.

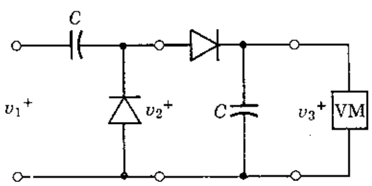

Figure P3.41

P3-42. Devise a circuit using ideal amplifiers to provide an output $v_o = 10 \int v_1\, dt - 5v_2$

P3-43. Devise a sweep circuit using an op amp to provide an output voltage proportional to time. Show a reset switch to ensure that $v_o = 0$ at $t = 0$.

P3-44. Find the effective and average values of the waveforms of Figs. P3.44a and b.

Answer: (a) effective value = 1.15 V; (b) effective value = 4.24 A.

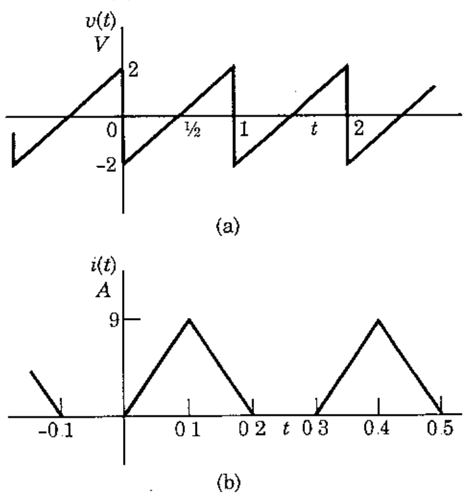

Figure P3.44

P3-45. A regular periodic sinusoidal voltage is given by $v = A \cos \omega t$. Find the effective value and average value for (a) the sinusoid, (b) the half-wave rectified sinusoid, and (c) the full-wave rectified sinusoid

P3-46. Consider a periodic triangular wave as shown in Fig. P3.46 Find the effective value of (a) the triangular wave, (b) the half-wave rectified triangular wave, and (c) the full-wave rectified triangular wave

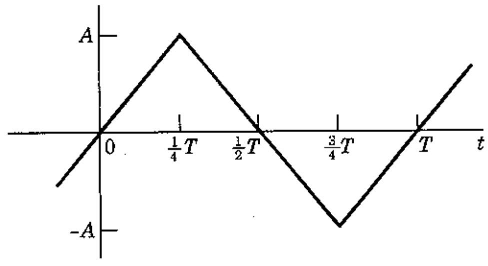

Figure P3 46

P3-47. If $V = 20$ volts and $R_L = 100\ \text{k}\Omega$, what is the instantaneous voltage drop across the diode and what is the instantaneous current in R_L? Assume ideal conditions and sketch v_p of the diode and i of the resistor current

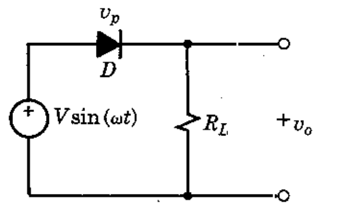

Figure P3 47

P3-48. Given a half-wave rectifier connected to a generator with 100 ohms internal resistance, find the instantaneous output voltage v_o. The forward diode resistance is 200 ohms, and the reverse resistance is 200 kilohms.

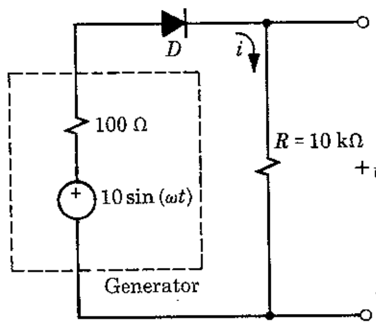

Figure P3 48

P3-49. Assume that the diode in the circuit of Fig. P3 49 is ideal. When the switch is closed at $t = 0$, the capacitor has no initial charge. Sketch at least one cycle of the output voltage v_o beginning at $t = 0$.

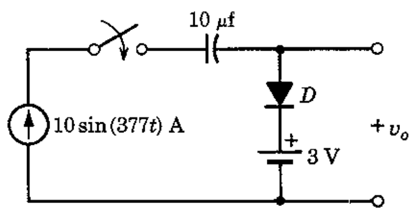

Figure P3 49

ADVANCED PROBLEMS

AP3-1. Demonstrate analytically that the tangent to any exponential function at time t intersects the time axis at $t + \tau$ where τ is the time constant.

AP3-2. The voltage across a 10-μF capacitor is observed on an oscilloscope. In 0.5 s after a 10-V source is removed, the voltage has decayed to 1.35 V. Derive and label a circuit model for this capacitor

AP3-3. A current $i = 2\cos 2000t$ A flows through a series combination of $L = 30$ mH and $C = 5$ μF. (C is initially uncharged.)

(a) Determine the total voltage across the combination as $f(t)$.

(b) Repeat part (a) for L increased to 50 mH and interpret this result physically.

AP3-4. A voltage consists of a dc component of magnitude V_0 and a sinusoidal component of effective value V_1; show that the effective value of the combination is $(V_0^2 + V_1^2)^{1/2}$.

AP3-5. The circuit of Fig. AP3.5 is a practical means for obtaining a high dc voltage without using a transformer. Stating any simplifying assumptions, predict voltages V_1 and V_I.

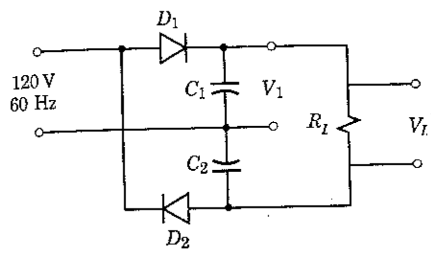

Figure AP3.5

AP3-6. A diode and battery are used in the "voltage regulator" circuit of Fig. AP3.6, where $R_S = 1000\ \Omega$ and $R_L = 2000\ \Omega$. If V_1 increases from 16 to 24 V (a 50% increase), calculate the corresponding variation in load voltage V_L. Is the "regulator" doing its job?

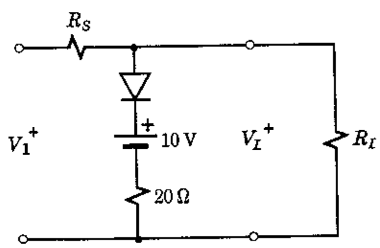

Figure AP3.6

AP3-7. A voltage v_1 varies from −3 to +6 V. For a certain purpose, this voltage must be limited to a maximum value of +4.0 V. A diode, a 6-V battery, and assorted resistances are available. Design a suitable circuit.

AP3-8. The output of a flowmeter is $v = Kq$, where q is in cm³/s and $K = 20$ mV·s/cm³. The effective output resistance of the flowmeter is 2000 Ω. Design a circuit that will develop an output voltage $V_o = 10$ V (to trip a relay) after 200 cm³ have passed the metering point.

AP3-9. In Fig. AP3.9, input voltages A and B are restricted to either 0 or +5 V. Tabulate the four possible combinations of A and B and the corresponding values of output voltage V_o. Define in words the output in terms of the inputs. Why is this called an **OR** circuit? Where is it useful?

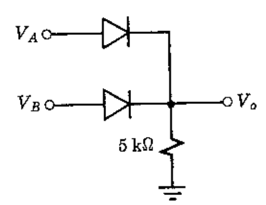

Figure AP3.9

AP3-10. Calculate the exact gain of the circuit of Fig. 3.18.