I-

The manufacturer of the diode D of Figure 1 provided its characteristic curve in Figure 2.

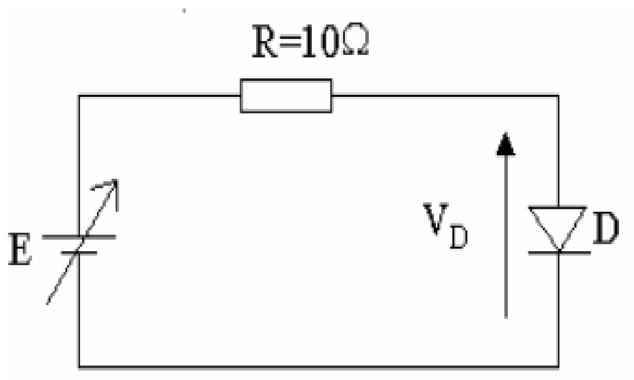


Figure 1

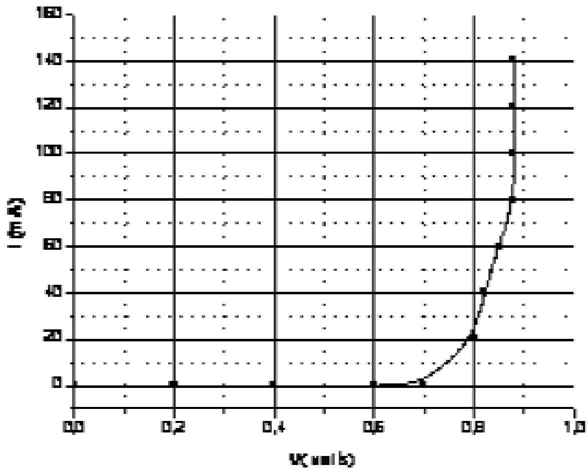


Figure2

1. What is the equation of the load line in Figure 1 ?
2. For E= 1.4 V, draw the graph of the load line.
3. Determine the coordinates of the : saturation point, cutoff point, operating point.
4. Compute the static resistance of the diode.
5. Focusing on its characteristic curve, determine the elements of the equivalent electrical circuit of the diode when it is forward bias or reverse bias.
6. The diode D is inserted in the circuit of Figure 3 :

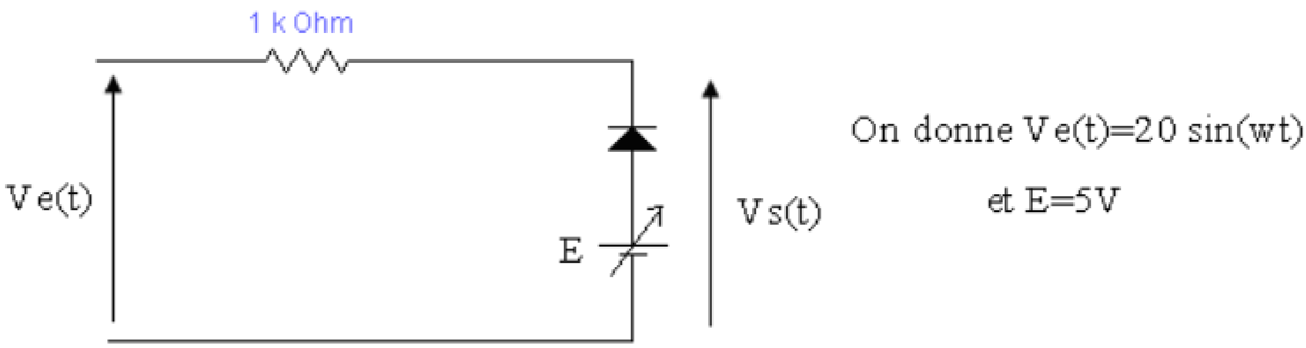


Figure 3

6.a What is the condition for the diode to be conducting ?

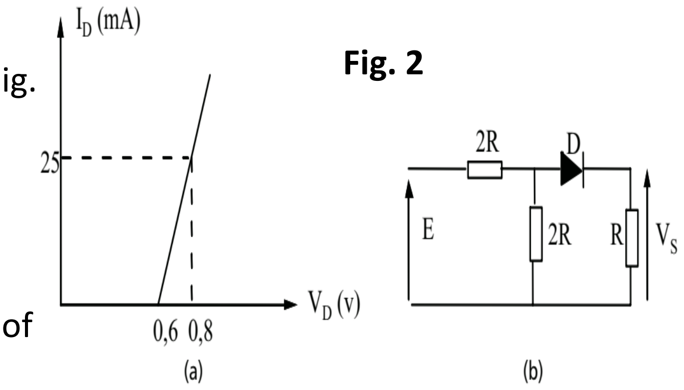
6.b Give the explicit expression Vs(t), and draw the graph of Vs(t).

II-

The characteristic curve of diode is drawn in Fig. 2 (a) and the diode is used in the circuit Fig. 2(b).

1. Draw the load line of the circuit and determine the coordinates of the: operating point, saturation point, and cutoff point.
2. Calculate the value of the static resistance of the diode.

Fig. 2



3. How does the load line varies if the voltage varies about ± 2 V? Deduce the dynamical resistance of the diode.
4. An alternative low frequency voltage of maximum amplitude 100 mV is superimpose to the continuous voltage E = 12 V. Compute and draw the output voltage Vs(t).

R = 50 Ω, E = 12 V.

III-

Let's consider a diode with a knee voltage 0.6 V and a vanishing dynamic resistance. R1 = 320 Ω, R2 = 460 Ω.

1. Determine the value of VE after which the diode conducts a current.
2. If VE = 6 V, calculate the current ID through the diode, and the voltages VR1 and VR2 across R1 and R2, respectively.

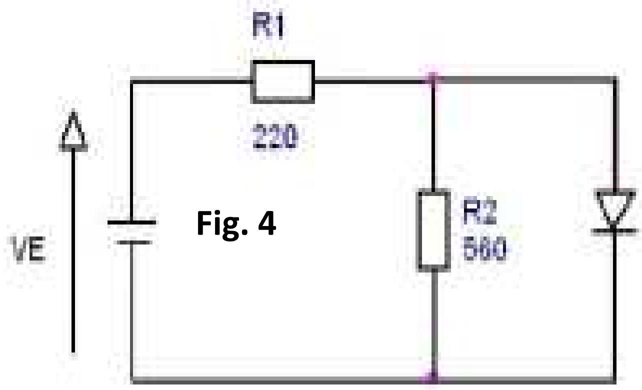


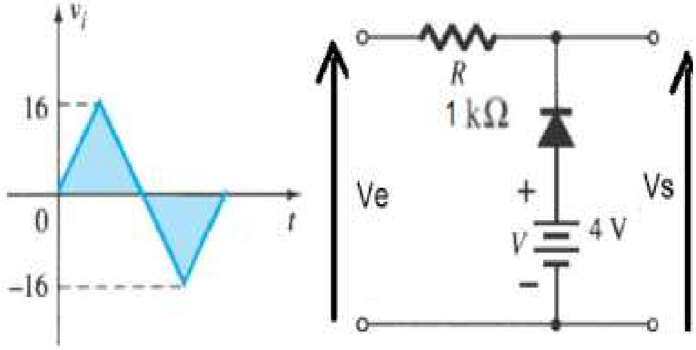
Fig. 4

IV-

Fig. 5

The diode of the circuit in Fig. 5 has a knee voltage 0.7 V with a zero dynamic resistance.

1. Draw the graph of the output voltage Vs(t) on the same graph of that of Ve(t).
2. Draw the graph Vs = f(ve).
3. What is the maximum (minimum) value of Vs?



4. Compute the value of Ve for which the diode conducts a current.
5. Do the above study for an ideal diode.

V-

Lets consider the circuit of Fig. 6 where the diodes are consider to be ideal ones. Draw the output voltage VS2(t) for the input voltages given below. What could be the electrical function of such a circuit?

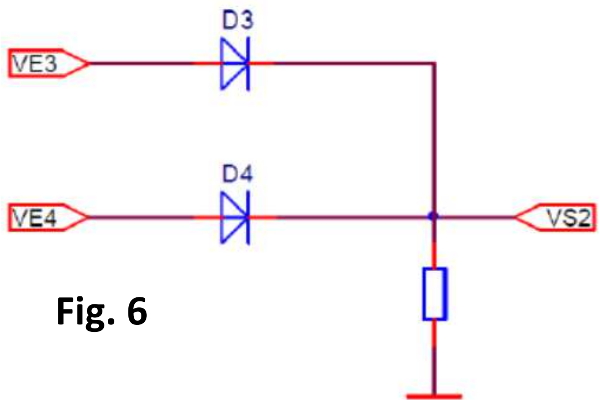
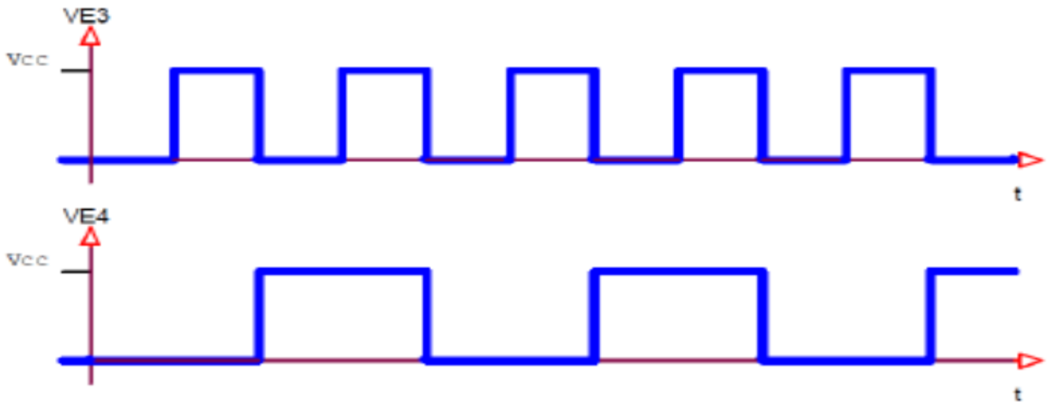


Fig. 6



VI-

$V(t) = V_0 \sin(\omega t)$, i(0) = 0.

Part I: ideal diode case

1. From the circuit of Fig. draw the output voltage Vs(t).
2. Draw the current curve i(t).
3. Compute the mean value of the current.
4. Determine the frequency of the output voltage.

Part II: diode second level of approximation

Solve again questions of Part I.

Part III:

Solve again questions of Part I for Fig. 8. At what time the diode starts to conduct a current?

Part IV:

Replace the inductive coil by a capacitor C. Solve again questions of Part I. At what time the diode starts to conduct a current?

Part V:

Solve again questions of Part I for Fig. 9. At what time the diode starts to conduct a current?

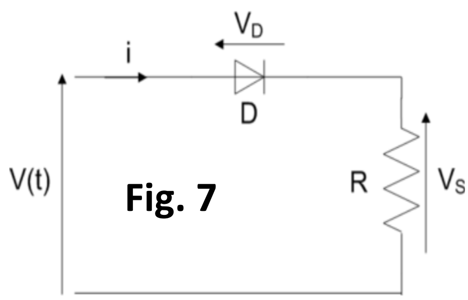


Fig. 7

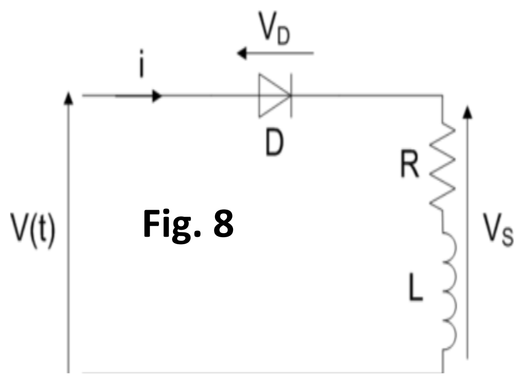


Fig. 8

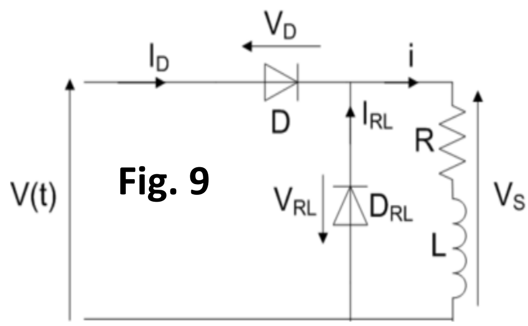


Fig. 9

VII-

Compute and draw the voltage v(t) of Fig. 10. $e(t) = 2E_1 \sin(\omega t)$.

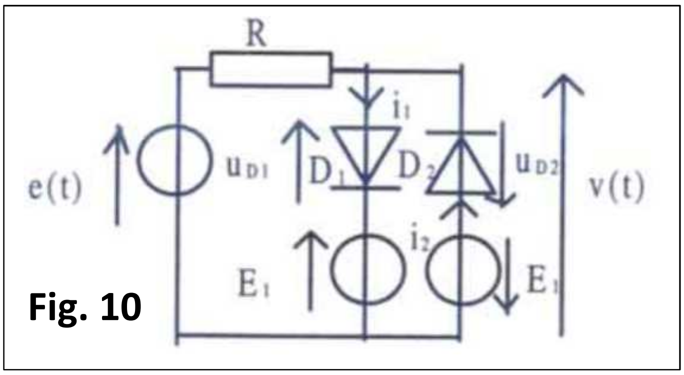


Fig. 10

VIII-

Suppose the zener diode of Fig. 11 is ideal and has a breakdown voltage of 10 V.

1. What are the minimum and maximum zener currents?
2. What is the value of V_{out} ? What could be some of the applications of the Zener diode ?
3. Is the zener diode of Fig. 12 operating in the breakdown region? Determine the load current and the current through the Zener diode.
4. Compute the load voltage of the Zener diode of Fig. 12 if it has a dynamic resistance of 8.5 Ω.

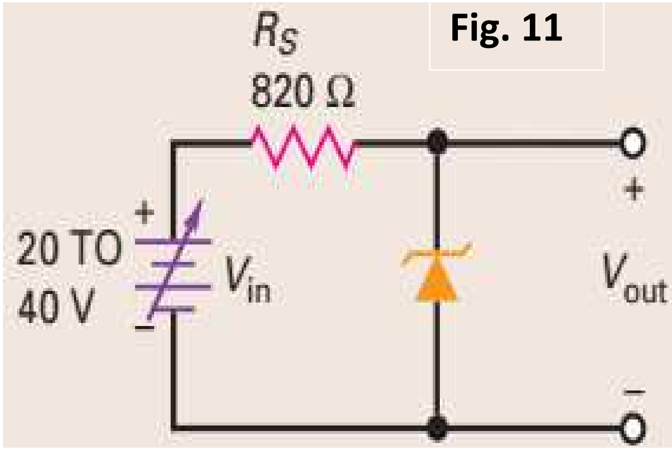


Fig. 11

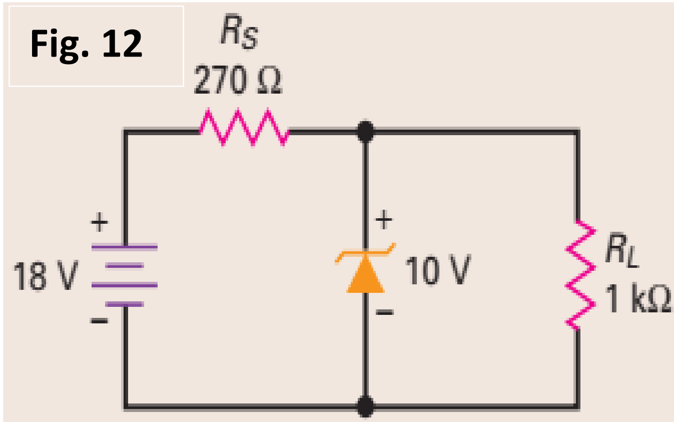


Fig. 12

IX- Explain what the following circuits do.

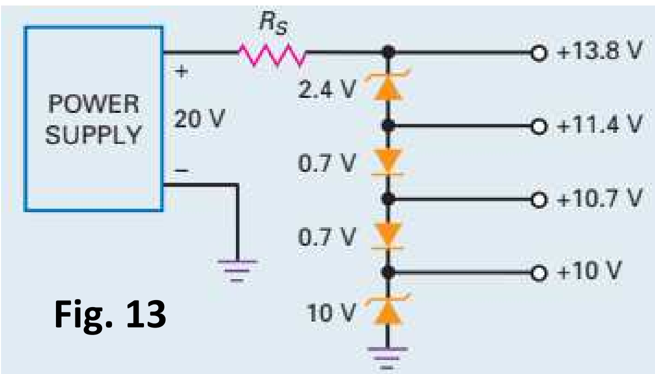


Fig. 13

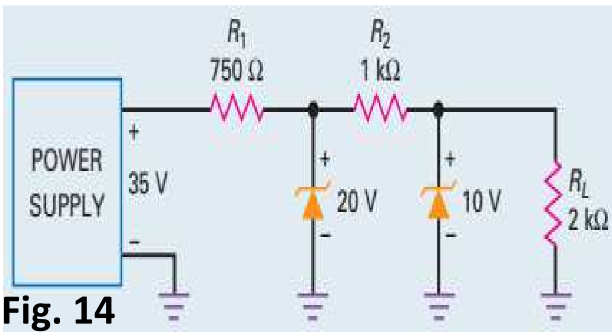


Fig. 14

X-

In each case, draw the output voltages, the triangular input voltage is supposed to be very higher than the knee voltage 0.6 V.

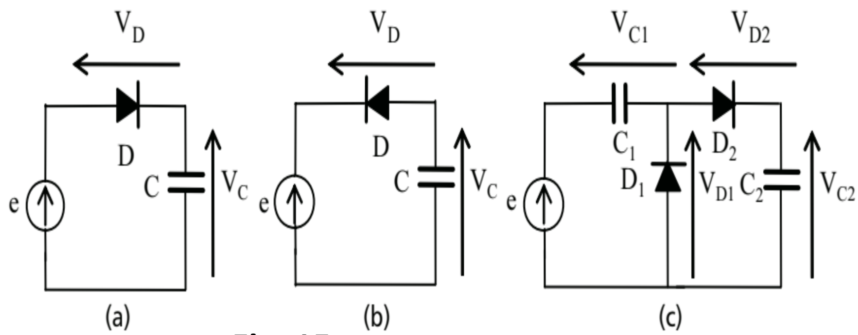


Fig. 15