1-24. In the circuit shown the switch K is closed at $t = 0$ (the reference time). The current flowing in the circuit is given by the equation $i(t) = (1 - e^{-t})$ amp, $t > 0$. At a certain time the current has a value of 0.63 amp. (a) At what rate is the current changing? (b) What is the value of the total flux linkages? (c) What is the rate of change of flux

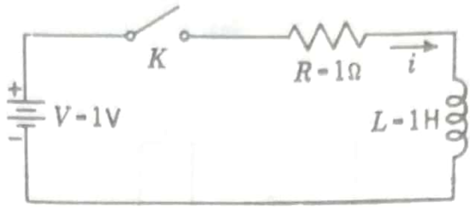


Fig. P1-24.

linkages? (d) What is the voltage across the inductor? (e) How much energy is stored in the magnetic field of the inductor? (f) What is the voltage across the resistor? (g) At what rate is energy being stored in the magnetic field of the inductor? (h) At what rate is energy being dissipated as heat? (i) At what rate is the battery supplying energy?

1-25. In the circuit shown the capacitor is charged to a voltage of 1 V, and at $t = 0$ the switch K is closed. The current in the circuit is known to be of the form $i(t) = e^{-t}$ amp, $t > 0$. At a certain time the current has a value of 0.37 amp. (a) At what rate is the voltage across the capacitor changing? (b) What is the value of the charge on the capacitor?

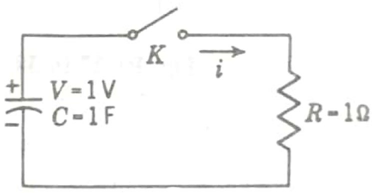


Fig. P1-25.

(c) What is the time rate of change of the product Cv? (d) What is the voltage across the capacitor? (e) How much energy is stored in the electric field of the capacitor? (f) What is the voltage across the resistor? (g) At what rate is energy being taken from the electric field of the capacitor? (h) At what rate is energy being dissipated as heat?

1-26. Show that the following quantities all have the dimension of time: (a) RC; (b) L/R; (c) $\sqrt{LC}$. Show that (d) R^2C has the dimension of inductance, (e) $\sqrt{L/C}$ has the dimension of resistance, (*f*) L/R^2 has the dimension of capacitance.

1-27–1-38. The following set of problems refers to the elements and the waveforms shown in the accompanying figure. For each part of this problem, sketch the required quantity, carefully making the time scale, significant amplitudes, slopes, and so on. Give enough detail to permit the waveform to be constructed from the data alone.

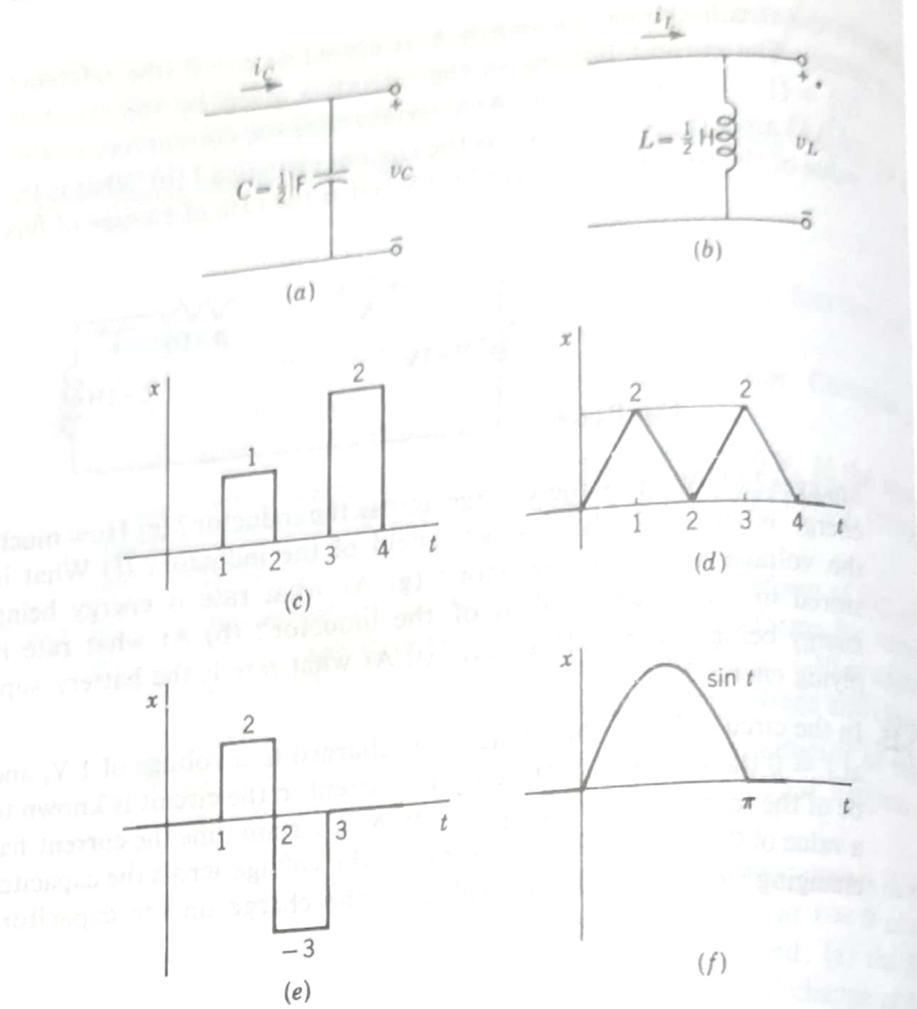


Fig. P1-27 to 38. (a, b, c, d, e, f)

Network of:	*Given that x is:*	*Shown in:*	*Sketch:*	*Initial Condition:*
1-27. a	v_C	d	i_C	none
1-28. a	v_C	f	i_C	none
1-29. a	i_C	c	v_C	$v_C(0) = 0$
1-30. a	i_C	d	v_C	$v_C(0) = 0$
1-31. a	i_C	e	v_C	$v_C(0) = 0$
1-32. a	i_C	f	v_C	$v_C(0) = 0$
1-33. b	v_L	c	i_L	$i_L(0) = 0$
1-34. b	v_L	d	i_L	$i_L(0) = 0$
1-35. b	v_L	e	i_L	$i_L(0) = 0$
1-36. b	v_L	f	i_L	$i_L(0) = 0$
1-37. b	i_L	d	v_L	none
1-38. b	i_L	f	v_L	none

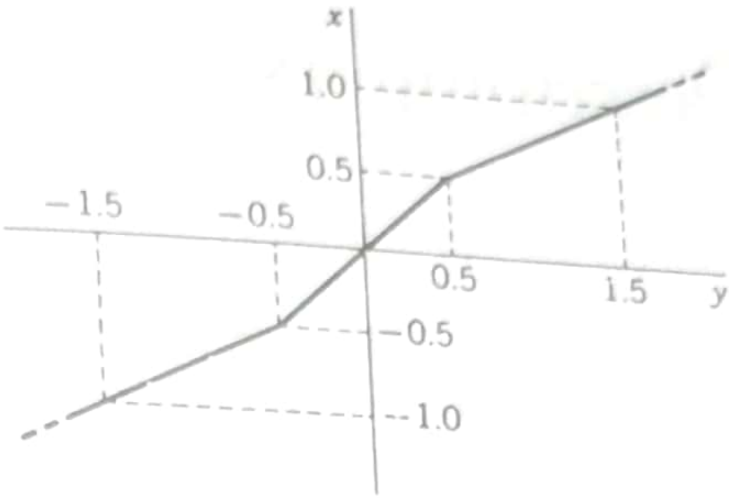


Fig. P1-39.

2-1. For the controlled source shown in the figure, prepare a plot similar to that given in Fig. 2-8(*b*).

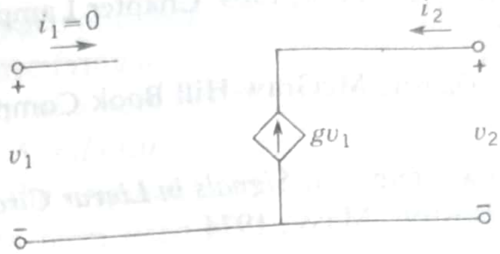


Fig. P2-1.

2-2. Repeat Prob. 2-1 for the controlled source given in the accompanying figure.

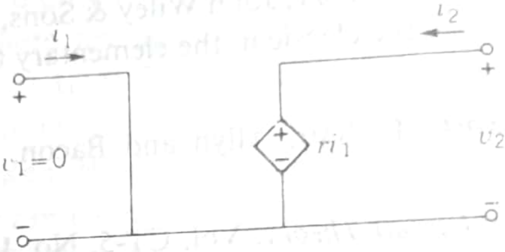


Fig. P2-2.

2-3. The network of the accompanying figure is a model for a battery of open-circuit terminal voltage V and internal resistance R_b. For this network, plot i as a function v. Identify features of the plot such as slopes, intercepts, and so on.

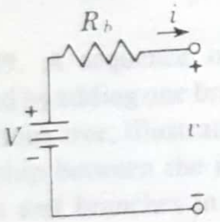


Fig. P2-3.

2-4. The magnetic system shown in the figure has three windings marked 1-1′, 2-2′, and 3-3′. Using three different forms of dots, establish polarity markings for these windings.

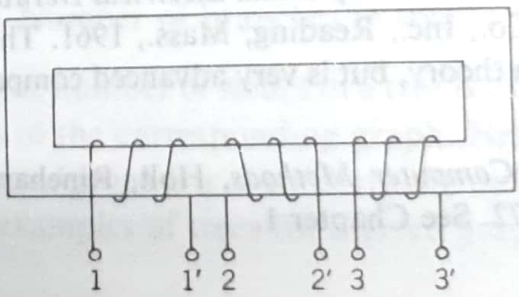


Fig. P2-4.

2-6. The figure shows four windings on a magnetic flux-conducting core. Using different shaped dots, establish polarity markings for the windings.

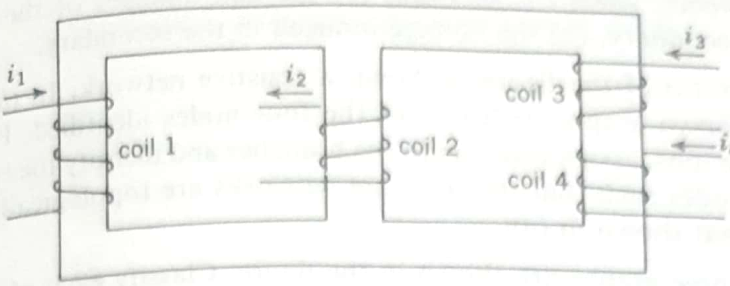


Fig. P2-6.

2-7. The accompanying schematic shows the equivalent circuit of a system with polarity marks on the three coupled coils. Draw a transformer with a core similar to that shown for Prob. 2-6 and place windings on the legs of the core in such a way as to be equivalent to the schematic. Show connections between the elements in the same drawing.

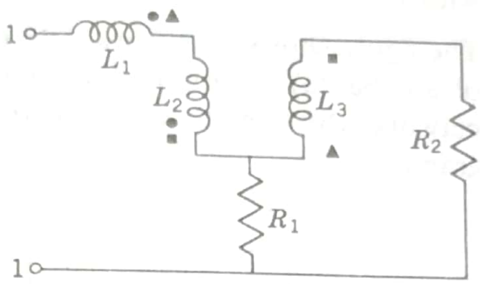


Fig. P2-7.

2-8. The accompanying schematics each show two inductors with coupling but with different dot markings. For each of the two systems, determine the equivalent inductance of the system at terminals 1-1′ by combining inductances.

2-9. A transformer has 100 turns on the primary (terminals 1-1′) and 200 turns on the secondary (terminals 2-2′). A current in the primary

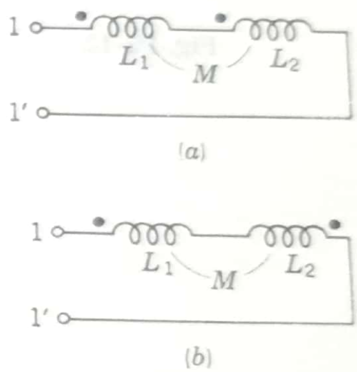


Fig. P2-8

3-1. What must be the relationship between C_{eq} and C_1 and C_2 in (a) of the figure of the networks if (a) and (c) are equivalent? Repeat for the network shown in (b).

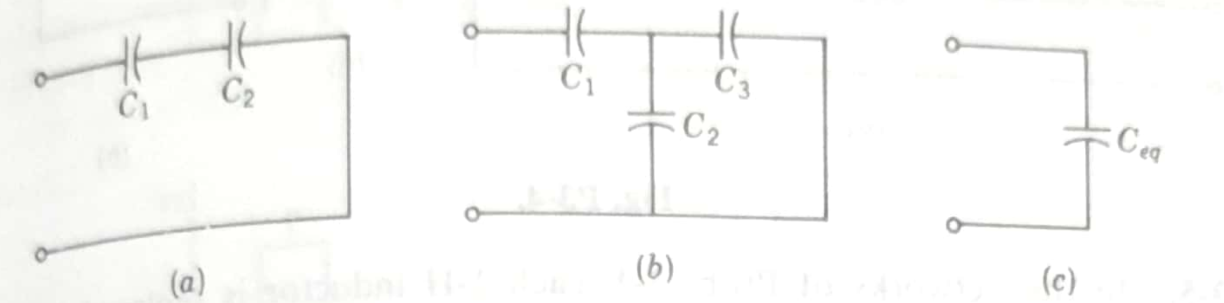


Fig. P3-1.

3-2. What must be the relationship between L_{eq} and L_1, L_2 and M for the networks of (a) and of (b) to be equivalent to that of (c)?

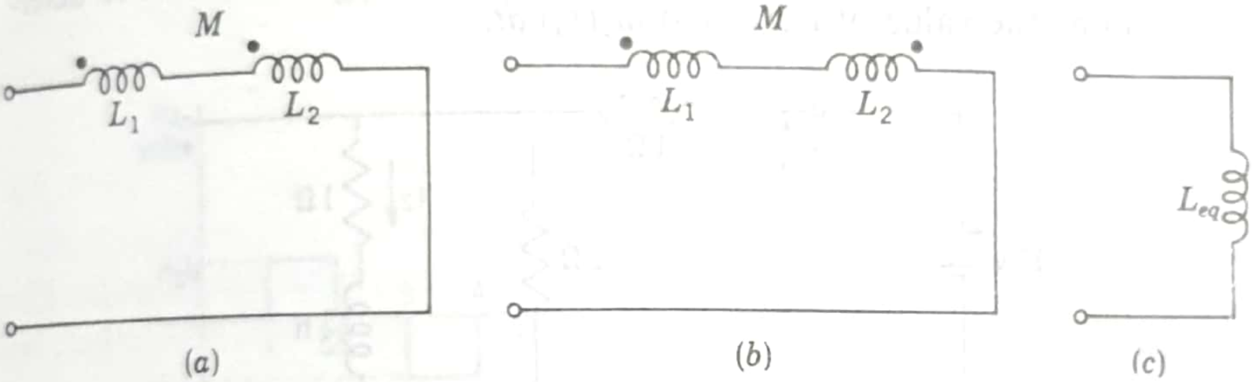


Fig. P3-2.

3-3. Repeat Prob. 3-2 for the three networks shown in the accompanying figure.

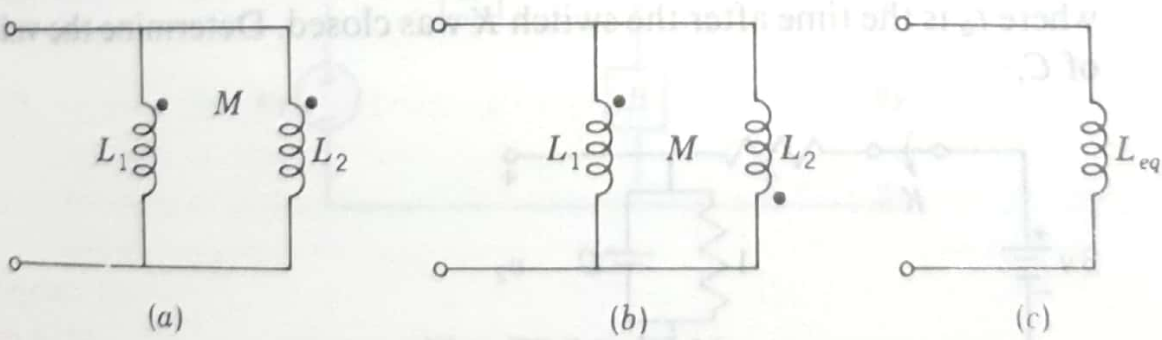


Fig. P3-3.

3-6. This problem may be solved using the two Kirchhoff laws and voltage-current relationships for the elements. At time t_0 after the switch K was closed, it is found that $v_2 = +5$ V. You are required to determine the value of $i_2(t_0)$ and $di_2(t_0)/dt$.

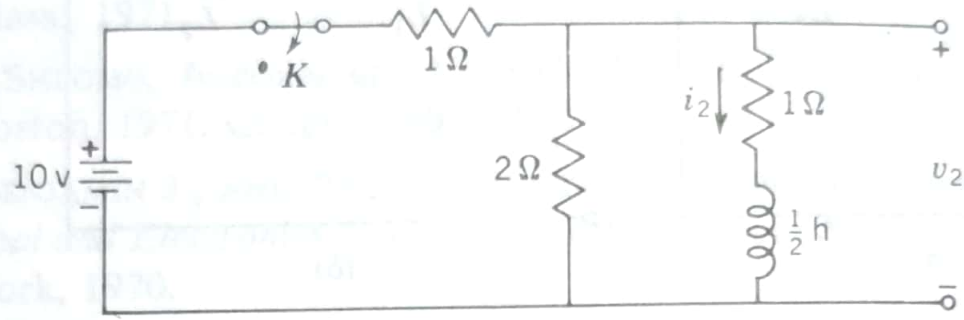


Fig. P3-6.

3-7. This problem is similar to Prob. 3-6. In the network given in the figure, it is given that $v_2(t_0) = 2$ V, and $(dv_2/dt)(t_0) = -10$ V/sec, where t_0 is the time after the switch K was closed. Determine the value of C.

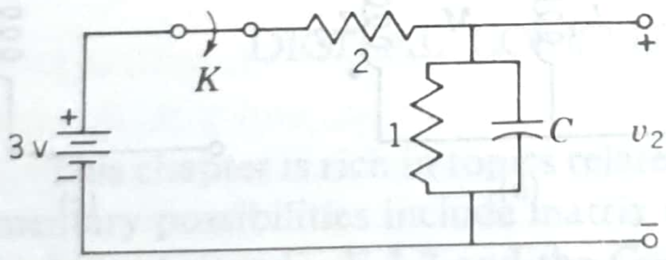
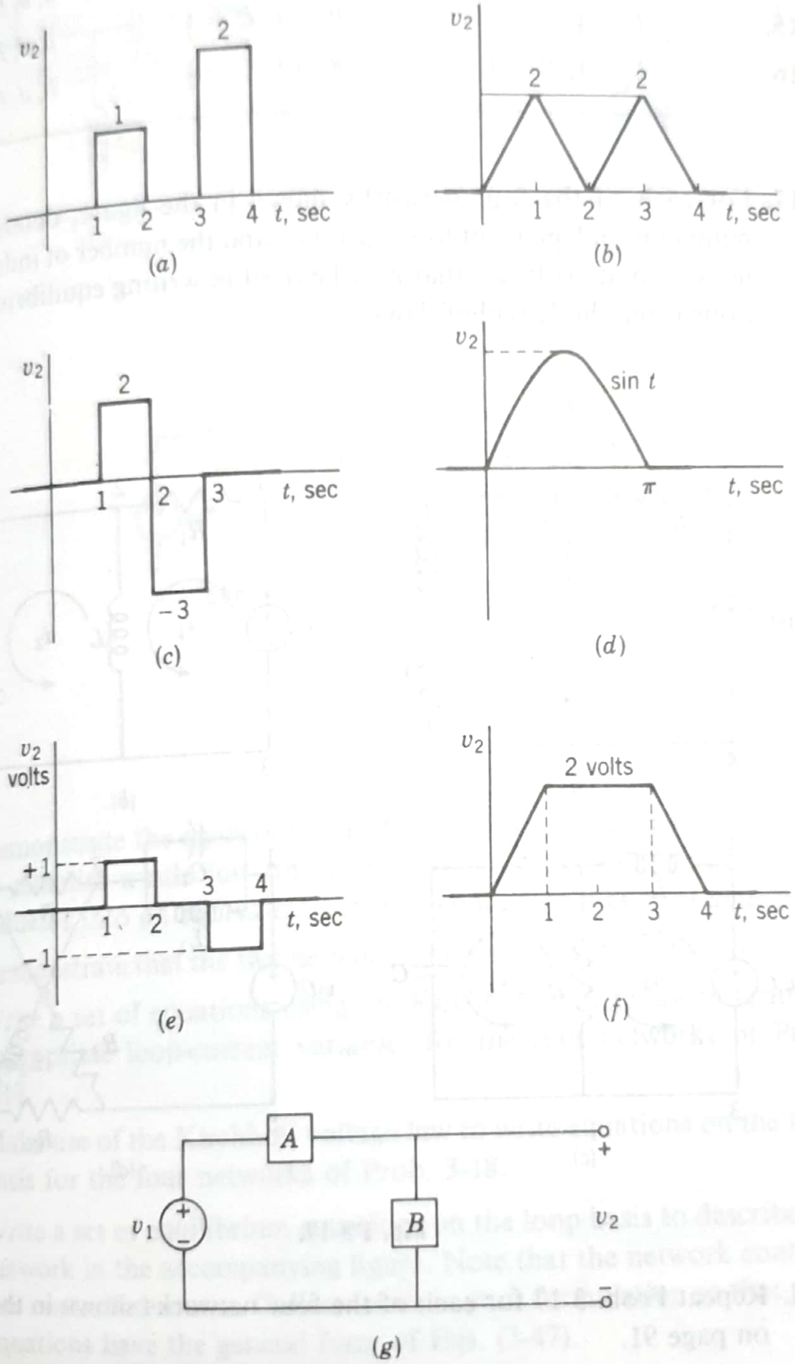


Fig. P3-7.

The series of problems described in the following table all pertain to the network of (*g*) of the figure with the network in *A* and *B* specified in the table. In A, two entries in the column implies a series connection of elements, while in *B*, two entries implies a parallel connection of elements. In each case, all initial conditions are equal to zero. For the specified waveform for v_2, you are required to determine v_1 in the form of a sketch of the waveform as it might be seen on a cathode ray oscilloscope. Evaluate significant amplitudes, slopes, and so on.



Figs. P3-8 to P3-16.

	Network of A	Network of B	Waveforms of v_2
3-8.	$R = 2$	$L = \frac{1}{2}$	a, b, c, d, e, f
3-9.	$C = \frac{1}{2}$	$L = 1$	a, b, c, d, e, f
3-10.	$C = \frac{1}{2}$, $R = 1$	$L = 2$	a, b, c, d, e, f
3-11.	$C = 1$, $R = \frac{1}{2}$	$L = \frac{1}{2}$, $R = 1$	a, b, c, d, e, f
3-12.	$R = 2$	$C = 1$	b, d, f
3-13.	$R = 1$	$R = 2$, $C = 1$	b, d, f
3-14.	$R = 2$	$R = 1$, $C = 1$	b, d, f
3-15.	$L = \frac{1}{2}$	$R = 1$, $C = \frac{1}{2}$	b, d, f
3-16.	$L = 1$, $R = 1$	$R = 1$, $C = \frac{1}{2}$	b, d, f

3-17. For each of the four networks shown in the figure, determine the number of independent loop currents, and the number of independent node-to-node voltages that may be used in writing equilibrium equations using the Kirchhoff laws.

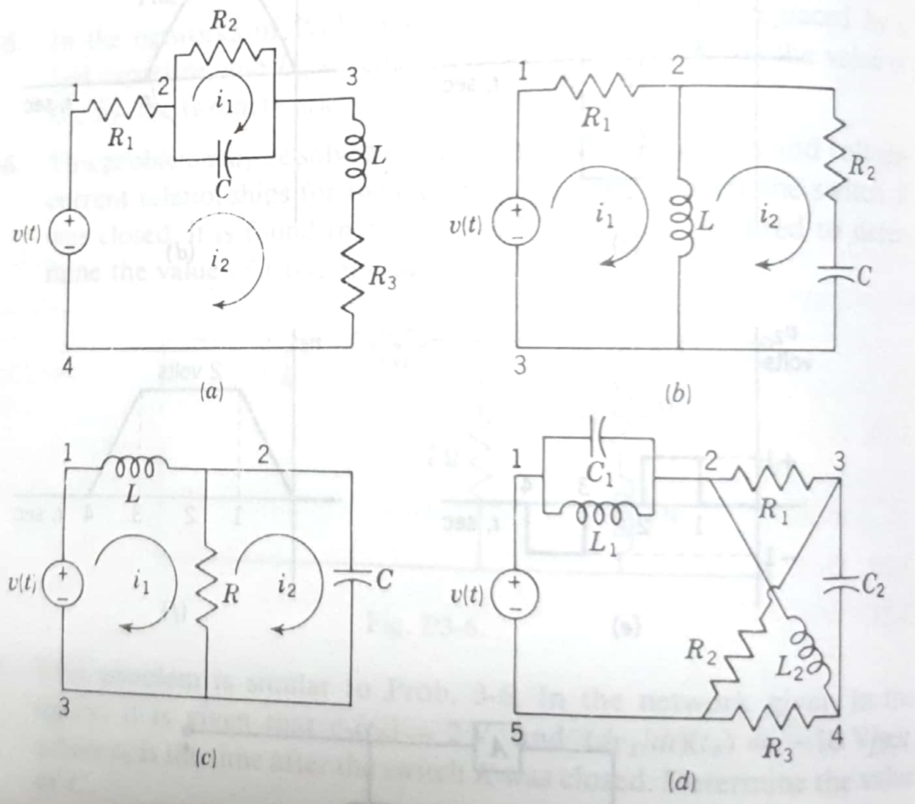


Fig. P3-17.

3-18. Repeat Prob. 3-17 for each of the four networks shown in the figure on page 91.

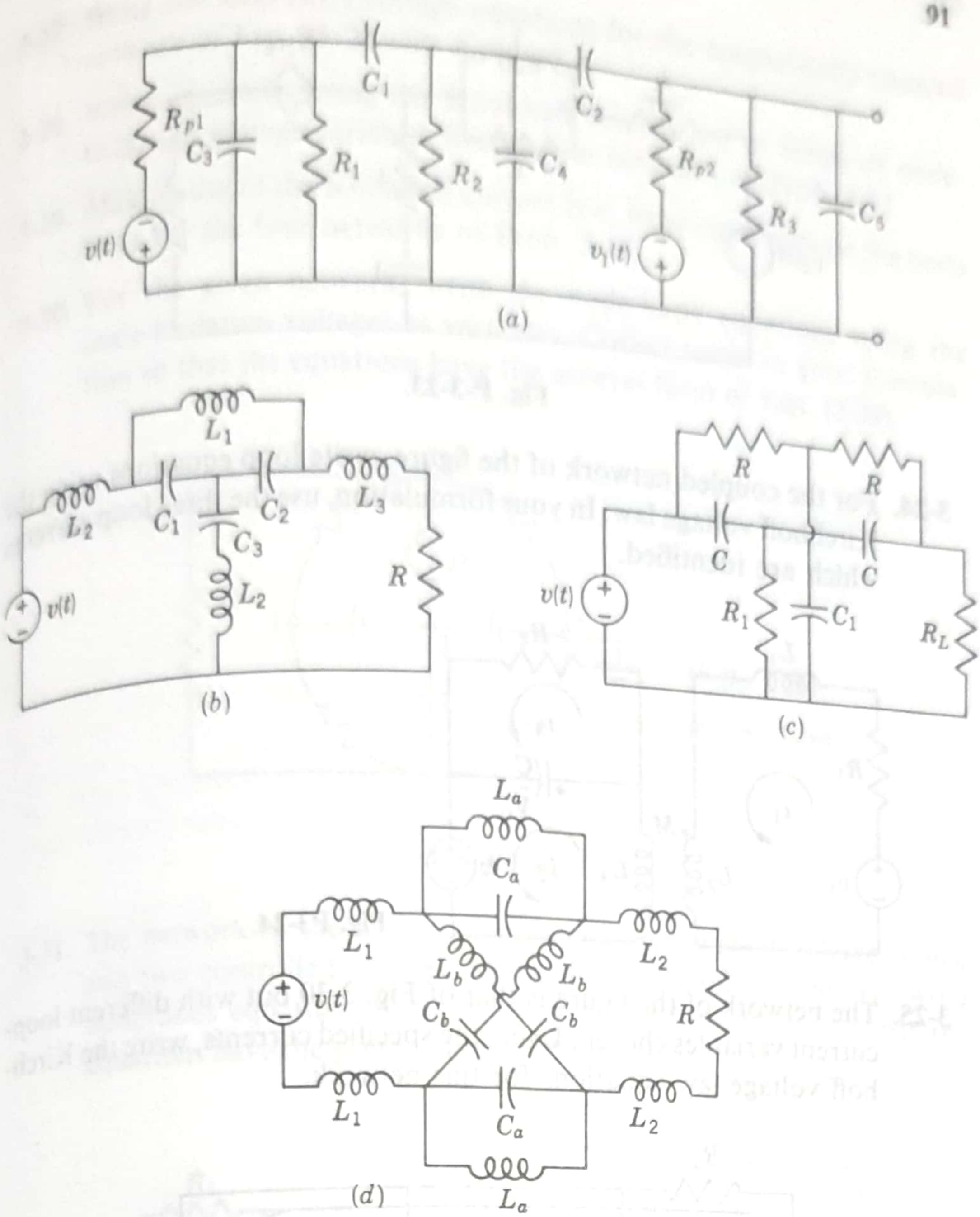


Fig. P3-18.

3-19. Demonstrate the equivalence of the networks shown in Fig. 3-17 and so establish a rule for converting a voltage source in series with an inductor into an equivalent network containing a current source.

3-20. Demonstrate that the two networks shown in Fig. 3-18 are equivalent.

3-21. Write a set of equations using the Kirchhoff voltage law in terms of appropriate loop-current variables for the four networks of Prob. 3-17.

3-22. Make use of the Kirchhoff voltage law to write equations on the loop basis for the four networks of Prob. 3-18.

3-23. Write a set of equilibrium equations on the loop basis to describe the network in the accompanying figure. Note that the network contains one controlled source. Collect terms in your formulation so that your equations have the general form of Eqs. (3-47).

3-25. The network of the figure is that of Fig. 3-30 but with different loop-current variables chosen. Using the specified currents, write the Kirchhoff voltage law equations for this network.

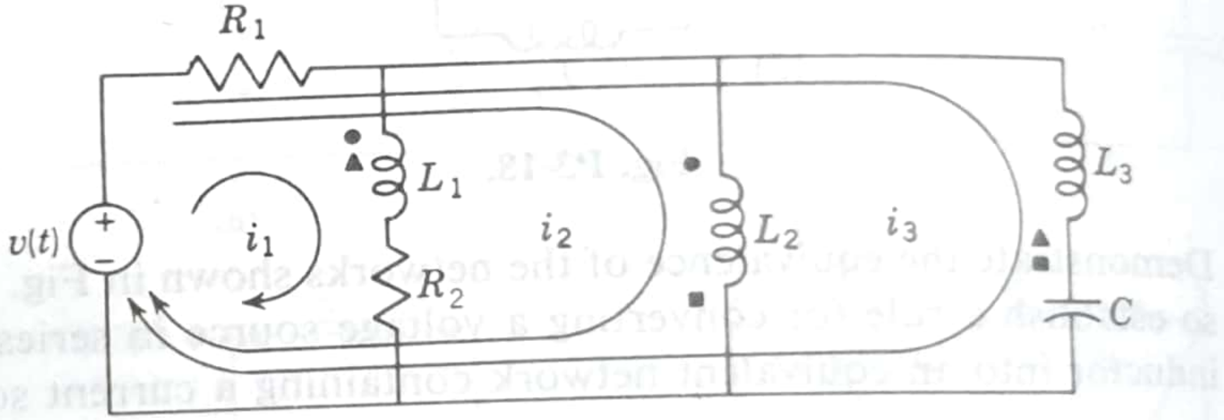


Fig. P3-25.

3-30. For the given network, write the node-basis equations using the node-to-datum voltages as variables. Collect terms in your formulation so that the equations have the general form of Eqs. (3-59).

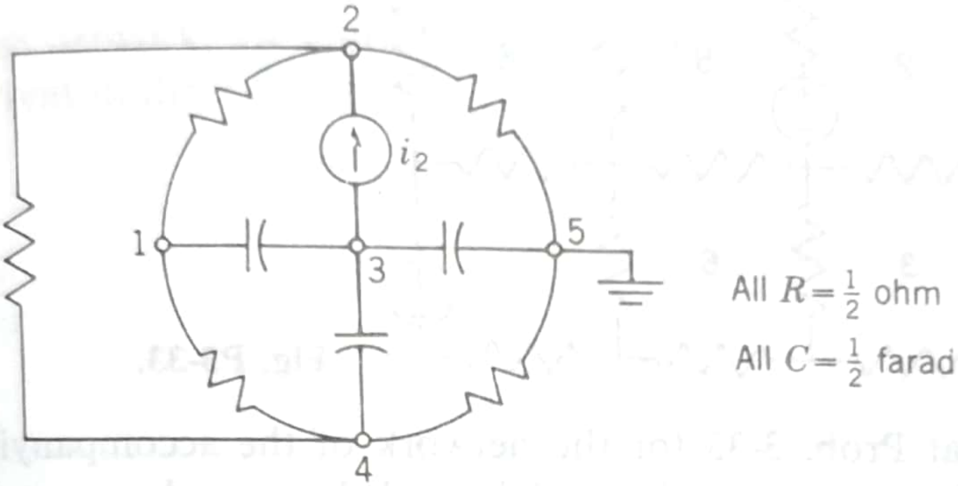


Fig. P3-30.

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3-40. In the given network, node d is selected as the datum. For the specified element and source values, determine values for the four node-to-datum voltages.

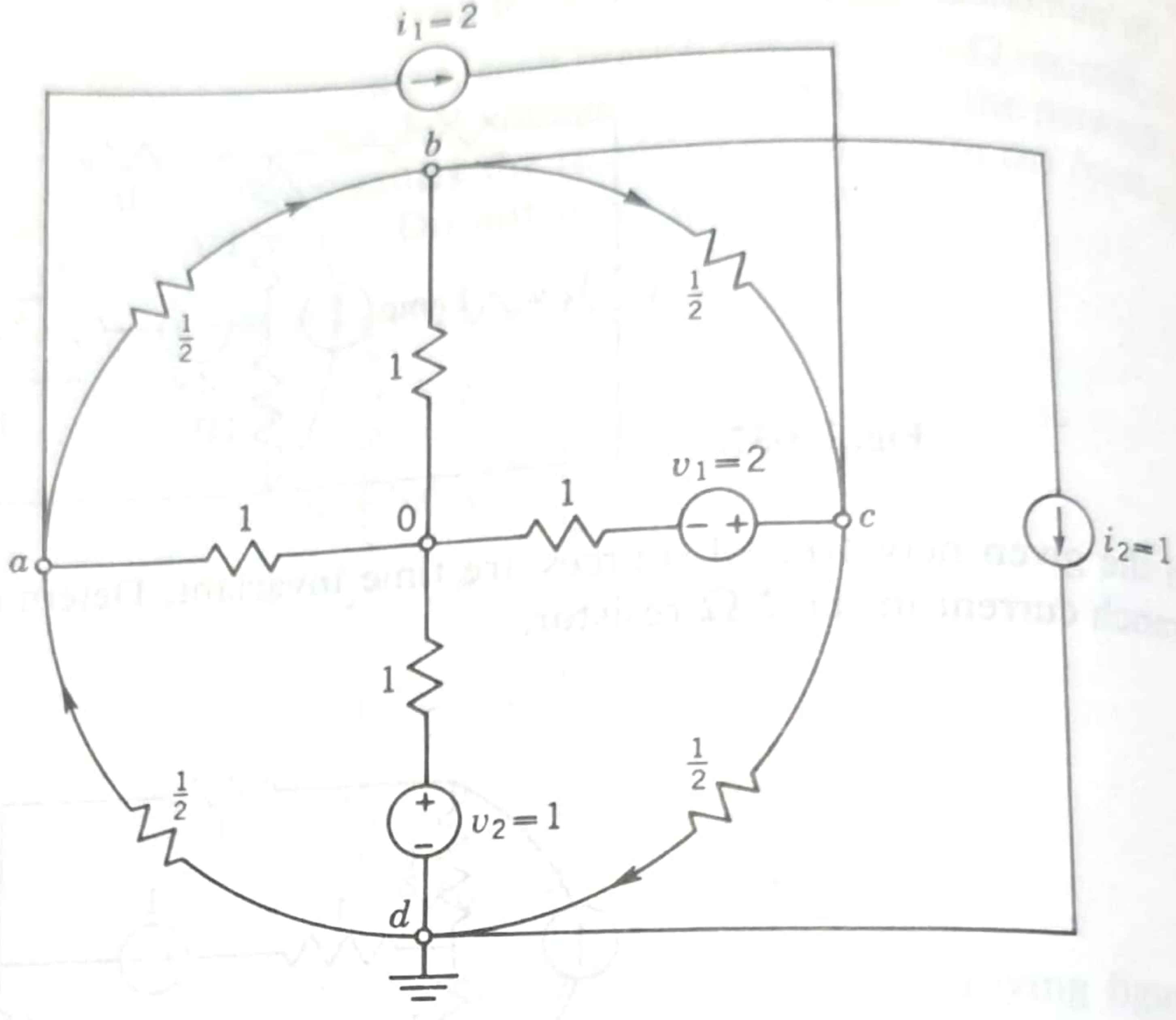

Fig. P3-40.

3-58. The element represented in the network is a *gyrator* which is described by the equations

$$v_1 = R_0 i_2$$
$$v_2 = -R_0 i_1$$

Find the two-element equivalent network shown in (*b*) of the figure.

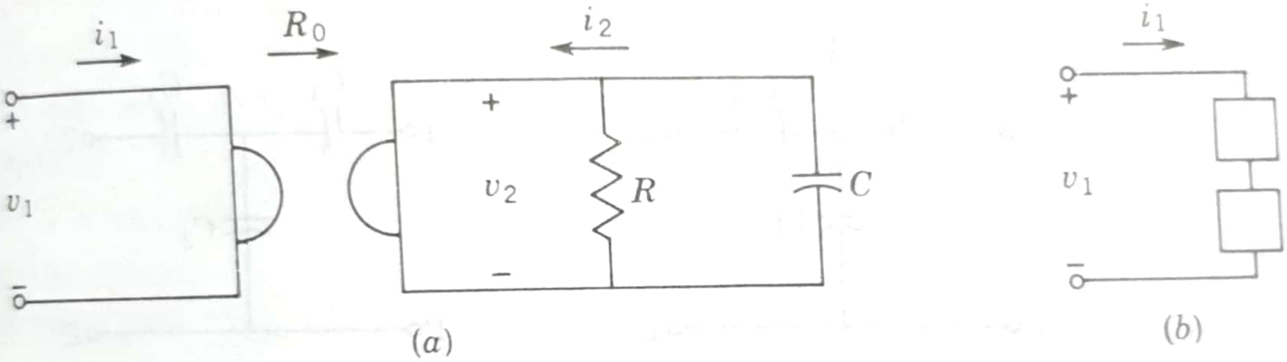

Fig. P3-58.