بسمه تعالی

Sign of M, equivalent inductance

3. The magnetic coupling between two linear time-invariant inductors is provided by a core as shown in Fig. P8.3. The values of the self-inductances are $L_{11} = 2$ henrys and $L_{22} = 3$ henrys, and the mutual inductance is $M = 1$ henry.

a. Calculate the equivalent inductance between terminals (1') and (2') when (1) and (2) are tied together.

b. Calculate the equivalent inductance between terminals (1') and (2) when (1) and (2') are tied together.

c. Suggest a procedure for measuring the mutual inductance between windings using only an inductance bridge.

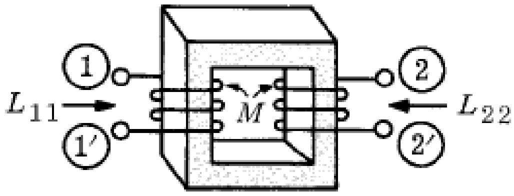

Fig. P8.3

Inductance matrix, equivalent two-ports

4. The inductors in the circuits shown in Fig. P8.4 are linear and time-invariant.

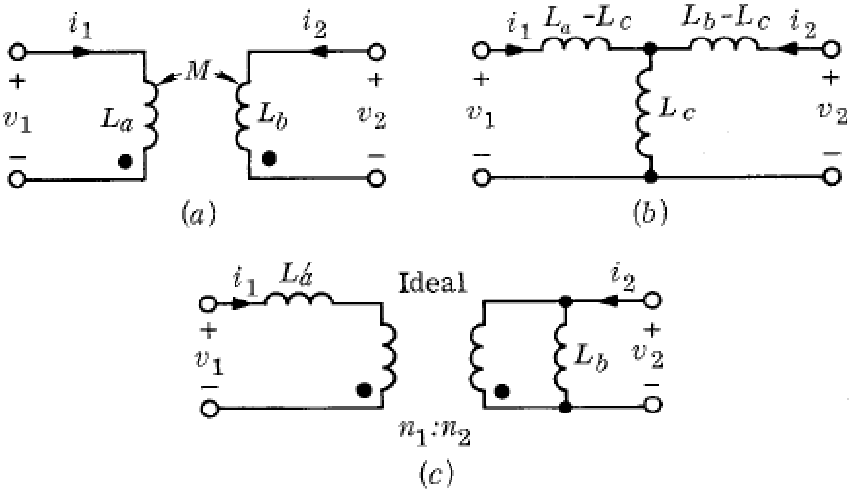

Fig. P8.4

a. Obtain the inductance matrix for each circuit.

b. Show that if $L_c = M$, circuits (*a*) and (*b*) have the same inductance matrix.

c. How should L_a' and n_1/n_2 be related with L_a and M so that circuits (*a*) and (*c*) have the same inductance matrix?

Mesh analysis

5. The circuit shown in Fig. P8.5 is in sinusoidal steady state, where the input is a voltage source $e_s(t) = \cos(2t + 30°)$. Determine the steady-state currents i_1 and i_2.

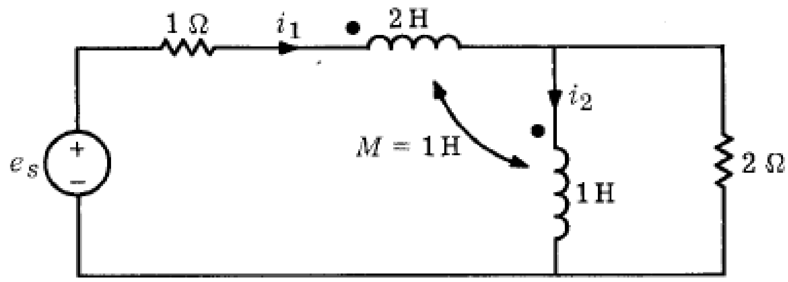

Fig. P8.5

Node analysis

6. Write the node equations for the circuit shown in Fig. P8.6. If $i_s(t) = \cos t$, determine the sinusoidal steady-state voltage $v_2(t)$.

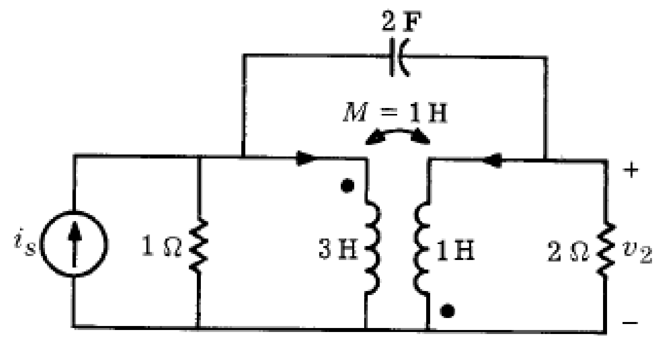

Fig. P8.6

Energy stored

8. In the circuit of Prob. 7, assume that i_s is a constant current source and $i_1 = 2$, $i_2 = 1$, and $i_3 = -3$ amp. What is the energy stored in the inductors?

$$L = \begin{bmatrix} 5 & 2 & 1 \\ 2 & 4 & -1 \\ 1 & -1 & 2 \end{bmatrix}$$

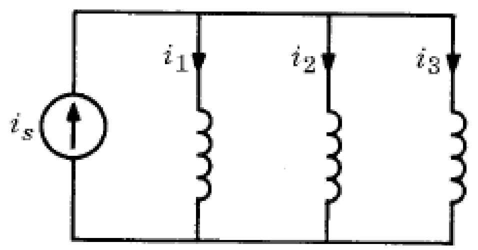

Fig. P8.7

Defining equations of ideal transformer

11. *a.* Determine the equivalent resistance of the one-port shown in Fig. P8.11.

b. Repeat the problem when points a and a' are connected by a short circuit.

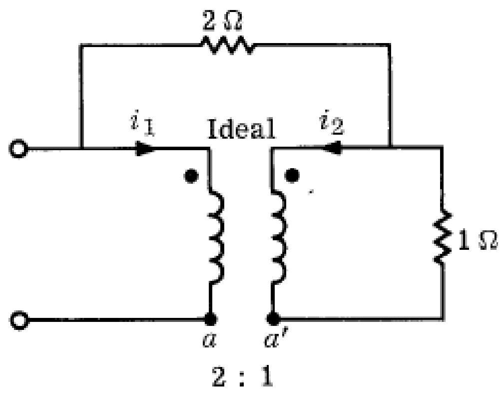

Fig. P8.11

Driving-point and transfer properties of ideal transformer

12. For the circuits shown in Fig. P8.12, calculate [using (*a*)] the impedances

$$Z_{11}(j\omega) = \frac{V_1}{I_1} \qquad \text{and} \qquad Z_{21}(j\omega) = \frac{V_2}{I_1}$$

and [using (*b*)] the impedances

$$Z_{22}(j\omega) = \frac{V_2}{I_2} \qquad \text{and} \qquad Z_{12}(j\omega) = \frac{V_1}{I_2}$$

where V_1 and V_2 are phasors that represent the sinusoidal output voltages $v_1(t)$ and $v_2(t)$, respectively, and I_1 and I_2 are phasors that represent the sinusoidal input currents $i_1(t)$ and $i_2(t)$, respectively. Note that in (*a*), terminals 2 and 2′ are left open-circuited, and in (*b*) terminals 1 and 1′ are left open-circuited.

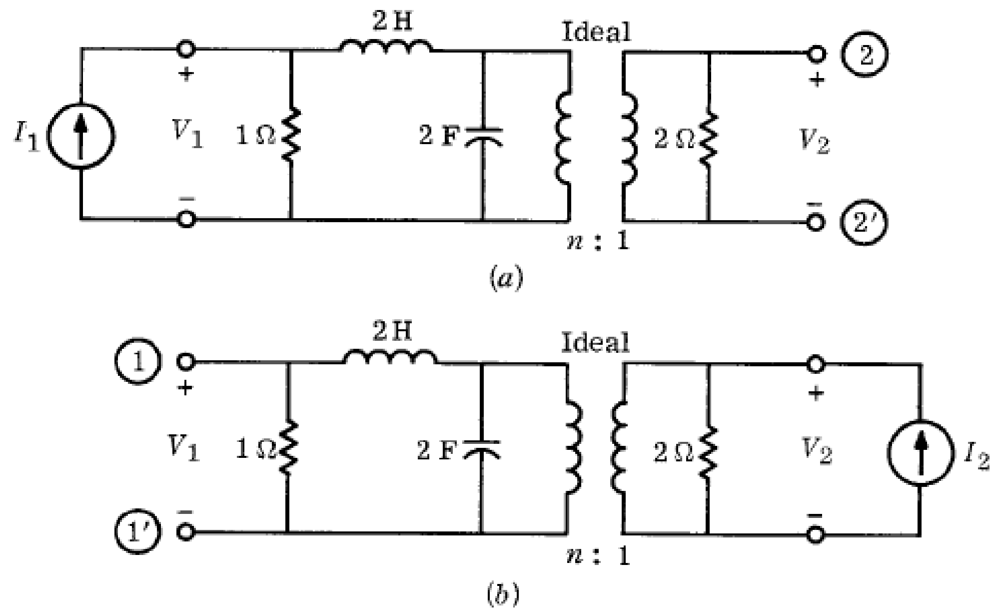

Fig. P8.12