11. **The measured voltage across an unloaded secondary of a transformer is usually**
a. the same as the rated secondary voltage.
b. 5 to 10% higher than the rated secondary voltage.
c. 50% higher than the rated secondary voltage.
d. 5 to 10% lower than the rated secondary voltage.

12. **A laminated iron-core transformer has reduced eddy-current losses because**
a. the laminations are stacked vertically.
b. more wire can be used with less dc resistance.
c. the magnetic flux is in the air gap of the core.
d. the laminations are insulated from each other.

13. **How much is the inductance of a coil that induces 50 V when its current changes at the rate of 500 A/s?**
a. 100 mH.
b. 1 H.
c. 100 μH.
d. 10 μH.

14. **A 100-mH inductor is in parallel with a 150-mH and a 120-mH inductor. Assuming no mutual inductance between coils, how much is L_{EQ}?**
a. 400 mH.
b. 370 mH.
c. 40 mH.
d. 80 mH.

15. **A 400-μH coil is in series with a 1.2-mH coil without mutual inductance. How much is L_T?**
a. 401.2 μH.
b. 300 μH.
c. 160 μH.
d. 1.6 mH.

16. **A step-down transformer has a turns ratio, $\frac{N_P}{N_S}$, of 4:1. If the primary voltage, V_P, is 120 Vac, how much is the secondary voltage, V_S?**
a. 480 Vac.
b. 120 Vac.
c. 30 Vac.
d. It cannot be determined.

17. **If an iron-core transformer has a turns ratio, $\frac{N_P}{N_S}$, of 3:1 and Z_S = 16 Ω, how much is Z_P?**
a. 48 Ω.
b. 144 Ω.
c. 1.78 Ω.
d. 288 Ω.

18. **How much is the induced voltage, V_L, across a 5-H inductor carrying a steady dc current of 200 mA?**
a. 0 V.
b. 1 V.
c. 100 kV.
d. 120 Vac.

19. **The secondary current, I_s, in an iron-core transformer equals 1.8 A. If the turns ratio, $\frac{N_P}{N_S}$, equals 3:1, how much is the primary current, I_P?**
a. I_P = 1.8 A.
b. I_P = 600 mA.
c. I_P = 5.4 A.
d. none of the above.

20. **For a coil, the dc resistance, r_i, and inductance, L, are**
a. in parallel.
b. infinite.
c. the same thing.
d. in series.

Essay Questions

1. Define 1 H of self-inductance and 1 H of mutual inductance.
2. State Lenz's law in terms of induced voltage produced by varying current.
3. Refer to Fig. 19-5. Explain why the polarity of v_L is the same for the examples in Fig. 19-5*a* and *d*.
4. Make a schematic diagram showing the primary and secondary of an iron-core transformer with a 1:6 voltage step-up ratio (a) using an autotransformer; (b) using a transformer with isolated secondary winding. Then (c) with 100 turns in the primary, how many turns are in the secondary for both cases?
5. Define the following: coefficient of coupling, transformer efficiency, stray inductance, and eddy-current losses.
6. Why are eddy-current losses reduced with the following cores: (a) laminated; (b) powdered iron; (c) ferrite?
7. Why is a good conductor used for an rf shield?
8. Show two methods of providing a variable inductance.
9. (a) Why will the primary of a power transformer have excessive current if the secondary is short-circuited? (b) Why is there no voltage across the secondary if the primary is open?
10. (a) Describe briefly how to check a coil for an open winding with an ohmmeter. Which ohmmeter range should be used? (b) Which leads will be checked on an autotransformer with one secondary and a transformer with two isolated secondary windings?
11. Derive the formula $L_M = (L_{T_a} - L_{T_o})/4$ from the fact that $L_{T_a} = L_1 + L_2 + 2L_M$ and $L_{T_o} = L_1 + L_2 - 2L_M$.
12. Explain how a transformer with a 1:1 turns ratio and an isolated secondary can be used to reduce the chance of electric shock from the 120-Vac power line.
13. Explain the terms *stray inductance* and *stray capacitance* and give an example of each.

Problems

SECTION 19–1 INDUCTION BY ALTERNATING CURRENT

19–1 Which can induce more voltage in a conductor, a steady dc current of 10 A or a small current change of 1 to 2 mA?

19–2 Examine the sine wave of alternating current in Fig. 19-1. Identify the points on the waveform (using the letters A–I) where the rate of current change, $\frac{di}{dt}$, is
a. greatest.
b. zero.

19–3 Which will induce more voltage across a conductor, a low-frequency alternating current or a high-frequency alternating current?

SECTION 19–2 SELF-INDUCTANCE L

19–4 Convert the following current changes, $\frac{di}{dt}$, to amperes per second:
a. 0 to 3 A in 2 s.
b. 0 to 50 mA in 5 μs.
c. 100 to 150 mA in 5 ms.
d. 150 to 100 mA in 20 μs.
e. 30 to 35 mA in 1 μs.
f. 80 to 96 mA in 0.4 μs.
g. 10 to 11 A in 1 s.

19–5 How much inductance, L, will be required to produce an induced voltage, V_L, of 15 V for each of the $\frac{di}{dt}$ values listed in Prob. 19–4?

19–6 How much is the inductance, L, of a coil that induces 75 V when the current changes at the rate of 2500 A/s?

19–7 How much is the inductance, L, of a coil that induces 20 V when the current changes at the rate of 400 A/s?

19–8 Calculate the inductance, L, for the following long coils: (Note: 1 m = 100 cm and 1 m^2 = 10,000 cm^2.)
a. air core, 20 turns, area 3.14 cm^2, length 25 cm.
b. same coil as step a with ferrite core having a μ_r of 5000.
c. air core, 200 turns, area 3.14 cm^2, length 25 cm.
d. air core, 20 turns, area 3.14 cm^2, length 50 cm.
e. iron core with μ_r of 2000, 100 turns, area 5 cm^2, length 10 cm.

19–9 Recalculate the inductance, L, in Prob. 19–8a if the number of turns is doubled to 40.

19–10 What is another name for an rf inductor?

SECTION 19–3 SELF-INDUCED VOLTAGE V_L

19–11 How much is the self-induced voltage across a 5-H inductance produced by a current change of 100 to 200 mA in 1 ms?

19–12 How much is the self-induced voltage across a 33-mH inductance when the current changes at the rate of 1500 A/s?

19–13 Calculate the self-induced voltage across a 100-mH inductor for the following values of $\frac{di}{dt}$:
a. 100 A/s.
b. 200 A/s.
c. 50 A/s.
d. 1000 A/s.

SECTION 19–5 MUTUAL INDUCTANCE L_M

19–14 A coil, L_1, produces 200 μWb of magnetic flux. A nearby coil, L_2, is linked with L_1 by 50 μWb of magnetic flux. What is the coefficient of coupling, k, between L_1 and L_2?

19–15 A coil, L_1, produces 40 μWb of magnetic flux. A coil, L_2, nearby, is linked with L_1 by 30 μWb of magnetic flux. What is the value of k?

19–16 Two 50-mH coils, L_1 and L_2, have a coefficient of coupling, k, equal to 0.6. Calculate L_M.

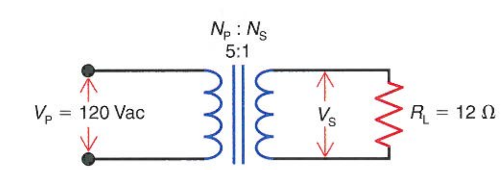
19–17 Two inductors, L_1 and L_2, have a coefficient of coupling, k, equal to 0.5. L_1 = 100 mH and L_2 = 150 mH. Calculate L_M.

19–18 What is the assumed value of k for an iron-core transformer?

SECTION 19–6 TRANSFORMERS

19–19 In Fig. 19–35, solve for
a. the secondary voltage, V_S.
b. the secondary current, I_S.
c. the secondary power, P_{sec}.
d. the primary power, P_{pri}.
e. the primary current, I_P.

Figure 19–35



19–20 Repeat Prob. 19–19 if N_P:N_S = 10:1.

19–21 In Fig. 19–36, solve for
a. V_{S_1} (secondary 1 voltage).
b. V_{S_2} (secondary 2 voltage).
c. I_{S_1} (secondary 1 current).
d. I_{S_2} (secondary 2 current).
e. P_{Sec_1}.
f. P_{Sec_2}.
g. P_{pri}.
h. I_P.