Practice Problems - Chapter 33

Alternating Current Circuits

Multiple Choice

4. A high-voltage powerline operates at 500 000 V-rms and carries an rms current of 500 A. If the resistance of the cable is 0.050Ω/km, what is the resistive power loss in 200 km of the powerline?

a. 250 kW
b. 500 kW
c. 1 Megawatt
d. 2.5 Megawatts
e. 250 Megawatts

12. A 10-μF capacitor is plugged into a 110 V-rms 60-Hz voltage source, with an ammeter in series. What is the rms value of the current through the capacitor?

a. 0.202 A (rms)
b. 0.415 A (rms)
c. 0.626 A (rms)
d. 0.838 A (rms)
e. 0.066 A (rms)

13. A 0.5-H inductor is connected into a 110 V-rms 60-Hz voltage source, with an ammeter in series. What is the rms value of the current through the inductor?

a. 0.189 A (rms)
b. 0.292 A (rms)
c. 0.584 A (rms)
d. 1.19 A (rms)
e. 0.093 A (rms)

15. The inductance of a tuning circuit of an AM radio is 4 mH. Find the capacitance of the circuit required for reception at 1200 kHz.

a. 2.1 pF
b. 4.4 pF
c. 21.2 pF
d. 43.4 pF
e. 27.6 pF

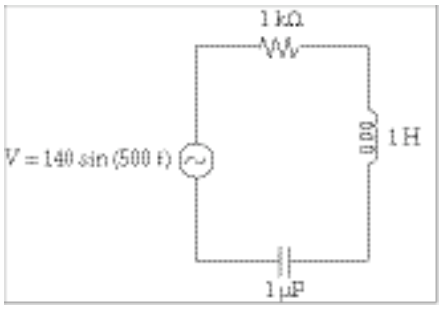
18. If an $R = 1$-kΩ resistor, a $C = 1$-μF capacitor, and an $L = 0.2$-H inductor are connected in series with a $V = 150 \sin(377t)$ volts source, what is the maximum current delivered by the source?

a. 0.007 A
b. 27 mA
c. 54 mA
d. 0.308 A
e. 0.34 A

20. An *RLC* series circuit has $R = 100$ ohms, $C = 25\ \mu$F, and $L = 0.16$ H. For what angular frequency of an ac voltage is the current flow maximum?

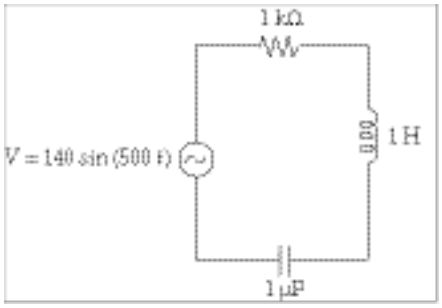
a. 251 rad/s
b. 500 rad/s
c. 757 rad/s
d. 884 rad/s
e. 79.6 rad/s

22. Determine the impedance for the circuit.



a. 600 Ω
b. 1200 Ω
c. 1800 Ω
d. 2300 Ω
e. 1100 Ω

23. Determine the rms current for the circuit.



a. 55 mA
b. 77 mA
c. 99 mA
d. 0.190 A
e. 61 mA

30. What is the average power dissipation in an *RLC* series circuit with $R = 10\Omega$, $L = 0.1$ H, $C = 10\ \mu$F when driven at resonance by a 100 V-rms source?

a. 100 W
b. 500 W
c. 1000 W
d. 2 kW
e. 700 W

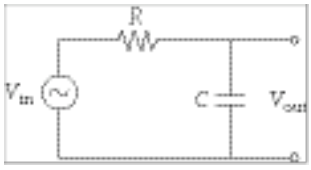
32. A transformer is to be designed to increase the 30 kV-rms output of a generator to the transmission-line voltage of 345 kV-rms. If the primary winding has 80 turns, how many turns must the secondary have?

a. 6
b. 70
c. 920
d. 9200
e. 12

33. The primary winding of an electric train transformer has 400 turns and the secondary has 50. If the input voltage is $120V$(rms) what is the output voltage?

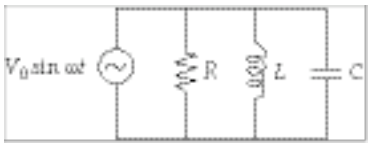
a. 15 V (rms)
b. 30 V (rms)
c. 60 V (rms)
d. 2.4 V (rms)
e. 960 V (rms)

37. Calculate $V_{\text{out}}/V_{\text{in}}$ for the circuit if $R = 2\ \text{k}\Omega$, $C = 0.02\ \mu\text{F}$ and $V = 140\text{V}\sin(50\,000t)$



a. 0.02
b. 0.45
c. 0.80
d. 0.98
e. 2.23

38. The impedance of the parallel *RLC* circuit shown is given by



a. $\dfrac{1}{R} + \dfrac{1}{\omega L} + \omega C$

b. $\left[\dfrac{1}{R^2} + \left(\omega C - \dfrac{1}{\omega L}\right)^2\right]^{-1/2}$

c. $\dfrac{1}{R} + \left(\dfrac{1}{\omega L} - \dfrac{1}{\omega C}\right)$

d. $\sqrt{R^2 + \left(\omega L - \dfrac{1}{\omega C}\right)^2}$

e. $\sqrt{\dfrac{1}{R^2} + \left[\omega C - \dfrac{1}{\omega L}\right]}$

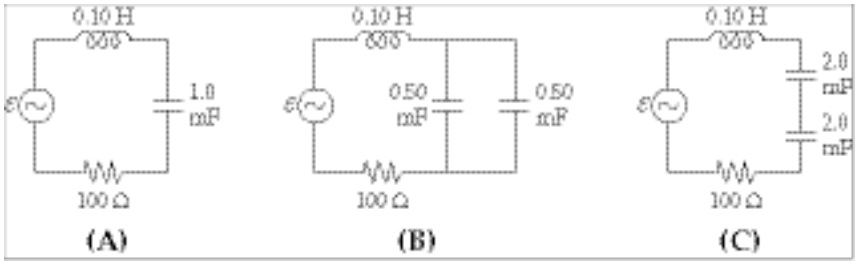
46. Whenever the alternating current frequency in a series *RLC* circuit is halved,

a. the inductive reactance is doubled and the capacitive reactance is halved.
b. the inductive reactance is doubled and the capacitive reactance is doubled.
c. the inductive reactance is halved and the capacitive reactance is halved.
d. the inductive reactance is halved and the capacitive reactance is doubled.
e. the reactance of the circuit remains the same.

47. The average power input to a series alternating current circuit is minimum when

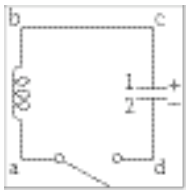
a. there are only a resistor and capacitor in the circuit.
b. there are only a resistor and inductor in the circuit.
c. there is only a resistor in the circuit.
d. $X_L = X_C$ and the circuit contains a resistor, an inductor and a capacitor.
e. there is only a capacitor in the circuit.

48. All three circuits shown below have $R = 100\,\Omega$, $L = 0.1\,\text{H}$ and emf $\mathcal{E} = (5.0\text{ V})\sin(377\,t)$. Which statement regarding the angular resonance frequencies ω_A, ω_B and ω_C is correct?



a. $\omega_C > \omega_A = \omega_B$
b. $\omega_C < \omega_A = \omega_B$
c. $\omega_A = \omega_B = \omega_C$
d. $\omega_B < \omega_A = \omega_C$
e. $\omega_B > \omega_A = \omega_C$

56. A 10-μF capacitor in an *LC* circuit made entirely of superconducting materials ($R = 0\,\Omega$) is charged to 100 μC. Then a superconducting switch is closed. At $t = 0$ s, plate 1 is positively charged and plate 2 is negatively charged. At a later time, $V_{ab} = +10V$. At that time, V_{dc} is



a. 0 V.
b. 3.54 V.
c. 5.0 V.
d. 7.07 V.
e. 10 V.

Open-Ended Problems

57. Suppose the circuit parameters in a series *RLC* circuit are: $L = 1.0\ \mu H$, $C = 10.0$ nF, $R = 100\Omega$, and the source voltage is 220 V. Determine the resonant frequency of the circuit and the amplitude of the current at resonance.

58. A 10-Ω resistor, 10-mH inductor, and 10-μF capacitor are connected in series with a 10-kHz voltage source. The rms current through the circuit is 0.20 A. Find the rms voltage drop across each of the 3 elements.

59. An ac power generator produces 50 A (rms) at 3600 V. The voltage is stepped up to 100 000 V by an ideal transformer and the energy is transmitted through a long distance power line which has a resistance of 100 ohms. What percentage of the power delivered by the generator is dissipated as heat in the long-distance power line?

Chapter 33

Alternating Current Circuits

1. c
2. a
3. d
4. d
5. d
6. a
7. a
8. b
9. a
10. d
11. d
12. b
13. c
14. d
15. b
16. b
17. c
18. c
19. d
20. b
21. a
22. c
23. a
24. a
25. a
26. b
27. c
28. b
29. b
30. c
31. a
32. c
33. a
34. b
35. d
36. d
37. b
38. b
39. b
40. a
41. e
42. c
43. d
44. a
45. d
46. d
47. e
48. c
49. c
50. a
51. d
52. c
53. b
54. d
55. d
56. e

57. 1.59 MHz, 2.2 A

58. 2.0 V, 125.6 V, 0.318 V

59. 0.18%