Chapter 23

Problems & Exercises

1.

Zero

3.

(a) CCW

(b) CW

(c) No current induced

5.

(a) 1 CCW, 2 CCW, 3 CW

(b) 1, 2, and 3 no current induced

(c) 1 CW, 2 CW, 3 CCW

9.

(a) 3.04 mV
(b) As a lower limit on the ring, estimate R = 1.00 mΩ. The heat transferred will be 2.31 mJ. This is not a significant amount of heat.

11.

0.157 V

13.

proportional to $\frac{1}{\mathrm{r}}$

17.

(a) 0.630 V

(b) No, this is a very small emf.

19.

2.22 m/s

25.

(a) 10.0 N

(b) 2.81×10^8 J

(c) 0.36 m/s

(d) For a week-long mission (168 hours), the change in velocity will be 60 m/s, or approximately 1%. In general, a decrease in velocity would cause the orbit to start spiraling inward because the velocity would no longer be sufficient to keep the circular orbit. The long-term consequences are that the shuttle would require a little more fuel to maintain the desired speed, otherwise the orbit would spiral slightly inward.

28.

474 V

30.

0.247 V

32.

(a) 50

(b) yes

34.

(a) 0.477 T

(b) This field strength is small enough that it can be obtained using either a permanent magnet or an electromagnet.

36.

(a) 5.89 V

(b) At t=0

(c) 0.393 s

(d) 0.785 s

38.

(a) 1.92×10^6 rad/s

(b) This angular velocity is unreasonably high, higher than can be obtained for any mechanical system.

(c) The assumption that a voltage as great as 12.0 kV could be obtained is unreasonable.

39.

(a) 12.00 Ω

(b) 1.67 A

41.

72.0 V

43.

0.100 Ω

44.

(a) 30.0

(b) 9.75×10^{-2} A

46.

(a) 20.0 mA

(b) 2.40 W

(c) Yes, this amount of power is quite reasonable for a small appliance.

48.

(a) 0.063 A

(b) Greater input current needed.

50.

(a) 2.2

(b) 0.45

(c) 0.20, or 20.0%

52.

(a) 335 MV

(b) way too high, well beyond the breakdown voltage of air over reasonable distances

(c) input voltage is too high

54.

(a) 15.0 V

(b) 75.0 A

(c) yes

55.

1.80 mH

57.

3.60 V

61.

(a) 31.3 kV

(b) 125 kJ

(c) 1.56 MW

(d) No, it is not surprising since this power is very high.

63.

(a) 1.39 mH

(b) 3.33 V

(c) Zero

65.

60.0 mH

67.

(a) 200 H

(b) 5.00ºC

69.

500 H

71.

50.0 Ω

73.

1.00×10^{-18} s to 0.100 s

75.

95.0%

77.

(a) 24.6 ms

(b) 26.7 ms

(c) 9% difference, which is greater than the inherent uncertainty in the given parameters.

79.

531 Hz

81.

1.33 nF

83.

(a) 2.55 A

(b) 1.53 mA

85.

63.7 µH

87.

(a) 21.2 mH

(b) 8.00 Ω

89.

(a) 3.18 mF

(b) 16.7 Ω

92.

(a) 40.02 Ω at 60.0 Hz, 193 Ω at 10.0 kHz

(b) At 60 Hz, with a capacitor, $Z = 531\ \Omega$, over 13 times as high as without the capacitor. The capacitor makes a large difference at low frequencies. At 10 kHz, with a capacitor $Z = 190\ \Omega$, about the same as without the capacitor. The capacitor has a smaller effect at high frequencies.

94.

(a) 529 Ω at 60.0 Hz, 185 Ω at 10.0 kHz

(b) These values are close to those obtained in Example 23.12 because at low frequency the capacitor dominates and at high frequency the inductor dominates. So in both cases the resistor makes little contribution to the total impedance.

96.

9.30 nF to 101 nF

98.

3.17 pF

100.

(a) 1.31 μH

(b) 1.66 pF

102.

(a) 12.8 $k\Omega$

(b) 1.31 $k\Omega$

(c) 31.9 mA at 500 Hz, 312 mA at 7.50 kHz

(d) 82.2 kHz

(e) 0.408 A

104.

(a) 0.159

(b) 80.9

(c) 26.4 W

(d) 166 W

106.

16.0 W

107.

(a) $|\text{emf}| = 1\frac{\Delta\phi}{\Delta t} = \frac{1.000(0.02000)}{100}\text{V} = 0.0002000\text{ V}$

(b) $|\text{emf}| = 2\frac{\Delta\phi}{\Delta t} = \frac{2(0.2500)(0.02000)}{100}\text{V} = 0.0001000\text{ V}$

(c) The average emf is 0 since the loops are made by a wire that crosses, so the voltage from each loop cancels the emf from the other.

(d) No.