Quiz – Chapter 9

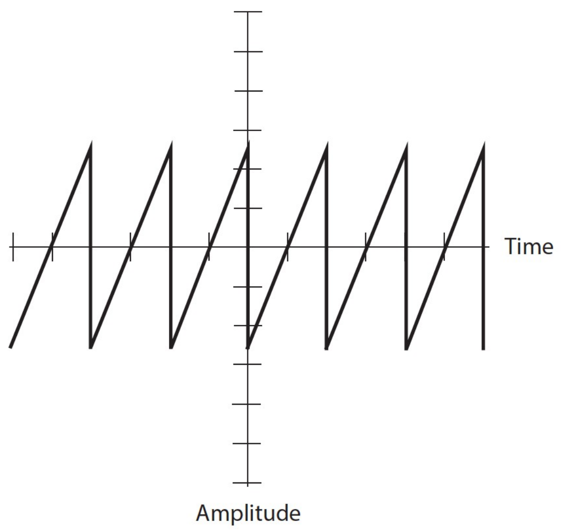
1. In a perfect AC sine wave with no DC component, the peak-to-peak voltage equals
(a) half the positive peak voltage.
(b) the positive peak voltage.
(c) twice the positive peak voltage.
(d) four times the positive peak voltage.

2. In a perfect AC sine wave with no DC component, $\pi/2$ radians of phase represents
(a) 1/6 of a full cycle.
(b) 1/4 of a full cycle.
(c) 1/3 of a full cycle.
(d) 2/3 of a full cycle.

3. A rectangular wave has
(a) an instantaneous rise time and a defined, finite decay time.
(b) a defined, finite rise time and an instantaneous decay time.
(c) a defined, finite rise time and an equal finite decay time.
(d) an instantaneous rise time and an instantaneous decay time.

4. An engineer says that an AC sine wave has a frequency of 100 Hz. A physicist might say that the angular frequency is
(a) 50π rad /s
(b) 100π rad /s
(c) 200π rad /s
(d) $100\pi^2$ rad /s

Waveform 9-1

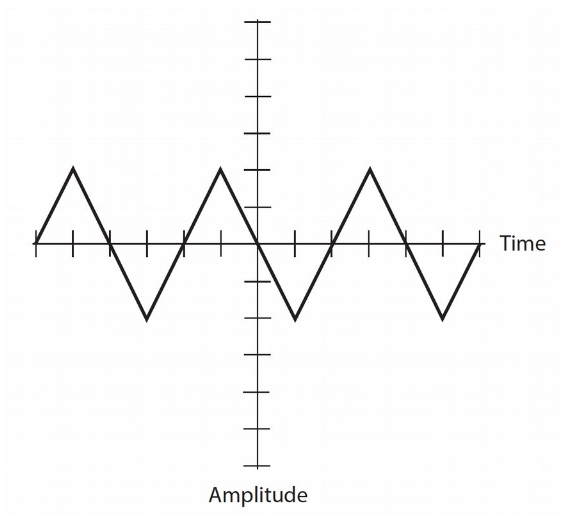


5. Waveform 9-1 shows an AC wave as it might appear on an oscilloscope screen. Each vertical division represents 100 mV. Each horizontal division represents 100 μs. What's the frequency of this wave?
(a) 2.00 kHz
(b) 5.00 kHz
(c) 10.0 kHz
(d) The graph lacks enough information to say.

6. What's the negative peak voltage of the wave shown in Fig. 9-1, based on the appearance of the graph? Positive voltages go upward on the vertical scale, while negative voltages go downward.

(a) -250 mV pk-
(b) -500 mV pk-
(c) -750 mV pk-
(d) The graph lacks enough information to say.

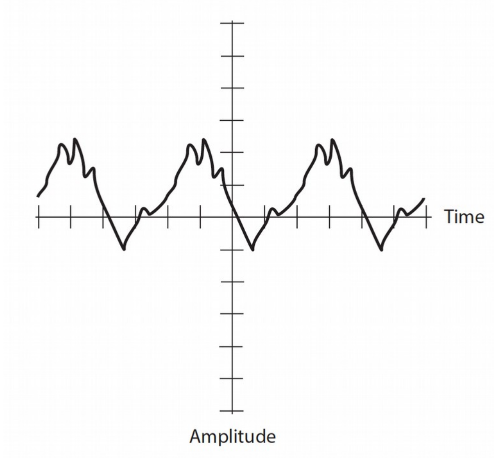
Waveform 9-2



7. Waveform 9-2 shows another wave. Each vertical division represents 100 mV, and each horizontal division represents 100 μs. What's the period?
(a) 100 μs
(b) 200 μs
(c) 400 μs
(d) The graph lacks enough information to say.

8. What's the peak-to-peak voltage of the wave shown in Waveform 9-2? Each vertical division represents 100 mV and each horizontal division represents 100 μs.
(a) 100 mV pk-pk
(b) 200 mV pk-pk
(c) 400 mV pk-pk
(d) The graph lacks enough information to say.

Waveform 9-3



9. Waveform 9-3 shows still another wave. Each vertical division represents 100 mV, and each

horizontal division represents 100 μs. What's the period?
(a) 100 μs
(b) 200 μs
(c) 400 μs
(d) The graph lacks enough information to say.

10. What's the frequency of the wave shown in Waveform 9-3?
(a) 1.25 kHz
(b) 2.50 kHz
(c) 500 kHz
(d) The graph lacks enough information to say.

11. What's the positive peak voltage of the wave shown in Waveform 9-3? Positive voltages go upward on the vertical scale, while negative voltages go downward.
(a) +240 mV pk+
(b) +120 mV pk+
(c) + 480 mV pk+
(d) The graph lacks enough information to say.

12. What's the negative peak voltage of the wave shown in Waveform 9-3?
(a) -100 mV pk-
(b) -200 mV pk-
(c) -500 mV pk-
(d) The graph lacks enough information to say.

13. What's the peak-to-peak voltage of the wave shown in Waveform 9-3?
(a) 170 mV pk-pk
(b) 141 mV pk-pk
(c) 340 mV pk-pk
(d) The graph lacks enough information to say.

14. Two sine waves have the same frequency along with DC components of unknown magnitude. The components are not the same for both waves, but the waves are in phase coincidence. One wave measures +21 V pk+ not including its DC component, while the other wave measures +17 V pk+ not including its DC component. What's the positive peak voltage of the composite wave?
(a) +38 V pk+
(b) +19 V pk+
(c) Zero
(d) We need more information to say.

15. Two sine waves have the same frequency, with DC components of +10 V each. The waves coincide in phase. One wave measures +21 V pk+ including its +10 V DC component, while the other wave measures +17 V pk+ including its +10 V DC component. What's the positive peak voltage of the composite wave?
(a) +58 V pk+
(b) + 48 V pk+
(c) +38 V pk+
(d) We need more information to say.

16. Two sine waves have the same frequency but differ in phase by 180°. Neither wave has a DC component. One wave measures +21 V pk+, while the other wave measures +17 V pk+. What's the positive peak voltage of the composite wave?
(a) +38 V pk+
(b) +19 V pk+
(c) + 8 V pk+
(d) + 4 V pk+

17. Two AC waves have the same frequency but differ in phase by 1/6 of a cycle. What's this phase difference expressed in degrees?
(a) 120°
(b) 90°
(c) 60°
(d) 45°

18. The frequency of an AC wave in megahertz (MHz) equals
(a) 1,000,000 times the reciprocal of its period in seconds.
(b) 1000 times the reciprocal of its period in seconds.
(c) 0.001 times the reciprocal of its period in seconds.
(d) 0.000001 times the reciprocal of its period in seconds.

19. The 7th harmonic of an AC wave with a period of 10.0 microseconds (μs) has a frequency of
(a) 7.00 MHz.
(b) 3.50 MHz.
(c) 700 kHz.
(d) 350 kHz.

20. If you connect a 126-V DC battery in series with the output of a 120-V RMS (not positive peak or negative peak) sine-wave AC wall outlet, you'll get
(a) pure DC.
(b) AC with equal positive and negative peak voltages.
(c) AC with different positive and negative peak voltages.
(d) fluctuating DC.

Answers:
1. c, 2. b, 3. d, 4. c, 5. b, 6. a, 7. c, 8. c, 9. c, 10. b, 11. a, 12. a, 13. c, 14. d, 15. c, 16. d, 17. c, 18. d, 19. c, 20. c

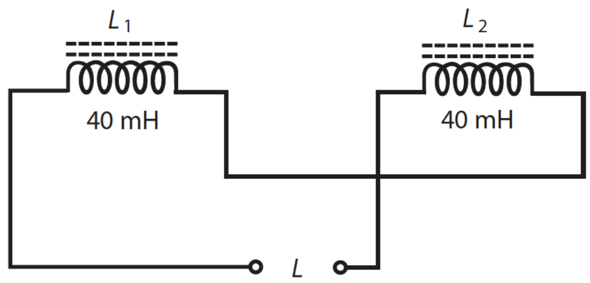
Quiz – Chapter 10

1. Which of the following statements represents an advantage of a toroidal coil over a solenoidal coil?
(a) You can easily permeability-tune a toroid but not a solenoid.
(b) A toroid can carry more current than a solenoid with the same gauge wire.
(c) A toroid can function with a ferromagnetic core, but a solenoid cannot.
(d) A toroid practically prevents unwanted mutual inductance, while solenoids allow it.

2. You connect four 44.0-mH toroidal inductors in parallel. They exhibit no mutual inductance. What's the net inductance of the combination?
(a) 11.0 mH
(b) 22.0 mH
(c) 88.0 mH
(d) 176 mH

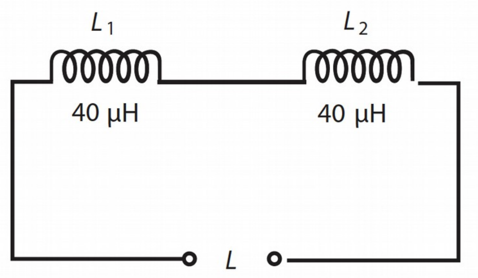
3. You connect two 44.0-mH solenoidal inductors in series. They exhibit no mutual inductance. What's the net inductance of the combination?
(a) 22.0 mH
(b) 88.0 mH
(c) 176 mH
(d) 352 mH

Schematic 10.1



4. In Schematic 10-1, both inductors have values of 40 mH. Their magnetic fields oppose each other. Some mutual inductance exists between them. The net inductance of the combination is
(a) less than 80 mH.
(b) exactly 80 mH.
(c) more than 80 mH.
(d) zero.

Schematic 10-2



5. In Schematic 10-2, both inductors have values of 40 µH. Their magnetic fields reinforce each other. Some mutual inductance exists between them. The net inductance of the combination is
(a) less than 80 µH.
(b) exactly 80 µH.
(c) more than 80 µH.
(d) 160 µH.

6. To obtain the lowest possible inductance for a 100-turn coil, you should use
(a) an air-core solenoid.
(b) a powdered-iron-core solenoid.
(c) a pot-core coil.
(d) a powdered-iron-core toroid.

7. Which of the following factors affects the inductance of a pot-core coil, if all other factors stay the same?
(a) The frequency of the applied signal
(b) The amplitude of the applied signal
(c) The wave shape of the applied signal
(d) The permeability of the core (shell) material

8. As the number of turns increases in an air-core coil, then its inductance, assuming all other factors remain constant,
(a) increases.
(b) stays the same.
(c) decreases.
(d) approaches zero.

9. As you increase the amplitude of the AC signal that you apply to a toroidal coil, leaving all other factors unchanged, the coil's inductance
(a) increases.
(b) stays the same.
(c) decreases.
(d) approaches zero.

10. To increase the inductance of a solenoidal coil without changing anything else, you can increase the
(a) signal frequency.
(b) core permeability.
(c) signal strength.
(d) wire diameter.

11. You connect a 500-μH inductor coil in series with a 900-μH inductor coil, winding them over each other so the coefficient of coupling is 1. Both coils are solenoids whose magnetic fields reinforce each other. What's the mutual inductance between the coils?
(a) 1.40 mH
(b) 700 μH
(c) 671 μH
(d) More information is needed to calculate it.

12. What's the net (total) inductance of the above combination?
(a) 2.74 mH
(b) 2.04 mH
(c) 2.01 mH
(d) More information is needed to calculate it.

13. At which of the following frequencies would you most likely use an air-core solenoidal coil to obtain useful inductance?
(a) 6 kHz
(b) 20 MHz
(c) 900 GHz
(d) Any of the above

14. You have two 50-turn, air-core, loop-like coils, each one measuring 2 centimeters in diameter. You align their axes, place them far from one another, and then gradually bring them closer together. What happens to the coefficient of coupling as you do this?
(a) It decreases.
(b) It stays the same.
(c) It increases.
(d) You'll need more information to answer this question.

15. What happens to the mutual inductance between the two coils as you carry out the exercise described in Question 14 above?
(a) It decreases.
(b) It stays the same.
(c) It increases.
(d) You'll need more information to answer this question.

16. You have two 50-turn loop-like coils, each one measuring 2 centimeters in diameter. You surround each coil with a pot-core shell, align their axes, place them far from one another, and then gradually bring them closer together. What happens to the coefficient of coupling as you do this?
(a) It decreases.
(b) It stays the same.
(c) It increases.
(d) You'll need more information to answer this question.

17. What happens to the mutual inductance between the two coils as you carry out the exercise described in Question 16 above?
(a) It decreases.
(b) It stays the same.
(c) It increases.
(d) You'll need more information to answer this question.

18. Consider a length of transmission line with its wires connected together at the far end. Suppose that the line's velocity factor is 0.750, and you apply a signal at 100 MHz to the open (near) end. To make this line measure . electrical wavelength, you must cut it to a physical length of
(a) 1.13 m.
(b) 79.5 cm.
(c) 56.3 cm.
(d) 23.1 cm.

19. If you decrease the frequency to 90 MHz in the situation described in Question 18 above but don't change anything else, and if you keep the wires at the line's far end connected together, then the signal source at the open (near) end will "see"
(a) a capacitance.
(b) a short circuit.
(c) an inductance.
(d) an open circuit.

20. If you increase the frequency to 230 MHz in the situation described in Question 18 but don't change anything else, and if you keep the wires at the line's far end connected together, then the signal source at the open (near) end will "see"
(a) a capacitance.
(b) a short circuit.
(c) an inductance.
(d) an open circuit.

Answers:
1. d, 2. a, 3. b, 4. a, 5. c, 6. a, 7. d, 8. a, 9. b, 10. b, 11. c, 12. a, 13. b, 14. c, 15. d, 16. b, 17. b, 18. c, 19. c, 20. c

Quiz – Chapter 11

1. If the value (capacitance) of a capacitor remains constant when the temperature changes within a reasonable range, then its temperature coefficient is
(a) zero.
(b) unity.
(c) infinite.
(d) undefined.

2. You can increase the value of a mica-dielectric capacitor, assuming all other factors remain constant, by replacing the mica with
(a) strontium titanate.
(b) polyethylene.
(c) paper.
(d) air.

3. Fill in the blank to make the following sentence true: "As you reduce the value of a capacitor, it ________ to completely charge after you connect a 6-V battery to its plates, assuming all other factors remain constant."
(a) takes more time

(b) becomes more difficult
(c) takes less time
(d) takes more energy

4. Which of the following values would you most likely find in an air-variable capacitor?
(a) 1000 μF
(b) 68 pF
(c) 3.3 μF
(d) 50,000 pF

5. Which of the following values would you least likely find in a single-layer disk-ceramic capacitor?
(a) 150 pF
(b) 680 pF
(c) 0.01 μF
(d) 330 μF

6. A capacitance of 0.01 nanofarad is the same as a capacitance of
(a) 0.1 pF.
(b) 1 pF.
(c) 10 pF.
(d) 100 pF.

7. If you connect four 100-pF capacitors in series, you get a net capacitance of
(a) 25 pF.
(b) 50 pF.
(c) 100 pF.
(d) 400 pF.

8. If you connect four 100-pF capacitors in parallel, you get a net capacitance of
(a) 25 pF.
(b) 50 pF.
(c) 100 pF.
(d) 400 pF.

9. If you connect four 100-pF capacitors in a 2 x 2 series-parallel matrix, you get a net capacitance of
(a) 25 pF.
(b) 50 pF.
(c) 100 pF.
(d) 400 pF.

10. If you connect nine 100-pF capacitors in a 3 x 3 series-parallel matrix, you get a net capacitance of
(a) 25 pF.
(b) 50 pF.
(c) 100 pF.
(d) 400 pF.

11. The main advantage of air as a dielectric material for capacitors is the fact that air
(a) allows for a lot of capacitance in a small volume.
(b) exhibits low loss.
(c) works well at low voltages.
(d) has a high dielectric constant.

12. A capacitance of 6800 nF is the same as
(a) 0.06800 μF.

(b) 0.6800 μF.
(c) 6.800 μF.
(d) 68.00 μF.

13. Which of the following properties is characteristic of tantalum capacitors?
(a) High reliability
(b) High capacitance per unit of volume
(c) High efficiency
(d) All of the above

14. Which of the following values would you most expect to find in an electrolytic capacitor?
(a) 0.100 pF
(b) 100 pF
(c) 0.100 μF
(d) 100 μF

15. You connect a 10-pF capacitor in parallel with a 20-pF capacitor. What's the net capacitance?
(a) 30 pF
(b) 15 pF
(c) 6.7 pF
(d) 5.5 pF

16. You connect a 10-pF capacitor in series with a 20-pF capacitor. What's the net capacitance?
(a) 30 pF
(b) 15 pF
(c) 6.7 pF
(d) 5.5 pF

17. You find a capacitor rated at 220 pF ±10%. Which of the following capacitance values lies outside the acceptable range?
(a) 180 pF
(b) 195 pF
(c) 246 pF
(d) All of the above

18. A capacitor, rated at 330 pF, shows an actual value of 340 pF. By how much does its actual capacitance differ from its rated capacitance?
(a) +2.94%
(b) +3.03%
(c) -2.94%
(d) -3.03%

19. Which of the following values would you most expect to see in a paper capacitor?
(a) 0.001 nF
(b) 1.00 pF
(c) 0.01 μF
(d) 100 μF

20. If the number of plates in an air-variable capacitor decreases while all other factors remain constant,
(a) the capacitance goes up.
(b) the capacitance goes down.
(c) the capacitance stays the same.
(d) You'll need more information to answer this question.

Answers:
1. a, 2. a, 3. c, 4. b, 5. d, 6. c, 7. a, 8. d, 9. c, 10. c, 11. b, 12. c, 13. d, 14. d, 15. a, 16. c, 17. d, 18. b, 19. c, 20.

b

Quiz – Chapter 12

1. A sine wave has a frequency of 50 kHz. Therefore, a complete cycle takes
(a) 0.20 microseconds (μs). (Note: 1 μs = 0.000001 second.)
(b) 2.0 μs.
(c) 20 μs.
(d) 200 μs.

2. Which of the following statements is not characteristic of a pure sine wave with a well-defined and constant period?
(a) The electrical energy is distributed over a wide range (band) of frequencies.
(b) The wave can be represented as a vector that rotates at a constant angular speed.
(c) The wave has a well-defined, constant wavelength as long as the medium that carries it doesn't change.
(d) The wave has a well-defined, constant frequency.

3. If someone says that two sine waves differ in phase by an amount that constantly changes, then we know that the waves have
(a) different periods.
(b) different wavelengths.
(c) different frequencies.
(d) All of the above

4. If wave X leads wave Y by ⅓ of a cycle, then
(a) Y lags 120Åã behind X.
(b) Y lags 90Åã behind X.
(c) Y lags 60Åã behind X.
(d) Y lags 30Åã behind X.

5. Fill in the blank to make the following statement true: "Suppose that two pure sine waves having identical frequencies and no DC components, coincide in phase. If you change the phase of one wave by ________, you'll get two waves in phase opposition."
(a) 90°
(b) 180°
(c) 270°
(d) 360°

6. We can change the phase of a pure sine wave having a constant frequency and no DC component by one of the following four phase angles, and end up with, in effect, the same wave. Which angle?
(a) 45°
(b) 90°
(c) 180°
(d) 360°

7. A phase difference of 22.5° in the circular-motion model of a sine wave represents
(a) 1/16 of a revolution.
(b) 1/8 of a revolution.
(c) 1/4 of a revolution.
(d) 1/2 of a revolution.

8. Two perfect sine waves exist in phase opposition. One wave has voltage peaks of +7 V pk+ and -7 V pk-, and the other wave has voltage peaks of +3 V pk+ and -3 V pk-. What's the peak-to-peak voltage of the composite wave?
(a) 4 V pk-pk
(b) 6 V pk-pk

(c) 8 V pk-pk
(d) 12 V pk-pk

9. A sine wave has a frequency of 60 Hz. How long does it take for 90° of phase to occur?
(Note: 1 ms = 0.001 second.)
(a) 2.1 ms
(b) 4.2 ms
(c) 8.3 ms
(d) We need more information to calculate it.

10. In effect, a cosine wave is a sine wave shifted by
(a) 60°.
(b) 90°.
(c) 120°.
(d) 180°.

11. Two sine waves have the same frequency but differ in phase by 60Åã. Neither wave has a DC component. The two waves are offset by
(a) 1/6 of a cycle.
(b) 1/4 of a cycle.
(c) 1/3 of a cycle.
(d) 1/2 of a cycle.

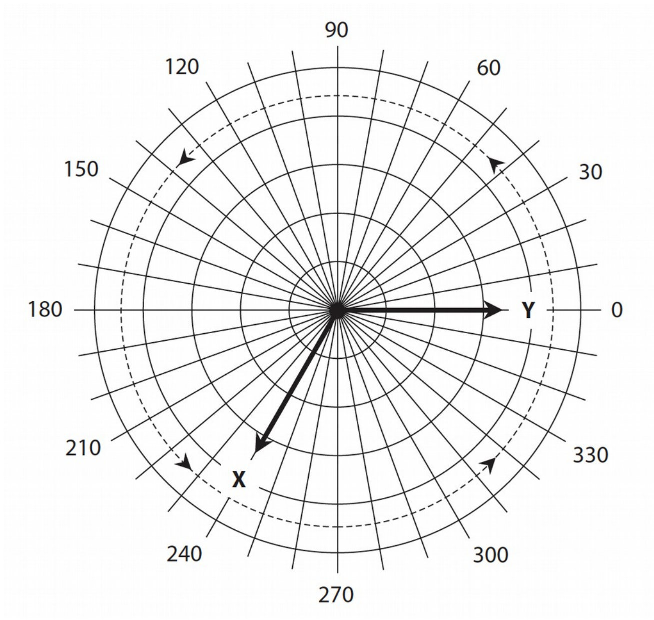
12. Technically, the term phase opposition refers to two waves (whether sine or not) having the same frequency and
(a) inverted with respect to each other.
(b) displaced in phase by 90°
(c) displaced in phase by 180°
(d) displaced in phase by 270°

13. In a polar-coordinate vector diagram in which the radius represents voltage, the length of the rotating vector for a pure sine wave containing no DC component represents
(a) half the peak voltage (positive or negative).
(b) the peak voltage (positive or negative).
(c) twice the peak voltage (positive or negative).
(d) the peak-to-peak voltage.

14. A sine wave X lags another sine wave Y by 45° of phase, so Y is
(a) 1/12 of a cycle ahead of X.
(b) 1/10 of a cycle ahead of X.
(c) 1/8 of a cycle ahead of X.
(d) 1/6 of a cycle ahead of X.

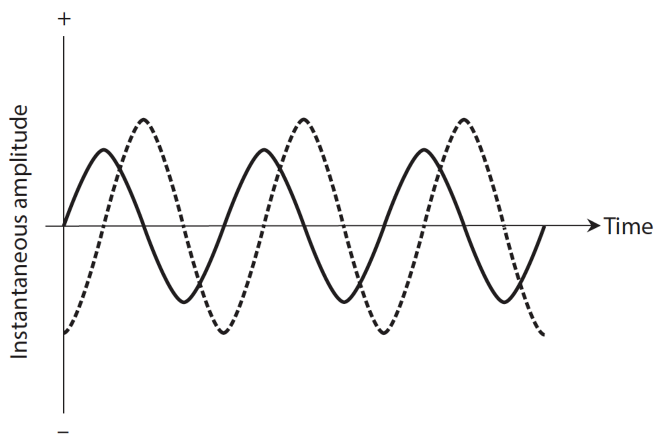
15. Figure 12-1 shows two sine waves X and Y that have the same frequency as a pair of polar vectors X and Y. Neither wave has a DC component. Which of the following statements holds true on the basis of this graph?
(a) wave X lags wave Y by 1/6 of a cycle.
(b) wave X lags wave Y by 1/3 of a cycle.
(c) wave X leads wave Y by 1/6 of a cycle.
(d) wave X leads wave Y by1/3 of a cycle.

Figure 12-1



16. Which, if any, of the following conclusions can we make about the relative peak-to-peak amplitudes of the two waves shown in Fig. 12-1?
(a) The two waves have the same peak-to-peak amplitude.
(b) The peak-to-peak amplitude of wave X exceeds the peak-to-peak amplitude of wave Y.
(c) The peak-to-peak amplitude of wave Y exceeds the peak-to-peak amplitude of wave X.
(d) We can't say anything definitive about the relative peak-to-peak amplitudes of the two waves.

Figure 12-2



17. Figure 12-2 illustrates two sine waves, neither of which has a DC component, that are in phase
(a) coincidence.
(b) opposition.
(c) quadrature.
(d) reinforcement.

18. If we invert one of the waves in Fig. 12-2, then the two waves will be in phase
(a) coincidence.
(b) opposition.
(c) quadrature.
(d) reinforcement.

19. Two AC waves (not necessarily sine waves) having the same frequency and both with 10-V peak-to-peak amplitude are in phase opposition. Neither wave has a DC component. What's the peak-to-peak voltage of the composite wave?
(a) 7.071 V pk-pk
(b) 14.14 V pk-pk
(c) 0 V pk-pk
(d) We need more information to know.

20. Imagine that the two waves from the previous question differ in phase by 180°. What's the peak-to-peak voltage of the composite wave? Remember that the waves don't have to be sinusoids; they can have any imaginable form.
(a) 7.071 V pk-pk
(b) 14.14 V pk-pk
(c) 0 V pk-pk
(d) We need more information to know.

Answers:
1. c, 2. a, 3. d, 4. a, 5. b, 6. d, 7. a, 8. c, 9. b, 10. b, 11. a, 12. a, 13. b, 14. c, 15. b, 16. a, 17. c, 18. c, 19. c, 20. d

Quiz – Chapter 13.

1. A coil has an inductive reactance of 120 Ω at 5.00 kHz. What's its inductance?
(a) 19.1 mH
(b) 1.91 mH
(c) 38.2 mH
(d) 3.82 mH

2. As a coil's inductance rises, its fixed-frequency reactance
(a) alternately increases and decreases.
(b) stays the same.
(c) increases.
(d) decreases.

3. An inductor has $X_L = 700\ \Omega$ at $f = 2.50$ MHz. What is L?
(a) 223 μH
(b) 22.3 μH
(c) 446 μH
(d) 44.6 μH

4. In a coil having zero resistance and an AC signal applied, the phase angle is
(a) 0 °.
(b) 45 °.
(c) 90 °.
(d) some value that depends on the signal frequency.

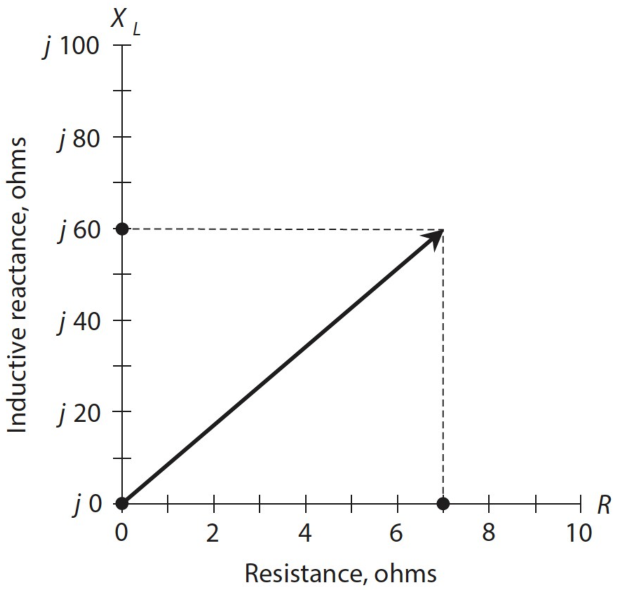
5. If the inductive reactance in ohms equals the resistance in ohms in an RL circuit with an AC signal applied, then the phase angle is
(a) between 0 ° and 45 °.
(b) 45 °.
(c) between 45 ° and 90 °.
(d) some value that depends on the signal frequency.

6. In a pure resistance without inductance and with an AC signal applied, the phase angle is
(a) 0 °.

(b) 45 °.
(c) 90 °.
(d) some value that depends on the signal frequency.

7. According to Fig. 13-14, X_L/R is
(a) 17.1.
(b) 8.57.
(c) 0.233.
(d) 0.117.

Figure 13-1.



8. In Fig. 13-14, the R and X_L graph scale divisions differ in size, but we can determine the phase angle anyway. It's about
(a) 6.67°.
(b) 13.1°.
(c) 83.3°.
(d) 86.7 °.

9. We apply an AC signal to a coil with an adjustable "roller tap" that lets us vary the number of coil turns through which the signal passes. (Engineers call this contraption a roller inductor.) When we set the tap so that the signal current must flow through the entire coil, we obtain a certain reactance that depends on the signal frequency. As we adjust the tap so the signal current passes through fewer and fewer turns, how must we change the signal frequency to maintain constant reactance? Assume that no resistance exists in the coil itself or in the components immediately external to it.
(a) We must not change the frequency.
(b) We must increase the frequency.
(c) We must decrease the frequency.
(d) We need more information to answer this question.

10. In the situation of Question 9, what happens to the phase angle as we adjust the coil in the manner described, assuming the coil is made of perfectly conducting wire?
(a) It stays the same.
(b) It gets larger.

(c) It gets smaller.
(d) We need more information to know.

11. The points along the vertical axis in the RX_L quarter-plane correspond one-to-one with values of
(a) inductance.
(b) inductive reactance.
(c) resistance.
(d) complex impedance.

12. A coil has an inductance of 50.0 mH. What's its reactance at 5.00 kHz?
(a) 15.7 Ω
(b) 31.4 Ω
(c) 785 Ω
(d) 1.57 k

13. A 1.0-mH inductor has a reactance of 3000 Ω. What's the frequency?
(a) We need more information to calculate it.
(b) 0.24 MHz
(c) 0.48 MHz
(d) 0.96 MHz

14. If we increase the resistance gradually from zero to unlimited values while keeping the inductive reactance constant in an RL circuit, the resulting points in the RX_L quarter-plane lie along
(a) a straight ray pointing up from some point on the resistance axis.
(b) a straight ray pointing to the right from some point on the reactance axis.
(c) a straight ray ramping up and to the right from the origin.
(d) a quarter-circle centered at the origin.

15. If we gradually increase both the resistance and the reactance in an RL circuit from zero to unlimited values at constant rates, the resulting points in the RX_L quarter-plane lie along
(a) a straight ray pointing up from some point on the resistance axis.
(b) a straight ray pointing to the right from some point on the reactance axis.
(c) a straight ray ramping up and to the right from the origin.
(d) a quarter-circle centered at the origin.

16. In a certain RL circuit, the ratio of the inductive reactance to the resistance starts out large and then decreases gradually to zero. The phase angle
(a) increases and approaches 90°.
(b) decreases and approaches 45°.
(c) increases and approaches 45°.
(d) decreases and approaches 0°.

17. In a certain RL circuit, the ratio of the inductive reactance to the resistance starts out at zero and gradually increases toward a limiting value of 1.732:1. The phase angle
(a) increases and approaches 30°.
(b) decreases and approaches 30°.
(c) increases and approaches 60°.
(d) decreases and approaches 60°.

18. A coil has an inductance of 100 nH at a frequency of 100 MHz. What's the inductive reactance?
(a) We need more information to calculate it.
(b) 126 Ω
(c) 62.8 Ω
(d) 31.4 Ω

19. An RL circuit comprises a 1.25-mH inductor and a 7.50-Ω resistor. The circuit's interconnecting wires conduct perfectly. What's the phase angle at 1.45 kHz?
(a) 56.6°
(b) 42.3°
(c) 33.4°
(d) 21.2°

20. What happens to the phase angle if we short out the resistor in the circuit described in the previous question?
(a) It depends on the signal frequency.
(b) It depends on the signal voltage.
(c) It stays the same.
(d) None of the above

Answers:
1. d, 2. c, 3. d, 4. c, 5. b, 6. a, 7. b, 8. c, 9. b, 10. a, 11. b, 12. d, 13. c, 14. b, 15. c, 16. d, 17. c, 18. c, 19. a, 20. d

Quiz – Chapter 14

1. In a circuit containing pure capacitive reactance and no resistance, the phase angle is always
(a) + 45°
(b) 0°
(c) - 45°
(d) −90°

2. In a circuit in which the resistance and the capacitive reactance are equal and opposite (the resistance positive, the reactance negative), the phase angle is always
(a) + 45°
(b) 0°
(c) - 45°
(d) −90°

3. In a circuit containing pure resistance and no reactance, the phase angle is always
(a) + 45°
(b) 0°
(c) - 45°
(d) −90°

4. A capacitor has a value of C = 200 pF. We apply a signal at f = 4.00 MHz. What's X_C?
(a) - 498 Ω
(b) -995 Ω
(c) -199 Ω
(d) -3.98 k

5. In an RC circuit containing a finite nonzero resistance, as the ratio X_C/R approaches zero (from the negative side), the phase angle approaches
(a) –90°
(b) - 45°
(c) 0°
(d) negative infinity.

6. A capacitor has a value of 0.0330 μF and a reactance of -123 Ω at a certain frequency. What frequency?
(a) 39.2 kHz

(b) 19.6 kHz
(c) 78.4 kHz
(d) We need more information to calculate it.

7. What happens to the value of a capacitor (in microfarads) as we decrease the spacing between the plates without changing anything else?
(a) It does not change.
(b) It increases.
(c) It decreases.
(d) We need more information to say.

8. What's the reactance of a 470-pF capacitor at 12.5 MHz?
(a) -2.71 k
(b) -271 Ω
(c) -27.1 Ω
(d) -2.71 Ω

9. What happens to the reactance of the capacitor described in Question 8 if we reduce the frequency by a factor of 10?
(a) It becomes 100 times what it was (negatively).
(b) It becomes 10 times what it was (negatively).
(c) It becomes 1/10 of what it was (negatively).
(d) It becomes 1/100 of what it was (negatively).

10. A capacitor has a reactance of -100 Ω at 200 kHz. What's its capacitance?
(a) 7.96 nF
(b) 79.6 nF
(c) 796 nF
(d) 7.96 μF

11. A series RC circuit comprises a capacitor whose reactance is -75 Ω at the frequency of operation, connected to a 50-Ω resistor. What's the phase angle?
(a) -34°
(b) -56°
(c) -85°
(d) -90°

12. A series RC circuit comprises a capacitor whose reactance is -50 Ω at the frequency of operation, connected to a 75-Ω resistor. What's the phase angle?
(a) -34°
(b) -56°
(c) -85°
(d) -90°

13. A series RC circuit comprises a capacitance of 0.01 μF along with a 4.7-Ω resistor. What's the phase angle for a signal with a constant frequency?
(a) - 60°
(b) - 45°
(c) -30°
(d) We need more information to answer this question.

14. What will happen to the phase angle in the circuit of Question 13 (whether or not we know its actual value) if we short out the resistor but leave the capacitor alone?
(a) It will become -90°
(b) It will become - 45°
(c) It will become 0°
(d) Nothing

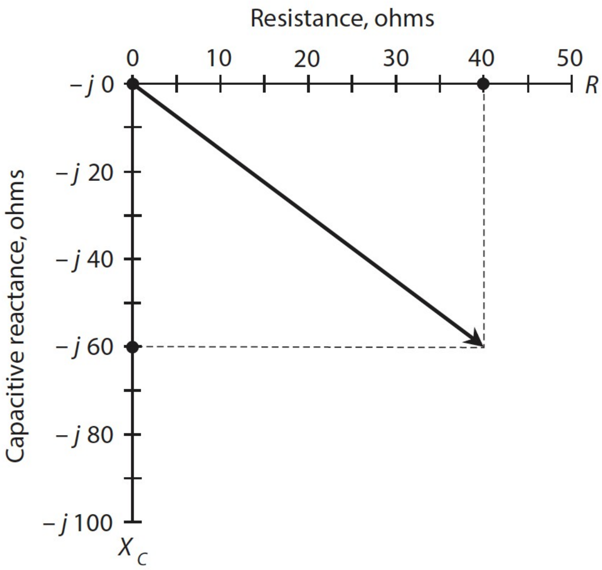
15. What will happen to the phase angle in the circuit of Question 14 (not 13!) if we short out the resistor and double the capacitance?
(a) It will become - 60°
(b) It will become - 45°
(c) It will become -30°
(d) Nothing

16. What will happen to the phase angle in the circuit of Question 15 (not 13 or 14!) if we triple the frequency while leaving all other factors constant?
(a) We need more information to answer this question.
(b) It will increase negatively (get closer to -90°).
(c) It will decrease negatively (get closer to 0°).
(d) Nothing.

17. A 470-pF capacitor has a reactance of -800 Ω at a certain frequency. What frequency?
(a) 423 kHz
(b) 846 kHz
(c) 212 kHz
(d) We need more information to answer this question.

18. In the situation of Question 17, what happens to X_C if we cut the frequency in half?
(a) It increases negatively by a factor of the square root of 2.
(b) It increases negatively by a factor of 2.
(c) It increases negatively by a factor of 4.
(d) Nothing.

Figure 14-1.



19. In the scenario portrayed by Fig. 14-1, the X_C/R ratio is roughly
(a) - 0.66.
(b) - 0.75.
(c) -1.5.
(d) -3.0.

20. In Fig. 14-13, the R and X_C scale divisions differ in size. We can nevertheless calculate the

phase angle as roughly
(a) -19°
(b) -56°
(c) -37°
(d) -33°

Answers:
1. d, 2. c, 3. b, 4. c, 5. c, 6. a, 7. b, 8. c, 9. b, 10. a, 11. b, 12. a, 13. d, 14. a, 15. d, 16. d, 17. a, 18. b, 19. c, 20. b

Quiz – Chapter 15

1. The positive square root of a negative real number equals
(a) a smaller real number.
(b) a larger real number.
(c) a positive real-number multiple of the j operator.
(d) 0.

2. The reciprocal of the j operator equals
(a) itself.
(b) its negative.
(c) a real number.
(d) 0.

3. If we add a real number to an imaginary number, we get
(a) a real number.
(b) an imaginary number.
(c) a complex number.
(d) -1.

4. What's the sum (-1 + j 7) + (3 - j 5)?
(a) 2 + j 2
(b) 2 - j 2
(c) -2 + j 2
(d) -2 - j 2

5. What's the sum (3 - j 5) + (-1 + j 7)?
(a) 2 + j 2
(b) 2 - j 2
(c) -2 + j 2
(d) -2 - j 2

6. What's the difference (-1 + j 7) - (3 - j 5)?
(a) 4 + j 12
(b) 4 - j 12
(c) -4 + j 12
(d) -4 - j 12

7. What's the difference (3 - j 5) - (-1 + j 7)?
(a) 4 + j 12
(b) 4 - j 12
(c) -4 + j 12
(d) -4 - j 12

8. If a specification paper tells you that a certain device has a nominal output impedance of "50 Ω," the manufacturer means that the load should ideally exhibit a complex impedance of
(a) 50 + j 50.

(b) 50 + j 50 or 50 - j 50.
(c) 0 + j 50 or 0 - j 50.
(d) None of the above

9. The complex impedance value 15 + j 15 could represent
(a) a pure resistance.
(b) a pure reactance.
(c) a resistor in series with an inductor.
(d) a resistor in series with a capacitor.

10. Which, if any, of the following complex numbers has an absolute value of 25?
(a) 15 - j 20
(b) 12.5 - j 12.5
(c) 5 - j 5
(d) None of the above

11. What's the absolute-value impedance of 4.50 + j 5.50?
(a) 4.50 Ω
(b) 5.50 Ω
(c) 7.11 Ω
(d) 50.5 Ω

12. What's the absolute-value impedance of 0.0 - j 36?
(a) 0.0 Ω
(b) 6.0 Ω
(c) 18 Ω
(d) 36 Ω

13. What's the magnitude of the vector whose end point lies at (1000,-j 1000) on the complexnumber plane?
(a) 1000
(b) 1414
(c) 2000
(d) 2828

14. What's the magnitude of the vector whose end point lies at (-1000,-j 1000) on the complex-number plane?
(a) 1000
(b) 1414
(c) 2000
(d) 2828

15. If we enlarge the inside radius of the shield of a coaxial cable but don't change anything else about the cable, what happens to its characteristic impedance?
(a) It increases.
(b) It does not change.
(c) It decreases.
(d) We need more information to answer this question.

16. If we increase the radii of both wires in a two-wire transmission line but don't change anything else about the line, what happens to its characteristic impedance?
(a) We need more information to answer this question.
(b) It increases.
(c) It does not change.
(d) It decreases.

17. Suppose that a capacitor has a value of 0.010 µF at 1.2 MHz. What's the capacitive

susceptance, stated as an imaginary number?
(a) $B_C = j\ 0.075$
(b) $B_C = -j\ 0.075$
(c) $B_C = j\ 13$
(d) $B_C = -j\ 13$

18. Absolute-value impedance equals the square root of
(a) the real-number coefficient of the reactance plus the imaginary-number part of the admittance.
(b) the real-number resistance plus the real-number coefficient of the reactance.
(c) the real-number conductance plus the real-number coefficient of the susceptance.
(d) None of the above

19. Suppose that an inductor has a value of 10.0 mH at 15.91 kHz. What's the inductive susceptance, stated as an imaginary number?
(a) $B_L = -j\ 1000$
(b) $B_L = j\ 1000$
(c) $B_L = -j\ 0.00100$
(d) $B_L = j\ 0.00100$

20. When we add the reciprocal of real-number resistance to the reciprocal of imaginary-number reactance, we get complex-number
(a) impedance.
(b) conductance.
(c) susceptance.
(d) admittance.

Answers:
1. c, 2. b, 3. c, 4. a, 5. a, 6. c, 7. b, 8. d, 9. c, 10. a, 11. c, 12. d, 13. b, 14. b, 15. a, 16. d, 17. a, 18. d, 19. c, 20. d

Quiz – Chapter 16

1. Suppose that in a series RLC circuit, R = 50 Ω and no net reactance exists. In which direction does the complex-impedance vector point?
(a) Straight up
(b) Straight down
(c) Straight toward the right
(d) Downward and toward the right

2. Suppose that in a parallel RLC circuit, G = 0.05 S and B = -0.05 S. In which direction does the complex-admittance (not the complex-impedance) vector point?
(a) Straight down
(b) Straight toward the right
(c) Upward and toward the right
(d) Downward and toward the right

3. Suppose that in a parallel RLC circuit, R = 10 Ω and $jX_C = -j10$. In which direction does the complex-admittance (not the complex-impedance) vector point?
(a) Straight up
(b) Straight toward the right
(c) Upward and toward the right
(d) Downward and toward the right

4. A vector pointing upward and toward the right in the GB half-plane would indicate
(a) pure conductance.

(b) conductance and inductive susceptance.
(c) conductance and capacitive susceptance.
(d) None of the above

5. A vector pointing upward and toward the left in the RX half-plane would indicate
(a) pure resistance.
(b) resistance and inductive reactance.
(c) resistance and capacitive reactance.
(d) None of the above

6. Suppose that a coil has a reactance of j 20 Ω. What's the susceptance, assuming that the circuit contains nothing else?
(a) j 0.050 S
(b) -j 0.050 S
(c) j 20 S
(d) -j 20 S

7. Suppose that a capacitor has a susceptance of j 0.040 S. What's the reactance, assuming that the circuit contains nothing else?
(a) j 0.040 Ω
(b) -j 0.040 Ω
(c) j 25 Ω
(d) -j 25 Ω

8. Suppose that we connect a coil and capacitor in series with j X_L = j 50 and j X_C = -j 100. What's the net reactance?
(a) j 50
(b) j 150
(c) -j 50
(d) -j 150

9. Suppose that we connect a coil of L = 3.00 μH and a capacitor of C = 100 pF in series, and then drive an AC signal through the combination at a frequency of f = 6.00 MHz. What's the net reactance?
(a) -j 152
(b) -j 378
(c) j 152
(d) j 378

10. Consider a resistor, a coil, and a capacitor in series with R = 10 Ω, X_L = 72 Ω, and X_C = -83 Ω. What's the net impedance Z?
(a) 10 + j 11
(b) 10 - j 11
(c) 82 - j 11
(d) -73 - j 11

11. Consider a resistor, a coil, and a capacitor connected in series. The resistor has a value of 220.0 Ω, the capacitance equals 500.00 pF, and the inductance equals 44.00 μH. We operate the circuit at a frequency of 5.650 MHz. What's the complex impedance?
(a) 220.0 + j 1506
(b) 220.0 - j 1506
(c) 0.000 + j 1506
(d) 220.0 + j 0

12. Suppose that we connect a resistor, a coil, and a capacitor in series. The resistance equals 75.3 Ω, the inductance equals 8.88 μH, and the capacitance equals 980 pF. We operate the circuit at a frequency of 1340 kHz. What's the complex impedance?
(a) 75.3 + j 0.00

(b) 75.3 + j 46.4
(c) 75.3 - j 46.4
(d) 0.00 - j 75.3

13. Consider a coil and capacitor connected in parallel with jB_L = -j 0.32 and jB_C = j 0.20. What's the net susceptance?
(a) j 0.52
(b) -j 0.52
(c) j 0.12
(d) -j 0.12

14. Suppose that we connect a coil of 8.5 μH and a capacitor of 100 pF in parallel and drive a signal through them at 7.10 MHz. What's the net susceptance?
(a) -j 0.0045
(b) j 0.0018
(c) -j 0.0026
(d) None of the above

15. What's the net susceptance of the parallel-connected inductor and capacitor described in Question 14 if we double the frequency to 14.2 MHz?
(a) -j 0.0090
(b) j 0.0036
(c) -j 0.0013
(d) None of the above

16. Consider a resistor, a coil, and a capacitor in parallel. The resistance is 7.50 Ω, the inductance is 22.0 μH, and the capacitance is 100 pF. The frequency is 5.33 MHz. What's the complex admittance?
(a) 0.133 + j 0.00199
(b) 0.133 - j 0.00199
(c) 7.50 + j 503
(d) 7.50 - j 503

17. Suppose that a circuit has an admittance of Y = 0.333 + j 0.667. What's the complex impedance, assuming the frequency does not change?
(a) 1.80 - j 0.833
(b) 1.80 + j 0.833
(c) 0.599 - j 1.20
(d) 0.599 + j 1.20

18. Suppose that we connect a resistor of 25 Ω, a capacitor of 0.0020 μF, and a coil of 7.7 μH in parallel (not in series!). We operate the circuit at 2.0 MHz. What's the complex impedance?
(a) 8.1 + j 22
(b) 8.1 - j 22
(c) 22 + j 8.1
(d) 22 - j 8.1

19. Suppose that a series RX circuit has a resistance of R = 20 Ω and a capacitive reactance of X = -20 Ω. Suppose that we apply 42 V RMS AC to this circuit. How much current flows?
(a) 0.67 A RMS
(b) 1.5 A RMS
(c) 2.3 A RMS
(d) 3.0 A RMS

20. Suppose that a parallel RX circuit has R = 50 Ω and X = 40 Ω. We supply the circuit with E = 155 V RMS. How much current does the entire circuit draw from the AC source?

(a) 5.0 A RMS
(b) 2.5 A RMS
(c) 400 mA RMS
(d) 200 mA RMS

Answers:
1. c, 2. d, 3. c, 4. c, 5. d, 6. b, 7. d, 8. c, 9. a, 10. b, 11. a, 12. c, 13. d, 14. b, 15. d, 16. a, 17. c, 18. d, 19. b, 20. a

Quiz – Chapter 17

1. A transmission line operates at its best efficiency when
(a) the load impedance constitutes a pure resistance equal to the characteristic impedance of the line.
(b) the load impedance constitutes a pure inductive reactance equal to the characteristic impedance of the line.
(c) the load impedance constitutes a pure capacitive reactance equal to the characteristic impedance of the line.
(d) the absolute-value impedance of the load equals the characteristic impedance of the line.

2. The ninth harmonic of 900 kHz is
(a) 100 kHz.
(b) 300 kHz.
(c) 1.20 MHz.
(d) 8.10 MHz.

3. A pure resistance dissipates or radiates
(a) complex power.
(b) imaginary power.
(c) true power.
(d) apparent power.

4. Suppose that we want to build a ó-wave dipole antenna designed to have a fundamental resonant frequency of 14.3 MHz. How long should we make the antenna, as measured from end to end in meters?
(a) 32.7 m
(b) 10.0 m
(c) 16.4 m
(d) We need more information to answer this question.

5. When a transmission line exhibits standing waves, we find a voltage maximum
(a) wherever we find a current maximum.
(b) wherever we find a current minimum.
(c) at the transmitter end of the line.
(d) at the load end of the line.

6. Standing waves on a transmission line (as compared with a line operating without any impedance mismatch) increase the loss in the wire conductors at the
(a) current maxima.
(b) voltage maxima.
(c) current minima and voltage maxima.
(d) current minima and voltage minima.

7. When we take the cosine of the phase angle in an AC circuit or system that contains both resistance and reactance, we get the
(a) true power.
(b) imaginary power.

(c) apparent power.
(d) power factor.

8. Which of the following parameters is an example of true power in an AC circuit or system?
(a) The AC that appears between the plates of a capacitor
(b) The AC that passes through a wire inductor
(c) The AC that dissipates as heat in a transmission line
(d) The AC that travels along a transmission line

9. Suppose that the apparent power in a circuit equals 40 W and the true power equals 30 W. What's the power factor?
(a) 60%
(b) 75%
(c) 80%
(d) We need more information to calculate it.

10. Suppose that the true power in a circuit equals 40 W and the imaginary power equals 30 W. What's the power factor?
(a) 60%
(b) 75%
(c) 80%
(d) We need more information to calculate it.

11. Consider a series circuit with a resistance of 24 Ω and an inductive reactance of 10 Ω. What's the power factor?
(a) 42%
(b) 58%
(c) 92%
(d) 18%

12. Imagine that you encounter a series circuit with a resistance of 24 Ω and a capacitive reactance of -10 Ω. What's the power factor?
(a) 42%
(b) 58%
(c) 92%
(d) 18%

13. Suppose that a circuit has 24 Ω of resistance and 10 Ω of inductive reactance in series. A meter shows 100 W, representing the VA power. What's the true power?
(a) 18 W
(b) 34 W
(c) 85 W
(d) 92 W

14. Suppose that the true power equals 100 W in a circuit that consists of a resistance of 60.0 Ω in series with an inductive reactance of 80.0 Ω. What's the VA power?
(a) 167 W
(b) 129 W
(c) 60.0 W
(d) 36.0 W

15. Suppose that the true power equals 100 W in a circuit that consists of a resistance of 80.0 Ω in series with an inductive reactance of 60.0 Ω. (The resistance and reactance numbers here are transposed from the values in Question 14.) What's the VA power?
(a) 64.0 W
(b) 80.0 W
(c) 125 W

(d) 156 W

16. Suppose that we connect a coil and capacitor in series. The inductance is 36 μH and the capacitance is 0.0010 μF. What's the resonant frequency?
(a) 36 kHz
(b) 0.84 MHz
(c) 2.4 MHz
(d) 6.0 MHz

17. What will happen to the resonant frequency of the circuit described in Question 16 if we connect a 100 Ω resistor in series with the existing coil and capacitor?
(a) It will increase.
(b) It will stay the same.
(c) It will decrease.
(d) We need more information to answer this question.

18. Suppose that we connect a coil and capacitor in parallel, with L = 75 μH and C = 150 pF. What's f_o ?
(a) 1.5 MHz
(b) 2.2 MHz
(c) 880 kHz
(d) 440 kHz

19. What will happen to the resonant frequency of the circuit described in Question 18 if we connect a 22-pF capacitor in parallel with the existing coil and capacitor?
(a) It will increase.
(b) It will stay the same.
(c) It will decrease.
(d) We need more information to answer this question.

20. We want to cut a .-wave section of transmission line for use at 18.1 MHz. The line has a velocity factor of 0.667. How long should we make the section?
(a) 9.05 m
(b) 3.62 m
(c) 3.00 m
(d) 2.76 m

Answers:
1. a, 2. d, 3. c, 4. b, 5. b, 6. a, 7. d, 8. c, 9. b, 10. c, 11. c, 12. c, 13. d, 14. a, 15. c, 16. b, 17. b, 18. a, 19. c, 20. d

Quiz – Chapter 18

1. An autotransformer
(a) can automatically match impedances over a wide range.
(b) can effectively step down an AC voltage or impedance.
(c) has an automatically variable center tap.
(d) consists of a variable length of transmission line.

2. Which of the following core types works best if you need a coil winding inductance of 35 nH?
(a) Air
(b) Powdered-iron solenoid
(c) Toroid
(d) Pot core

3. Which of the following statements concerning air cores as compared with powdered-iron cores is true?

(a) Air concentrates the magnetic lines of flux more than powdered iron, allowing for higher inductance for a given number of turns per winding.
(b) Air-core transformers have greater loss than powdered-iron-core transformers, so air-core transformers work poorly for impedance matching.
(c) Air-core transformers require toroidal windings, limiting the possible configurations, while powdered-iron-core transformers have no such constraints.
(d) Air-core transformers operate best at the highest frequencies, while powdered-iron-core transformers are generally necessary at the lowest frequencies.

4. If a load contains no reactance whatsoever, then in theory we can use a transformer to match it perfectly to a transmission line
(a) having any characteristic impedance within reason.
(b) whose characteristic impedance is the same as the load impedance or lower, but not higher.
(c) whose characteristic impedance is the same as the load impedance or higher, but not lower.
(d) at only one frequency.

5. The primary-winding impedance always exceeds the secondary-winding impedance in
(a) an autotransformer.
(b) a step-up transformer.
(c) a step-down transformer.
(d) a balanced-to-unbalanced transformer.

6. We can minimize eddy currents in a 60-Hz AC utility transformer by
(a) using an air core.
(b) using a laminated-iron core.
(c) using the core winding method.
(d) winding the primary directly over the secondary.

7. If we wind the secondary directly over the primary in an air-core transformer, we should always expect to see
(a) a large impedance-transfer ratio.
(b) excellent performance at high frequencies.
(c) relatively high capacitance between the windings.
(d) significant hysteresis loss.

8. Suppose that a transformer has a primary-to-secondary turns ratio of exactly 4.00:1. We apply 20.0 V RMS AC across the primary terminals. How much AC RMS voltage can we expect to see across the secondary?
(a) 80.0 V RMS
(b) 40.0 V RMS
(c) 10.0 V RMS
(d) 5.00 V RMS

9. Suppose that a transformer has a primary-to-secondary turns ratio of exactly 1:4.00. The voltage at the primary equals 20.0 V RMS. What's the AC RMS voltage at the secondary?
(a) 80.0 V RMS
(b) 40.0 V RMS
(c) 10.0 V RMS
(d) 5.00 V RMS

10. Suppose that a transformer has a secondary-to-primary turns ratio of exactly 2.00:1. We apply 20.0 V RMS AC across the primary terminals. How much AC RMS voltage can we expect to see across the secondary?
(a) 80.0 V RMS
(b) 40.0 V RMS
(c) 10.0 V RMS
(d) 5.00 V RMS

11. Suppose that a transformer has a secondary-to-primary turns ratio of exactly 1:2.00. The voltage at the primary equals 20.0 V RMS. What's the AC RMS voltage at the secondary?
(a) 80.0 V RMS
(b) 40.0 V RMS
(c) 10.0 V RMS
(d) 5.00 V RMS

12. We want a transformer to match an input impedance of 300 Ω, purely resistive, to an output impedance of 50.0 Ω, also purely resistive. What's the required primary-to-secondary turns ratio?
(a) 36.0:1
(b) 6.00:1
(c) 2.45:1
(d) 2.00:1

13. Suppose that a transformer has a primary-to-secondary turns ratio of 4.00:1. The load, connected to the transformer output, constitutes a pure resistance of 50.0 Ω. What's the impedance at the primary?
(a) 12.8 k
(b) 800 Ω
(c) 400 Ω
(d) 200 Ω

14. A transformer has a primary-to-secondary impedance-transfer ratio of 4.00:1. We apply an AC signal of 200 V RMS to the primary. What's the RMS AC signal voltage at the secondary?
(a) 800 V RMS
(b) 400 V RMS
(c) 141 V RMS
(d) 100 V RMS

15. An antenna has a purely resistive impedance of 600 Ω. We connect it to a ¼ wave section of 92-Ω coaxial cable. What's the impedance at the input end of the section?
(a) 14 Ω
(b) 55 k
(c) 6.5 Ω
(d) 346 Ω

16. Suppose that we operate the system described in Question 15 at a frequency of 14 MHz. Our 92-Ω coaxial cable has a velocity factor of 0.75. How much cable will we need to construct a ¼ wave section?
(a) 8.0 m
(b) 7.5 m
(c) 5.3 m
(d) 4.0 m

17. A radio transmitter is designed to operate into a purely resistive impedance of 50 Ω. We have an antenna that exhibits a purely resistive impedance of 800 Ω. If we want to build an impedancematching transformer to match these two impedances, what should its primary-to-secondary turns ratio be if we connect the transmitter to the primary and the antenna to the secondary?
(a) 1:16
(b) 1:8
(c) 1:4
(d) 1:2

18. Suppose that, in the situation described by Question 17, we want to use a 1/4-wave section of transmission line to match the transmitter impedance to the antenna impedance. We need a line

whose characteristic impedance equals
(a) 400 Ω
(b) 200 Ω
(c) 141 Ω
(d) 100 Ω

19. Imagine that the situation in the preceding two questions gets more complicated. The antenna has reactance in addition to the 800-Ω resistive component. That reactance results in a complex antenna impedance of 800 + j 35 at a frequency of 14 MHz. Our antenna constitutes an unbalanced system, so it's designed to work with a coaxial-cable transmission line or an unbalanced transformer secondary. How can we modify the antenna so that it will work properly at 14 MHz with either of the impedance-matching systems described in Questions 17 and 18?
(a) We can connect a capacitor in series with the antenna at the point where the transformer secondary or .-wave section output meets the antenna, such that the capacitive reactance equals -35 ohms at 14 MHz.
(b) We can connect an inductor in series with the antenna at the point where the transformer secondary or .-wave section output meets the antenna, such that the inductive reactance equals 35 ohms at 14 MHz.
(c) We can connect a capacitor in series with the system at the point where the transmitter output meets the transformer primary or .-wave section input, such that the capacitive reactance equals -35 Ω at 14 MHz.
(d) We can connect an inductor in series with the system at the point where the transmitter output meets the transformer primary or .-wave section input, such that the inductive reactance equals 35 Ω at 14 MHz.

20. Suppose that we want to use the antenna system described in Questions 17 through 19 over a continuous range of frequencies from 10 MHz to 20 MHz. In that case, what can we do to obtain a perfect impedance match at any frequency in that range?
(a) We can place a variable inductor in series with the antenna at the point where the transformer secondary or .-wave section output meets the antenna.
(b) We can place a variable capacitor in series with the antenna at the point where the transformer secondary or .-wave section output meets the antenna.
(c) We can place a well-engineered transmatch in series with the antenna at the point where the transformer secondary or .-wave section output meets the antenna.
(d) We can't do anything. We can never expect to get a perfect impedance match over a continuous range of frequencies in a situation of this sort.

Answers:
1. b, 2. a, 3. d, 4. a, 5. c, 6. b, 7 c, 8. d, 9. a, 10. b, 11. c, 12. c, 13. b, 14. d, 15. a, 16. d, 17. c, 18. b, 19. a, 20. c

Test – Part 2

1. If two pure sine waves of the same frequency are 135° out of phase, it's equivalent to
(a) 1/16 of a cycle.
(b) 1/10 of a cycle.
(c) 1/6 of a cycle.
(d) 3/8 of a cycle.
(e) 3/4 of a cycle.

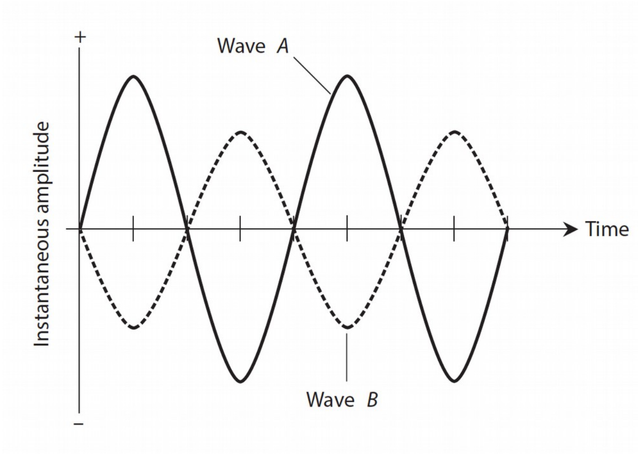
2. What should we do with the individual resistance values in a series RLC circuit if we want to determine the net resistance?
(a) Add them all up.
(b) Multiply them by each other.
(c) Convert them to conductances, add those values to each other, and then convert the result back to resistance.
(d) Convert them to susceptances, multiply them by each other, and then convert the result

back to resistance.
(e) Multiply them by each other and then take the square root of the result.

3. When two identical capacitors are connected in series and no mutual capacitance exists, the net capacitance is
(a) ¼ of the value of either individual capacitor.
(b) half the value of either individual capacitor.
(c) the same as the value of either individual capacitor.
(d) twice the value of either individual capacitor.
(e) four times the value of either individual capacitor.

4. At any particular frequency, a capacitor with a negative temperature coefficient
(a) gets less reliable as the temperature rises.
(b) gets more reliable as the temperature rises.
(c) heats up more as its reactance gets farther from zero (increases negatively).
(d) has reactance that gets farther from zero (increases negatively) as the temperature rises.
(e) has reactance that gets closer to zero (decreases negatively) as the temperature rises.

Figure Test 2-1



5. Refer to Fig. Test 2-1. What's the phase relationship between the two pure sine waves A and B?
(a) Wave A lags wave B by 90°.
(b) Wave A lags wave B by 45°.
(c) Wave A lags wave B by 30°.
(d) Waves A and B coincide in phase.
(e) Waves A and B oppose in phase.

6. Refer to Fig. Test 2-1 again. What can we say about the period of wave A with respect to the period of wave B?
(a) The period of wave A equals the period of wave B.
(b) The period of wave A equals half the period of wave B.
(c) The period of wave A equals one and a half times the period of wave B.
(d) The period of wave A equals twice the period of wave B.
(e) Nothing, because we can't define the relative period.

7. If we connect a 12.6-V automotive battery directly to a 100-Ω resistor, then that resistor dissipates 1.59 W of
(a) conductive power.
(b) apparent power.
(c) true power.
(d) resistive power.

(e) imaginary power.

8. How long does it take for 36.00° of a cycle to pass in a 60.00-Hz sine wave?
(a) 0.01667 ms
(b) 0.1667 ms
(c) 1.667 ms
(d) 16.67 ms
(e) 166.7 ms

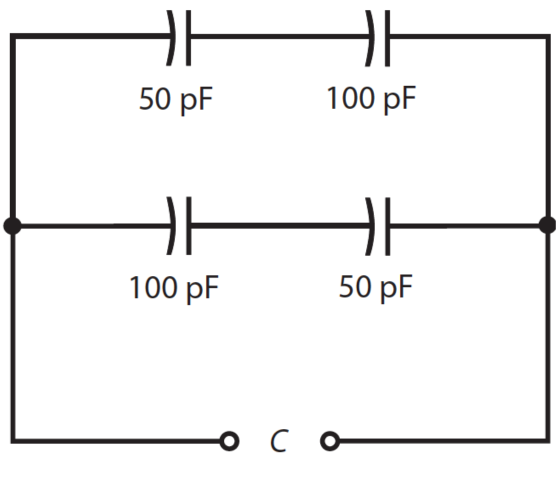
9. What's the period of an AC wave whose frequency is 1.00 kHz?
(a) 1.00 ms
(b) 1.25 ms
(c) 2.50 ms
(d) 5.00 ms
(e) 25.0 ms

10. Consider a series circuit comprising a pure resistance of 60 Ω and an inductive reactance of 100 Ω. What's the circuit's complex-number impedance?
(a) 60 - j 100
(b) -100 - j 60
(c) 60 + j 100
(d) -100 + j 60
(e) 160 Ω

11. Which of the following capacitor types would most likely have a value of 0.01 μF?
(a) Ceramic
(b) Air variable
(c) Photovoltaic
(d) Electrolytic
(e) Electrodynamic

12. If we connect five 100-pF capacitors in parallel, the net capacitance is
(a) 20 pF.
(b) 50 pF.
(c) 100 pF.
(d) 500 pF.
(e) We need more information to answer this question.

Figure Test 2-2.



13. If we connect four capacitors as shown in Fig. Test 2-2, the net capacitance C (rounded to

two significant figures) is
(a) 33 pF.
(b) 38 pF.
(c) 50 pF.
(d) 67 pF.
(e) 88 pF.

14. When we want an antenna system to work at its best, which of the following properties should we make sure that it has?
(a) The characteristic impedance of the feed line should equal the resistive part of the antenna impedance, and the antenna itself should have no reactance.
(b) The characteristic impedance of the feed line should equal the reactive part of the antenna impedance, and the antenna itself should be a pure reactance.
(c) The characteristic impedance of the feed line should equal the sum of the resistive and reactive parts of the antenna impedance.
(d) The standing-wave ratio (SWR) on the feed line should be zero.
(e) The SWR on the feed line should be extremely high (ideally, infinite).

15. If a pure sine wave has a positive peak voltage of +170 V pk+ and a negative peak voltage of -170 V pk-, then its peak-to-peak voltage is
(a) zero.
(b) 240 V pk-pk.
(c) 340 V pk-pk.
(d) 120 V pk-pk.
(e) a value that requires more information to calculate.

16. If a pure sine wave has a positive peak voltage of +170 V pk+ and a negative peak voltage of -170 V pk-, then its effective or RMS voltage is
(a) zero.
(b) 240 V RMS.
(c) 340 V RMS.
(d) 120 V RMS.
(e) a value that requires more information to calculate.

17. If a pure sine wave has a positive peak voltage of +170 V pk+ and a negative peak voltage of -170 V pk-, then its average voltage is
(a) zero.
(b) 240 V.
(c) 340 V.
(d) 120 V.
(e) a value that requires more information to calculate.

18. We connect two components in series. One has a complex impedance of 10 + j 20, the other 40 - j 20. What's the net complex-number impedance of the combination?
(a) 50 + j 40
(b) 50 - j 40
(c) 50 + j 0
(d) 30 + j 40
(e) 30 - j 40

19. The situation described in Question 18 represents an example of
(a) reactance.
(b) quadrature.
(c) dissipation.
(d) dissonance.
(e) resonance.

20. We run a small electric generator with a moderate load. Then we disconnect that load to let the generator "run free." What happens?
(a) The generator motor speeds up.
(b) The generator motor slows down.
(c) The output voltage decreases.
(d) It takes more mechanical power to turn the generator's motor shaft.
(e) The output current increases.

21. Consider a series RLC circuit, where R represents the resistance and X represents the net reactance. We can find the absolute-value impedance according to one of the following formulas. Which one?
(a) $Z = R + X$
(b) $Z = (R^2 + X^2)^{1/2}$
(c) $Z = [RX / (R^2 + X^2)]^{1/2}$
(d) $Z = 1 / (R^2 + X^2)$
(e) $Z = R^2 X^2 / (R + X)$

22. The resistance is less than the reactance in an RL circuit, but neither value is zero or "infinity." What's the phase angle?
(a) 0°
(b) Something between 0° and 45°
(c) 45°
(d) Something between 45° and 90°
(e) 90°

23. The resistance equals the reactance in an RL circuit; both values are finite and nonzero. What's the phase angle?
(a) 0°
(b) Something between 0° and 45°
(c) 45°
(d) Something between 45° and 90°
(e) 90°

24. The resistance is greater than the reactance in an RL circuit, but neither value is zero or "infinity." What's the phase angle?
(a) 0°
(b) Something between 0° and 45°
(c) 45°
(d) Something between 45° and 90°
(e) 90°

25. In a series-resonant RLC circuit, which (if any) of the following formulas always holds true? (Remember that L and C stand for actual inductance and capacitance values, not reactance values.)
(a) $R = 0$
(b) $L = C$
(c) $L = 0$
(d) $C = 0$
(e) None of the above

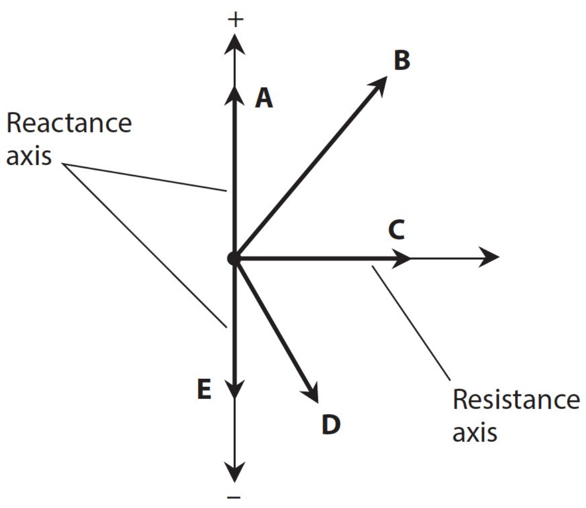
26. A perfectly conducting (loss-free) AC transmission line carries 200 mA RMS and 100 V RMS. The load contains no reactance, but its resistance equals the characteristic impedance of the line. How much reactive power does the load dissipate?
(a) None
(b) 7.07 W
(c) 14.1 W
(d) 20.0 W

(e) 28.3 W

27. We connect a 400-pF capacitor in parallel with a 20-μH inductor. Then we increase the capacitance to 800 pF and decrease the inductance to 10 μH. What happens to the resonant frequency of the circuit?
(a) It stays the same.
(b) It increases by a factor of 2π.
(c) It increases by a factor of $4\pi_2$.
(d) It decreases by a factor of 2π.
(e) It decreases by a factor of $4\pi_2$.

28. We connect a 400-pF capacitor in series with a 20-μH inductor. Then we increase the capacitance to 800 pF and decrease the inductance to 10 μH. What happens to the resonant frequency of the circuit?
(a) It stays the same.
(b) It increases by a factor of 2π.
(c) It increases by a factor of $4\pi^2$
(d) It decreases by a factor of 2π.
(e) It decreases by a factor of $4\pi^2$

Figure Test 2-3.



29. In Fig. Test 2-3, vector A represents
(a) pure inductance.
(b) pure resistance.
(c) pure capacitance.
(d) a combination of resistance and inductance.
(e) a combination of resistance and capacitance.

30. In Fig. Test 2-3, vector B represents
(a) pure inductance.
(b) pure resistance.
(c) pure capacitance.
(d) a combination of resistance and inductance.
(e) a combination of resistance and capacitance.

31. In Fig. Test 2-3, vector C represents

(a) pure inductance.
(b) pure resistance.
(c) pure capacitance.
(d) a combination of resistance and inductance.
(e) a combination of resistance and capacitance.

32. In Fig. Test 2-3, vector D represents
(a) pure inductance.
(b) pure resistance.
(c) pure capacitance.
(d) a combination of resistance and inductance.
(e) a combination of resistance and capacitance.

33. In Fig. Test 2-3, vector E represents
(a) pure inductance.
(b) pure resistance.
(c) pure capacitance.
(d) a combination of resistance and inductance.
(e) a combination of resistance and capacitance.

34. An air-core coil
(a) works well as a 60-Hz AC transformer.
(b) has less inductance than a toroid-core coil with the same number of turns.
(c) provides high inductance with relatively few turns.
(d) works best at very-low frequencies (VLF) and low frequencies (LF).
(e) makes an efficient loop antenna for VLF and LF transmitting.

35. What's the net inductance of three 60-mH toroid-core inductors connected in parallel? (Remember that mutual inductance is not a factor with toroidal coils because all the magnetic flux is confined to the core.)
(a) It's impossible to calculate without more information.
(b) 20 mH
(c) 60 mH
(d) 120 mH
(e) 180 mH

36. What's the net capacitance of three 60-pF ceramic capacitors connected in parallel? (Assume that no mutual capacitance exists.)
(a) It's impossible to calculate without more information.
(b) 20 pF
(c) 60 pF
(d) 120 pF
(e) 180 pF

37. A step-up RF transformer has a turns ratio of 1:10. We connect a purely resistive load of 10k to the secondary winding. If we connect a radio transmitter to the primary winding, what purely resistive impedance will that transmitter "see"?
(a) 0.10 Ω
(b) 1.0 Ω
(c) 10 Ω
(d) 0.10k
(e) 1.0k

38. Consider again the transformer described in Question 37. If the transmitter is designed to operate into a purely resistive impedance of 50 Ω (as most ham radios are, for example), what purely resistive impedance should we connect to the secondary to get optimum performance from the transmitter, which remains connected to the primary?

(a) 5.0k
(b) 0.50k
(c) 50 Ω
(d) 5.0 Ω
(e) 0.50 Ω

39. When we translate 100 nH into microhenrys, we get
(a) 0.001 μH.
(b) 0.010 μH.
(c) 0.100 μH.
(d) 1.00 μH.
(e) 10.0 μH.

40. We can denote a specific pure inductive reactance on the RX_L half-plane as a point
(a) on the positive real-number axis.
(b) on the positive imaginary-number axis.
(c) in the lower-right part of the half-plane, but not on either axis.
(d) in the upper-right part of the half-plane, but not on either axis.
(e) on the negative imaginary-number axis.

41. How many degrees of phase indicate the time-point in a cycle at which a pure sine wave, with no DC component, has a negative-going voltage of zero? (A cycle begins when the voltage is zero and positive-going.)
(a) 0°
(b) 45°
(c) 90°
(d) 180°
(e) 270°

42. How many degrees of phase indicate the time-point in a cycle at which a pure sine wave, with no DC component, reaches its maximum negative instantaneous voltage?
(a) 0°
(b) 45°
(c) 90°
(d) 180°
(e) 270°

43. You want to use a quarter-wave transmission-line section to match a feed line with a characteristic impedance of 50 Ω to an antenna with a purely resistive impedance of 113 Ω. What characteristic impedance should that matching section have?
(a) 63 Ω
(b) 69 Ω
(c) 75 Ω
(d) 82 Ω
(e) 91 Ω

44. What AC waveform from the list below has the most harmonic energy?
(a) Sine
(b) Triangular
(c) Ramp
(d) Square
(e) We need more information to say.

45. In a resonant RLC circuit, the complex-number reactance values are both nonzero, but when you add them, you get
(a) j 0.
(b) a positive imaginary number.

(c) a negative imaginary number.
(d) a positive real number.
(e) a negative real number.

46. In an RLC circuit comprising a discrete resistor, inductor, and capacitor, resonance occurs at
(a) a specific frequency and all its even-numbered harmonics.
(b) a specific frequency and all its odd-numbered harmonics.
(c) a specific frequency and all its harmonics.
(d) a single specific frequency.
(e) None of the above

47. Which of the following factors (a), (b), (c), or (d), if any, does not affect the characteristic impedance of coaxial cable?
(a) The outside diameter of the center conductor
(b) The inside diameter of the shield
(c) The spacing between the center conductor and shield
(d) The nature of the insulating material (dielectric) between the center conductor and shield
(e) Any or all of the above factors can affect the characteristic impedance of coaxial cable.

48. In a series RL circuit in which R = 910 Ω and X_L = 910 Ω, the current lags the voltage by
(a) 90°.
(b) 60°.
(c) 45°.
(d) 30°.
(e) 0°.

49. Two pure sine-wave signals both lack DC components, have the same frequency, and have the same peak-to-peak voltage; yet when we combine them we get no signal whatsoever. What's the phase difference between these two sine waves?
(a) 0°
(b) 180°
(c) 360°
(d) Any whole-number multiple of 180°
(e) We need more information to say.

50. A series RC circuit has a resistance of 10k and a capacitive reactance of -j 13 Ω at a particular frequency. The current leads the voltage by
(a) 90°.
(b) 60°.
(c) 45°.
(d) 30°.
(e) None of the above

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