
CHAPTER 3

Signals

Review Questions

1. A sine wave has three characteristics: the amplitude, the period or frequency and the phase. The amplitude is the value of the signal at any point on the wave; it is the distance from a given point on the wave to the horizontal axis. The period is the time a signal needs to complete one cycle and the frequency gives the number of periods in one second. The phase indicates the status of the first cycle and describes the position of the waveform at time zero.
3. Analog signals have an infinite range of values, while digital signals have a limited number of values.
5. Frequency and period are the inverse of each other. $T = 1/f$ and $f = 1/T$.
7. The amplitude of a signal measures the value of the signal at any point.
9. The phase describes the position of the waveform relative to time zero.
11. Fourier analysis.
13. Bit rate refers to the number of bit intervals per second; its counterpart in analog signals is frequency.
15. Decibel measures the relative strength of two signals or a signal at two different points.
17. The wavelength is the distance a simple signal can travel in one period. Wavelength = propagation speed x period

Multiple-Choice Questions

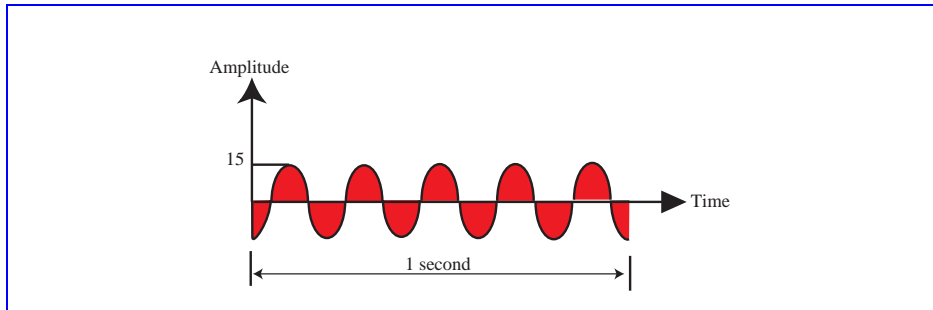
19. b
21. a
23. a
25. a
27. d
29. a

- 31. a
- 33. a
- 35. b
- 37. b
- 39. b
- 41. c
- 43. b
- 45. d
- 47. c

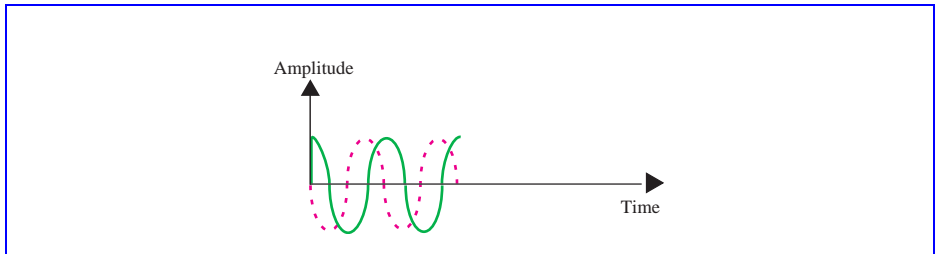
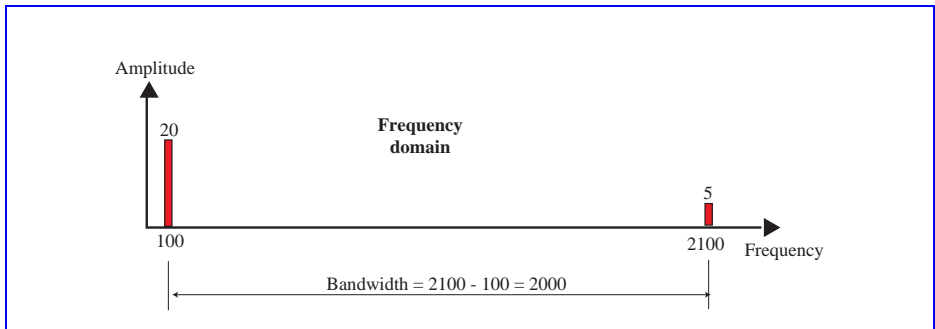
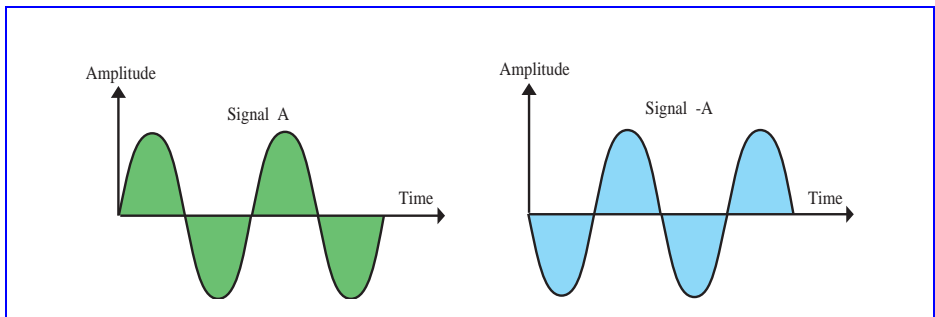
Exercises

- 49.
 - a. 0.2 Hz , $2 \times 10^{-4} \text{ KHz}$, $2 \times 10^{-7} \text{ MHz}$, $2 \times 10^{-10} \text{ GHz}$, $2 \times 10^{-13} \text{ THz}$
 - b. $8.33 \times 10^4 \text{ Hz}$, 83.3 KHz , $8.33 \times 10^{-2} \text{ MHz}$, $8.33 \times 10^{-5} \text{ GHz}$, $8.33 \times 10^{-8} \text{ THz}$
 - c. $4.55 \times 10^6 \text{ Hz}$, $4.55 \times 10^3 \text{ KHz}$, 4.55 MHz , $4.55 \times 10^{-3} \text{ GHz}$, $4.55 \times 10^{-6} \text{ THz}$
 - d. $1.23 \times 10^{10} \text{ Hz}$, $1.23 \times 10^7 \text{ KHz}$, $1.23 \times 10^4 \text{ MHz}$, 12.3 GHz , $1.23 \times 10^{-2} \text{ THz}$
- 51.
 - a. 360 or 0 degrees
 - b. 180 degrees
 - c. 270 degrees
 - d. 120 degrees
- 53. See Figure 3.1

Figure 3.1 Exercise 53



- 55. See Figure 3.2.
- 57. See Figure 3.3
- 59. See Figure 3.4
- 61.
 - a. 1 Kbps
 - b. 500 bps

Figure 3.2 Exercise 55**Figure 3.3** Exercise 57**Figure 3.4** Exercise 59

- c. 500 Kbps
 - d. 4 Tbps (4×10^{12} bps)
- 63.
- a. 0.01 s
 - b. 8 ms
 - c. 800 s
65. 2 KHz
67. 2 MHz. See Figure 3.5.
69. 0 Hz
71. See Figure 3.6

Figure 3.5 Exercise 67

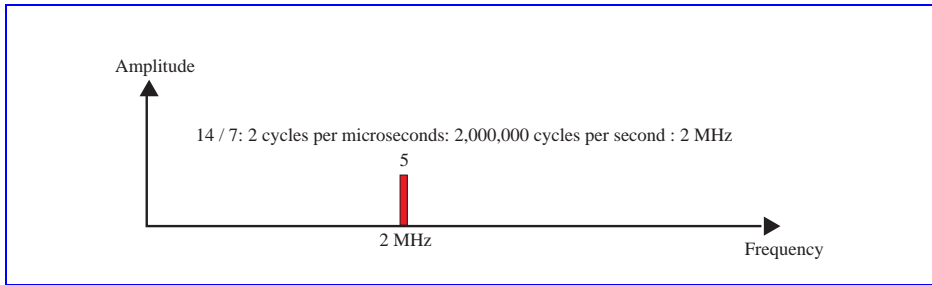
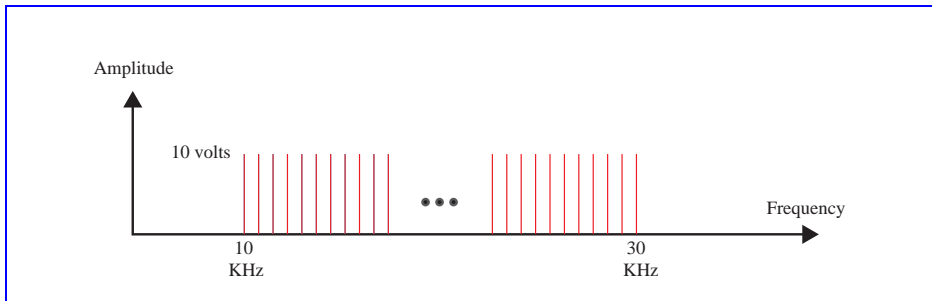


Figure 3.6 Exercise 71



- 73. $s(t) = 10 \sin(5000\pi t + \pi/6)$
- 75. 200 Hz
- 77. 1 harmonic, 3 Mbps
3 harmonics, 12 Mbps
5 harmonics, 27 Mbps
- 79. $-10 = 10 \log_{10}(P_2 / 5)$ $P_2 = 0.5$
- 81. $100,000 \text{ bits} / 5 \text{ Kbps} = 20 \text{ s}$
- 83. $1 \mu\text{m} \times 5 = 5 \mu\text{m}$
- 85. $4,000 \log_2(1 + 10 / 0.005) = 43,866 \text{ bps}$