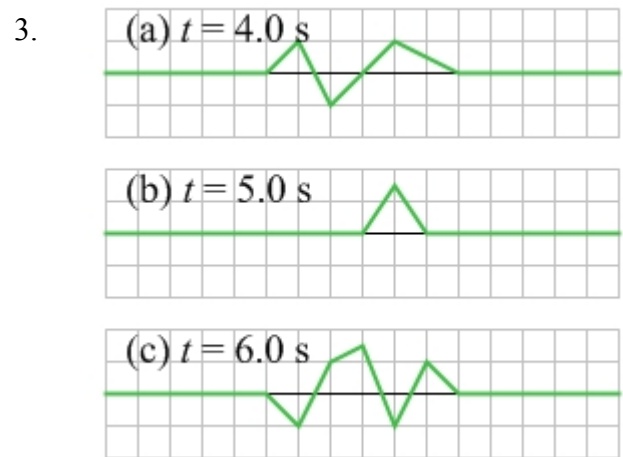
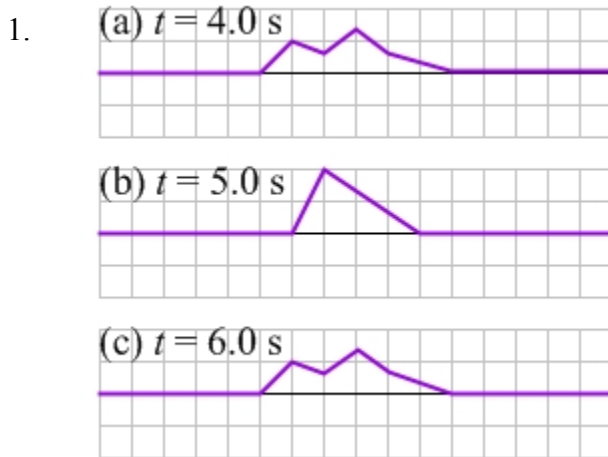
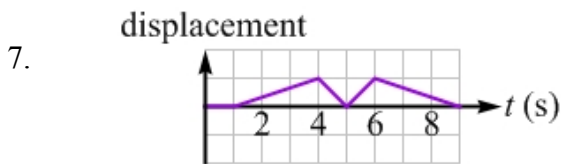


Answers to selected problems from Essential Physics, Chapter 21

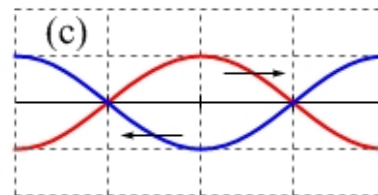
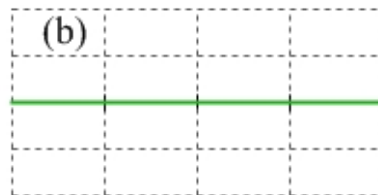


5. (a) The midpoint between the speakers always experiences constructive interference, because the path length difference for that point is zero. The midpoint is the same distance from both speakers, so the waves always interfere constructively.



9. There are six different beat frequencies, at 3 Hz, 4 Hz, 5 Hz, 7 Hz, 8 Hz, and 12 Hz.

11. (a) 3.0 cm



13. (a) 7.0 mm (b) 4π rad/s (c) 2.0 Hz (d) 2.0 m (e) 4.0 m/s

15. (a) 104 rad/s (b) 2.4 mm.

17. (a) 25 Hz (b) 23 m/s (c) 0.92 m (d) $y = (5.0 \text{ mm}) \cos[(50 \pi \text{ rad/s})t + (6.80 \text{ m}^{-1})x]$

19. $3.2 \times 10^{-5} \text{ W/m}^2$

21. (a) 96 dB (b) 84 dB

23. (a) 265 Hz (b) 247 Hz

25. (a) 16.8 m/s (b) 301 Hz

27. (a) 71.1 kHz (b) 74.3 kHz

29. (a) 3.8 cm (b) 1.9 cm

31. 379 Hz

33. 26 ms

37. (a) C:E:G = 6:5:4 (b) The G pipe is 0.43 m long

39. (a) 24 ms (b) 0.24 m

41. (a) positive x-direction (b) $y = -(4.0 \text{ cm})\sin[(100\pi \text{ rad/s})t - (5\pi \text{ m}^{-1})x]$
(c) Yes, both the negative signs in the equation switch to positive signs.

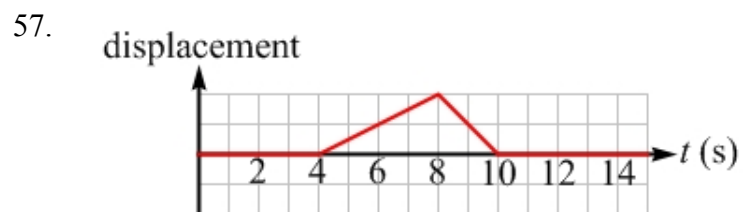
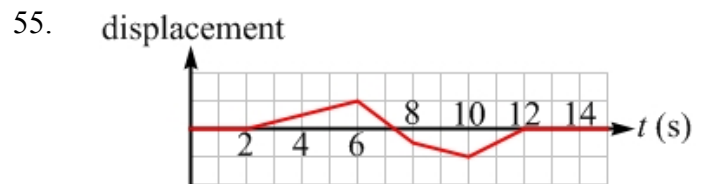
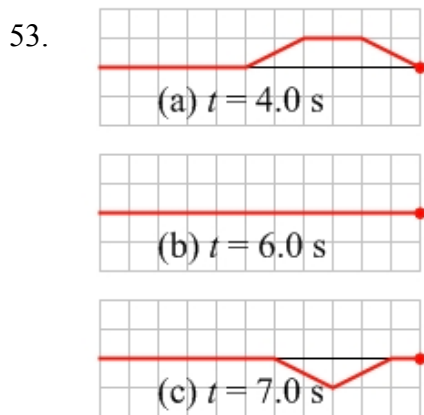
43. There are four possibilities, all of which require the second train to also be traveling east. If the second train is behind the first train (both moving east), the second train could either be traveling at 0.9 m/s or at 9.0 m/s. If the second train is ahead of the first train (both moving east), the second train could either be traveling at 0.9 m/s or 9.2 m/s.

45. (a) 3.00 MHz (b) 2.97 MHz (c) 3.04 MHz.

47. (a) 300 kHz (b) 200 kHz

49. (a) to the left (b) The source speed is twice the wave speed. (c) 160 Hz

51. (a) 200 Hz, 400 Hz, and 600 Hz (b) 100 Hz, 300 Hz, and 500 Hz



59. 40.9 N

61. (a) 18.3 m/s (b) 0.21 m (c) 62 Hz