Chapter 10 Answers to Problems

1. 0.097 mm 2. 29 μm 3. 2.2 cm 4. 7.69×10¹⁰ Pa 5. 0.80 mm 6. 0.48 mm 7. 5.0 mm 8. (a) 1.2×10⁻⁴ W (b) 5.4×10⁻⁶ No (c) 3.7×10⁻⁷ J (d) 3.7×10⁻⁴ W Yes 9. 1.5×10¹⁰ N/m² 9.0×10⁹ N/m² 10. 1.7 mm 11. 8.7×10⁻⁵ m 12. (a) 7.3×10⁴ Pa·m³/kg 6.5×10⁴ Pa·m³/kg 13. Tendon is stronger than steel.  (b) 1.0×10⁷ Pa·m³/kg 1.5×10⁷ Pa·m³/kg Concrete is stronger than bone. 13. 630 N 14. 1300 N 15. 3 cm² 7.1 cm² 16. 4.0×10⁸ Pa 17. (a) 2.8×10⁻⁷ Pa (b) 4.7×10⁻⁴ (c) 9.3×10⁻⁴ m (d) 5.0×10⁻⁵ N 18. (a) 1.3 mm 8.7×10⁷ N/m² (b) 570 N 19. 7.7×10⁻⁴ 2.6×10⁻⁴ 20. 0.45% 21. The volume of the steel sphere would decrease by 57×10⁻⁶ cm³. 22. The volume of the aluminum sphere would increase 1.4×10⁻⁶ cm³. 23. 7.5×10⁵ N 24. −6.71 cm² 25. 0.30 N 26. (a) 2.8 mm (b) 2.0×10⁴ Pa 27. 7.9 m/s² 28. 7.0 cm/s 29. 3.10 m/s 8560 m/s² 30. 0.63 m/s 32. (a) 60 N/m (b) x(t) = (12.0 cm)cos[(6.00π s⁻¹)t] 33. (a) High frequency (b) 1.3×10⁻⁶ m/s 1.6×10⁻⁴ m/s (c) 0.0013 m/s 160 m/s² 35. 5.0 rad/s 36. (a) 2kx (b) √(2k/m) 37. 2.5 Hz 38. 2.5 Hz 39. (a) 1.7×10⁻⁴ m (b) 0.13 m/s (c) 510 N 40. 0.157 m/s 24.7 m/s² 41. (a) 1.4 kN (b) 0.13 J 42. (a) g (b) 0.78 m 43. (a) 0.39 m (b) 2.0 m/s 44. −0.031 J 45. 0.70 s 46. (a) 0.90 s (b) 0.56 m/s 47. 0.250 Hz 48. 2.0 mJ 49. (a) A vertical straight line of length 24 cm. (b) A positive cosine plot of amplitude 12 cm. 51. (a) 2αA/π (b) αA (c) 2/π (d) If the acceleration were constant so that the speed varied linearly, the average speed would be ½ of the maximum velocity. Since the actual speed is always larger than what it would be for constant acceleration, the average speed must be larger. 52. Not a sine or cosine function. 53. (d) U, K and E would gradually be reduced to zero. 55. 4.0 s 56. 3.0 cm 57. 1.5 s 58. 2.8 s 59. (a) v₁ = πAcos ωt (b) mω²A²/2 60. 0.25 m 61. 1.11 62. (a) less (b) 5.57 m/s² 63. 3.14 cm/s 64. (a) 2.01 s (b) 11.3% 65. 11 mJ 67. (a) 6.1 mJ (b) 1.1% 68. The energy has decreased by a factor of 400. 69. −9.75% 70. 2.16 Hz 71. 2.5 s 72. Assume the pendulum is located on Earth. 0.994 m 73. (a) more (b) 56 N 74. 13 s 75. (a) The frequency and period don’t vary with amplitude, they only vary with m and k. Since these two values remain constant, so do the frequency and period. (b) The total energy for an amplitude of 2D is four times that for an amplitude of D. (c) The frequency and period are still the same. (d) The energy is greater when given an initial push, since it has an amplitude greater than 2D. The increase in energy is mν²/2. 76. 91 Hz 77. The distance between adjacent dots should be least at the endpoints and greatest at the center, so its speed is lowest at the endpoints and fastest at its equilibrium position. 78. 2.1 m/s 370 m²/s 80. (a) 98.0 N/m (b) 0.472 m/s (c) 0.409 m/s (d) 3.33 s 81. y = (1.6 cm)cos[(25 rad/s)t] 83. (a) 0.395 m (b) 1.11 m/s (c) 0.960 m/s 84. 2.0° 85. 8.0×10⁸ Pa; it is just under the elastic limit. 86. (a) 8×10⁻⁴ (b) 8.0 kN (c) 5×10⁻⁵ m² (d) No 87. 0.63 Hz 88. (a) 3.6 cm² (b) 7.8×10⁶ Pa (c) 3.3×10⁻⁴ m 89. (a) ρgh (b) 7.6 km (c) no 90. (a) 3.42 s (b) No 91. (a) 42.2° (b) 48 g (c) 9.1 cm 92. (a) 1.64 s (b) 1.53 s (c) 1.94 s 93. (a) √(2gL) (b) π√(gL)/2 larger 94. (b) k = mg/L 95. (a) 2π√[2L(m₁+3m₂)/3g[m₁+2m₂³] (b) For m₁>>m₂, T=2π√(2L/3g), and for m₁<<m₂, T=2π√(L/g) 96. (a) 5.1 N (b) 7.7×10⁻² J