Updates for Knight *Physics for Scientists and Engineers* 1e 12/1/05

Changes to the text (see below for changes to end-of-chapter problems)

Inside front cover: value for the permeability constant should have an exponent of *minus* 6.

p. 128, Figure 5.4 In the "Known" list, change "–9.8 m/s" to "–9.8 m/s^2".

p. 158, Example 6.3. In the equation for a_y, in the right column, the units should be m/s^2. Also, in 4th text line (2nd line after the first equations), change "v_{0y} = 2.0 m/s" to "v_{0x} = 2.0 m/s".

p. 222, Figure 8.25. The label under blocks should read $m_B > m_A$.

p. 271, 4th line after Eq. 7. v_sub_f should be v_sub_fy with an italic y. That is, it should be v_{fy}.

p. 375, Example 13.4, last sentence of problem statement before VISUALIZE step. Change "6.0 rad/s" to "6.0 rad/s^2".

p. 381. In the equation 2 lines after Equation 13.22, change the "*a*" at the end of the equation to lower case italic greek alpha "α".

p. 389, Example 13.13. (1) In Figure 13.34, part (b), add a downward red force arrow with its tail on the axle (the black dot) of the cylinder. Make it half as long as the $\vec{n}$ arrow, and label it $\vec{w}$. Then increase the length of the $\vec{n}$ arrow to 150%. (2) In the second column of text, 3rd line, change "... normal force $\vec{n}$ to balance $\vec{T}_c$." to "... normal force $\vec{n}$ to balance $\vec{T}_c$ and $\vec{w}$."

p. 392. In the first paragraph, delete the entire last sentence "Rotational kinetic energy ... is moving."

p. 405, box labeled Conservation Laws. In the equation $\vec{L} = m\vec{r} \times \vec{p}$, delete the *m*. Should be $\vec{L} = \vec{r} \times \vec{p}$.

p. 467, Example 15.11. (1) Five lines before ASSESS, change the equation "p_1 = 0.75 kPa + 1 atm ..." to "p_1 = 75 kPa + 1 atm ..." (2) In the display equation one line before ASSESS, change the value 176,300 Pa to105,900 Pa.

p. 530, Example 17.8. In the second line of Solve, change "200 cm^{-3}" to "200 cm^3".

p. 553, Example 18.4. In the first line, change "50°C" to "60°C". p. 553. Also, in the equation N/V = ..., the number "333" should be "333 K".

p. 563, Example 18.10. In Step (a), change the values of E_{1i} and E_{2i} (in the equations) from 1871 to 1870. Third line from bottom of left column, change the value of E_{tot} from 3742 to 3740. First equation in the right column, change 3742 J to 3740 J (two occurrences) and change E_{1f} from 2495 to 2493. Second set of equations in the right column, change Q_1 to 623 and Q_2 to –623. Two lines after these equations, change 624 J to 623 J. In the set of equations at the bottom of the right column, change 624 J in the numerator to 623 J (two occurrences).

p. 606, Knowledge Structure IV. In the Energy Transformation figure, the two purple arrows on the right should point away from the box, not toward.

p. 654, two lines before Example 21.2. Change "The string vibrates three times faster ..." to "The string vibrates four times faster ..."

p. 655, Example 21.4. (1) In the problem statement, change 1.25 cm to 6.0 cm. (2) In the SOLVE paragraph, change "λ = 2.5 cm = 0.025 m" to "λ = 12 cm = 0.12 m" (3) In the display equation for *f*, change the denominator from 0.025 m to 0.12 m, change 1.2×10^{10} Hz to 2.5×10^9 Hz, and change 12 GHz to 2.5 GHz.

p. 665. In the 4th paragraph, second line, change "... a portion is reflected back to the right." to "... a portion is reflected back to the left." In the 6th line, change "... waves traveling to the right, " to "... waves traveling to the left,"

p. 687. Second paragraph after Fig. 22.3, first line. Change "... of equal length ..." to "... of equal wavelength ..."

p. 702. Paragraph above Section 22.6, 5th line. Change "... always 1 mm in size." to "... always > 1 mm in size."

p. 742, Figure 23.48. Switch the labels "Radius R_1 of first surface" and "Radius R_2 of second surface".

p. 746 In the very last line on the page, change "... focus at distance." to "... focus at distance *f*."

p. 750, box labeled Applications. Change the equation "$M = h'/h = s'/s$" to "$M = -h'/h = -s'/s$".

p. 799, Example 25.3. In the display equation for $F_{1 \text{ on } 3}$, change q_2 in the numerator to q_3.

p. 809, Example 25.8. In 3rd line of SOLVE, change "...= 1.0×10^{-9} C" to "... = -1.0×10^{-9} C."

p. 828, Example 26.4. In the first line of the right column, change 0.010 cm to 0.010 m.

p. 838, Example 26.9. The equation "a = ..." has the mass of the electron (in the denominator) as 9.11×10^{-19} kg. It should be 9.11×10^{-31} kg. The value for a is correct.

p. 873. In the Surface Integrals box on the right, 4th line, change $\rightarrow \int \vec{E} \bullet \delta \vec{A}$ to $\rightarrow \int \vec{E} \bullet d\vec{A}$

p. 884. In the last paragraph before the Stop To Think, 4th line, "drift speed of 10^{-4} s" should be "drift speed of 10^{-4} m/s".

p. 895. First line after Example 28.7. Change "Example 28.7" to "Example 28.6".

p. 924, Example 29.13. In the last line, -6.2×10^{-19} J should be -6.2×10^{-16} J

p. 936, Example 30.2 The final expression for E (line before the ASSESS step) should only have 1 for the first numerator, not Q.

p. 985. Line above Equation 31.32. Change "Figure 31.33b" to "Figure 31.35b."

p. 1005, Problem Solving Strategy 32.1. In the equation on the SOLVE line, change the subscript i on vector B to subscript k. Example 32.3 – all subscripts should be k.

p. 1083, Stop To Think 33.5. In the 3rd line, change "cw" to "ccw".

p. 1187. Third line after the Law of Conservation of Total Energy box. Change "total mass" to "total energy".

p. 1201. Second line after Eq. 37.1. Change "... a *downward* circular arc." to "... an *upward* circular arc."

p. 1234, Example 38.8. In the next-to-last line of the left column, change 3.8 eV to 38 eV. In the right column, change 3.8 to 38, 15.2 to 152, and 34.2 to 342. Delete the Assess step (last 2 lines).

p. 1320, Equation 41.5. In the 3rd term, the square root should not extend over the $\hbar$. The square root should only go over the $l(l + 1)$.

p. 1373, "equation" 3 lines before from the bottom: "Biologically effective dose in rem" should be "Biologically equivalent dose in rem".

p. A-5, Appendix C. Under the entries for Sulfur, add a new last line. The new line entries are

36 35.967081 0.02 stable

Changes to end-of-chapter problems

1.30d Change 1/44.4 to 44.4^{-1}.

2.62 Change 3rd sentence to "The train comes to a stop 6.0 m from the point at which it was released."

6.4 Add "The puck starts from the origin."

6.21 Change final sentence to "What acceleration is required to move an ion 2.0 cm to one side?"

6.22 Change to: "A projectile's horizontal range on level ground is $R = v_0^2 \sin 2\theta / g$. At what launch angle or angles will the projectile land at half of its maximum possible range?"

6.26 Change "40° angle" to "40.0° angle." Change part (b) to: "Repeat the calculation of part (a) for angles of 42.5°, 45.0°, and 47.5°. Put all your results, including 40.0°, in a table. At what angle of release does she throw the farthest?"

7.5 Change 1.5×10^{11} km to 1.5×10^{11} m.

7.12. Change the electric force from "9.2×10^{-8} N" to "8.2×10^{-8} N".

7.25 Change the wording to "A 3.0-cm-diameter crankshaft ..."

8.4 Change to "A mountain climber is using a massless rope …"

9.10 In the figure, the units on the horizontal axis should be "ms", not "s".

10.26 Change to: "A 50 g ball of clay traveling at speed v_0 hits and sticks ..."

12.59 In the 5th line and last line, change "increase" to "decrease".

12.70 In the demoninator of the last fraction on the last line, change 3.50×10^6 to 3.48×10^6.

12.72 Add the following. **Hint:** Use the binomial approximation. SOHO's distance from earth is very small in comparison with the earth's distance from the sun."

13.29 Change "5.0 s^{-1}" to "5.0 revolutions per s."

13.60 Change "Figure P13.35" to "Figure 13.35".

13.66 Change "Figure P13.34" to Figure 13.34."

13.82 Change "1.5 rpm" to "1.5 rev/s" at the beginning of second line. Also, edit the third sentence "In this orientation ... of the rod" to "In this orientation, the skater can be modeled as a cylindrical torso (40 kg, 20 cm average diameter, 168 cm tall) plus two rod-like arms (2.5 kg each, 78 cm long). Each rod extends to the skater's center line and rotates about an axis through the end of the rod."

14.26 Change part (e) to "The initial angle."

15.2 Change to: "Containers A and B have equal volumes. Container A holds helium gas at 1.0 atm pressure and 0°C. Container B is completely filled with a liquid whose mass is 7000 times the mass of helium gas in container A. Identify the liquid in container B."

15.46 Change to: "The average density of the body of a fish is 1080 kg/m^3. To keep from sinking, the fish increases its volume by inflating an internal air bladder with air. By what percent must the fish increase its volume to be neutrally buoyant in fresh water. You can use the Table 15.1 value for the density of air."

16.64 Change "and at room temperature..." to "and at 20°C..."

17.17 Change "at room temperature..." to "at 20°C..."

17.34. Change to "An 11 kg bowling ball <u>at 0°C</u> is dropped …"

17.49 Change part (a) to "What is the total microscopic translational kinetic energy of the gas?"

18.42 ... box contains 0.010 mol of nitrogen at ..."

19.34 Change W to W_s.

19.70 Change "A 2 .0 kg piston..." to "A 10-cm-diameter, 2.0 kg piston..."

20.25 Change part (a) to "... of a sound wave <u>in air</u> with ..."

21.50 Change 70.8 cm to 70.9 cm.

23.2 Change "take light to pass ..." to "take light incident perpendicular to the glass to pass ..."

23.8 Add a new sentence at the end of part (b): "Consider only the shadow due to light coming directly from the bulb, not light reflected by the mirror.

23.55b Change "at angle θ_1..." to "at angle θ_c..."

25.64 Add "N/C" at the end of parts a, b, and c.

25.65 Add "N/C" at the end of parts a, b, and c.

26.28 Change wording at the end of 3rd line to "At this instant, what are (a) the force (magnitude and direction) and (b) the magnitude of the torque on the dipole?"

26.68 In the first equation, 10^{-12} should be 10^{12}.

26.72 After part (b), add "**Hint:** $\ln(1 + u) \approx u$ if $u << 1$."

27.25 In the second line, change "3×10^6 V/m" to "3×10^6 N/C".

27.30 In the figure, "$\Phi = 2q/\varepsilon_0$" should be "$\Phi = -2q/\varepsilon_0$".

27.35 Change wording at the start to "An initially neutral conductor contains ..."

27.46 Change the last sentence to "Find the electric fields $\vec{E}_1$ to $\vec{E}_4$ in regions 1 to 4."

28.49 Change the first words to "What is the electron drift speed at the 3.0-mm-diameter end ..."

29.40. Change part (b) to "What is the magnitude of the electric field at point on the x-axis, between the charges, where the electric potential is zero."

29.50 Change "–10 nC" to "10 nC".

29.67 After the first sentence, add "The positive charges are located at $y = \pm s$."

30.54 In second line, change 125 μC to 12.5 nC.

31.70 Change the "4 Ω" label that is on the right side of the middle branch to "5 Ω".

32.15. In the figure, the upper circle with a dot in it should be centered on y = + 1 cm.

32.32. Add a sentence to the text in parentheses to read "(For this problem, assume that all the data you need are good to six significant figures. Although N_2^+ …"

32.70 Change the wording at the very end to be "… note there the comment about accuracy and significant figures."

33.33 Delete the word "uniform" in the third line.

35.5 $\mathcal{E}_{\text{rms}}$ should be $\mathcal{E}_0$.

35.7 Change "... produces an rms voltage ..." to "... produces a peak voltage ..."

33.8 The magnetic field value shown in the figure should be 0.10 T.

33.35 In Figure P33.35, delete the purple arrow next to label I_1 in the lower left part of the figure.

35.17 Change "... produces an rms voltage ..." to "... produces a peak voltage ..."

35.59 Second line, change 200 μF to 200 μH.

35.60 In the last sentence of part (b), change "maximum" to "minimum."

36.20 Change "You return two days later." to "You return two days later at the same speed."

36.73 In the 8th line, change 226.015 to 226.025.

37.36 In part (a), change 13.90 to 13.89

37.47 In part (b), change the end to read: "A falling drop quickly reaches a constant speed, called the terminal speed. Write an equation for the terminal speed v_{term} in terms of m, g, and b."

38.11 Change 2.0 V to 1.93 V.

38.38 Delete part (d).

39.22 In the first sentence, delete "... the middle of ..."

40.1 Change wording to: An electron in a box absorbs light. The longest wavelength in the absorption spectrum is 600 nm. How long is the box?

41.60 Add the following: **Hint:** This problem requires a numerical solution."

42.66 Change the 2nd sentence to read: One of the nuclei in the decay series of ^{238}U is the radon isotope ^{222}Rn, which decays by emitting a 5.50 MeV alpha particle with $t_{1/2}$ = 3.82 days.

42.70 Delete the last sentence in part (b). It starts "Then rearrange…"

Lenses

15.10–15.12 Activ Online Physics

A lens consists of *two* spherical surfaces having radii of curvature R_1 and R_2 and thickness t. The lens material has index of refraction n, and for simplicity we'll assume that the lens is surrounded by air. We'll analyze the converging lens shown in Figure 23.48, but our results will apply to any lens if we use the sign convention given above in Table 23.3.

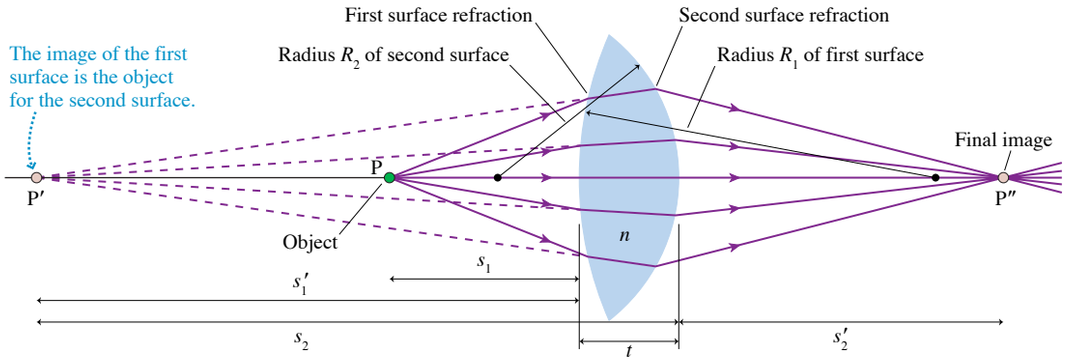

FIGURE 23.48 Image formation by a lens.

The object at point P is distance s_1 to the left of the lens. The first surface of the lens, of radius R_1, refracts the rays from P to create an image at point P′. We can use Equation 23.21 for a spherical surface to find the image distance s_1':

$$\frac{1}{s_1} + \frac{n}{s_1'} = \frac{n-1}{R_1} \tag{23.22}$$

where we used $n_1 = 1$ for the air and $n_2 = n$ for the lens. We'll assume that the image P′ is a virtual image, but this assumption isn't essential to the outcome.

The image P′ of the first surface becomes the object for the second surface. Object distance s_2 from P′ to the second surface looks like it should be $s_2 = s_1' + t$, but P′ is a virtual image of the first surface, so s_1' is a *negative* number. Thus the distance to the second surface is $s_2 = |s_1'| + t = t - s_1'$. We can find the image of P′ by a second application of Equation 23.21, but with a switch. The rays are incident on the surface from within the lens, so this time $n_1 = n$ and $n_2 = 1$. Consequently,

$$\frac{n}{t - s_1'} + \frac{1}{s_2'} = \frac{1-n}{R_2} \tag{23.23}$$

For a *thick lens,* where the thickness t is not negligible, we can solve Equations 23.22 and 23.23 in sequence to find the position of the image point P″. But our primary interest is the *thin lens*. In the limit $t \to 0$, Equation 23.23 becomes

$$-\frac{n}{s_1'} + \frac{1}{s_2'} = \frac{1-n}{R_2} = -\frac{n-1}{R_2} \tag{23.24}$$

Our goal is to find the distance s_2' to point P″, the image produced by the lens as a whole. This goal is easily reached if we simply add Equations 23.22 and 23.24, eliminating s_1' and giving

$$\frac{1}{s_1} + \frac{1}{s_2'} = \frac{n-1}{R_1} - \frac{n-1}{R_2} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) \tag{23.25}$$

Errata for Knight *Physics for Scientists and Engineers*

NOTE: Theses changes apply mostly to the first printing of the book. A few apply to the second printing. The third and subsequent printings have no know errors. To find what printing your book is, look at the bottom right corner of the copyright page. You'll see the letters DOW, preceded by a string of digits such as 2 3 4 5 6 7 8 9 10. The first digit in the series is the printing number. If you have a first or second printing, mark any relevant changes in your textbook.

Changes to the text

Inside front cover. For the value of μ_0, the permeability constant, change 10^6 to 10^{-6}.

p. 828, Example 26.4. In the first line of the right column, change 0.010 cm to 0.010 m.

p. 742, Figure 23.48. The labels "Radius R_1 of first surface" and "Radius R_2 of second surface" need to be switched.

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Changes to end-of-chapter problems

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Changes in the odd-answer list at the back of the book

26.15b $3.49 \rightarrow 1.49$

26.29 9.0×10^{-13} N → (9.0×10^{-13} N, direction opposite $\vec{p}$)

26.41a Delete the $\hat{\imath}$ at the end of the expression

27.15b $4\pi R^2 E \rightarrow 2\pi R^2 E$

27.33a Delete the $\hat{r}$

27.53 Should be "b. 0 N/C c. 4.64×10^{13} N/C".

31.3	$5.0 \rightarrow 2.0$
31.65b	$50.0 \rightarrow 0.50$
32.43a	$1.60 \rightarrow 1.26$
33.19	$0.235 \rightarrow 0.253$
33.67a	$0.625 \rightarrow 0.628$
34.17	$10^6 \rightarrow 1.0 \times 10^6$

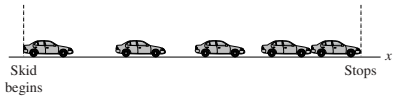
Answers

Answers to Odd-Numbered Exercises and Problems

Solutions to questions posed in the Part Overview captions can be found at the end of this answer list.

Chapter 1

1.



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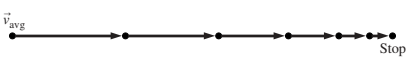
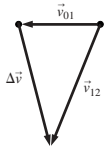
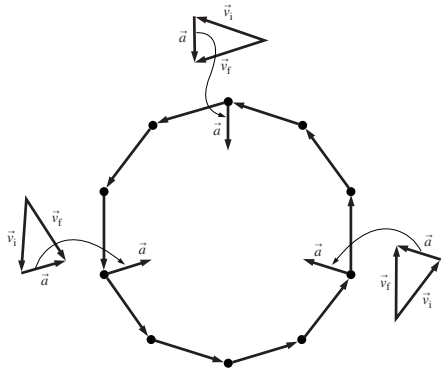


9. a.



b. Greater

11.



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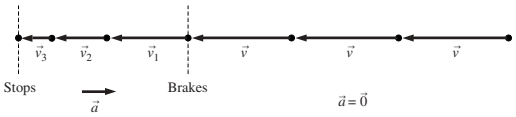

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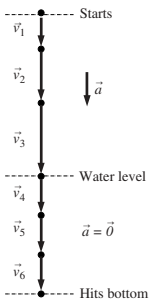

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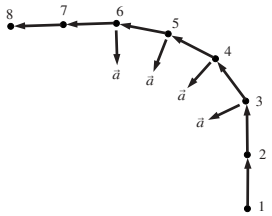

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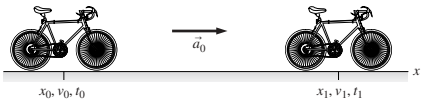


Known		
$v_0 = 0$	$t_0 = 0$	$x_0 = 0$
$a_0 = 1.5$ m/s^2		
$v_1 = 7.5$ m/s		

Find

x_1

21. a. 9.12×10^{-6} s b. 3.42×10^{3} m c. 440 m/s d. 22.2 m/s

23. a. 3.60×10^{3} s b. 8.64×10^{4} s c. 3.16×10^{7} s d. 9.75 m/s^2

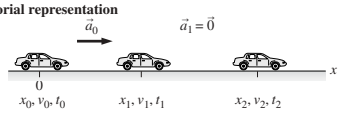
25. 6.40×10^{3} m^2 and 8.25×10^{3} m^2

27. a. 3 b. 3 c. 3 d. 2

29. a. 846 b. 7.9 c. 5.77 d. 13.1

35.

Pictorial representation



Motion diagram

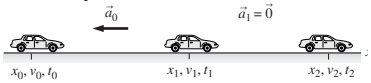
Known		
$x_0 = 0$	$a_0 = 5$ m/s^2	
$v_0 = 0$	$t_1 = 5$ s	
$t_0 = 0$	$t_2 = 8$ s	
$v_2 = v_1$	$a_1 = 0$	

Find

x_2

37.

Pictorial representation

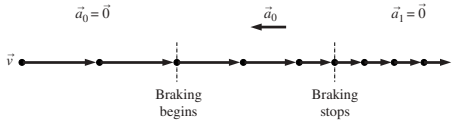


Known		
$x_0 = 0$	$v_0 = 60$ mph	$t_0 = 0$
$v_1 = 30$ mph	$t_1 = 3$ s	
$v_2 = 30$ mph		

Find

x_1

Motion diagram



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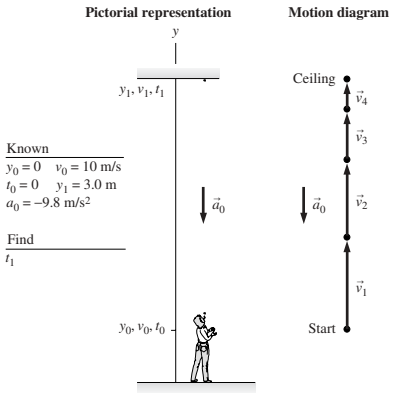

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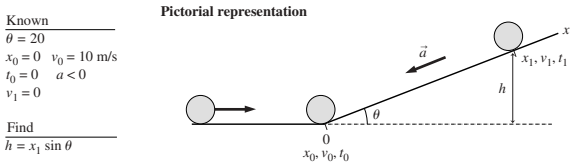
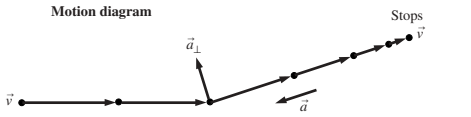
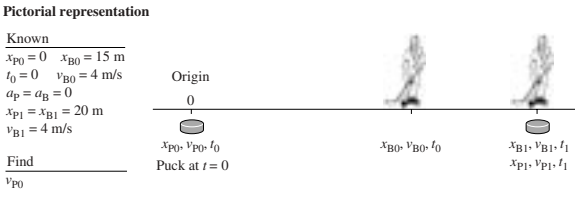
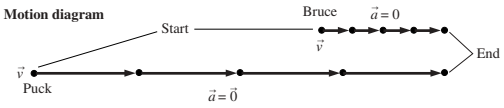


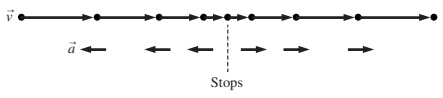


43.

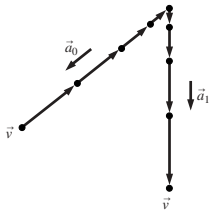




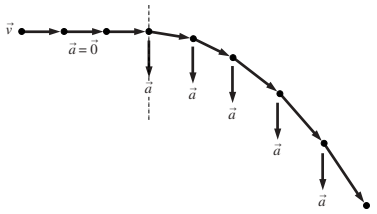
51. a.



53. a.



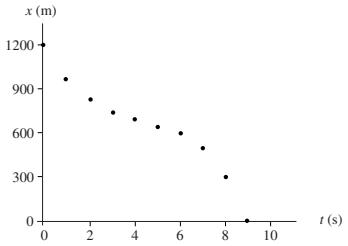
55. a.



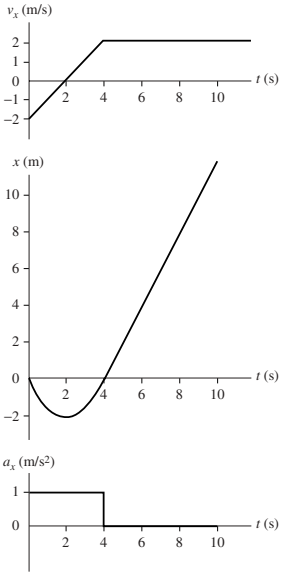
57. a. Neither is zero. b. Velocity is zero, acceleration is not zero.

Chapter 2

1. b.

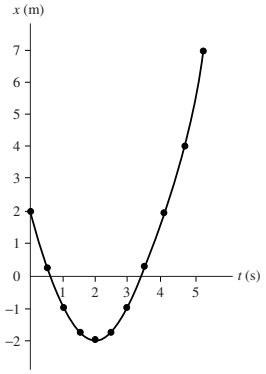


5. 450 m
7. a. Beth b. 20 min
9. a. 48 mph b. 50 mph
11. a. 26 m, 28 m, 26 m b. At $t = 3$ s
13. a.



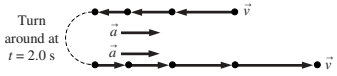
b. 1 m/s²
15. a. 2.68 m/s² b. 27.3% c. 134 m or 440 ft
17. −2.8 m/s²
19. a. 78.4 m b. −39.2 m/s
21. 3.2 s
23. 134 m
25. a. 15 m b. 23 m/s c. 24 m/s²
27. 16 m/s

29. a.



c. −2 m/s d. −2 m e. 2 m

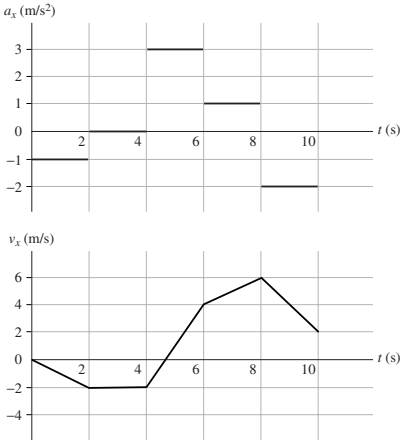
f.



31. $v_A = -10$ m/s, $v_B = -20$ m/s $v_C = 75$ m/s

33. 0, 5, 20, 30, and 30 m/s

35. a.

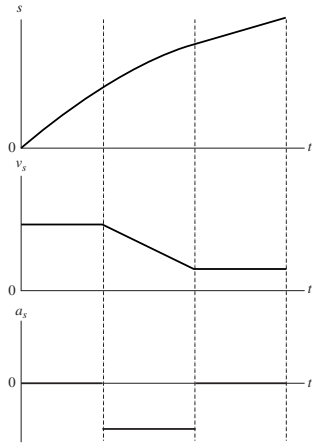


b. Displaced upward by 2.0 m/s

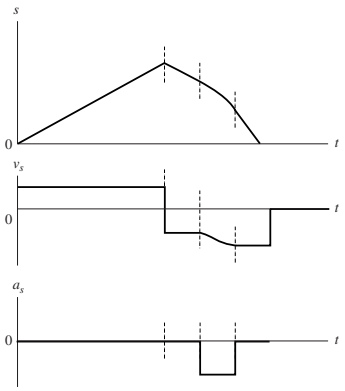
37. a. 0 s and 3 s b. 12 m and −18 m/s²; −15 m and 18 m/s²

39. 2.0 m/s³

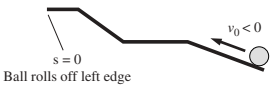
41.



43.



45.

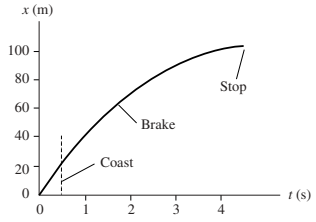


47. a. 179 mph b. Yes c. 35 s d. No

49. Yes

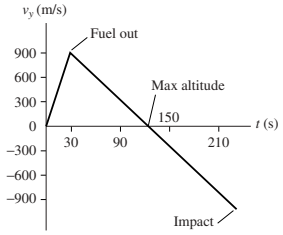
51. a. 100 m

b.



53. a. 54.8 km b. 228 s

c.



55. 19.7 m

57. 216 m

59. 9.9 m/s

61. a. 2.32 m/s b. 5.00 m/s c. 0%

63. Yes

65. a. 214 km/hr b. 16%

67. 14 m/s

69. a. 900 m b. 60 m/s

71. No

73. 5.5 m/s²

75. c. 17.2 m/s

77. c. $x_1 = 250$ m, $x_2 = 750$ m

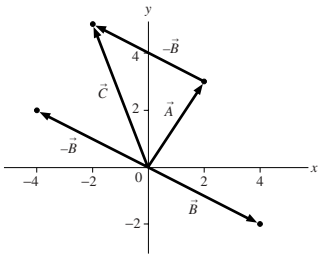
79. 70 m/s

81. a. 10.0 s b. 3.83 m/s² c. 6.4%

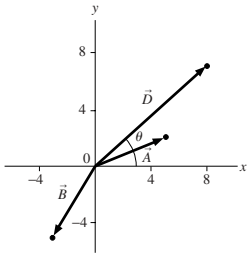
83. −4500 m/s²

Chapter 3

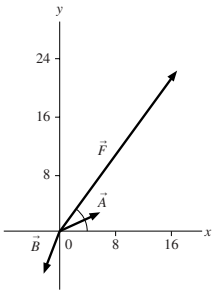
1. a. Yes b. No
3. a. If $\vec{B}$ is in the same direction as $\vec{A}$. b. If $\vec{B}$ is opposite to $\vec{A}$.
7. 11.9 m/s
9. a. (70.7, −70.7) m b. (282, 103) m/s c. (0, −5.0) m/s^2
   d. (−40, 30) N
11. $\vec{C}$: (−3.04, 0.815) m; $\vec{D}$: (12.8, −22.2)
13. a. 7.21, 56.3° below +x-axis b. 94.3 m, 58.0° above the +x-axis
    c. 44.7 m/s, 63.4° above the −x-axis
    d. 6.3 m/s^2, 18.4° right of the −y-axis
15. Known: $\vec{A} = 2\hat{i} + 3\hat{j}$; $\vec{B} = 4\hat{i} - 2\hat{j}$. Find: $\vec{C} = \vec{A} - \vec{B}$



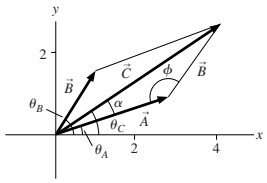
17. a. $8\hat{i} + 7\hat{j}$
    b. Known: $\vec{A} = 5\hat{i} + 2\hat{j}$; $\vec{B} = -3\hat{i} - 5\hat{j}$. Find: $\vec{D} = \vec{A} - \vec{B}$, D and θ



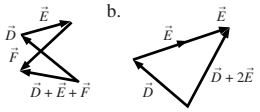
    c. 10.6, 41.2° above the +x-axis
19. a. $17\hat{i} + 22\hat{j}$
    b. Known: $\vec{A} = 5\hat{i} + 2\hat{j}$; $\vec{B} = -3\hat{i} - 5\hat{j}$. Find: $\vec{F} = \vec{A} - 4\vec{B}$, F and θ



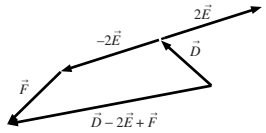
    c. 27.8, 52.3° above the +x-axis
21. Coordinate system 1: $\vec{A} = -4\hat{j}$ m, $\vec{B} = (-4.33\hat{i} + 2.50\hat{j})$ m; Coordinate system 2: $\vec{A} = (-2.00\hat{j} - 3.46\hat{j})$ m, $\vec{B} = (-2.50\hat{i} + 4.33\hat{j})$ m
23. a. Known: $\theta_A = 20$, $\theta_B = 60$, $A = 3$, $B = 2$, $\phi = 180$, $-(\theta_B - \theta_A) = 140$. Find: C, θ_c



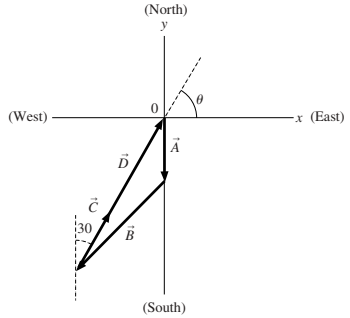
    b. 4.71, 35.8° above the +x-axis c. 4.71, 35.8° above the +x-axis
25. a. $-6\hat{i} + 2\hat{j}$ b. 6.32, 18.4° above the −x-axis
27. $(4.90\hat{i} + 2.83\hat{j})$ m
29. a. b.



    c.



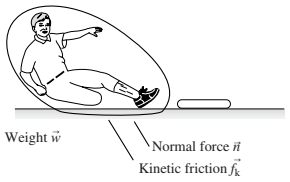
31. $0.707\hat{i} + 0.707\hat{j}$
33. a. 100 m lower
    b. (500 m, east) + (5000 m, north) − (100 m, vertical)
35. a. Known: $\vec{A}$ $\vec{B}$ $\vec{C}$. Find: $\vec{D}$ D θ



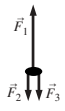
    b. 360 m, 59.4° north of east
37. 7.5 m
39. 86.6 m/s
41. 385 paces, 24.6° west of north
43. −15.0 m/s
45. a. −3.4 m/s b. −9.4 m/s
47. 4.36 units, 83.4° below the −x-axis
49. 7.29 N, 79.2° below the −x-axis

Chapter 4

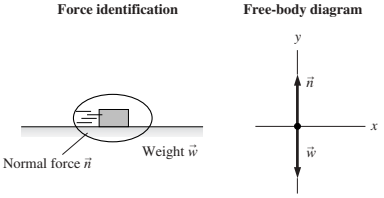
3.



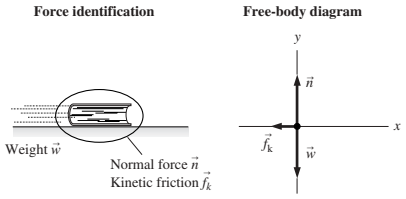
5. $m_1 = 0.08$ kg; $m_3 = 0.50$ kg
9. 0.25 kg
11. a. ≈0.05 N b. ≈100 N
13.



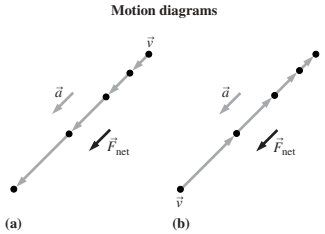
19.



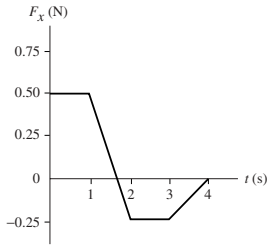
21.



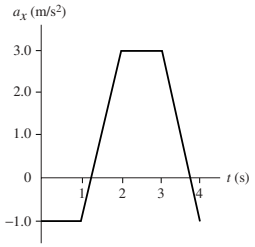
23.



25.

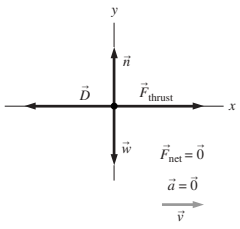


27.

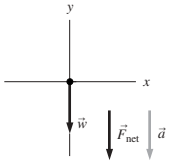


29. a. 16 m/s² b. 4 m/s² c. 8 m/s² d. 32 m/s²

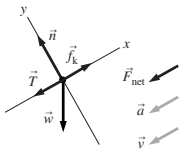
31.



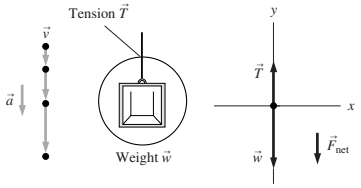
33.



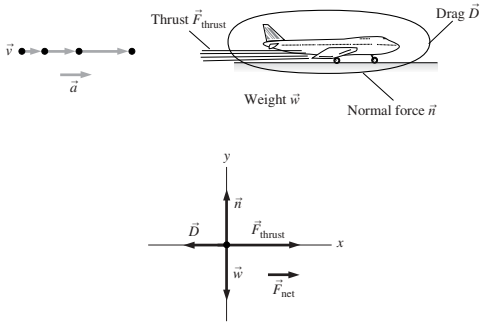
35.



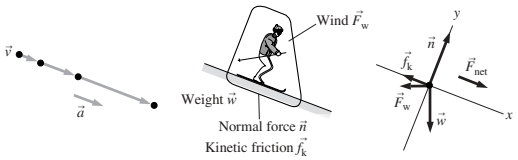
37.



39.



41.



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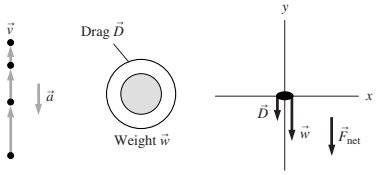

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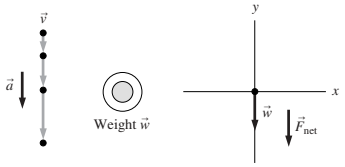
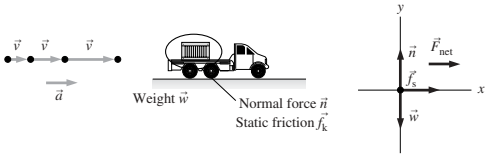
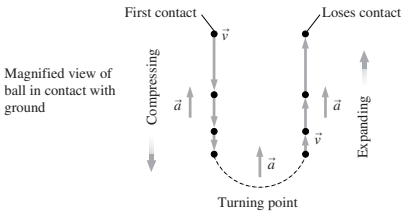


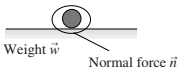
47.



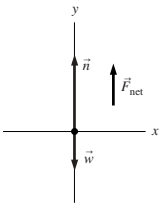
49. a.



b.



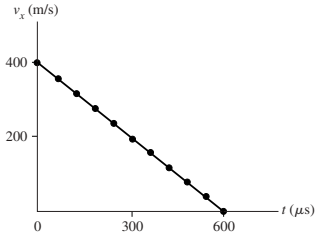
c.



Chapter 5

1. $T_1 = 86.7$ N, $T_2 = 50.0$ N
3. 147 N
5. a. $a_x = 1.0$ m/s^2, $a_y = 0$ m/s^2 b. $a_x = 1.0$ m/s^2, $a_y = 0$ m/s^2
7. 8 N, 0 N, −12 N
9. a. 0 N b. 0 N c. 250 N
11. 307 N
13. a. 590 N b. 740 N c. 590 N
15. 0.25
17. 136 m
19. 2550 m
21. 192 m/s
23. ≈3 m/s^2
25. 4.0 m/s
27. Left first, then right.
29. a. 0.0036 N b. 0.0104 N
31. a. 784 N b. 1050 N
33. a. 58.8 N b. 67.8° c. 79.0 N
35. a. 6670 N b. 600 μs

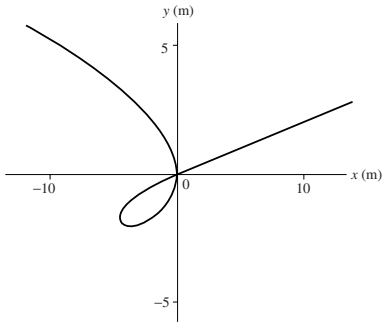
c.



37. a. 3.96 N b. 2.32 N
39. a. 15.7 N b. 2.87 m/s c. 4.36 m/s
41. 0.165
43. 0.68 m
45. a. 3.79 m b. 6.97 m/s
47. 0.12
49. 14.3
51. 23.1 N
53. 51 m/s
55. b. 12.3 m/s^2
57. Defective cable
59. 13.0 m/s^2
67. $T = 144$ N
69. $\theta = 11.3°$
71. Green
73. b. 134 s and 402 s c. No

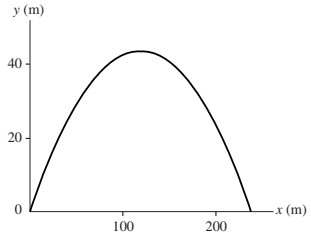
Chapter 6

1. a. $(2\hat{\imath} - 2\hat{\jmath})$ m/s^2 b. $(22\hat{\imath} - 16\hat{\jmath})$ m, $(9\hat{\imath} - 9\hat{\jmath})$ m/s, 12.7 m/s
3. a.



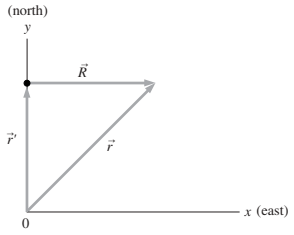
b. $\vec{0}$ m, 2.0 m/s at $t = 0$ s; $\vec{0}$ m, 8.3 m/s at $t = 4$ s
c. −90° at $t = 0$ s; 14° at $t = 4$ s
5. 38.8 m
9. a. At $t = 6$ s, $x = 240$ m, $y = 3.6$ m, $v_x = 40$ m/s, $v_y = -28.8$ m/s, $v = 49.3$ m/s

b.

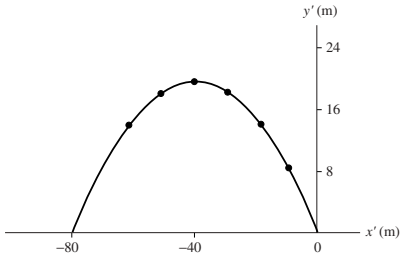


11. a. 0.0639 s b. 0.782 m/s
13. 2.0 km/hr
15. 0.40 m
17. a. 39.1 mi b. 19.5 mph
19. a. 55.6 hr b. 0.0917° c. Yes
21. 6.56×10^{12} m/s^2
23. a. $v_0^2 \sin^2\theta/2g$ b. $h = 14.4$ m, 28.8 m, 43.2 m; $d = 99.8$ m, 115.2 m, 99.8 m
25. a. Launch point 80.8 m higher b. 34.4 m
c. 49.8 m/s, 72.5° below horizontal
27. a. 276 m b. 12.75 s
29. Clears by 1.01 m
31. No
33. 34.3°
35. 678 m
37. a. 239 m b. 42.9 m
39. 106 m/s
41. 4.48 m/s
43. 105 m
45. Crocodile food.
47. 2.96 m
49. b. $\theta = 11.5°$
51. b. $x_1 = -29.2$ m

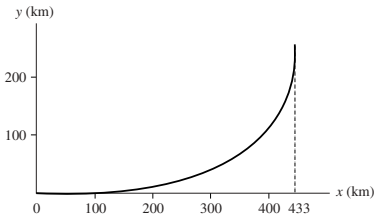
53. a. On the opposite bank 150 m east of where she started.
b.



55. a. 44.4° above the $-x'$-axis
b.

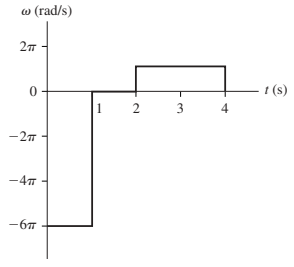


57. 10.1°
59. a. 30° toward the rear of the car b. 17.3 m/s
61. a. 7.18° south of east b. 2.48 hr
63. 3.0×10^8 m/s
65. 40.6° below horizontal
67. 4.78 m/s
69. a. Rotate the spacecraft 153.4° counterclockwise so that the exhaust is 26.6° below the positive x-axis. Fire with a thrust of 103,300 N for 433 s.
b.



Chapter 7

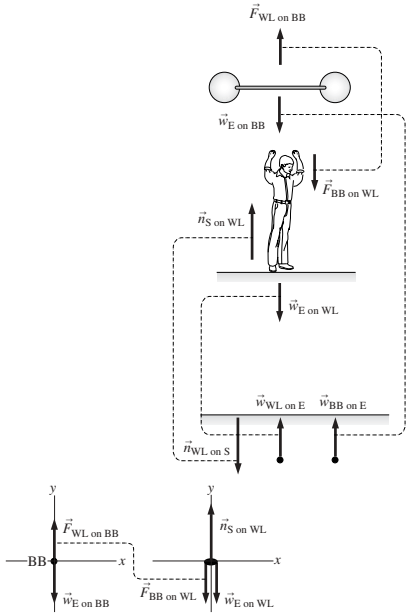
1. b.



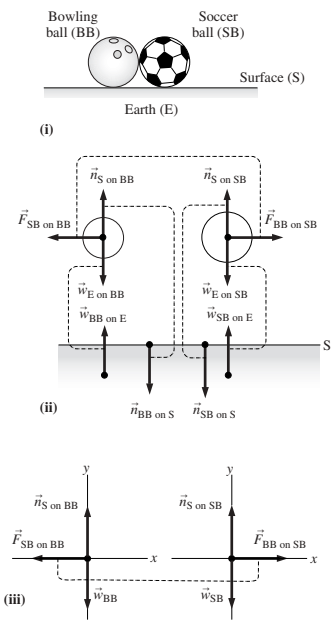
3. a. 1.5π rad/s b. 1.33 s
5. a. 3.0×10^4 m/s b. 2.0×10^{-7} rad/s c. 6.0×10^{-3} m/s^2
7. 5.65 m/s and 106 m/s^2
9. 34.3 m/s
11. a. 3.93 m/s b. 6.18 N
13. 7.27°
15. 2.0×10^{20} N
17. 1.58 m/s^2
19. 12.1 m/s
21. 19.8 m/s
23. $a_r = 2.72$ m/s^2; $a_t = 1.27$ m/s^2
25. a. -2.618 m/s^2 b. 31.25 rev
27. 49.5°
29. a. 0.967 m/s^2 b. $14.3g$
31. 2.5 N higher at the north pole.
33. 172 N
35. 34.5 m/s
37. No
39. a. 5.00 N b. 30.2 rpm
41. 24.4 rpm
43. a. -9.80 m/s^2 b. -12.92 m/s^2 c. -6.68 m/s^2
45. a. 4.9 N b. 2.9 N c. 32.5 N
47. a. 319 N and 1397 N b. 5.68 s
49. 29.9 rpm
51. 2.63 m right of the point where the string was cut.
53. a. 1.90 m/s^2 at 20.6° from the r-axis b. 23.5 s
55. 3.75 rev
57. b. $\omega = 20$ rad/s
59. b. $\omega_f = 0.40$ rad/s
61. 14.19 N and 8.31 N
63. c. 94.5 rpm

Chapter 8

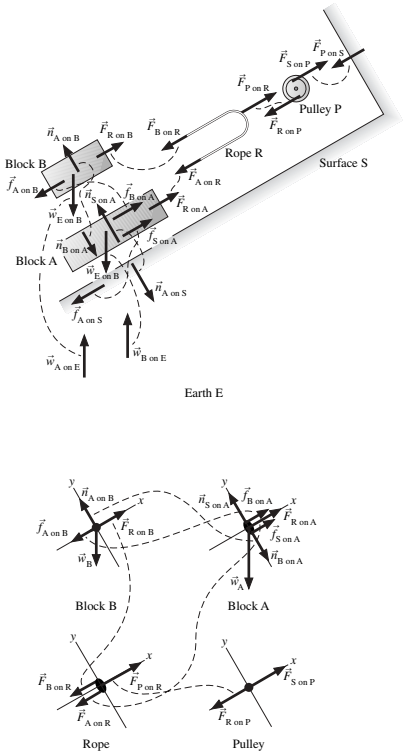
1.



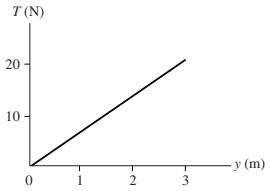
3.



5. a.



7. a. 784 N b. 1580 N
9. $F_{2\text{ on }3} = 6$ N; $F_{2\text{ on }1} = 10$ N
11. 588 N
13. a. 20 N b. 21 N
15. 66.6 N at 36°
17. 60 N
19.



21. No
23. 99.0 m
25. 1.48 s
27. a. 3.92 N b. 2.16 m/s^2
29. 154.7 N
31. 200 kg
33. 98.9 kg
35. 2.29 m/s^2
37. a. 19.6 N b. Down c. 20.6 N
39. a. 3770 N b. 28.2 m/s
41. 3.27 m/s^2
43. 3590 N
47. a. 1.0 m/s b. 90 N
49. b. 8.99 N

Chapter 9

1. a. 1.5×10^4 kg m/s b. 8.0 kg m/s
3. 1500 N
5. 5.0 N s
7. a. 1.5 m/s to the right b. 0.5 m/s to the right
9. 0.50 s
11. 0.20 s
13. 1.43 m/s
15. 0.20 m/s
17. 3.6 m/s
19. 2.0 mph
21. 1.7 m/s 45° north of east
23. 2.89×10^{34} kg m^2/s
25. a. (1.083, 0.625) kg m/s when thrown, (1.083, 0) kg m/s at the top
27. a. 6.4 m/s b. 360 N
29. a. 0.432 N s upward c. 40 to 80 N is reasonable estimate
31. a. 0.588 N s b. −0.588 N s
33. a. 6.7×10^{-8} m/s b. 2×10^{-10}%
35. 13.3 s
37. 1.73 m/s at 54.7° south of east
39. 7.57 cm in the direction Brutus was running
41. 402 m
43. a. 286 μs, 26,200 N b. 0.0214 m/s
45. 27.8 m/s
47. 5 s^{-1}
49. 1.46×10^7 m/s in the forward direction
51. 14 u
53. b. and c. 1.40×10^{-22} kg m/s in the direction of the electron
55. 0.850 m/s, 72.5° below the x-axis
57. 1.97×10^3 m/s
59. 4.5 rpm

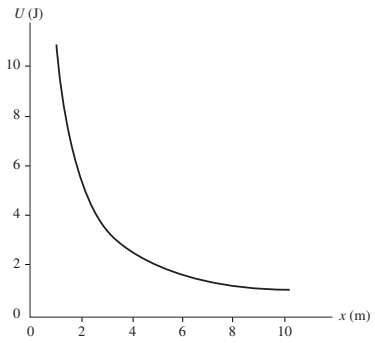
61. a. 2.80 m/s b. 2.22 m/s at a radius of 25.2 cm
63. c. $(v_{1x})_2 = 6.0$ m/s
65. c. $(v_{fx})_1 = -12$ m/s
67. 5.65 m/s
69. 90.3 m/s
71. 8

Chapter 10

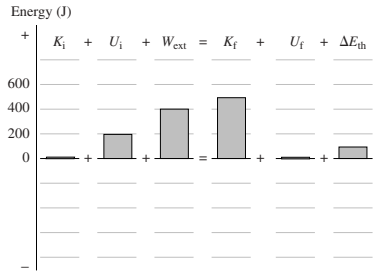
1. The bullet
3. 112 km/hr
5. a. 6.75×10^5 J b. 45.9 m c. No
7. a. 12.9 m/s b. 14.0 m/s
9. 7.67 m/s
11. a. 1.403 m/s b. 30°
13. a. Yes b. 14.1 m/s
15. a. 49 N b. 1450 N/m c. 3.4 cm
17. 98 N/m
19. 10 J
21. 2.00 m/s
23. 3.00 m/s
25. 0.857 m/s and 2.86 m/s
27. a. −5.0 m/s and 5.0 m/s b. Both 2.5 m/s
29. a. Right b. 20.0 m/s at $x = 2.0$ m c. 1.0 and 6.0 m
31. 63.2 m/s
33. Yes
35. a. No b. 17.3 m/s
37. a. Left b. Yes c. 200 N/m d. 19.0 m/s
39. $v_0/\sqrt{2}$
41. 25.8 cm
43. 51.0 cm
45. 19.6 N/m
47. a. 14.8 m/s b. Go hungry.
49. a. 21,600 N/m b. 18.6 m/s
51. a. 3.33 m/s b. 11.8 cm c. 0.833 m/s and 6.45 cm
53. a. $\frac{3}{2}R$ b. 15 m
55. $2.5R$
57. 7.94 m/s
59. 100 g ball 0.80 m/s to the left; 400 g ball 2.2 m/s to the right
61. a. Vibrates about an equilibrium position on one side of the H_3 plane or the other.
    b. Oscillates from one side of the H_3 plane to the other side.
65. c. $k = 35.6$ N/m
67. $v_f = 2.65$ m/s
69. a. 1.46 m b. 19.6 cm
71. b. 453 m/s
73. 100 g ball to 79.3°, 200 g ball to 14.7°

Chapter 11

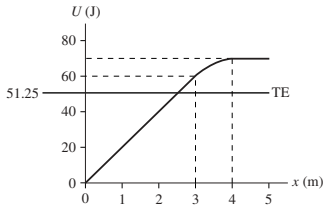
1. a. 15.3 b. −4.0 c. 0
3. a. −30 b. 0
5. a. 12.0 J b. −6.0 J
7. 0 J
9. 12,500 J by the weight, −7920 J by $\vec{T}_1$, −4580 J by $\vec{T}_2$
11. 4.0 J, −4.0 J, 4.0 J, 0 J, −3.0 J
13. 7.35 m/s, 9.17 m/s, 9.70 m/s
15. 8.0 N
17. −30 N at 1 m, 20 N at 3 m
19. a.



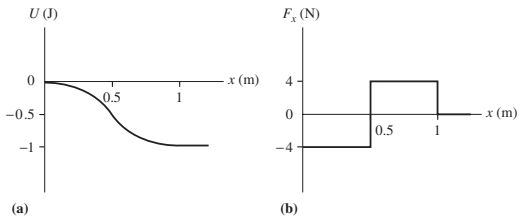
    b. 2.5 N, 0.40 N, and 0.156 N
21. 1360 m/s
23. a. Potential energy is transformed to kinetic and thermal energy.
    b. 548 J
25.



27. 6.26 m/s
29. a. 176.4 J b. 58.8 J
31. Night light
33. a. 102 N b. 416 W, 832 W, and 1248 W
35. a.

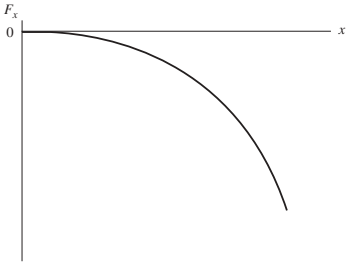


    b. 51.25 J d. 2.56 m
37.

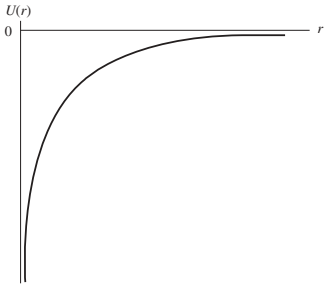


39. a. −98,000 J b. 108,000 J c. 10,000 J d. 4.47 m/s
41. a. and b. 3.97 m/s
43. 2.37 m/s
45. 0.037
47. a. 1.70 m/s b. No
49. a. 571 J b. −196 J c. −38.5 J d. 0 J
51. a. 2.16 m/s b. 0.0058
53. a. 9.90 m/s b. 9.39 m/s c. 93.9 cm d. 10
55. a. $\sqrt{2gh}$ b. $h - \mu_k L$

57. a. N/m^3
b.



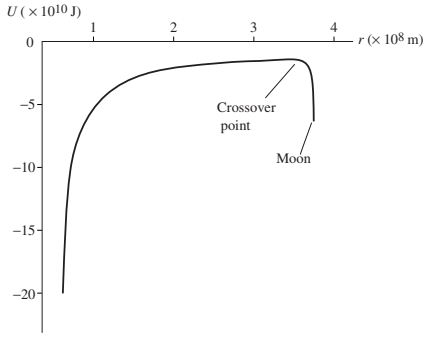
c. $\frac{1}{4}qx^4$ d. 10 m/s
61. 233 W
63. a. −245 J b. 255,000 kg
65. ≈15 m/s
67. a. 6.53 m/s^2 b. 16.7 m/s c. 2.56 s
69. c. $v_1 = 6.34$ m/s
71. c. $P = 32.4$ kW
73. 6.68 m
75. a.



b. Infinity c. 689,000 m/s and 172,000 m/s

Chapter 12

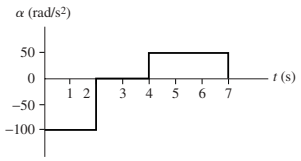
1. a. 3.53×10^{22} N b. 1.99×10^{20} N c. 0.56%
3. 6.00×10^{-4}
5. 1.60×10^{-7}
7. a. 8.97 N
9. a. 1.62 m/s^2 b. 25.9 m/s^2
11. 2430 m
13. a. 3.0×10^{24} kg b. 0.889 m/s^2
15. 418 km
17. 60.2 km/s
19. a. 1.80×10^7 m b. 9410 m/s
21. a. 7680 m/s b. 92.4 min
23. 4.2 hr
25. 2.01×10^{30} kg
27. 6.72×10^8 J
29. 46 kg and 104 kg
31. 1.19×10^{-3} rad or 0.0679°
33. (11.7 cm, 0 cm)
35. a. (4.72×10^{-7} N, 45° ccw from −y-axis)
b. (4.56×10^{-7} N, 7.6° cw from y-axis)
37. a. -10.0×10^{-8} J b. -9.65×10^{-8} J
39. a. 1.38×10^7 m b. 4450 m/s
41. a. 2.82×10^6 m b. 3670 m/s
43. 32,600 m/s
45. a. $\sqrt{16GM/7R}$ b. $\sqrt{4GM/3R}$
47. a. 3.46×10^8
b.



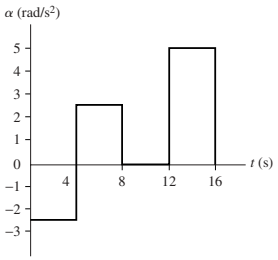
c. -2.24×10^{10} J d. 9.60×10^9 J e. 11.0 km/s
49. 3.0×10^4 m/s
51. 1.405 hr
53. a. 6.95 m/s b. 12.3 m/s
55. 8.67×10^7 m
57. a. $y = (q/p)x + (\log C)/p$ b. linear c. q/p e. 1.996×10^{30} kg
59. 317 m (8.26×10^{-5}%) and 2.9 s (1.25×10^{-4}%)
61. 9.33×10^{10} m
63. 3.71 km/s
65. 4.49 km/s
67. Yes
69. c. 1.00×10^8 m
71. $v_{f1} = 596$ m/s, $v_{f2} = 298$ m/s
73. a. 2.05×10^8 yr d. 9.4×10^{10}
75. Crash.

Chapter 13

1.

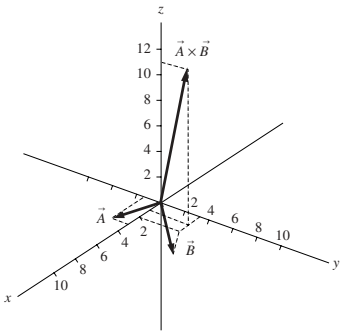


3. a.



5. 13.2 m/s
7. a. −100.5 rad/s^2 b. 50.0
9. 36.3 cm/s
11. −0.20 N m
13. 175.5 N
15. 12,500 N m
17. a. (0.0571 m, 0.0571 m) b. 0.0080 $kg\,m^2$
19. a. (0.060 m, 0.040 m) b. 0.0020 $kg\,m^2$ c. 0.00128 $kg\,m^2$
21. 0.75 rad/s
23. 0.0471 N m
25. 11.76 N m

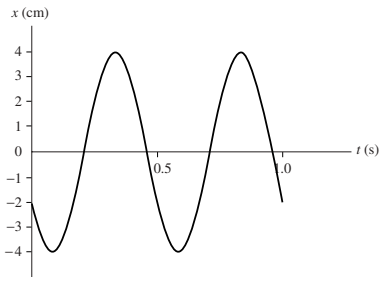
27. 1.40 m
29. 15.8 J
31. 1.75 J
33. 0.375 J
35. a. (20.78, out of page) b. (24, into page)
37. a. $\hat{j}$ b. $\hat{j}$
39. a. $\hat{i} + 3\hat{j} + 11\hat{k}$
    b.



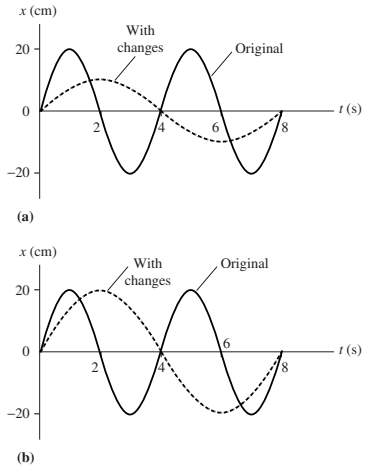
41. $-50\hat{k}$ N m
43. a. 8.97 s b. 0.448 kg m^2/s
45. $1.20\hat{k}$ kg m^2/s or (1.20 kg m^2/s, out of page)
47. $-0.0251\hat{i}$ kg m^2/s or (0.0251 kg m^2/s, into page)
49. 28.3 m/s
51. a. 0.010 kg m^2 b. 0.030 kg m^2
53. a. $\frac{1}{2}M(R^2 + r^2)$ c. 1.37 m/s
55. $\frac{1}{6}ML^2$
57. Yes
59. 1.00 m
61. a. (20 cm, 80 cm) b. 0.48 kg m^2 c. 1.0 N m d. 56.4°
63. a. 24.4 yr b. 4080 m/s and 12,250 m/s
65. a. 177 s b. 5.55×10^5 J c. 139 kW d. 1300 N m
67. 1.11 s
69. 1.57 N
71. 4.25 m
73. a. $\sqrt{2g/R}$ b. $\sqrt{8gR}$
75. $20\pi/13MR^2$
77. a. 42.9 cm b. No
79. 50 rpm
81. a. No b. 2000 m/s c. 4000 m/s
83. a. $3v_0/2d$ b. No
85. 393 m/s
87. a. 68,700 m b. 4.32×10^6 m/s

Chapter 14

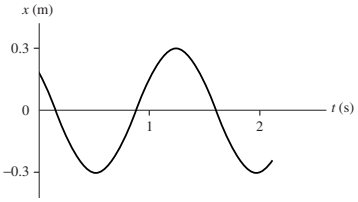
1. 2.27 ms
3. a. 3.3 s b. 0.303 Hz c. 1.904 rad/s d. 0.25 m e. 0.476 m/s
5. a. 10 cm b. 0.50 Hz c. $\pi/3$ rad or 60°
7.



9. $x(t) = (4.0\text{ cm})\cos[(8.0\pi\text{ rad/s})t - \pi/2]$
11. a. $-2\pi/3$ rad or $-120°$ b. $-2\pi/3$ rad, 0 rad, $2\pi/3$ rad, $4\pi/3$ rad
13. 5.48 N/m
15. a. 0.50 s b. 4π rad/s c. 5.54 cm d. 0.445 rad e. 69.6 cm/s f. 875 cm/s^2 g. 0.484 J h. 3.81 cm
17. a. 10.0 cm b. 34.6 cm/s
19. a. 0.169 kg b. 0.565 m/s
21. c. 12° d. 10° e. 0° to 10°
23. 35.7 cm
25. 0.330 m
27. 5.0 s
29. 21
31.



33. a. $-\pi/3$ rad or $-60°$ b. 6.80 cm/s b. 7.85 cm/s
35. a. 0.25 Hz, 3.0 s b. 6.0 s, 1.5 s c. 2.25
37. 1.405 s,



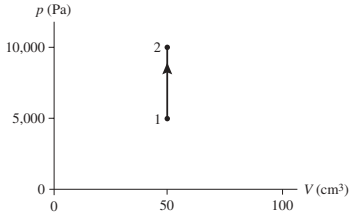
39. 0.0955 s
43. a. 6.40 cm b. 160 cm/s^2 c. −6.40 cm d. 0.283 m/s
45. 1.02 m/s
47. a. 3.18 Hz b. 0.0707 m c. 5.0 J
49. a. 1.125 Hz b. 23.5 cm c.−4.09 cm
51. a. 47,400 N/m b. 1.80 Hz
53. a. 0.314 s b. It would be unchanged.
55. 0.716
57. 0.669 s
59. a. 200.9 s b. 200.4 s c. Yes d. 9.77 m/s^2
61. 0.110 m at 1.72 s
63. a. 502 m/s b. No
65. $f = (1/2\pi)\sqrt{2T/mL}$
67. $T = 2\pi\sqrt{R/g}$
69. $g_X = 5.86$ m/s^2
71. a. 6.03 cm b. 6.32 s
73. 7.3°
77. 1.83 Hz
79. 2.23 cm

Chapter 15

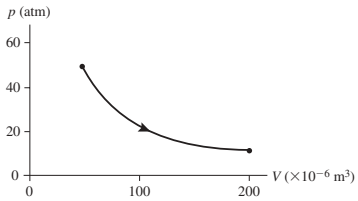
1. 1200 kg/m^3
3. 1.44×10^5 kg
5. 1097 atm
7. 2440 kg
9. 3153 m
11. 88,000 Pa
13. 55.2 cm
15. Ethyl alcohol
17. 45.8 kg
19. 1.87 N
21. 3.18 m/s
23. $1.27v_0$
25. 2.0 kg
27. 1.0 mm
29. 0.2%
31. a. 5830 N b. 5990 N
33. a. 0.377 N b. 20.4 m/s
35. 5.27×10^{18} kg
37. a. 10.85 m b. 10.21 m
39. a. 0.483 m b. 2.34 cm
41. 3.7 mm
43. a. $\frac{1}{2}\rho g w d^2$ b. 1.76×10^9 N
45. a. 8080 m b. 1.05 kg/m^3, 82%
47. 667 kg/m^3
49. 74.7 N
51. 43.9 N
53. 8.38 cm
55. $(\rho - \rho_1)/(\rho_2 - \rho_1)$
57. 5.22 cm
59. 14.1 cm
61. a. p_{atmos} b. 4.61 m
63. a. Lower b. 835 Pa c. 75,100 N
65. a. 144 m/s and 5.78 m/s b. 4.54×10^{-4} m^3/s
67. a. 3.34 L/min b. 1.06 mm/min
69. 1.23 mm
71. 1.30 L
73. 3.6 g
75. e. 18.9 s

Chapter 16

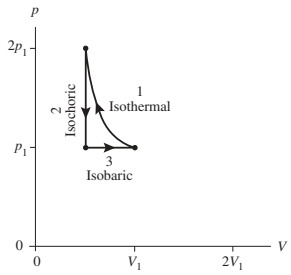
1. 22.6 m^3
3. 8.33 cm
5. 4.82×10^{23} atoms
7. a. 6.02×10^{28} atoms/m^3 b. 3.28×10^{28} atoms/m^3
9. 2.17 cm
11. Lowest: $-88°\text{C} = 185$ K; highest $58°\text{C} = 331$ K
13. a. 171°Z b. $671°\text{C} = 944$ K
15. a. 32.02°F, 608 Pa b. $-68.8°\text{F}$, 5.06×10^5 Pa
17. Freezing point lower, boiling point higher.
19. a. 0.0497 m^3 b. 1.33 atm
21. 18.8 atm
23. a. 55.1 mol b. 1.234 m^3
25. a. 5.41×10^{23} atoms b. 3.59 g c. 2.30×10^{26} m^{-3} d. 1.52 kg/m^3
27. a. 0.732 atm b. 0.523 atm
29. a. 9520 kPa
    b.



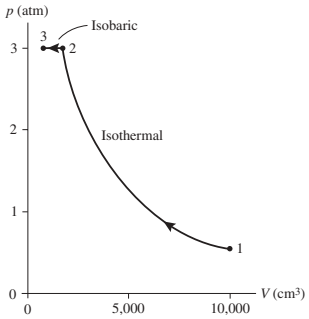
31. a. 12.02 atm
    b.



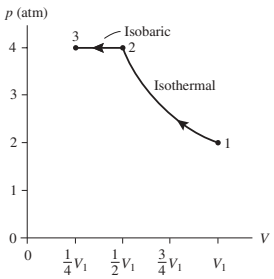
33. a. Isothermal b. Both are 914 K c. 300 cm^3
35. 0.228 nm
37. a. 7.03×10^{-21} J b. 2060 m/s
39. 1.1×10^{15} m^{-3}
41. a. 1.32×10^{-13} b. 1.24×10^{11} molecules
43. 174°C
45. 92.8 cm^3
47. 34.7 psi
49. 174.3°C
51. a. 3.05×10^{21} b. 2.02 mg
53. No
55.



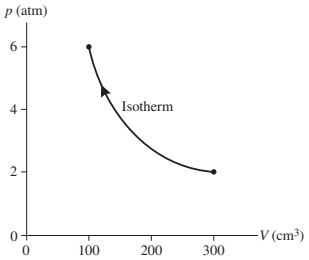
57. a. 884 kPa b. 323°C, −49.5°C, 397.5°C
59. a. Both 366 K = 93°C b. Isothermal c. 1098 K = 825°C
61. a. 0.509 atm b. −112°C
    c.



63. a. 4.0 atm, −73°C
    b.

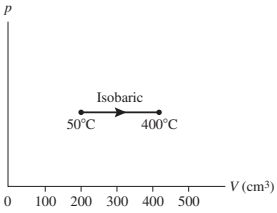


65. b.



c. 6 atm

67. b.

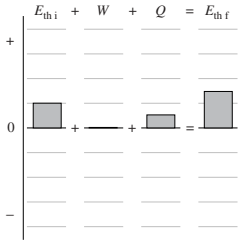


c. 417 cm^3

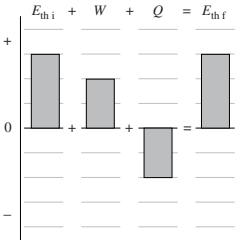
69. a. 23.5 cm b. 7.8 cm
71. a. 2.73 m b. 10.96 atm
73. 1.02 cm

Chapter 17

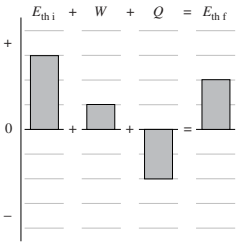
1. 490 J
3. 40 J
5. 200 cm^3
7.



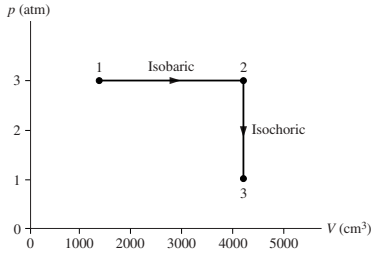
9.



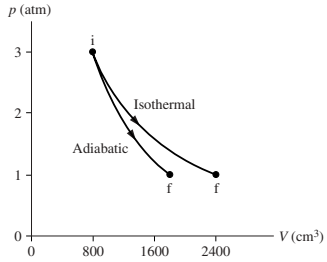
11.



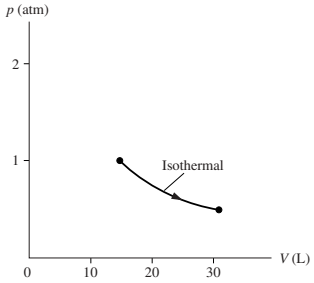
13. 700 J from the system
15. 12,500 J
17. 6864 J
19. 6.79×10^4 J
21. 27.5°C
23. 73.5°C
25. Iron
27. a. 91.2 J b. 140°C
29. a. 1.14 atm b. 48.5°C
31. a. 26.4 b. 7.07
33. 8.73 hr
35. 994 cm^3
37. −56.4°C
39. Aluminum
41. 87.3 min
43. a. 83.3 J/kgK b. 2.0×10^5 J/kg
45. 0.0605 kg = 60.5 g
47. 5450 J
49. a. 245 J b. 944 m/s
51. 1660 J
53. a. 253°C b. 32.6 cm
55. 7750 J
57. a. 4290 cm^3, 606°C b. 3050 J c. 1.0 atm d. 2180 J
e.



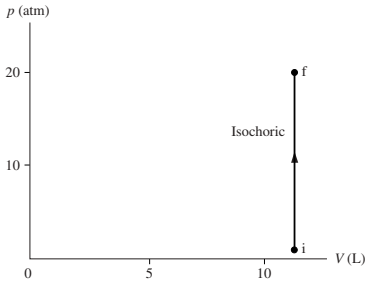
59. A: −1010 J, B: 1419 J
61. a. 810 J b. −486 J c. 0 J
63. a. A: 2.46×10^{-3} m^3, 300 K; B: 1.80×10^{-3} m^3, 220 K
b.



65. a. −50.7 J b. −24.8 J c.25.9 J
67. 1100 K, 23.9 cm^3
69. a. 39.3 b. 171
71. a. 0.5 atm b. −1074 J c. 1074 J d. 0 J
e.



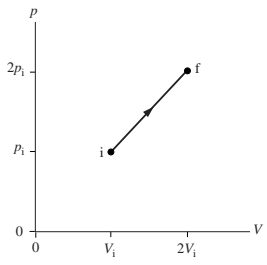
73. a. 5460 K b. 0 J c. 5.39×10^4 J d. 20
e.



75. b. 0.0156 mol
77. b. 0.472 kg
79. a. At 1: 3.0 atm, 946°C, 1000 cm^3. At 2: 1.0 atm, 946°C, 3000 cm^3. At 3: 0.48 atm, 310°C, 3000 cm^3. b. −334 J, 0 J, 239 J
c. 334 J, −239 J, 0 J
81. 14.5 atm

Chapter 18

1. $2.69 \times 10^{25}\ m^{-3}$
3. a. $3.30 \times 10^{12}\ m^{-3}$ b. 1.71×10^6 m
5. 61
7. a. $0\hat{i} + 0\hat{j}$ b. 59.2 m/s c. 61.6 m/s
9. a. 9.16×10^4 Pa b. 332 K
11. $1.91 \times 10^{24}\ s^{-1}$
13. 2820 m/s, 891 m/s
15. 283 m/s
17. a. 68.3 K b. 1090 K
19. 7.22×10^{12} K
21. a. 3400 J b. 3400 J c. 3400 J
23. a. 4×10^{-16} J b. 7×10^5 m/s
25. 3.65×10^7 J
27. a. 0.0800°C b. 0.0481°C c. 0.0400°C
29. a. 62.4 J b. 104 J c. 104 J d. 145 J
31. a. Gas B b. A: 5200 J, B: 7800 J
33. 8.48
35. a. Helium b. 1367 m/s c. 1.86×10^{-6} m
37. 9.6×10^{-5} m/s
39. a. $\lambda = 1/[\sqrt{2}\pi(N/V)r^2]$ b. 1.82×10^{-6} Pa or 1.80×10^{-11} atm
41. a. $1.273 \times 10^{25}\ m^{-3}$ b. 449 m/s c. 259 m/s d. $1.296 \times 10^{25}\ s^{-1}$
e. 56,800 Pa f. 56,700 Pa
43. a. Helium: 30.4 J; Argon: 121.6 J b. Helium: 47.3 J; Argon: 104.7 J
c. 16.9 J is transferred from the argon to the helium. d. 580 K
e. Helium: 3.11 atm; Argon: 3.45 atm
45. 482 K
51. a. $R = 8.31$ J/mol K b. $2R = 16.6$ J/mol K
53. a. 4 b. 1 c. 16
55. 1/2
57. a. 2.03×10^6 J b. 4.83×10^{-6} c. 0.00132 K
59. a. b. $9p_iV_i$



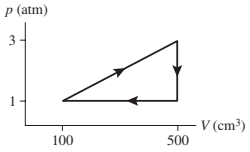
61. c. 436 K, 850 J is transferred from the oxygen to the helium.

Chapter 19

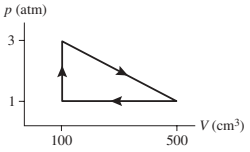
1. a. 10 J, 110 J b. 0.0833
3. a. 0.273 b. 15 kJ
5. a. 250 J b. 150 J
7. a. 200 J b. 250 J
9. 96,000
11.

	ΔE_{th}	W_s	Q
A	+	0	+
B	0	+	+
C	−	+	0
D	−	−	−

13. 40.5 J
15. a. 0.0952 b. 285 J
17. 24.7
19. a. b only b. a only
21. 7°C
23. a. 40% b. 215°C
25. 233 K
27. a. 6.32 b. 32 W c. 232 J/s
29. a. 60 J b. −23°C
31. 8.44×10^5 J
33. 5.34×10^4 J
39. 8.25%
41. 47°C and −33°C
43. 2/3
45. a. 2.5 kW b. $270 and $45
47. a. 48 m b. 32.1%
49. 37%
51.



or



53. a.

	W_s (J)	Q (J)	ΔE_{th} (J)
1 → 2	3.04	16.97	13.93
2 → 3	0	−10.13	−10.13
3 → 1	−1.52	−5.32	−3.80
Net	1.52	1.52	0

b. 8.96% c. 12.7 W
55. a.

	W_s (J)	Q (J)	ΔE_{th} (J)
1 → 2	0	282.2	282.2
2 → 3	207.2	0	−207.2
3 → 1	−50.0	−125.0	−75.0
Net	157.2	157.2	0

b. 52.2%

57. a. 5.743×10^4 Pa, 4000×10^{-6} m^3, 229.7 K
b.

	ΔE_{th} (J)	W_s (J)	Q (J)
$1 \rightarrow 2$	425.7	−425.7	0
$2 \rightarrow 3$	0	554.5	554.5
$3 \rightarrow 1$	−425.7	0	−425.7
Net	0	128.8	128.8

c. 23.2%

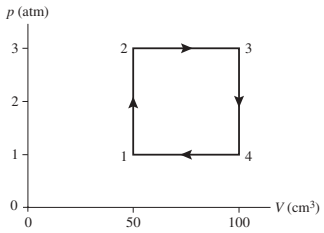
59. a. Point 1: 1.013×10^5 Pa, 1.0×10^{-3} m^3, 406 K;
Point 2: 5.06×10^5 Pa, 1.0×10^{-3} m^3, 2030 K;
Point 3: 1.013×10^5 Pa, 5.0×10^{-3} m^3, 2030 K b. 28.8% c. 80%

61. a. 1620 K, 2407 K, 6479 K
b.

	ΔE_{th} (J)	W_s (J)	Q (J)
$1 \rightarrow 2$	327	−327	0
$2 \rightarrow 3$	1692	677	2369
$3 \rightarrow 1$	−2019	0	−2019
Net	0	350	350

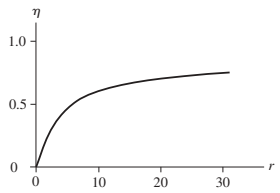
c. 14.8%

63. 345.6 J, 24.0%
65. b. $T_H = 1092°C$
67. b. $Q_H = 100$ J, $Q_C = 80$ J
69. a.



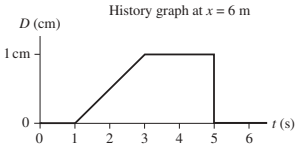
b. 10.13 J c. 12.9%

71. c.

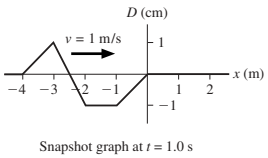


Chapter 20

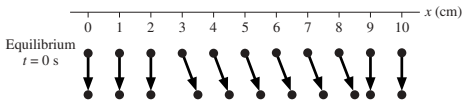
1.



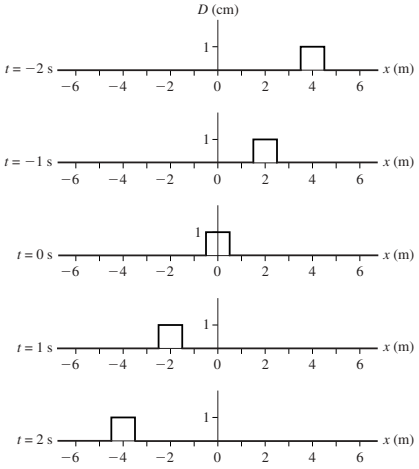
3.



5.

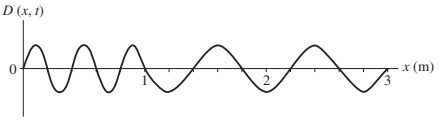


7. 283 m/s
9. 140 m/s
11. a. 4.19 m b. 47.7 Hz
13. a. 11.5 Hz b. 1.14 m c. 13.1 m/s
15. 4.0 cm, 12 m, 2.0 Hz
17. 40 cm
19. 34 Hz, 68 Hz
21. 0.076 s
23. 793 m
25. a. 1715 Hz b. 1.50 GHz c. 987 nm
27. a. 10 GHz b. 0.167 ms
29. a. 1.50×10^{-11} s b. 3.38 mm
31. 459 nm
33. 6.05×10^5 J
35. a. 1.11×10^{-3} W/m^2 b. 1.11×10^{-7} J
37. 38.1 m/s
39. a. 432 Hz b. 429 Hz
41. a.



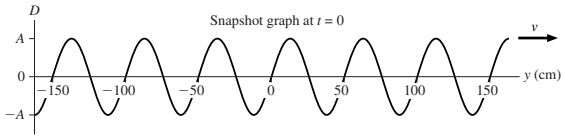
b. 2 m/s c. 2 m/s

43. a. 0.80 m b. $-\frac{1}{2}\pi$ rad
c. $D(x, t) = (2.0 \text{ mm})\sin(2.5\pi x - 10\pi t - \frac{1}{2}\pi)$
45. 25 g
47. 2.34 m, 1.66 m
49.

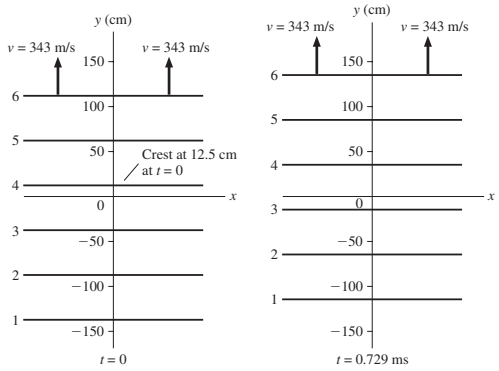


51. 1, 4.31, 4.31
53. 0.07°C
55. a. $-x$ direction b. 12.0 m/s, 5.0 Hz, 2.62 rad/m c. −1.50 cm
57. $D(y, t) = (5.0 \text{ cm})\sin[(4\pi \text{ rad/m})y + (16\pi \text{ rad/s})t]$
61. $\pi/2$ rad = 90°

63. a.

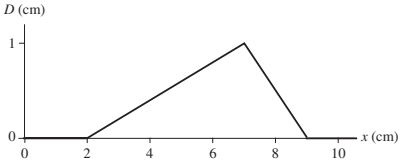


b. 0 rad c. $D(y, t) = A\sin[(12.57\ \text{m}^{-1})y - (4310\ \text{s}^{-1})t]$
d. and e.



f. $-\frac{1}{2}\pi$ rad and $-\frac{3}{2}\pi$ rad

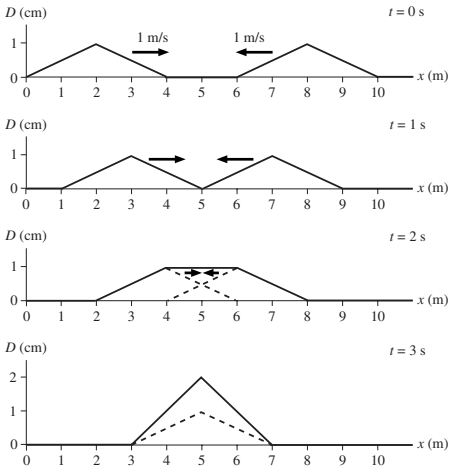
65.

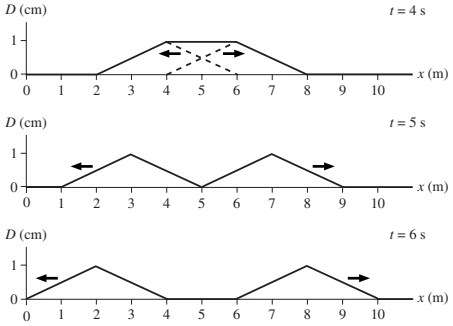


67. 15.9 Hz, 2.0 cm
69. a. 0.040 W/m^2 b. 637,000 W/m^2
71. a. 250 μW/m^2 b. 15.8 km
73. 85.8 m/s, away from you
77. 796 nm, infrared
79. $200 million
81. 8
83. b. 5.17×10^{-11} s

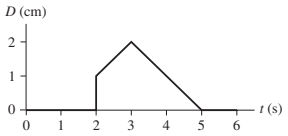
Chapter 21

1.

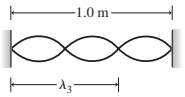




5. a. $t = 4$ s
b.



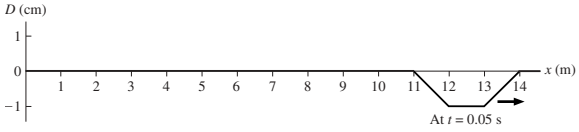
7. 60 Hz
9. a. 6 b. $2f_0$
11. a. 12 Hz, 24 m/s
b.



13. a. 700 Hz b. 56.4 N
15. 400 m/s
17. 10.5 m
19. 4.8 cm
21. a. 0.25 m b. 0.25 m
23. 1.0 m, 3.0 m, 5.0 m
25. 200 nm
27. a. Out of phase b.

	r_1	r_2	Δr	C/D
P	2λ	3λ	λ	D
Q	3λ	1.5λ	1.5λ	C
R	2.5λ	3λ	0.5λ	C

29. Perfect destructive
31. 527 Hz
33.

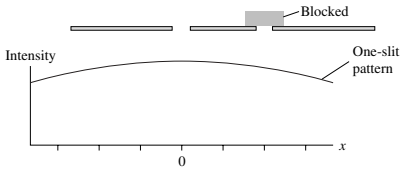


35. 0.62 cm, 1.18 cm, 1.62 cm, 1.90 cm, 2.00 cm
37. 1.41 cm
39. 1.23 m
41. 28.4 cm
43. 8.19 m/s^2
45. 18 cm
47. 13.0 cm
49. 328 m/s
51. 26.1 cm, 55.6 cm, 85.2 cm
53. 450 N
55. 1605 Hz
59. 7.89 cm

61. a. 850 Hz b. $-\frac{1}{2}\pi$ rad
63. 345 nm
65. 7.15 cm
67. 20
69. a. 170 Hz b. 510 Hz and 850 Hz
71. 150 MHz
73. a. a b. 1.0 m c. 9
75. a. 5 beats/s b. 4.6 mm
77. 7.0 m/s
79. b. 2.0%
81. 8.00 m/s^2
83. c. 2.09 cm/s d. 2.2 mm
85. a. $\frac{1}{4}\lambda$ b. $\frac{1}{2}\pi$ rad c. $\frac{1}{4}T$ d. 75 m, 250 ns

Chapter 22

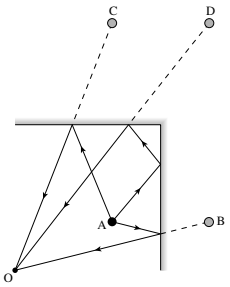
1. a.



3. 0.020 rad = 1.15°
5. 500 nm
7. 0.40 mm
9. 530
11. a. 1.258 m b. 7
13. 14.5 cm
15. 4.0 mm
17. 611 nm
19. 7.56 m
21. 0.25 mm
23. 0.01525 rad = 0.874°
25. 30,467
27. 19
29. a. Single slit b. 0.15 mm
31. 0.286°
33. 1.33 mm
35. 500 nm
37. 500 nm
39. 667.8 nm
41. 396 nm
43. 533 to 700 nm
45. 500 nm
47. 0.118 mm
49. a. 2 b. 1.15 c. 1
51. 0.10 mm
53. 0.122 mm
55. a. 550 nm b. 0.40 mm
57. a. No b. 0.0295° c. 0.30 cm d. 103 cm
59. a. 3.0 mm b. $\frac{1}{4}$ c. $\frac{1}{2}\pi$ rad d. 0.75 mm toward the slit
61. 14.2 μm closer to the beam splitter
63. a. 376 nm b. 1319 c. 1319
65. 1.5525
67. 12.0 μm
69. b. 0.022°, 0.058°
71. b. −11.5°, −53.1°
73. c. 1.3 m

Chapter 23

1. a. 3.33 ns b. 0.75 m, 0.67 m, 0.51 m
3. 8.0 cm
5. 668 m
7. 9.0 cm
9. 42°
11. 433 cm
13. 65.0°
15. 1.37
17. 76.7°
19. 3.18 cm
21. 1.52
23. b. 1.1°
25. 1580 nm
27. Inverted image 15 cm behind the lens
29. Upright image 6 cm in front of the lens
31. 68 cm
33. −203 cm
35. 1.54 cm
37. 54.6 km
39. b. Relative to the intersection of the two mirrors, 3 images are at coordinates (+1 m, −2 m), (−1 m, +2 m), and (+1 m, +2 m)
    c.



41. 10.0 m
43. 41.8°
45. 82.8°
47. a. Bottom of tank coming up b. 60.0 cm
49. 4.73 m
51. a. Deep b. 17.5 m
53. 1.552
55. a. 17.9° b. 27.9° to the left of the normal
57. 3.0 cm
59. b. 40 cm, 2 cm
61. b. −60 cm, 8.0 cm
63. b. −8.6 cm, 1.14 cm
65. 44.4 cm, 67 cm
67. c. ≈3.6 cm
69. 15.7 cm
71. b. 20 cm in front of second lens, 2.0 cm tall
73. 11.5 km
75. a. 2 μm b. 165 MB
77. b. 1.574
79. b. 40 cm, 156.5 cm
81. a. −200 cm

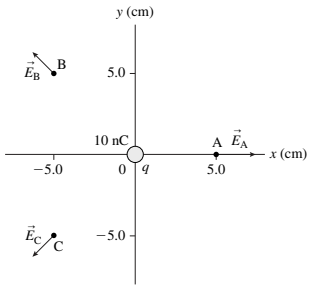
Chapter 24

1. 410.3 nm, 389.0 nm, 379.9 nm
3. $n = 8$
5. 63.8°
7. 4

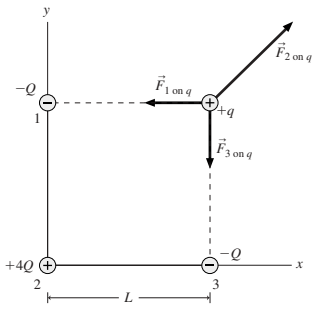
9. 1.99×10^{-16} J
11. 1.2×10^{5} J
13. a. 3.6×10^{6} m/s b. 2.0×10^{3} m/s
15. a. 1.1×10^{-34} m b. 1.7×10^{-23} m/s
17. 0.20 nm
19. a. 121.6 nm, 102.6 nm, 97.3 nm, 95.0 nm b. 91.18 nm c. 31.4 cm
21. a. 2.0×10^{-12} m b. 2.51×10^{5}
23. a. 3.14×10^{-19} J b. 3.19×10^{15}
25. 18.7°, 50.8°, and 71.6°
27. b. 2.4 nm and 1.2 nm
29. a. 0.818 μm b. 1.09×10^{3} m/s
31. 170 m/s
33. a. 1.23×10^{-19} J, 4.92×10^{-19} J, 1.11×10^{-18} J
    b. 3.69×10^{-19} J c. 539 nm
35. 1.35 nm
37. a. $(h/2mL)n$ b. 1.819×10^{6} m/s, 3.64×10^{6} m/s, 5.46×10^{6} m/s
39. a. 72.5°, 53.1°, and 25.8° b. 64.9° and 31.9°
    c. 19.9° and 76.9°, matching the peaks in Figure 24.7c
41. b. 7.28×10^{4} m/s, 1.46×10^{5} m/s, 2.18×10^{5} m/s, 2.91×10^{5} m/s

Chapter 25

1. a. Electrons removed from glass b. 3.13×10^{10}
3. 3.04×10^{-11}
7. Right negatively charged, left positively charged
11. a. 9.0×10^{9} N b. 9.0×10^{9} m/s^2
13. -10 nC
15. $\vec{F}_{\text{B on A}} = 4.50 \times 10^{-3}\,\hat{j}$ N, $\vec{F}_{\text{A on B}} = -4.50 \times 10^{-3}\,\hat{j}$ N
17. 30 N/kg
19. a. (9.83 N/kg, toward earth) b. (2.70×10^{-3} N/kg, toward earth)
21. 0.111 nC
23. -8.0 nC
25. (3.27×10^{6} N/C, downward)
27. a. $3.6 \times 10^{4}\,\hat{i}$ N/C, $(-1.27 \times 10^{4}\,\hat{i} + 1.27 \times 10^{4}\,\hat{j})$ N/C, $(-1.27 \times 10^{4}\,\hat{i} - 1.27 \times 10^{4}\,\hat{j})$ N/C
    b.



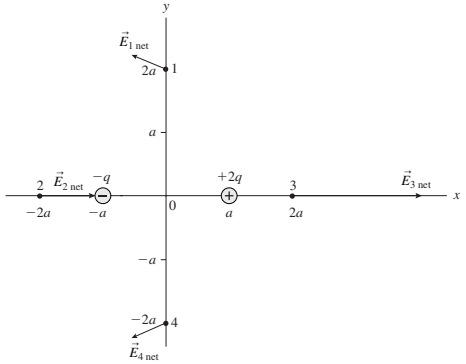
29. 1.36×10^{5} C, -1.36×10^{5} C
31. a. Electrons removed from sphere and added to rod b. 2.5×10^{10}
33. -160 nC and 0 nC
35. a. 498 N b. 2.98×10^{29} m/s^2
37. a. 0.45 N b. 1.0×10^{-6} C, 5.0×10^{-7} C c. 4.5 m/s^2
39. 1.80×10^{-4} N to the right
41. 4.74×10^{-3} N, 71.6° above $-x$-axis
43. 1.74×10^{-4} N, 51.75° below $+x$-axis
45. $-1.02 \times 10^{-3}\,\hat{i}$ N
47. $(1.02 \times 10^{-5}\,\hat{i} + 2.16 \times 10^{-5}\,\hat{j})$ N
49. 0.68 nC
51. $-2KQqa/(y^2 + a^2)^{3/2}$
53. a.



    b. $(2 - \sqrt{2})KQq/L^2$
55. a. 243 N b. Yes. Any difference must therefore be smaller than 1 part in 10^9.
57. 3.2×10^{15}
59. 4.42°
61. $1.0 \times 10^{5}\,\hat{j}$ N/C, $(2.88 \times 10^{4}\,\hat{i} + 2.16 \times 10^{4}\,\hat{j})$ N/C, $5.63 \times 10^{4}\,\hat{i}$ N/C
63. $(4.02 \times 10^{4}\,\hat{i} + 8.05 \times 10^{4}\,\hat{j})$ N/C, $4.5 \times 10^{5}\,\hat{i}$ N/C, $(4.02 \times 10^{4}\,\hat{i} - 8.05 \times 10^{4}\,\hat{j})$ N/C
65. a. (−1 cm, 2 cm) b. (3 cm, 3 cm) c. (4 cm, −2 cm)
67. a. $(3.20\,\hat{i} + 6.40\,\hat{j}) \times 10^{-17}$ N b. $(-3.20\,\hat{i} - 6.40\,\hat{j}) \times 10^{-17}$ N c. 4.28×10^{10} m/s^2 d. 7.85×10^{13} m/s^2
69. 14.3°
71. b. 22.4 nC
73. b. 5.13 nC
75. 4.06 g

Chapter 26

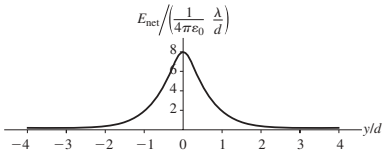
1. (2550 N/C, 0° above horizontal)
3. (3975 N/C, 9.3° above horizontal)
5. a. 18.0 N/C b. 36.0 N/C
7. 2.28×10^{5} N/C, 1.67×10^{5} N/C, 2.28×10^{5} N/C
9. (8.78×10^{-4} N, toward rod)
11. -0.056 nC
13. a. 0 N/C b. 4110 N/C
15. a. 0 N/C b. 1.49×10^{5} N/C
17. 1.39×10^{-3} nC
19. 1.41×10^{5} N/C
21. 1.86 cm
23. 6.13×10^{5} N/C, down
25. 5.93×10^{5} N/C
27. 0.185 m
29. (9.0×10^{-13} N, direction opposite $\vec{p}$)
31. $(132{,}600\,\hat{i} - 12{,}130\,\hat{j})$ N/C; (133,200 N/C, 5.23° below the $+x$-axis)
33. $(675\,\hat{i} - 78{,}400\,\hat{j})$ N/C; (78,400 N/C, 89.5° below the $+x$-axis)
35. a. $\vec{E}_1 = [q/(4\pi\epsilon_0)5\sqrt{5}a^2](-3\,\hat{i} + 2\,\hat{j})$; $\vec{E}_2 = [7q/(4\pi\epsilon_0)9a^2]\,\hat{i}$; $\vec{E}_3 = [17q/(4\pi\epsilon_0)9a^2]\,\hat{i}$; $\vec{E}_4 = [q/(4\pi\epsilon_0)5\sqrt{5}a^2](-3\,\hat{i} - 2\,\hat{j})$
    b.



39. 1.08×10^5 N/C

41. a. $\dfrac{8\lambda d}{4\pi\epsilon_0(4y^2 + d^2)}$

b.



43. −2.29 nC/m

45. $\dfrac{Q}{4\pi\epsilon_0}\dfrac{1}{x\sqrt{x^2 + L^2}}\hat{\imath} - \dfrac{Q}{4\pi\epsilon_0 Lx}\left(1 - \dfrac{x}{\sqrt{x^2 + L^2}}\right)\hat{\jmath}$

47. b. $(1/4\pi\epsilon_0)(2Q/3\sqrt{3}R^2)$

49. c. $(1/4\pi\epsilon_0)(2Q/\pi R^2)(\hat{\imath} + \hat{\jmath})$

51. 0.9995 cm

53. 1.19×10^7 m/s

55. a. Positive b. 37,500 N/C c. 2.5 mm

57. a. 8.84×10^5 N/C b. ±0.188 nC

59. -9.89×10^{-12} C

61. 18.6 nm

63. a. mC^2/N or C^2s^2/kg b. $((1/4\pi\epsilon_0)^2(2\alpha q^2/r^5)$, toward ion)

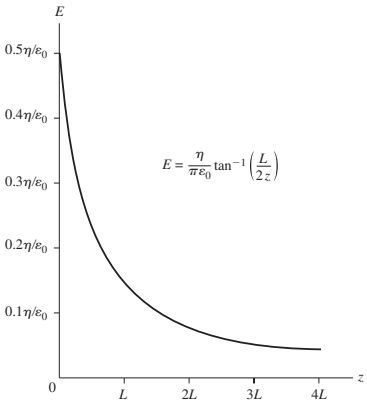
65. b. 1.0 mm

67. b. $z = R/\sqrt{3}$

69. 4.16×10^{-4} N

71. a. $(\eta/\pi\epsilon_0)\tan^{-1}(L/2z)\,\hat{k}$

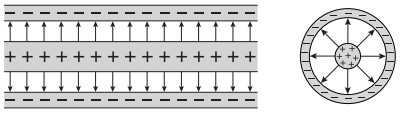
c.



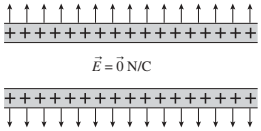
73. c. 2.0×10^{12} Hz

Chapter 27

1.



3.



5. No charge

7. 5 N/C, pointing in

9. $-1.0\ Nm^2/C$

11. a. $6.0 \times 10^{-2}\ Nm^2/C$ b. $0\ Nm^2/C$

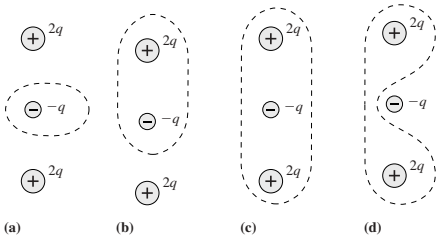
13. $1.26\ Nm^2/C$

15. a. 0 b. $2\pi R^2 E$

17. $-1.0\ Nm^2/C$

19. 5.31 nC

21.



23. $113\ Nm^2/C$

25. $2.66 \times 10^{-5}\ C/m^2$

27. a. $-0.390\ Nm^2/C$, $0.225\ Nm^2/C$, $0.390\ Nm^2/C$, $-0.225\ Nm^2/C$
b. $0\ Nm^2/C$

29. a. $-3.46\ Nm^2/C$ b. $1.15\ Nm^2/C$

31. $-2Q/\epsilon_0$

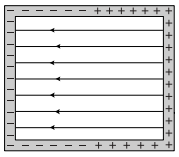
33. a. 2000 N/C b. $251\ Nm^2/C$ c. 2.22 nC

35. a. −100 nC b. +50 nC

37. a. $2.39 \times 10^{-6}\ C/m^3$ b. 1.25 nC, 10.0 nC, 80.0 nC
c. 4500 N/C, 9000 N/C, 18,000 N/C

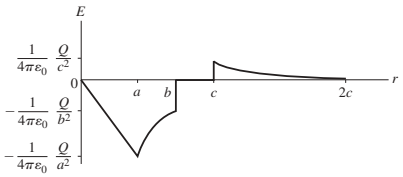
39. a. -1.068×10^{-8} C b. $+1.068 \times 10^{-8}$ C c. 4.82×10^{-8} C

41.

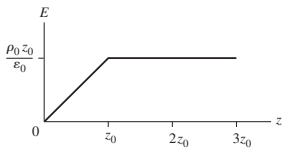


43. a. $(q/4\pi\epsilon_0 r^2)\,\hat{r}$ b. $-(q/4\pi\epsilon_0 r^2)\,\hat{r}$

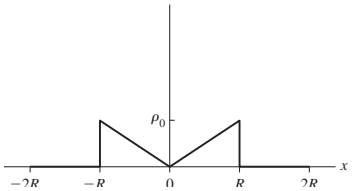
45. a. $(-Qr/4\pi\epsilon_0 a^3)\,\hat{r}$, $-(Q/4\pi\epsilon_0 r^2)\,\hat{r}$, $\vec{0}$, $(Q/4\pi\epsilon_0 r^2)\,\hat{r}$
b.



47. a. $\rho_0 z/\epsilon_0$ b. $\rho_0 z_0/\epsilon_0$
c.



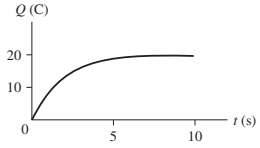
49. a. $3Q/2A\epsilon_0$, 0, $Q/2A\epsilon_0$, 0, $3Q/2A\epsilon_0$ b. $\frac{3}{2}Q/A$, $-\frac{1}{2}Q/A$, $\frac{1}{2}Q/A$, $\frac{3}{2}Q/A$
51. a. $(\lambda/2\pi\epsilon_0 r)\,\hat{r}$ b. $(\lambda r/2\pi\epsilon_0 R^2)\,\hat{r}$
53. b. 0 N/C c. 4.64×10^{13} N/C
55. a.



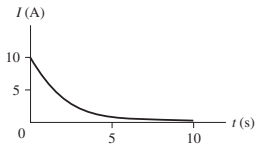
c. $(\lambda r^2/2\pi\epsilon_0 R^3)\,\hat{r}$

Chapter 28

1. 7.5×10^{-5} m/s
3. 2.62×10^{5} s
5. Aluminum
7. a. 4.63×10^{21} b. 4.32×10^{-12} m
9. 0.31 N/C
11. 9.4×10^{18}
13. 3.2 mA
15. a. 6.25×10^{5} A/m^2 b. 6.51×10^{-5} m/s
17. a. 1.73×10^{7} A/m^2 b. 5.31×10^{18} s^{-1}
19. 0.141 mA
21. 2.08×10^{-14} s, 4.19×10^{-15} s
23. 1.68 A
25. $5.01 \times 10^{-8}\ \Omega$m
27. a. 1.64×10^{-3} N/C b. 1.10×10^{-5} m/s
31. a. Doubled b. Unchanged c. Unchanged d. Doubled
33. a. 3.12×10^{14} b. 398 A/m^2 c. 9.11×10^{5} N/C d. 0.227 W
35. 22.6 mA
37. a. 120 C b. 0.449 mm
39. 1/4
41. 10.4 A
43. a. $I/4\pi\sigma r^2$ b. 3.32×10^{-4} N/C, 5.31×10^{-5} N/C
45. a.



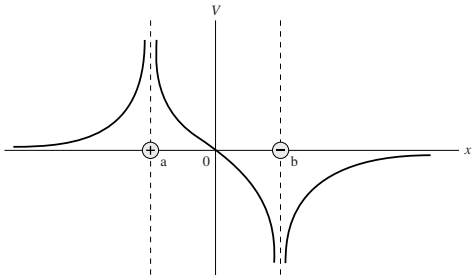
b. $(10\text{ A})e^{-t/(2.0\text{ s})}$ c. 10.0 A
d.



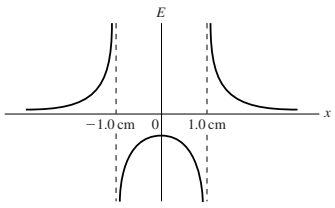
47. 2.43 A
49. 5.6×10^{-6} m/s
51. 1/2
53. 1.01×10^{23}
55. a. 1.15×10^{5} m/s b. 1.5 nm
57. a. $(\epsilon_0 I/A)(1/\sigma_2 - 1/\sigma_1)$ b. 3.68×10^{-18} C

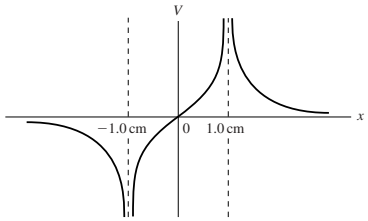
Chapter 29

1. 1.38×10^{5} m/s
3. 7.07×10^{4} m/s
5. 2.82×10^{-6} J
7. -2.24×10^{-19} J
9. 1.61×10^{8} N/C
11. 1.87×10^{7} m/s
13. -2.09×10^{4} V
15. a. Lower b. -0.712 V
19. a. 200 V b. 3.54×10^{-10} C
21. a. Right plate b. 1.0×10^{5} V/m c. 2.40×10^{-17} J
23. a. 1800 V, 1800 V, 900 V b. -2.88×10^{-16} J, -2.88×10^{-16} J, -1.44×10^{-16} J c. 0 V, -900 V
25. 4.17×10^{-10} C
27. $+1410$ V
29. a. 3140 V b. 5.02×10^{-16} J
31. $x = 3$ cm and 6 cm
33. a. q_a is positive, q_b is negative with the same magnitude
b.



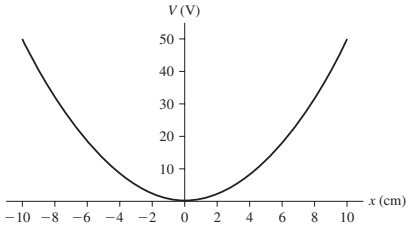
35. 0 V
37. 1.44×10^{-3} N
39. a. $x = \pm\infty$ b. $x = \pm\infty$ and 0
c.





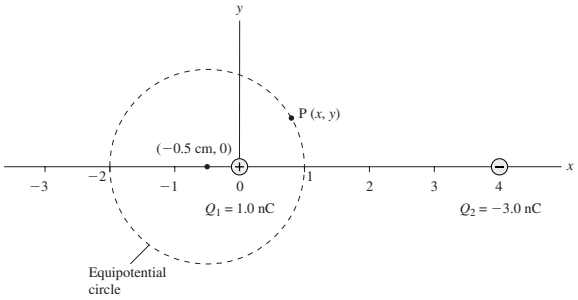
41. a. 0.720 J b. 14.4 N c. 21.9 m/s and 10.95 m/s
43. 25.3×10^{-6} J
45. a. 1000 V b. 1.39×10^{-9} C c. 7.0×10^{6} m/s

47. a.



b. SHM c. 3.20×10^{-7} J d. 2.53 cm/s

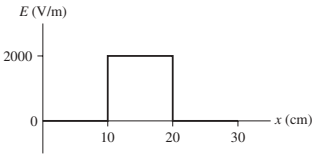
49. 1.17×10^{6} m/s
51. Disk
53. 3.99×10^{7} m/s
55. 4.07×10^{7} m/s
57. a. 2.09×10^{-10} C, 3000 V/m, 15 V b. 2.09×10^{-10} C, 3000 V/m, 30 V c. 2.09×10^{-10} C, 750 V/m, 3.75 V
59. a. V_0/R b. 100,000 V/m
61. b. 8.33 μC c. 0 V/m, 3.33×10^{6} V/m
63. 2126 V, point b higher
65. a. $4q/(4\pi\epsilon_0 s) + 16qx^2/(4\pi\epsilon_0 s^3)$ b. SHM
67. $(2qs^2)/(4\pi\epsilon_0 y^3)$
69. $(Q/4\pi\epsilon_0 L)\ln[(x + L/2)/(x - L/2)]$
71. $Q/4\pi\epsilon_0 R$
73. b. q_1 and q_2 are 10 nC and 30 nC
75. b. $Q = 0.35$ nC
77.



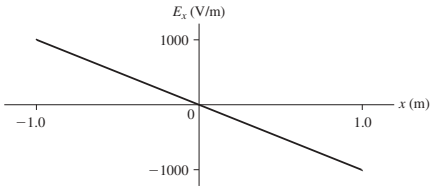
79. $v_A = 0.0548$ m/s, $v_B = 0.110$ m/s
83. c. 2.30×10^{-13} J

Chapter 30

1. −200 V
3. −1000 V/m
5.

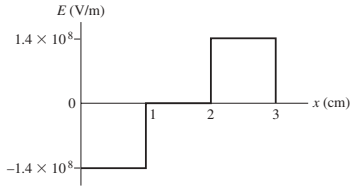


7. 10,000 V/m to the left
9. −20 V
11. 1.5×10^{-6} J
13. 12 V
15. a. 0.087 Ω b. 3.5 Ω
17. 3.0 V
19. 2.29 mA
21. 4.75 cm
23. 24.0 V
25. 32 μF
27. 200 pF
29. 1414 V
31. 1/2
33. a. 1.11×10^{-7} J b. 0.708 J/m^3
35. a.

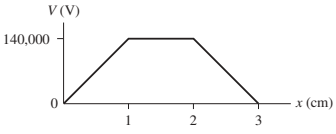


b. +25 V

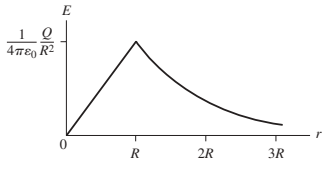
37. $V_0 - (\lambda/2\pi\epsilon_0)\ln(r/R)$
39. a.



b.

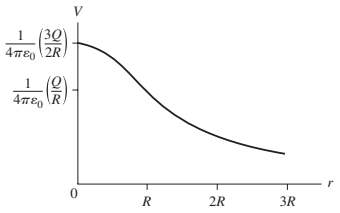


41. $(Q/2\pi\epsilon_0 R^2)[1 - z/(R^2 + z^2)^{1/2}]$
43. Point 1: 3750 V/m, downward; point 2: 7500 V/m, upward
45. 1000 V/m, 53.1° above the $-x$-axis
47. 2 nC and 4 nC
49. 1.1 nC
51. 9.1 A
53. 1800 C
55. a. $\pm 3.19 \times 10^{-11}$ C, 9 V b. $\pm 3.19 \times 10^{-11}$ C, 18 V
57. 5.90 cm and 6.10 cm
59. 150 μF, in series
61. 37 μF
63. 60 μC on each; 5.0 V, 15.0 V, 10.0 V
65. 45 μC, 9 V; 21.6 μC, 5.4 V; 21.6 μC, 3.6 V
67. 1.67 pF
69. 1.33×10^{-12} F = 1.33 pF
71. 20 μF
73. 2.4 J
75. 0.177 J/m^3
77. 179 km × 179 km; not feasible
79. b. $L = 4.86$ m
81. b. $C = 2$ μF
83. $-\rho R^2/4\epsilon_0$
85. a.



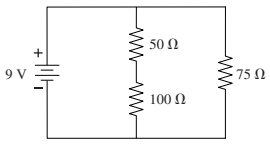
b. $(Q/4\pi\epsilon_0 R)[3/2 - r^2/2R^2]$ c. 3/2

d.



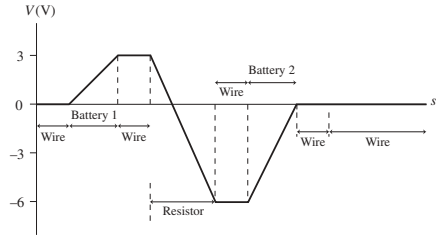
Chapter 31

1. 5.5 Ω
3. 2.0 A
5. 0.64 mm
7.



9. 5 A, toward the junction
11. a. 0.50 A, left to right

b.



13. 9.6 Ω, 12.5 A
15. 23.6 μm
17. a. 11.6 A b. 10.4 Ω
19. 78.4 mΩ
21. 25 Ω
23. 93.4 W
25. 3.23%
27. $R/4$
29. 12.0 Ω
31. 24 Ω
33. 183.3 Ω
35. 13 V, 9 V, 0 V, −2 V
37. 2 ms
39. 6.93 ms
41. 869 Ω
43. A > D = E > B = C
45. Increase
47. 8.4×10^{-8} Ω
49. 7 Ω
51. 60 V, 10 Ω
53. 9.00 V, 0.50 Ω
55. 2.0 V for each
57. 1.0 A, 2.0 A, 15.0 V
59. 3.0 A
61. a. $14.40 b. 34.7 months
63. a. 8 A, 8 V b. 9.14 A, 0 V
65. a. 0.505 Ω b. 0.50 Ω
67.

R (Ω)	I (A)	ΔV (V)
6	2.0	12.0
15	0.8	12.0
6	1.2	7.2
4	1.2	4.8

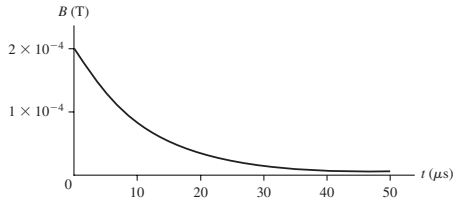
69.

R (Ω)	I (A)	ΔV (V)
4	2	8
6	$\frac{4}{3}$	8
8	1	8
24	$\frac{1}{3}$	8
24	$\frac{2}{3}$	16

71. a. 10 A b. 80 W c. 60 V
73. 36.4 Ω
75. 0.69 ms
77. a. 80 μC b. 0.23 ms
81. b. 5140 Ω

Chapter 32

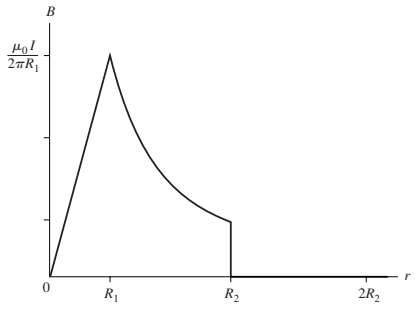
1. Out of the page
3. (2.0 mT, into the page), (4.0 mT, into the page)
5. a. $1.60 \times 10^{-15}\,\hat{k}$ T b. 0 T c. 0 T
7. $1.13 \times 10^{-15}\,\hat{k}$ T
9. 6.25×10^6 m/s in the $+z$-direction
11. 4.0 cm, 0.4 mm, 20 μm to 2 μm, 0.20 μm
13. a. 20 A b. 1.60×10^{-3} m
15. $2.0 \times 10^{-4}\,\hat{\imath}$ T, $4.0 \times 10^{-4}\,\hat{\imath}$ T, and $2.0 \times 10^{-4}\,\hat{\imath}$ T
17. a. 0.025 A m^2 b. 5.0 μT
19. 8.75×10^{-5} m^2
21. 0.0707 T m
23. 1.0 A
25. 2390 A
27. a. Into the page b. No deflection
29. a. In the plane of the paper, 45° cw from straight up
    b. In the plane of the paper, 45° ccw from straight down
31. a. $-8.0 \times 10^{-13}\,\hat{k}$ N b. $5.66 \times 10^{-13}\,(-\hat{\jmath} - \hat{k})$ N
33. 1.61×10^{-3} T
35. 2.9×10^{28} m^{-3}
37. 0.025 N, to the right
39. 3.0 Ω
41. 7.5×10^{-4} N m
43. a. 1.26×10^{-11} N m b. Rotated 90°
45. a. 1.0 μT b. 2.0% c. 2.0 μT d. 2.0 μT; twice field in (a)
47. (5.2×10^{-5} T, out of the page); 0 T
49.



51. 750 A
53. a. 1.13×10^{10} A b. 0.014 A/m^2
    c. The current density in the earth is much less than the current density in the wire.

55. #18 gauge; 4.06 A
57. a. $(1.25)^{-3/2}\mu_0 NI/R$ b. 1.80×10^{-4} T
59. $\mu_0 I/4R$
61. 0; $(\mu_0 I/2\pi r)[(r^2 - R_1^2)/(R_2^2 - R_1^2)]$; $\mu_0 I/2\pi r$
63. 2.9×10^{-3} T
65. a. $(2.4 \times 10^{10}$ m/s^2, down) b. $(2.2 \times 10^{11}$ m/s^2, up)
67. a. 4.6×10^{-13} J b. 2850
69. 2.10 T
71. 2.0 A
73. (0.00864 T, down)
75. 12.5 T
77. 0.036 mm
81. a. $\mu_0 IL/4\pi d\sqrt{(L/2)^2 + d^2}$ b. $\sqrt{2}\mu_0 I/\pi R$ c. 90.0%
83. a. $\mu_0 Ir/2\pi R_1^2$, $\mu_0 I/2\pi r$, 0

b.

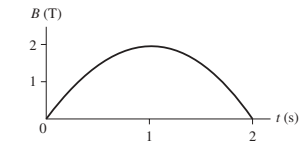


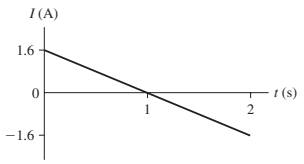
Chapter 33

1. (0.10 T, out of the page)
3. a. 4.0 m/s b. 2.24 T
5. 6.28×10^{-5} Wb in both cases
7. a. Right to left b. No
9. cw
11. 3.14 V
13. Increasing at 2.34 T/s
15. 100 V, increase
17. 9.47×10^{-5} J
19. 0.253 μH
21. 900 Ω
23. 3.54×10^{-4} Wb
25. a.

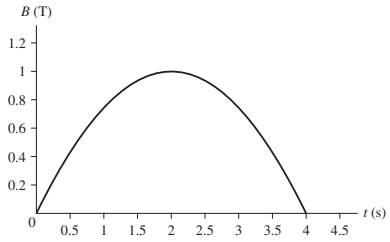
t (s)	B (T)	$\mathcal{E}$ (V)	I (A)
0.0	0.00	0.16	1.6
0.5	1.50	0.08	0.8
1.0	2.00	0.00	0.0
1.5	1.50	−0.08	−0.8
2.0	2.00	−0.16	−1.6

b.

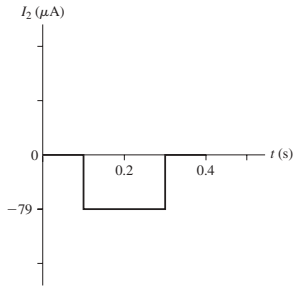




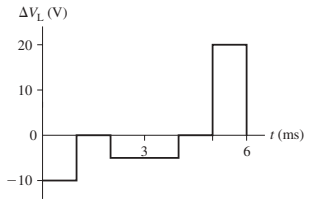
27. a.



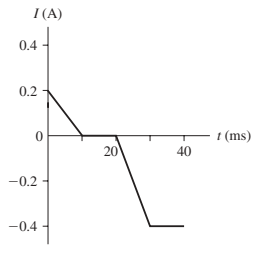
b. $0.0628(1 - \frac{1}{2}t)$ A c. 31.4 mA, 0.0 A, −31.4 mA
29. 41.7 mV
31. 43.9 μA
33. 0.853 mA
35. i



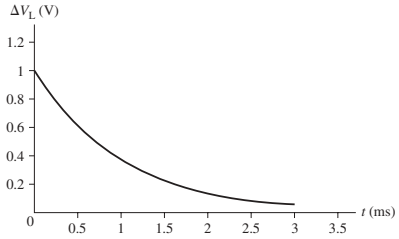
37. (7.44 mA)cos($2\pi ft$)
39. a. 12,500 b. 2.0 A
41. 39.5 nA
43. a. 0.20 A b. 4.0×10^{-3} N c. 11°C
45. a. $(4.93 \times 10^{-3})f\sin(2\pi ft)$ A b. 405 Hz; not feasible
47. a. $(vlB\cos\theta)/R$ b. $(mgR\tan\theta)/(l^2B^2\cos\theta)$
49. a. $(mgR)/(l^2B^2)$ b. 0.98 m/s
51. 12 V
53. 500
55. a. 0.0637 J/m^3 b. 0.628 J/m^3
57. a. 1.0×10^{16} J b. 0.25%
59. 3.0 s
61.



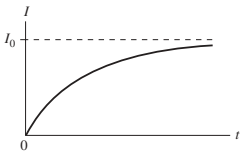
63.



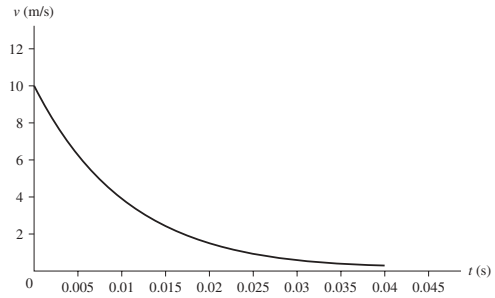
65. a. $(LI_0/\tau)e^{-t/\tau}$ b. 1.0 V, 0.37 V, 0.13 V, 0.05 V
c.



67. a. 0.628 ms b. 25 V
69. $0.707Q_0$
71. a. 76 mA b. 0.50 ms
73. a. 1.0 A b. 2.0 A
75. a. $\Delta V_{bat}/R$ b. $I_0(1 - e^{-t/(L/R)})$
c.



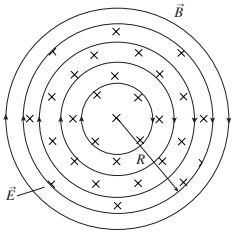
77. $(\mu_0 vI/2\pi)\ln[(d + l)/d]$
79. a. $v_0\exp[-(l^2B^2/mR)t]$
b.



81. a. $(\mu_0/2\pi)\ln(r_2/r_1)$ b. 0.36 μH/m

Chapter 34

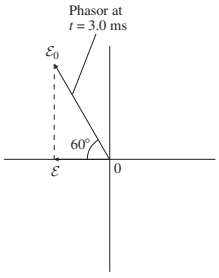
1. (2.0 T, into the face)
3. $(-3.2\ \hat{\imath} - 4.8\ \hat{\jmath}) \times 10^{-14}$ N
5. $(1.73 \times 10^6$ V/m, left)
7. a. $(2.0 \times 10^6$ m/s, 45° from the y-axis)
b. $(1.47 \times 10^6$ m/s, 16.2° from the y'-axis)
9. $-1.0 \times 10^6\ \hat{\jmath}$ V/m, $1.11 \times 10^{-5}\ \hat{k}$ T
11. 16.3°
13. a. 0 V/m b. 0.040 V/m
17. 1.0×10^6 V/s
19. 22.1 μA
21. 6.0×10^5 V/m
23. a. 1.00×10^{-8} m b. 3.0×10^{16} Hz c. 6.67×10^{-8} T
27. 1.2×10^{-10} W/m^2
29. a. 2.21×10^{-6} W/m^2 b. 0.041 V/m
31. 3.3×10^{-6} N
33. 60°
35. 131 W/m^2
37. a. (0.10 T, into the page) b. 0 V/m, (0.10 T, into the page)
39. 1.0×10^7 m/s parallel to the current
41. $(R^2/2r)(dB/dt)$
43. b. 1.48×10^{-13} A
45. a. $(2.83 \times 10^3 t^2)$ V m
b.



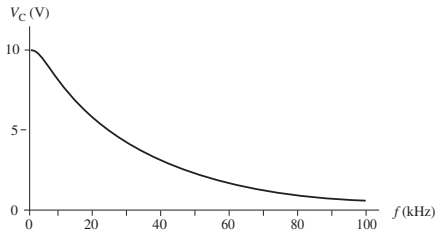
c. $1.11 \times 10^{-9} rt$ T; 4.44×10^{-12} T
d. $1.00 \times 10^{-14} t/r$ T; 5.0×10^{-12} T
47. a. 3.85×10^{26} W b. 589 W/m^2
49. Yes
51. 73.5 W
53. 0.408 m/s
55. $I_0/8$
57. b. 6.67×10^{-6} J/m^3
59. a. IR/L; $\mu_0 I/2\pi r$ b. $(I^2R/2\pi rL$, radially inward)

Chapter 35

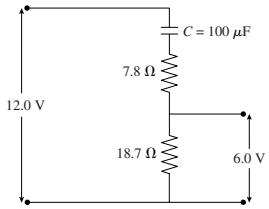
1. a. 175 rad/s b. −8.66 V
3.



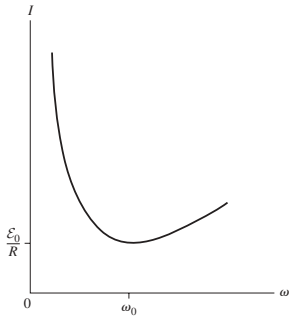
5. a. 50 mA b. 50 mA
7. a. 1.88 mA b. 1.88 A
9. a. 79.6 kHz b. 0 V
11. 125 Ω
13. 6.02 V, 7.99 V
15. 1.59 μF
17. a. 0.796 A b. 0.796 mA
19. a. 3.18×10^4 Hz b. 0 V
21. 80 Ω
23. 1.27 μF
25. a. 200 kHz b. 141 kHz
27. a. −27.2° b. +26.3°
29. 9.6 Ω
31. 43.5 Ω
33. 395 W
35. a. $1/\sqrt{3}RC$ b. $(\sqrt{3}/2)\mathcal{E}_0$ c. 3630 rad/s
37. a. 9.95 V, 9.57 V, 7.05 V, 3.15 V, 0.990 V
b.



41. a. 10.0 Hz b. 4.47 V, 3.45 V, 2.24 V
43. a. 25.1 mA b. 6.67 V
45. 44.1 Hz
47. a. $\mathcal{E}_0/\sqrt{R^2 + \omega^2 L^2}$, $\mathcal{E}_0 R/\sqrt{R^2 + \omega^2 L^2}$, $\mathcal{E}_0 \omega L/\sqrt{R^2 + \omega^2 L^2}$
    c. Low d. R/L
49. a. 1.62 A b. $-17.7°$ c. 137 W
51. a. 3.16×10^4 rad/s $= 5.03 \times 10^3$ Hz b. 10.0 V, 31.6 V
53. a. 69.53 Ω, 0.072 A, $-44.0°$ b. 50.0 Ω, 0.100 A, 0°
    c. 62.42 Ω, 0.080 A, 36.8°
55. a. 3.60 V b. 3.47 V c. -3.60 V
59. a. 11.6 pF b. 1.5×10^{-3} Ω
61. 40 W: 14.4 W; 60 W: 9.6 W; 100 W: 100 W
63. a. 0.833 b. 100 V c. 12.5 Ω d. 320 μF
65.



67. b. 10.0 V, 11.55 V
69. c. $\sqrt{1/LC}$
    d.



Chapter 36

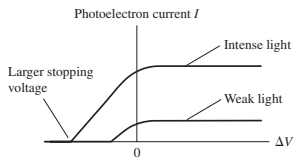
1. 5 m, 1 s; -5 m, 5 s
3. 345 m/s, 15 m/s
5. a. 15 m/s b. 5 m/s c. 11.2 m/s
7. 3.00×10^8 m/s
9. 167 ns
11. 2 μs
13. Bolt 2 first, by 20 μs
15. Simultaneously
17. 0.866c
19. a. 0.8c b. 16 y
21. 4.8 ns
23. Yes
25. 0.78 m
27. 9.5×10^4 m/s
29. (8.25×10^{10} m, 325 s)
31. 0.36c
33. 0.71c
35. 0.8c
37. 0.71c
39. a. 1.8×10^{16} J b. 9.0×10^9
41. 0.943c
43. 50 g ball: 1.33 m/s to the right; 100 g ball: 3.33 m/s to the right
45. 1st ball: 4.0 m/s to the right; 2nd ball: 2.0 m/s to the left
47. 11.2 hr
49. a. No b. 67.1 y
51. a. 0.9965c b. 59.8 ly
53. 4600 kg/m^3
55. a. 8.50 ly, 17 y b. 7.36 ly, 14.7 y
57. 0.96c
59. 0.9997c
61. a. 0.98c b. 8.49×10^{-11} J
63. b. Lengths perpendicular to the motion are not affected.
65. a. $u_y' = u_y/\gamma(1 - u_x v/c^2)$ b. 0.877c
67. 3.87mc
69. 0.786c
71. a. 7.56×10^{16} J b. 0.84 kg
73. 7.5×10^{-13} J
75. 1.06×10^{-12} m
77. 22 m
79. 0.845c
81. Yes

Chapter 37

3. 6.25×10^{10}
5. (5.0×10^{-3} T, out of page)
7. 0.521 μm
9. a. 71.2 eV b. -14.4 eV c. 5.0 keV
11. a. 5.93×10^6 m/s b. 3.10×10^7 m/s c. Alpha particle
15. a. 3, 4, and 5 b. 6, 6, and 6 c. 4, 7, and 8
17. a. ^{2}H b. $^{14}N^{++}$
19. a. 82 protons, 82 electrons, 125 neutrons
    b. 1.66×10^7 V, 2.34×10^{21} V/m
21. a. 2 and 3; 2 and 4; 2 and 5; 2 and 6 b. 397.1 nm
23. 121.6 nm, 102.6 nm, 97.3 nm, 95.0 nm
25. a. 6.66 GeV b. 3.63 MeV
27. 0.512 MeV and 939 MeV
29. 173 MeV
31. (0.0457 T, into page)
33. a. 7.2×10^{13} b. 1.16 μA
35. 0.0000000000058% occupied, 99.999999999942% empty
37. a. 50,000 kg/m^3 b. 3.2×10^{-10} m c. 1.7×10^{17} kg/m^3
39. a. 57.6 N b. 4.65×10^{-35} N
    c. Very strong, very short range, independent of charge
41. 1.77×10^7 V
43. a. 3.43×10^7 m/s b. 6.14×10^6 V
45. 2.52×10^5 m/s, 65° below the $+x$-axis
47. a. mg/E_0 b. mg/b d. 2.40×10^{-18} C e. 15

Chapter 38

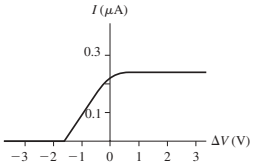
3.

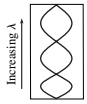


5. 6.25×10^{13}
7. 3.20 eV
9. 1.78 eV
11. a. Aluminum b. 1.93 V
13. a. 4140 nm; infrared b. 414 nm; visible c. 41.4 nm; ultraviolet
15. 497 nm
17. 6.0×10^{-6} V
19. 0.427 nm

21. 0.354 nm
23. a. Yes b. 0.5 eV
25. Yes to $n = 2$, no to $n = 3$
27. a. 69 b. 3.2×10^4 m/s, -0.0029 eV
29. 3.40 eV
33. 91.18 nm
35. a.

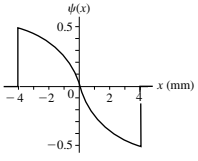
n	r_n (nm)	v_n (m/s)	E_n (eV)
1	0.026	4.38×10^6	-54.4
2	0.106	2.19×10^6	-13.6
3	0.238	1.46×10^6	-6.0

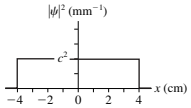
37. 1.44
39. a. 1.74×10^{18} b. 1.74×10^{26} photons/s
41. Potassium: a. 5.56×10^{14} Hz b. 540 nm c. 1.08×10^6 m/s d. 3.35 V; Gold: a. 1.23×10^{15} Hz b. 244 nm c. 4.4×10^5 m/s d. 0.55 V
43. Sodium
45. 

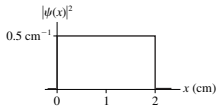
47. a. $p = E/c$ b. $\lambda = h/p$ c. $\lambda = h/mv$
49. a. 2.09×10^{-4} eV b. 1.985 nm c. 3.5 m
51. 0.427 nm
53. 

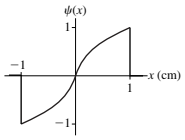
55. a. 6.5 eV b. 355 nm, 276 nm c. Both ultraviolet d. 6.16×10^5 m/s
57. -0.278 eV
59. 1876 nm
61. a. $n = 99$: 518 nm, 2.21×10^4 m/s; $n = 100$: 529 nm, 2.19×10^4 m/s b. 6.79×10^9 Hz, 6.59×10^9 Hz c. 6.68×10^9 Hz d. 0.15%
63. 10.28 nm, 7.62 nm, 6.80 nm; ultraviolet
65. 4.16 eV
67. a. ϵ^N b. 2.4 mA c. 4.5×10^6 d. 3.0
69. a. 1.518×10^{-16} s b. 1.32×10^6
71. a. 4.26×10^{-5} nm, 1.31×10^7 m/s b. 0.0164 nm c. X ray d. 7.3×10^{13} orbits

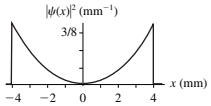
Chapter 39

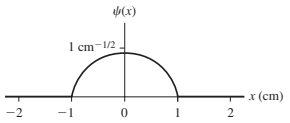
1. 20%, 10%
3. a. 7.7% b. 25%
5. a. 1/6 b. 1/6 c. 5/18
7. 2.0×10^7
11. a. 3333 b. 1111
13. a. 5.0×10^{-3} b. 2.5×10^{-3} c. 0 d. 2.5×10^{-3}
15. a. 0.25 mm^{-1} b. 

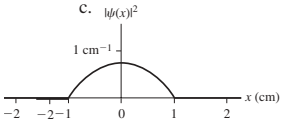
c. 0.25
17. a. 0.354 mm$^{-1/2}$ b. 

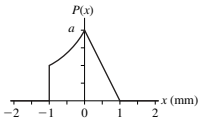
c. 0.25
19. 25 ns
21. 100,000
23. 18 μm
25. $0 \text{ m/s} \le v \le 2.5 \times 10^7$ m/s
27. 85 m
29. 1.0×10^5 pulses/s
31. a. 

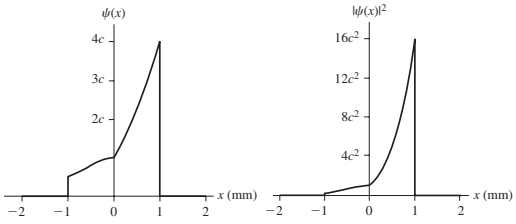
b. 1.0% c. 10^4 d. 0.50 cm^{-1}
33. a. Yes b. 

c. 0.000, 0.0050, 0.0010 d. 900
35. a. $\sqrt{3/8}$ mm$^{-1/2}$
b. 

c. 
d. 0.125
37. a. 0.27% b. 31.8%
39. a. 0.866 cm$^{-1/2}$
b. 

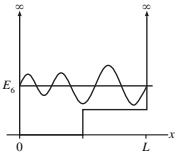
c. 

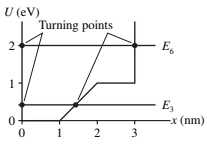
d. 3440
41. a. $a = b$ b. 

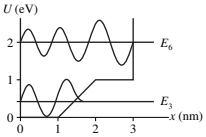
c. Both 0.838 d. 58.1%
43. No; 1.4×10^{-27} m
45. a. $0 \le v \le 1.8 \times 10^{10}$ m/s b. Not possible
47. a. 1.5×10^{-13} m; no b. 4.4×10^{11} m
49. a. $b = c$
b. 

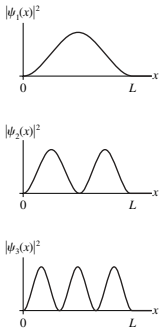
c. 91%

Chapter 40

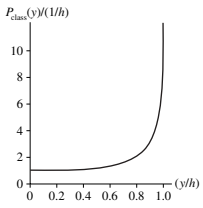
1. 0.739 nm
3. 0.752 nm
7. 0.135
9. 0.038 eV
11. 

13. a. 

b. 

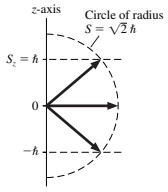
15. 150 nm
17. a. 0.49 eV, 1.46 eV, 2.43 eV b. 640 nm
19. 1.35 N/m
21. 1.22%
25. a. $\lambda = 8mcL^2/3h$ b. 0.795 nm
29. a. 

n	b. Most	c. Least	d. Probability	e. Probability
1	$\frac{1}{2}L$	0 and L	$<\frac{1}{3}$	0.195
2	$\frac{1}{4}L, \frac{3}{4}L$	$0, \frac{1}{2}L, L$	$<\frac{1}{3}$	0.402
3	$\frac{1}{6}L, \frac{3}{6}L, \frac{5}{6}L$	$0, \frac{1}{3}L, \frac{2}{3}L, L$	$=\frac{1}{3}$	0.333

31. 4.77×10^7 m/s
35. a. $(\pi b^2)^{-1/4}$ b. $2(\pi b^2)^{-1/2}\int_b^\infty \exp(-x^2/b^2)\,dx$ c. 15.7%
37. a. $\dfrac{1}{2h\sqrt{1-(y/h)}}$ b. 

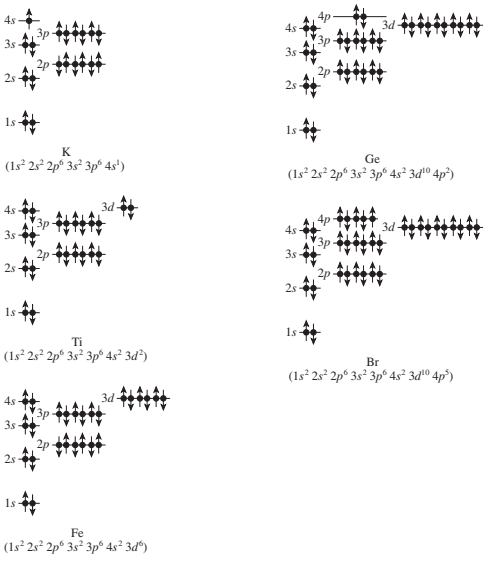
39. a. 4.95 eV b. 4.80 eV c. 4.55 eV
43. b. 0.0091 eV, 0.0272 eV, 0.0453 eV, 0.0634 eV c. 69 μm; infrared
45. $10^{1.17\times10^{-32}}$ or $10^{-11700000000000000000000000000000}$

Chapter 41

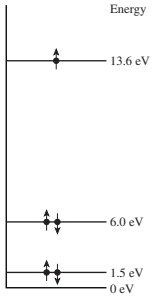
1. a. $\sqrt{2}\hbar$ b. $\sqrt{12}\hbar$
3. a. f b. -0.85 eV
5. -0.378 eV; $\sqrt{12}\hbar$
7. a. 2 b. 1
11. Si: $1s^22s^22p^63s^23p^2$; Ge: $1s^22s^22p^63s^23p^64s^23d^{10}4p^2$;
Pb: $1s^22s^22p^63s^23p^64s^23d^{10}4p^65s^24d^{10}5p^66s^24f^{14}5d^{10}6p^2$.
13. a. Fluorine; excited state b. Nickel; ground state
15. $1s^23s^1$
19. a. Yes; 2.21 μm b. No; $\Delta l \neq 1$
21. 0.020
23. a. 9.0×10^5 b. 8.7 ns
25. 5.3×10^{22}
27. a. 1.48×10^{-34} J s b. $-1, 0, 1$
c. 

29. $\sqrt{6}\hbar$
31. a. 3.68×10^{-3} b. 5.41×10^{-3} c. 2.93×10^{-3}
37. a.

L_z	S_z	J_z	m_j
$\hbar$	$\frac{1}{2}\hbar$	$\frac{3}{2}\hbar$	$\frac{3}{2}$
$\hbar$	$-\frac{1}{2}\hbar$	$\frac{1}{2}\hbar$	$\frac{1}{2}$
0	$\frac{1}{2}\hbar$	$\frac{1}{2}\hbar$	$\frac{1}{2}$
0	$-\frac{1}{2}\hbar$	$-\frac{1}{2}\hbar$	$-\frac{1}{2}$
$-\hbar$	$\frac{1}{2}\hbar$	$-\frac{1}{2}\hbar$	$-\frac{1}{2}$
$-\hbar$	$-\frac{1}{2}\hbar$	$-\frac{3}{2}\hbar$	$-\frac{3}{2}$

b. $\frac{1}{2}, \frac{3}{2}$
39. 

41. a. $6s \rightarrow 5p$, $6s \rightarrow 4p$, and $6s \rightarrow 3p$ b. 7290 nm; 1630 nm; 515 nm
43. a.



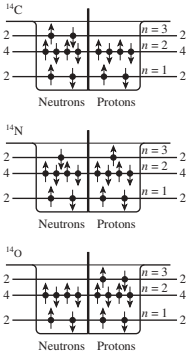
b. 21.7 eV
45. 1.13×10^6 m/s
47.

Transition	a. Wavelength	b. Type	c. Absorption
$2p \rightarrow 2s$	670 nm	VIS	Yes
$3s \rightarrow 2p$	816 nm	IR	No
$3p \rightarrow 2s$	324 nm	UV	Yes
$3p \rightarrow 3s$	2696 nm	IR	No
$3d \rightarrow 2p$	611 nm	VIS	No
$3d \rightarrow 3p$	25 μm	IR	No
$4s \rightarrow 2p$	498 nm	VIS	No
$4s \rightarrow 3p$	2430 nm	IR	No

49. a. $6.25 \times 10^8\ s^{-1}$ b. 0.17 ns
51. 5.72 ns
53. $5.0 \times 10^{16}\ s^{-1}$
55. a. 1.06 μm b. 1.87 W
57. 0.677
61. $1.5a_B$; $5a_B$

Chapter 42

1. a. 1 proton; 2 neutrons b. 18 protons; 22 neutrons
   c. 20 protons; 20 neutrons d. 94 protons; 145 neutrons
3. a. 3.8 fm b. 8.2 fm c. 14.5 fm
5. 3.6×10^{26} protons; 3.6×10^{26} neutrons
7. 1.2×10^{11} kg
9. a. ^{36}S and ^{36}Ar b. 5, 8
11. ^{40}Ar: 344 MeV, 8.59 MeV/nucleon; ^{40}Ca: 342 MeV, 8.55 MeV/nucleon
13. ^{12}C: 7.68 MeV/nucleon; ^{13}C: 7.47 MeV/nucleon; ^{12}C
15. 20.179 u
17. 8000 N
19. 2.3×10^{-38}
21. a.



b. ^{14}N stable; ^{14}C beta-minus decay; ^{14}O beta-plus decay
23. a. 9.3×10^{11} b. 4.7×10^{11} c. 5.5×10^8
25. a. 3.32 b. 6.64
27. 80.2 days
29. a. ^{228}Th b. ^{207}Tl c. ^{7}Li d. ^{60}Ni
31. 5.52 MeV
33. 4.82 MeV
35. 60 mrem
37. 0.225 J
39. a. 3.50×10^7 m/s b. 25.6 MeV
41. a. 12.7 km b. 780 μs
43. a. 1.46×10^{-8} u; 1.45×10^{-6}% b. 0.0304 u; 0.76%
45. 6.0 MeV
47. a. ^{17}N, ^{17}O, ^{17}F b. ^{17}O
    c. ^{17}N $\rightarrow$ ^{17}O by beta-minus; ^{17}F $\rightarrow$ ^{17}O by EC
51. 7.16×10^{11} Bq or 19.4 Ci
53. 2.73×10^{17}
55. a. 18.9 s b. No
57. 1.19 hr
59. 210 million years
61. 69.7 mrem
63. 3.31×10^{12}
65. a. 2.61×10^{10} b. 0.0239 Bq c. 1.436×10^7 rem/year
    d. Yes; ≈50 million times the natural background.
67. 15 cm
69. ≈6 billion years
71. a. 65.0 MeV; 5.0 MeV b. $3.7 \times 10^{21}\ s^{-1}$ c. 6.6×10^{-39}
    d. 650 million years