

Corrections to the 3rd Edition of *Matter & Interactions*

How to tell which printing you have:

Look at the bottom of the copyright page.

If the numbers say 10 9 8 7 6 5 4 3 2 1 it is the first printing.

If the numbers say 10 9 8 7 6 5 4 3 2 it is the second printing.

Errors in the WebAssign ebook version

In addition to the errors listed below by page number, here are two errors that are found only in the ebook version available through WebAssign, which does not have page numbers:

Section 5.5: In the box titled PERPENDICULAR COMPONENT OF $d\vec{p}/dt$ AND $\vec{a} = d\vec{v}/dt$, after the first “=” sign, $|p|$ should be $|\vec{p}|$.

Section 19.8, subsection “Potential Difference Across Connecting Wires”: The steady-state electron current is $nA\vec{v} = nAuE$.

Significant errors that appear in all printings

p. 12, 1st paragraph: ...the vector as a whole, except that if all the components are zero we say that this is a zero vector.

p. 13, 3rd equation: The $\frac{1}{2}$ should not have brackets.

p. 14, just before Calculating Unit Vectors: are both approximately unit vectors, since the magnitude of each is approximately equal to 1.

p. 14, last equation: The m/s units in the denominator should be outside the square root.

p. 19, last Solution: There is a missing unit “m” in the numerator of the equation for \hat{r} , and the “m” in the denominator belongs outside the square root.

p. 22, next-to-last paragraph: What was the average speed of the bee, assuming that it flew in a straight line? (The calculation gives the average speed of the bee in this straight-line case.)

p. 23, Similar to p. 22, in 1.X.29 and 1.X.30, assume that the motion is nearly in a straight line.

p. 24, 1.X.32: Replace “velocity” with “average velocity”.

p. 47, 1.X.38: $\langle 0, 0, -2.415 \times 10^{-22} \rangle$ kg · m/s, 2.415×10^{-22} kg · m/s

p. 47, 1.X.41: $\langle 111.31, 0, 18.46 \rangle$ m

p. 47, 1.X.43: (a) $\langle -1.6 \times 10^{28}, 0, -1.6 \times 10^{28} \rangle$ kg · m/s

p. 47, 1.X.44: (a) $\langle 0, 0, 2 \rangle$; (b) $\langle 7, 0, 0 \rangle$

p. 53, part (b) at top of page: Delete “(2 seconds)”.

p. 56: End of 2nd equation should be (0.6 s).

p. 60, just before “Solution”: “...over this 6-second interval?”

p. 66, 2.X.15, last sentence: “In Chapter 3...” (not Chapter 4).

p. 68, third step: $s = -0.0411$ m; $p_{fy} = -0.0118$ kg · m/s; the other values are correct.

p. 75, 2.X.23 (b): The question should ask for speed, not velocity.

p. 79, end of first paragraph in Estimating Times: “about 0.005 second”.

p. 84, last equation: Delete the word “only”.

p. 91, 2.P.57: ...at an angle of 59° ...

p. 94, 2.X.25 (a): Student on the left.

p. 100, Figure 3.12: The force should be labeled $\vec{F}_{\text{on } S \text{ by } P}$.

p. 125, second equation: Middle term should be $M_{\text{total}} \frac{d\vec{v}_{\text{CM}}}{dt}$

- p. 129: The multiparticle Momentum Principle is $\Delta\vec{p}_{\text{sys}} = \vec{F}_{\text{net,surr}}\Delta t$
- p. 132, 3.P.52: Sphere 1 is at location $\langle 0.50, -0.20, 0 \rangle$ m, and sphere 2 is at location $\langle -0.40, 0.40, 0 \rangle$ m.
- p. 154, end of 2nd full paragraph: "...see Problem 4.P.90."
- p. 157, next to next to last equation: $\frac{dp_x}{dt} = -k_s x$
- p. 163, Example: From Section 4.5 (p. 145) $k_s = 29.6$ N/m, not 27 N/m. This gives a speed of 3810 m/s.
- p. 172, 4.P.44: There are 6.02×10^{23} atoms in one mole.
- p. 218, 2nd column: The URL should be <http://www.astro.ucla.edu/~ghezgroup/gc>
- p. 271, first sentence of 3rd paragraph: "...incoming momentum p_1 ... is greater than the momentum p_{min} ..."
- p. 304, last line: power = $\frac{\vec{F} \bullet d\vec{r}}{dt} = \vec{F} \bullet \frac{d\vec{r}}{dt} = \vec{F} \bullet \vec{v}$
- p. 317, paragraph preceding equations for A and $\cos\phi$: "...determined by the following expressions, where $\omega_F^2 = k_s/m$:"
- p. 322, 7.P.47 (a): The large calorie is 4.2×10^3 J.
- p. 423, last section: This should be titled "If the Masses Don't Lie in a Plane Perpendicular to the Axis."
- p. 424: Exercises 11.X.6 and 11.X.7 should be moved to p. 426, just before 11.X.8. In 11.X.6, replace "previous exercise" with 11.X.5.
- p. 429, start of last paragraph: The result $r_1 v_1 = r_2 v_2$...
- p. 507, 12.P.40 (c): There are approximately 60 atoms in this object.
- p. 540, bottom of page: $\Delta S_{\text{Universe}} = -\frac{Q_H}{T_H} + \frac{Q_L}{T_L} \geq 0$
- p. 541, QUESTION at top of page: Replace W with $|W|$, in two places. In the later part of the page, W is an input to the system and is positive.
- p. 544: In the two centered equations, replace \dot{W} with $|\dot{W}|$.
- p. 548: In the equation following the paragraph that starts with "For the inner, reversible engine", replace \dot{Q}_L with \dot{Q}_H .
- p. 549: Replace \dot{W} with $|\dot{W}|$, in five places.
- p. 550, righthand column: Replace W with $|W|$ and \dot{W} with $|\dot{W}|$.
- p. 550, 13.X.16: ...through the hole (at 0 °C)...
- p. 577, 14.X.31, 2nd sentence (correct in 1st printing): "What is the magnitude of the electric field due to the proton at a location 1×10^{-10} m away?"
- p. 578, 14.P.39: ...of charge $1\mu\text{C}$...
- p. 659, 16.X.54: In the questions following part (H), replace the word "field" with "force" (in three places).
- p. 662, 16.P.67 (b): The measured polarizability with correct units is $\alpha = 7.4 \times 10^{-41}$ C·m/(N/C).
- p. 676, 3rd equation: E_{1x} should be preceded by a minus sign.
- p. 697: In the summary, remove the (incorrect) units from field energy density.
- p. 723: Just below *Location of piece*:, on the line starting with " $\Delta\vec{l}$:" should say that $\Delta\vec{l} = \langle -R\Delta\theta, 0, 0 \rangle$, with no absolute value bars. Also, for some printings early printings, in the equation for $\Delta\vec{B}$, replace $d\vec{l}$ with $\Delta\vec{l}$.
- p. 771, Fig. 19.43: On the right, the curving arrow should go from C to F .
- p. 884, 21.P.44, just before Figure 21.90, needs a minus sign in the second component: "...has velocity $\langle -1.5 \times 10^5, -1.8 \times 10^5, 0 \rangle$ m/s."
- p. 893, 21.X.91: The rails are conducting, not insulating.

p. 949, next to last line, needs a minus sign: "...that the direction of $-d\vec{B}_1/dt$ is the same as..."

p. 979, 23.P.27: Figure 23.67 is missing a dot labeled "Q" on the loop, opposite the "P".

Significant errors that were corrected after the second printing and before the fifth printing:

p. 27, 1.X.36: What is asked for is the *instantaneous* acceleration (two places).

p. 38, 1.X.45 (b): They see light that is not red.

p. 43, 1.X.83: (a) What is the vector pointing from the star to the planet? (b) What is the vector pointing from the planet to the star?

p. 43, 1.X.84: (a) What is the vector \vec{r} pointing from the star to the planet? (b) What is the magnitude of \vec{r} ? (c) What is the unit vector \hat{r} (vector with magnitude 1) in the direction of \vec{r} ?

p. 47, 1.X.31: $\langle 2.1 \times 10^5, 1.4 \times 10^5, -2.8 \times 10^5 \rangle$ m

p. 47, 1.X.36: The acceleration at time t is $\langle 0, 8, -36t \rangle$, and the acceleration at time $t = 0$ is $\langle 0, 8, 0 \rangle$.

p. 81, top left inset: Force has units (kg)(m/s)/s.

p. 84, 3rd equation: $p_x = F_{\text{net},x}t + p_{ix}$

p. 94, 2.X.9: The average x -component of velocity is 83.3 km/hr.

p. 102, middle of page: $\vec{g} = \langle 0, -g, 0 \rangle$.

p. 137, 3.X.19: Units of velocity are m/s.

p. 144, next to last equation: $A = \pi(0.0025 \text{ m})^2 = 1.96 \times 10^{-5} \text{ m}^2$

p. 159: In parts (c) and (d) of the problem statement, the text should read "...if the initial stretched length of the spring were 35 cm instead of 30 cm?"

p. 173, 4.P.51: The initial length of the wire should be 0.95 m.

p. 193, 5.X.6 (d): Is the rate of change of the magnitude of the comet's momentum positive, negative, or zero?

p. 199, first equation: The distance in the numerator should be 6.4×10^6 m.

p. 206, top line: Delete final ")".

p. 218, 5.X.5: number 3 on the right; toward the center of the kissing circle

p. 243, next to the next to the last equation in the Example: $K_f + (0.1 \text{ kg})(9.8 \text{ N/kg})(-3 \text{ m}) = 0$

p. 264, last sentence of 1st paragraph: Change "momentum" to "velocity" (in two places).

p. 278, 6.X.53: In the first sentence, $E = \gamma mc^2$.

p. 385, start of last paragraph: $K_1 + K_2$ might change...

p. 423, last section: In the first sentence, delete "perpendicular to the Axis,".

p. 425, Figure 11.24: The vector from A to the center of mass should be labeled \vec{r}_{CM} .

p. 440, Figure 11.51: The location A should be at the top of the rod, so that the torque $\vec{\tau}_A = 0$.

p. 454, Figure 11.71: The label on the left should be \vec{L}_{24} and the label on the right should be \vec{L}_{13} .

p. 515: In the calculation at the bottom of the page, a factor of $\frac{1}{4}$ is missing in the intermediate calculation; the final result is correct.

p. 555, two places (midpage and Figure 14.2): The number of atoms in a cubic centimeter of solid metal is closer to 1×10^{23} than 1×10^{24} .

p. 632, Figure 16.7: E_y at $y = -0.35$ and $y = -0.45$ should be positive.

p. 684, Figure 17.33: The top path (A - B - C), is Path 1.

p. 713, equation at top of page: $B_{\text{Earth}} = 2 \times 10^{-5} \text{ T}$

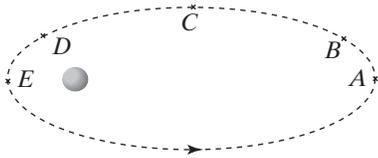
- p. 714: In the second bullet at the top of the page, and in the last paragraph, replace “angular momentum” with “cross product”.
- p. 721: There is a missing “I” from the first part of “*Magnetic field due to one piece*”.
- p. 723: Just before “*Origin: Center of loop*”, replace “the diagram” with “Figure 18.27”.
- p. 738, summary for Magnetic field of a loop: $\mu = (\pi R^2)I$
- p. 748, Fig. 18.96: There should be an arrow pointing up on the page to represent North.
- p. 785, 19.X.50: The two sentences in part 7 should be considered two parts, 7 and 8.
- p. 807, last equation at bottom of page: $i = \frac{I}{|q|}$, not $i = \frac{1}{|q|}$.
- p. 834, answer to 20.X.19 is missing: -8.0 volts; 3.2 watts; 4.8 watts
- p. 854, last line: “...on proton 2 due to proton 1?”
- p. 967, 2nd paragraph of Transformers section: “ $N_2 = 20$, so the emf is 20 times the emf in one turn...”
- p. 979, 23.P.27: Add “At location Q ?” to part (f).

If you have the hardbound edition with all 25 chapters, be aware that there is a blank page between the inside back cover and a useful list of Greek symbols and other information.

Significant errors that were corrected after the first printing:

- p. 11, midpage: Should read $\sqrt{(4\text{m})^2 + (3\text{m})^2 + (2\text{m})^2} = \sqrt{29} \text{ m} = 5.39 \text{ m}$.
- p. 29, Example statement: “a velocity of $(2 \times 10^7) \text{ m/s}$ ” should be “a velocity of $\langle 2 \times 10^7, 1 \times 10^7, -3 \times 10^7 \rangle \text{ m/s}$ ”, and in the first equation of part (a) the second term under the square root should be $(1 \times 10^7)^2$. Also, in the second line of the solution, c in the denominator should be 3×10^8 .
- p. 31, Example statement: “(ns = nanosecond = $1 \times 10^{-19} \text{ s}$)” should be “(ns = nanosecond = $1 \times 10^{-9} \text{ s}$)”
- p. 47, 1.X.14: 18.5 m/s
- p. 51, 2.X.3: 3 N instead of 5 N ; 1.5 N instead of 2.5 N .
- p. 60, 2nd equation in Solution: $\Delta \vec{p}_2 = \langle 0, -0.6, 0 \rangle \text{ kg} \cdot \text{m/s}$
- p. 67, first equation: $\vec{L} = \langle 0, 0.1, 0 \rangle - \langle 0, 0, 0 \rangle = \langle 0, 0.1, 0 \rangle \text{ m}$
- pp. 78-80: The mass of a hockey puck is 0.16 kg , not 0.04 kg . The mass was omitted in calculating the momentum change, which should be $\vec{p}_f - \vec{p}_i = \langle 0, 0, 5.072 \rangle \text{ kg} \cdot \text{m/s}$, and $\Delta t = 0.005 \text{ s}$. In 0.005 s the puck travels 0.1 m in the x direction and 0.08 m in the y direction. At the top of p. 80, if we guess that the puck slid 20 cm , $\Delta t = 0.01 \text{ s}$, a factor of 2 different from what we find in the full analysis.
- p. 84, 3rd from last equation: Last quantity should be v_{ix} .
- p. 99, 4th bullet: Calculate $-\hat{r} = -\vec{r}/|\vec{r}|$...
- p. 99, last 2 lines: The distance is $3.35 \times 10^{11} \text{ m}$, and the force is $7.15 \times 10^{21} \text{ N}$.
- p. 100: $\hat{F}_{\text{on } P \text{ by } S} = \langle -0.298, -0.745, 0.596 \rangle$
- $$\sqrt{(-0.298)^2 + (-0.745)^2 + (0.596)^2} = 0.9995$$
- The last line of the example should be this:
- $$\vec{F}_{\text{on } S \text{ by } P} = \langle 2.13 \times 10^{21}, 5.33 \times 10^{21}, -4.26 \times 10^{21} \rangle \text{ N}$$
- p. 110, paragraph after first question: “Two negatively charged particles such as electrons also REPEL each other...”
- p. 132, 3.X.56: Replace “At a certain instant” with “When they are far apart”. Change the y component of the later momentum from $1.6 \times 10^{-21} \text{ kg} \cdot \text{m/s}$ to $1.55 \times 10^{-21} \text{ kg} \cdot \text{m/s}$.

- p. 134, last sentence of 3.P.70: "...of the meteor, and \vec{v} is the initial velocity of the center of mass of the satellite, in the x direction."
- p. 137, 3.X.17 (a) and (b): x component should be -4 .
- p. 137, 3.X.22: (b) $\langle 0, -7.84, 0 \rangle$ N; (c) $\langle 2.2, -1.184, 2.6 \rangle$ kg \cdot m/s.
- p. 156, 4.X.12: Change the final x component of velocity from 5.02 to 4.98.
- p. 176: Section 14.13 should be Section 4.13.
- p. 177, 4.X.12: The x components in the three vectors are -2, -0.16, and -0.16.
- p. 208, point 2 in left column: "...and drawing the resultant arrow starting at the tip of \vec{p}_i ..."
- p. 222: For added clarity, in the box labeled "REST ENERGY" the equation should read $E_{\text{rest}} = mc^2$, and in the first sentence after this box $m = E_{\text{rest}}/c^2$.
- p. 278, 6.X.53: Add to the first sentence "where $E = \gamma mc^2$ ". In F and G replace W_{ext} with W_{surr} .
- p. 279, 6.P.60: Interchange the words "final" and "initial" between A and B.
- p. 279, 6.P.67: In (a) the force is 240 N. In (b) the force is 60 N and the displacement is 3 meters.
- p. 280: Figure 6.X.71 should look like this:



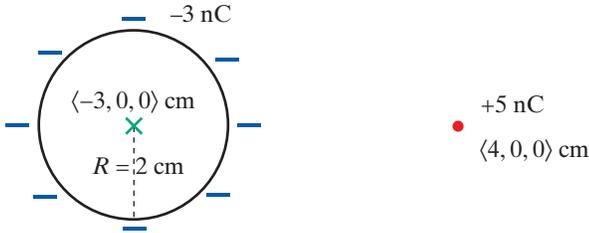
- p. 281, 6.P.82: The radius of an airless planet is 2000 km (2×10^6 m), and its mass is 1.2×10^{23} kg. An object is launched straight up from the surface. (a) What initial speed is needed so that when the object is far from the planet its final speed is 900 m/s? (b) What initial speed is needed so that when the object is far from the planet its final speed is 0 m/s? (This is called the "escape speed.")
- p. 302, Figure 7.29: The green arrow should be labeled $Q < 0$.
- p. 319, 7.X.25: The relaxed length is 0.66 meters.
- p. 320, 7.P.32: "heavy black horizontal line" should be "green horizontal line".
- p. 320, 7.P.33 (a): Delete "(shown here as an example to get you started)".
- p. 321: Heading should be Sections 7.4-7.9.
- p. 322: Heading should be Sections 7.10-17.14.
- p. 327, last equation: $E_{H,f} + K_{\text{photon}} = E_{H*,i}$
- p. 337, 8.X.11: "What is the energy of the photon emitted by a..."
- p. 348, in last line: $M_1 \vec{R}_1 = m_{11} \vec{r}_{11} + m_{12} \vec{r}_{12} + \dots$
- p. 391, last two equations:

$$0 = p_3 \cos(90^\circ - \theta) + p_4 \cos(90^\circ + \phi)$$

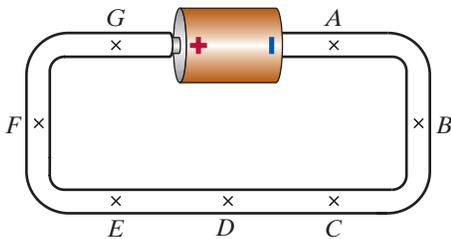
$$\frac{p_1^2}{2m} = \frac{p_3^2}{2m} + \frac{p_4^2}{2M}$$
- p. 423, last section: In the first sentence, delete "the same plane,"
- p. 423, last section: Add to the caption for Figure 11.20, "The two masses at this instant are in the xy plane." (This is implicitly shown by the momenta coming out of the page.) Also, in the last paragraph on p. 423, replace r by r_1 in three places.
- p. 433, result at top of page: $\omega = 0.316$ radians/s.
- p. 453, Figure 11.68: The Earth's orbit should pass behind the Sun.

- p. 465, 11.P.69: The two figures of the diver are reversed. First the diver is tucked, then extended.
- p. 471, 11.X.5 and 11.X.7: All of these angular momenta are into the page. Also, the answer to 11.X.5 (c) is $I = 0.072 \text{ kg} \cdot \text{m}^2$.
- p. 579, 14.P.46, 1st sentence: “The electric field at a location C points west, and the magnitude is $2 \times 10^6 \text{ N/C}$.”
- p. 580, Figure 14.64 should look like this:

$\times \langle 0, 6, 0 \rangle \text{ cm}$



- p. 620, 15.X.53: In (A) delete “static”. In (D) and (E) replace “at equilibrium” by “in equilibrium”.
- p. 620, 15.X.54: Delete the 2nd sentence (about static equilibrium). In (A) change “not zero” to “zero” and change “at static equilibrium” to “in equilibrium”. In (B) change “aluminum” to “metal”. In (C) replace “at static equilibrium” by “in equilibrium”. In (E) delete “static” and replace “no” by “a”.
- p. 653, just before Figure 16.47: $E_{\text{fringe}} \approx \frac{Q/A}{2\epsilon_0} \left(\frac{s}{R} \right)$
- p. 687: In the integrand in the final equation, replace q by Q .
- p. 727, 4th equation: $B_{\text{magnet}} = \frac{\mu_0}{4\pi} \frac{2\mu}{r^3}$
- p. 785: Figure 19.75 should look like this:



- p. 785: Figure 19.76 should be the same as Figure 19.72.
- p. 791, 19.X.3: 0.011 N/C
- p. 834, top of page: More accurate values for the currents are $I_1 = 0.4394 \text{ A}$, $I_2 = 0.3312 \text{ A}$, $I_3 = 0.0065 \text{ A}$, $I_4 = 0.1082 \text{ A}$, $I_5 = 0.3247 \text{ A}$, $I_6 = 0.4329 \text{ A}$,
- p. 876, first set of equations: $E'_y = (E_y - vB_z) / \sqrt{1 - v^2/c^2}$
- p. 884: Section 20.2 should be Section 21.2.
- p. 892: Section 20.6 should be Section 21.6.
- p. 893: Sections 20.7-20.8 should be Section 21.7, Section 20.9 should be Section 21.8, Section 20.10 should be Section 21.9, and Section 20.11 should be Section 21.10.
- p. 1035, Figure 24.115: There is a missing θ between the \vec{a} vector and the \vec{r} vector.