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Page Count Difference:

The page count in this revision is 605, down from 616 last revision. This difference is due to errata changes.

Errata:

Below is a table containing submitted errata and the resolutions that OpenStax has provided for this latest text.

Location	Detail	Resolution Notes	Error Type
Unit 1 Optics: Chapter 1 The Nature of Light: Section 1.3 Refraction	"The exact mathematical relationship is the law of refraction, or Snell's law, after the Dutch mathematician Willebrord Snell (1591–1626), who discovered it in 1621." While it is true that Snell discovered the law of refraction, and we have since attached his name to it, priority belongs to Ibn Sahl, who discovered and used the law of refraction in 984. I would advocate adding "While the law has been named after Snell, the Arabian physicist Ibn Sahl found the law of refraction in 984 and used it in his work On Burning Mirrors and Lenses."	Revise the sentence "The exact mathematical relationship is..." to "The exact mathematical relationship is the law of refraction, or Snell's law, after the Dutch mathematician Willebrord Snell (1591–1626). While the law has been named after Snell, the Arabian physicist Ibn Sahl found the law of refraction in 984 and used it in his work On Burning Mirrors and Lenses."	Other factual inaccuracy in content

Unit 1 Optics: Chapter 1 The Nature of Light: Section 1.5 Dispersion	Example 1.5 states the second media is flint glass and the indecies of refraction given are those for flint glass. However, the final calculated angle values for the angles of refration of red and violet light are not correct for flint glass, but appear to be correct for crown glass.	In the denominator, revise "1.662" to "1.512" and "1.698" to "1.530".	Incorrect answer, calculation, or solution
Unit 1 Optics: Chapter 1 The Nature of Light: Section 1.5 Dispersion	Example 1.5: The Web view example asks question using Flint Glass but then answer uses Index of refraction numbers for Crown Glass. The printed version (col12067) seems to try to fix that and properly uses the Index of Refraction for Flint Glass in the problem setup but left the same answers that were calculated when using Crown Glass.	Revise "flint glass" to "crown glass". The figure in the example will also be updated.	Incorrect answer, calculation, or solution
Unit 1 Optics: Chapter 2 Geometric Optics and Image Formation: Section 2.1 Images Formed by Plane Mirrors	The diagram to the right of figure 2.4 is incorrect. Image 1,2 should be on the corner of the rectangle defined by the Object, image 1 and image 2. It is clearly misplaced. Suggested resolution: Put Image 1,2 in the correct position. Possibly explain that image 1,2 can be located by finding the image of Image1 in the extension of Mirror 2, and/or by taking the image of Image 2 in the extension of mirror 1.	Replace with updated figure.	Other factual inaccuracy in content
Unit 1 Optics: Chapter 2 Geometric Optics and Image Formation:	"Part (b) of Example 2.1 miscalculates the cross-sectional area of the cylinder. The *proper* definition of cross-sectional area is (using LaTeX code) \int_{area} \hat{r}\cdot d\vec{A}, where	Revise as appropriate.	Other factual inaccuracy in content

Section 2.2 Spherical Mirrors	\hat{r} is a unit vector indicating the direction you are looking at the object from. The cross-sectional area calculated in the example is correct only if you are looking at the quarter-cylinder from the axis of the cylinder (that is, every point on the cylinder you look at, you are looking at it from normal incidence). The correct calculation of cross-sectional area (for sunlight, incident from infinitely far away) may be more trouble than it is worth; I would suggest re-wording the solution to the example so that it is clear what is being calculated is estimated maximum, not the exact value of cross-sectional area."		
Unit 1 Optics: Chapter 2 Geometric Optics and Image Formation: Section 2.4 Thin Lenses	Problem #57: FROM: The magnification of a book held 7.50 cm from a 10.0 cm-focal length lens is 3.00. TO: The magnification of a book held 7.50 cm from a 10.0 cm-focal length lens is 4.00.	Revise "3.00" to "4.00".	Other factual inaccuracy in content
Unit 1 Optics: Chapter 2 Geometric Optics and Image Formation: Section 2.4 Thin Lenses	The caption to Figure 2.21 describes the exact opposite of what the figure shows. I see the point that the caption is trying to make (if you reverse the direction of rays, you have the focal point on the other side, too), but for the students, it is very confusing to read a caption that describes the *exact opposite* of what the figure is showing. The caption should simply describes what	Revise caption as appropriate.	General/pedagogical suggestion or question

	the figure shows: the light rays come from *left*, not right (and all other necessary corrections that follow). If the point about having the same focal length on either side is important enough to have in the textbook, there should be a separate paragraph for it (or even a separate figure for it).		
Unit 1 Optics: Chapter 2 Geometric Optics and Image Formation: Section 2.4 Thin Lenses	In Figure 2.19, inconsistent letters (h in figure, d in caption) are used for the thickness of the lens. But if you are correcting them anyway, I would suggest that letter t should be used for thickness of the lens, as elsewhere in the section (for example, in Figure 2.24)	This figure and caption will be updated to use t for the thickness of the lens.	Typo
Unit 1 Optics: Chapter 2 Geometric Optics and Image Formation: Section 2.5 The Eye	I suggest that the lens be labeled in this diagram.	This figure will be updated.	General/pedagogical suggestion or question
Unit 1 Optics: Chapter 2 Geometric Optics and Image Formation: Section 2.7 The Simple Magnifier	the angle_image in Equation 2.27 (with regards to the angular magnification) of the textbook and the figure 2.37 don't match. The textbook defines \theta_i = h_i/L, and I think that's correct, in which case the figure displays the angle \theta_image incorrectly, since according to the figure \theta_image= h_i/|d_i|.	This figure will be updated.	Other factual inaccuracy in content
Unit 1 Optics: Chapter 2	Based on the content in the text, and the definition of theta_image, I'm pretty sure	This figure will be updated.	Other factual

Geometric Optics and Image Formation: Section 2.7 The Simple Magnifier	that the angle indicated by theta_image in this figure should be measured between the horizontal and the *black* dashed line, rather than the lower *blue* dashed line, as currently drawn.		inaccuracy in content
Unit 1 Optics: Chapter 2 Geometric Optics and Image Formation: Section 2.8 Microscopes and Telescopes	Example 2.11 has this explanatory text: "Inserting this result into Equation 2.34 along with the known values fobj=6.20mm=0.620cm..." Here, "fobj=6.20mm=0.620cm" should be "fobj=6.00mm=0.600cm". (The equation below has the correct value of fobj plugged in.)	Revise as appropriate.	Typo
Unit 1 Optics: Chapter 2 Geometric Optics and Image Formation: Section 2.8 Microscopes and Telescopes	Problem #112 introduces a lens as "diverging" and then refers to what I assume to be the same lens as "converging"	Revise "diverging" to "converging".	Typo
Unit 1 Optics: Chapter 2 Geometric Optics and Image Formation: Section 2.8 Microscopes and Telescopes	Immediately before equation 2.36, the text states that "From Figure 2.39, we see that L=f^{obj}-d_i^{obj}." Looking at Figure 2.39, this is incorrect. If L is the distance between F_O and F_e in Figure 2.39 (as the text suggests, then L=d_i^{obj}-f^{obj}, a factor of -1 different than the text states. More evidence is given for this in that the value of m^{obj} should be negative, since the image is inverted, but when this incorrect	Revise the sentence before equation 2.35 to "The magnification of the objective can be obtained from the thin-lens equation for magnification, which is" and revise the sentence before equation 2.36 to "If the length of the compound microscope L is roughly the focal length of the objective, we can substitute L in for d_i^obj to get".	Other factual inaccuracy in content

	substitution is made for L, Equation 2.36 shows m^{obj} as positive. The minus sign appears to be re-included by the time Equation 2.38 rolls around.		
Unit 1 Optics: Chapter 2 Geometric Optics and Image Formation: Section 2.8 Microscopes and Telescopes	Figure 2.38 and the surrounding text use different variables. I suggest these be edited to be consistent within the section.	Revise the caption to add the following to the end: "The d_o and d_i shown will be discussed with superscripts "obj" below to denote they are measured from the objective lens, while the eye piece variables will have superscripts of "eye" to denote this lens."	General/pedagogical suggestion or question
Unit 1 Optics: Chapter 3 Interference: Section 3.1 Young's Double-Slit Interference	In the caption for Figure 3.2 (which shows a photograph of interfering water waves), the last sentence is incorrect and should probably just be omitted to avoid confusion. The problem is that when viewed from above, high points appear bright and low points appear dark, so undisturbed ("calm") points are in between and are actually difficult to make out. Constructive interference happens not only when two crests meet, but also when two troughs meet. The white areas are crests; the dark areas between are troughs. So both the whitest and the darkest areas show constructive interference. But stating this in this photograph might be confusing later when looking at interference fringes from light waves, where dark spots are clearly destructive	Delete the last sentence in the caption (starts "The points where...").	Other factual inaccuracy in content

	interference. This is because light intensity is proportional to the *square* of the wave (time averaged), so whether there is a crest or trough is immaterial, it shows up as "bright". The water wave photo is not showing intensity, it is showing the actual instantaneous wave oscillations. So if the truth about the water waves is to be stated anywhere, it needs to be discussed plainly in the text, and then later the light wave interference pattern needs to be clearly distinguished by stating that what we see is intensity and not wave amplitude. Otherwise, I suggest just leaving out that last caption sentence completely.		
Unit 1 Optics: Chapter 3 Interference : Section 3.2 Mathem atics of Interference	In Figure 3.7, part (a), the distance between slits and the screen is denoted as "x". Elsewhere in the section, the same distance is referred to as "D", including a text that says, "Referring back to part (a) of the figure, θ is typically small enough that sinθ≈tanθ≈ym/D", making it appear that this distance should be capital D, not "x".	This figure will be updated.	Typo
Unit 1 Optics: Chapter 3 Interference : Additional Problems	Problem #77: The solution author forgot to include the effect of the film's index of refraction on the wavelength inside the film. So the given answer (160 nm) must be divided by the index of refraction of the film (1.28) to give the correct answer of 125	Revise the answer to "125 nm".	Incorrect answer, calculation, or solution

	nm. [I submitted this erratum twice because it is in two sources: the textbook (this submission) and the solutions manual (my earlier submission.]		
Unit 1 Optics: Chapter 3 Interference: Additional Problems	The problem statement does not include the wavelength of the light source, which is required for the solution. The suggested resolution is to include the sentence: "The light source is a He Ne laser, λ=632.8 nm."	Revise the last sentence in the question to "The light source is a He-Ne laser with wavelength of 632.8 nm. Calculate the thickness of the foil."	Other
Unit 1 Optics: Chapter 4 Diffraction	Chapter 4 (Diffraction) uses capital D for the width of a single slit. However, before that in Chapter 3 (Interference), D was used for the distance between slits and the screen. I think this inconsistency can be confusing for students, especially since diffraction and interference occur together in some of the problems. I think it would be helpful in Chapter 4 to use lower case "a" for the slit width, and then D can be used in both chapters for the distance from the slits to the screen. This will also help distinguish the formulas for interference and diffraction, since the slit *separation* will be lower case "d" and the slit width will be lower case "a".	Revise "D" to "a" as indicated.	General/pedagogical suggestion or question
Unit 1 Optics: Chapter 4	Figure 4.4 uses D as the slit width while the textbook uses a. I tried to fix it with minimal	This figure will be updated.	Typo

Diffraction: Section 4.1 Single-Slit Diffraction	loss of data using Inkscape and an online png to jpeg converter.		
Unit 1 Optics: Chapter 4 Diffraction: Section 4.2 Intensity in Single-Slit Diffraction	The letter "D" is used to represent slit width whereas everywhere else in the section the letter "a" is used for slit width. The suggested resolution is to replace "D" with "a" in the sentence.	Revise "D" to "a".	Typo
Unit 1 Optics: Chapter 4 Diffraction: Section 4.3 Double-Slit Diffraction	In the solution to Example 4.4, where it says, "Using sinθ=mλ for θ=2.5×10−2rad," it should instead say "Using d*sinθ=mλ for θ=2.5×10−2rad." The rest of the solution is correct.	Revise as appropriate.	Typo
Unit 1 Optics: Chapter 4 Diffraction: Section 4.4 Diffraction Gratings	In Figure 4.14, I think the rainbows are backwards. The higher wavelength red colors should be diffracted to a larger angle than the violet colors. This is similar to the correct Figure 4.16	This figure will be updated.	Other factual inaccuracy in content
Unit 2 Modern Physics: Chapter 5 Relativity: Section 5.1 Invariance of Physical Laws	The following statement is incorrect: “The term ‘special’ in ‘special relativity’ refers to dealing only with inertial frames of reference. Einstein’s later theory of general relativity deals with all kinds of reference frames, including accelerating, and therefore non-inertial, reference frames.” Special relativity can handle accelerating frames of reference just fine. It's "special" because it's a special flat case of general relativity. This affects the answer to the end of the chapter question, which asks	Revise "The term ‘special’ in ‘special relativity’ refers to dealing only with inertial frames of reference. Einstein’s later theory of general relativity deals with all kinds of reference frames, including accelerating, and therefore non-inertial, reference frames" to "Special relativity handles accelerating frames as a constant and velocities as relative to the observer. General relativity treats both velocity and acceleration as relative to the observer, thus making the use of curved space-time."	Other factual inaccuracy in content

	about the difference between these two theories.		
Unit 2 Modern Physics: Chapter 5 Relativity: Section 5.3 Time Dilation	The question uses the term 'decelerates' but in Vol 1 Chapter 3.3 on page 117 is says: "The term deceleration ...., so we don't use it". I agree and the term should be removed/changed in the book.	Revise "decelerates" to "accelerates opposite the motion". This will also be updated throughout the book.	General/pedagogical suggestion or question
Unit 2 Modern Physics: Chapter 5 Relativity: Section 5.5 The Lorentz Transformation	The separation from A to C is described in the equation at the top of 213 using the difference in position of (x_A-x_B)^2+(x_A-x_B)^2+.... This should use subscripts A and C. Also each term should not be the difference between x's, but should also have a y-term and a z-term.	All of the B subscripts in those two equations will be changed to C's. Also add "in one dimension" after "characterized".	Other factual inaccuracy in content
Unit 2 Modern Physics: Chapter 5 Relativity: Section 5.5 The Lorentz Transformation	First of all, I think that the statement in which "Spacecraft S' is on its way to Alpha Centauri when Spacecraft S passes it at relative speed c/2." is confusing. That is because I don't know if whether Spacecraft is traveling in the opposite direction with a relative speed c/2 or whether Spacecraft S' overtaking S with a relative speed c/2. Other than that, the (d) part of the calculation should be 1.38564s instead of 1.6 s.	Revise the first line of the example to "Spacecraft S′ is at rest, eventually heading toward Alpha Centauri, when Spacecraft S passes it at relative speed c/2." Also revise the answer from "1.6" to "1.4".	Other factual inaccuracy in content
Unit 2 Modern Physics: Chapter 5 Relativity: Section 5.5	The space time intervals on page 513 (just after figure 5.15) have only x's in them; they should have y and z.	These will be revised to also include y and z.	Incorrect answer, calculation, or solution

The Lorentz Transformation			
Unit 2 Modern Physics: Chapter 5 Relativity: Section 5.5 The Lorentz Transformation	Please refer to the attached screenshot from the given URL under the sub-heading 'The Lorentz Transformation Equations'. The last line of the screenshot says, "With the help of a friend in S, the S' observer also measures the distance from the event to the origin of S′ and finds it to be x′sqrt(1−v^2/c^2)." S and the first S' have been interchanged. The line should read "With the help of a friend in S', the S observer also measures the distance from the event to the origin of S′ and finds it to be x′sqrt(1−v^2/c^2)."	Revise "in S, the S′" to "in S′, the S".	Typo
Unit 2 Modern Physics: Chapter 5 Relativity: Section 5.5 The Lorentz Transformation	Example 5.7: Need to be careful of the primed and non-primed frames. x2-x1 is 100m, not x'2-x'1	Revise to non-prime: "x_2 – x_1"	Incorrect answer, calculation, or solution
Unit 2 Modern Physics: Chapter 5 Relativity: Section 5.5 The Lorentz Transformation	The equations relating Delta s^2 and Delta tau^2 are missing a factor of c^2. The factor is present in the equation resolving the twin paradox on p. 215 (c^2 Delta tau^2 = - Delta s^2).	Add "c^2" before delta.	Incorrect answer, calculation, or solution
Unit 2 Modern Physics:	I will use a capital D to represent Delta. The sentence preceding the equation states	Revise "(c^2 delta t)^2" to "(c delta t)^2".	Other factual

Chapter 5 Relativity: Section 5.5 The Lorentz Transformation	that D x = D y = D z = 0. The error I wish to report is in the equation following this statement. It states that D Tau squared = D s squared = D t squared. But according to the definition of the spacetime interval on the previous page, setting D x = D y = D z = 0 yields: D Tau squared = D s squared = (c * D t) squared.		inaccuracy in content
Unit 2 Modern Physics: Chapter 5 Relativity: Section 5.9 Relativistic Energy	Problem 66 states, "There is approximately 1034 J of energy available from fusion of hydrogen in the world's oceans. (a) If 1033 J of this energy were utilized, what would be the decrease in mass of the oceans? (b) How great a volume of water does this correspond to? (c) Comment on whether this is a significant fraction of the total mass of the oceans." It is true that there is about this much hydrogen, but if you take 10% of the hydrogen out you leave oxygen, not water. So instead of losing the mass of .026505 from the fusion of 6 mol H you lose the 24g of oxygen and all the hydrogen leaves the ocean as well. That means the answer of a negligible decrease in volume is incorrect. It is based on the mass of hydrogen lost and setting it equal to the volume of water that would be lost completely ignoring what is actually happening. This would underestimate the mass loss by orders of magnitude.	Add the following to the end of part (a) in the problem stem: "(ignoring the loss of mass from the leftover oxygen)".	Incorrect answer, calculation, or solution
Unit 2 Modern	At the bottom of page 220, where relativistic energy is	Revise to mc^2.	Incorrect answer,

Physics: Chapter 5 Relativity: Section 5.9 Relativistic Energy	introduced, (first equation of the subsection "Total Relativistic Energy"), the numerator should be mc^2, not mu^2.		calculation, or solution
Unit 2 Modern Physics: Chapter 5 Relativity: Key Equations	In the expression for relativistic momentum under Chapter 5 Review -> Key Equations, there is a factor of c missing in the expression as it currently shows sqrt(1-u^2/c) in the denominator.	Revise the "c" in the denominator to "c^2".	Typo
Unit 2 Modern Physics: Chapter 6 Photons and Matter Waves: Section 6.1 Blackbody Radiation	I am getting different solutions to many problems. So far in chapter 6: #58 I get f=3.31E14Hz; #65 phi=3.68eV; #68 K_max=0.256eV; #82 E=0.0936eV; #94 gives the shortest wavelength, but not the longest lamda=121.6 nm; #115 I get v=2.21E-19 not E-20; #157 I get 3.705E-12 m not E-9 m. This is only a small sample of the errors in 20 problems that I have assigned so far. The instructor's solution manual could definitely be improved.	58. f=3.31E14 Hz 65. phi=3.68 eV 68. K_max=0.256 eV 82. E=0.0936 eV 94. 91.25 nm, and 121.6 nm 115. v= 2.21 x 10^-19 m/s 157. 3.705 x 10^-12 m	
Unit 2 Modern Physics: Chapter 6 Photons and Matter Waves: Section 6.1 Blackbody Radiation	Question #58 asks for "At what frequency does the filament radiate maximum energy?" Students in lower-division physics do not have enough information to answer this correctly, as frequency of maximum energy is not given by the simple relationship f_max = c/lambda_max. This is because the size of "frequency bin" per unit "wavelength bin" depends on the value of wavelength (for more, read discussion here,	Revise "frequency" to "wavelength".	General/pedagogical suggestion or question

	https://physics.stackexchange.com/questions/91192/the-strange-thing-about-the-maximum-in-plancks-law, too long to replicate here). Since students in lower-division physics are not expected to know how to correctly transform intensity density in terms of one variable into intensity density in terms of another variable, all quantitative questions that relate to blackbody spectrum should only use wavelength as the variable, not frequency. An alternate approach would be include a discussion of blackbody radiation spectrum in terms of frequency in the textbook (but I don't suggest this).		
Unit 2 Modern Physics: Chapter 6 Photons and Matter Waves: Section 6.2 Photoelectric Effect	Figure 6.13: Wrong numbers, you should delete one zero from each value. Or add "angstrem" unit, but I recommend you cut the zeros.	This figure will be updated.	Incorrect answer, calculation, or solution
Unit 2 Modern Physics: Chapter 6 Photons and Matter Waves: Section 6.2 Photoelectric Effect	Problem #69 is about the photoelectric effect for a GOLD plated electrode. However, in Table 6.1, the listed elements do not include gold, and the work function for gold is not included anywhere. Please either add the work function for gold to Table 6.1, or change Problem 69 to use an element that is already on the table (like silver).	Revise "gold" to "silver" and change the answer to 5.60 eV.	Incorrect answer, calculation, or solution

Unit 2 Modern Physics: Chapter 6 Photons and Matter Waves: Section 6.2 Photoelectric Effect	The cut-off frequency calculation shows an answer of 1.47 x 10^-15 Hz. I'm pretty sure the exponent should be positive.	Revise "1.47 × 10^−15" to "1.47 × 10^15".	Incorrect answer, calculation, or solution
Unit 2 Modern Physics: Chapter 6 Photons and Matter Waves: Section 6.2 Photoelectric Effect	In Figure 6.8 when describing the photoelectric effect, the metal on which light light is shone is labelled as "anode". I believe this is incorrect. Anodes collect electrons, cathodes emit electrons, hence "cathode rays". This is a common mistake, because anodes are frequently labelled "C" for "collector" and cathodes are often labelled "E" for “emitter". Figure 6.8 could be improved by showing a variable voltage supply since the potential difference is applied two different ways in a classic photoelectric effect experiment. The second paragraph of section 6.2 (p 256 in the paper edition) must be reviewed to correct the anode-cathode mistake.	This figure will be updated. In the text before this figure, update the sentence beginning "The target material serves..." to "The target material serves as the cathode, which becomes the emitter of photoelectrons when it is illuminated by monochromatic radiation. We call this electrode the photoelectrode. Photoelectrons are collected at the anode, which is kept at a higher potential with respect to the cathode."	Other factual inaccuracy in content
Unit 2 Modern Physics: Chapter 6 Photons and Matter Waves: Section 6.5 De Broglie’s Matter Waves	The text of Problem #108 uses 20 keV for the potential, this should be 20 kV	Revise "keV" to "kV".	Typo

Unit 2 Modern Physics: Chapter 6 Photons and Matter Waves: Section 6.5 De Broglie's Matter Waves	In sentence "we must use the relativistic momentum $p=mu=m_0\gamma u=E_0\gamma\beta$", the last expression is missing a factor of c. To be consistent in units, it must be "$E_0\gamma\beta/c$". But I would actually make a further suggestion, as it looks like the expressions are presuming the outdated notion of "relativistic mass". As Chapter 5, Section 8 of the same textbook points out, "Because the mass of a moving object cannot be determined independently of momentum, the only meaningful mass is rest mass." I recommend that the entire sequence of expressions for momentum be re-written as "p=gamma m u=gamma (E_0/c^2) beta c", retaining the remainder of text which talks about rest energy (with all "m_0" replaced with "m", in order to avoid the confusing notations of "m" and "m_0" as distinct quantities).	Revise "$E_0\gamma\beta$" to "$E_0\gamma\beta/c$" and replace "m_0" with "m".	Typo
Unit 2 Modern Physics: Chapter 6 Photons and Matter Waves: Section 6.5 De Broglie's Matter Waves	In "Strategy", beta*gamma = 0.75/sqrt(1-0.75^2) = 1.134, not 1.714 as currently in the text. As a result, the wavelength should be 1.16 fm.	Revise "1.714" to "1.134" and "0.77" to "1.16".	Incorrect answer, calculation, or solution
Unit 2 Modern Physics: Chapter 7 Quantum	The calculation for the expectation value of the kinetic energy in Example 7.4 looks incorrect to me. The second derivative of the wave	Revise "2" to "8" in the denominators in the expectation value of the kinetic energy.	Incorrect answer, calculation, or solution

Mechanics: Section 7.1 Wave Functions	function should have a factor of 8 instead of 2 (assuming the usual definition of h_bar = h / (2 * pi)). This result is then substituted into the expectation for kinetic energy, which is also missing the factor of 8 everywhere. Alternatively you can keep it in terms of h_bar, which then requires multiplying the expression by pi^2.		
Unit 2 Modern Physics: Chapter 7 Quantum Mechanics: Section 7.2 The Heisenberg Uncertainty Principle	Part (b) of question #38 asks "What would the uncertainty in kinetic energy of this electron be," but unless the correct answer is "0" (in which case I think this is an awful trick question), the question seems to be based on an incorrect understanding of position-momentum uncertainty principle. A spatially confined particle can have arbitrarily-precisely determined energy, while having a momentum uncertainty consistent with uncertainty principle. A useful counter-example to consider is infinite square well energy eigenstates, which have Delta E = 0 (by definition) but momentum uncertainty consistent with uncertainty principle (the wavefunction is a superposition of p=+h/lambda and p=-h/lambda states).	Revise the question to "Suppose an electron is confined to a region of length 0.1 nm (of the order of the size of a hydrogen atom). (a) What is the minimum uncertainty of its momentum? (b) What would the uncertainty in momentum be if the confined length region doubled to 0.2 nm?”	General/pedagogical suggestion or question
Unit 2 Modern Physics: Chapter 7 Quantum Mechanics:	In Example 7.12, there is an error in the intermediate calculation where value of beta2 is plugged in the place for 2*beta2. This error is carried through to the final	Revise the exponent "–5.12 L/nm" to "–10.25 L/nm ". Then revise the remaining parts of T(L1,E2) to "1.44 e ^(–51.2) = 1.44 (5.81 × 10^–23) = 8.36% x 10^–25" and T(L2,E2) to " =	Incorrect answer, calculation, or solution

Section 7.6 The Quantum Tunneling of Particles through Potential Barriers	number for T(L1,E2) and T(L2,E2). P.S. Credit for finding this error goes to my eagle-eyed student Zhenkai (actually most of my errata submissions are from my students, but I thought this one particularly deserved a named credit).	1.44 (3.53 x 10^–5) = 5.09% × 10^–7".	
Unit 2 Modern Physics: Chapter 7 Quantum Mechanics: Key Equations	In Key Equations section, the time-independent equation for a harmonic oscillator (listed as "Stationary Schrödinger equation") is missing a power of 2 for the hbar factor in the kinetic energy term. Also, the equation probably should be listed as "Schrödinger's equation (harmonic oscillator)" since the key difference from other equations is that it's for SHO potential, not that it's time-independent.	Revise to "Schrödinger's equation (harmonic oscillator)" and add the square to the hbar factor.	Typo
Unit 2 Modern Physics: Chapter 7 Quantum Mechanics: Key Equations	The expression for Schrodinger's time-dependent equation has an extra square on the numerator of the time derivative i.e. \partial^2 \Psi(x,t) instead of \partial \Psi(x,t)	Revise the superscript 2.	Typo
Unit 2 Modern Physics: Chapter 8 Atomic Structure: Section 8.1 The Hydrogen Atom	In Chapter 8, Question 27 and 29 are duplicates. They both ask the exact same question, "What are the possible values of m for an electron in the n=4 state?" Maybe one of them should be slightly modified (beyond changing "n=4" to another number) to be a different question along a similar line? P.S. I wouldn't suggest removing a question, since that would mess up the numbering for other questions.	Revise question 29 to "How many possible states are there for the l = 4 state?" The solution is "18".	Incorrect answer, calculation, or solution

Unit 2 Modern Physics: Chapter 8 Atomic Structure: Section 8.1 The Hydrogen Atom	In equation 8.3, an hbar symbol is missing in the denominator. The denominator says 2^2 but it should be 2 hbar^2.	Revise this denominator to "2hbar^2".	Typo
Unit 2 Modern Physics: Chapter 8 Atomic Structure: Section 8.3 Electron Spin	The formula states that the z-component of the electron magnetic moment is ±μ_B ħ when it should be just ±μ_B. The previous step in the equation is missing a factor of ħ.	Add an h-bar before the second equal sign.	Typo
Unit 2 Modern Physics: Chapter 8 Atomic Structure: Section 8.5 Atomic Spectra and X-rays	According to my calculation, hc ≈ 1240 eV/nm, not 1940 eV/nm, as you state in the third paragraph. Case 49180	Revise "1940" to "1240".	Incorrect answer, calculation, or solution
Unit 2 Modern Physics: Chapter 10 Nuclear Physics: Section 10.1 Properties of Nuclei	Figure 10.4: In the partial chart of nuclides, the top row lists nuclides of chlorine as "C128", etc. instead of "Cl28", etc. ("l" replaced with "1" erroneously).	This figure will be updated.	Typo
Unit 2 Modern Physics: Chapter 10 Nuclear Physics:	The third paragraph of this section (second paragraph of page 461) starts by saying "A graph of binding energy per nucleon versus atomic number A" when it should say "A graph	Revise "atomic number" to "mass number".	Typo

Section 10.2 Nuclear Binding Energy	of binding energy per nucleon versus mass number A"		
Unit 2 Modern Physics: Chapter 10 Nuclear Physics: Section 10.4 Nuclear Reactions	The caption to Figure 10.16 says "Earth is heated by nuclear reactions (alpha, beta, and gamma decays). Without these reactions, Earth's surface would be much cooler than it is now." The temperature of the Earth's surface is primarily influenced by the flux of radiation it receives from the Sun -and- thermal heat trapping of its atmosphere. It is a common misconception for students to think that the interior heat of the Earth plays a significant role with the surface temperature. The most significant influence the heat of radioactive decay has on the Earth's temperature is in the Earth's interior. The correction that I suggest is to change the last sentence to read: "Without these reactions, Earth's *core and mantle* would be much cooler than it is now."	Revise "Earth's surface" to "Earth's core and mantle" in the caption.	General/pedagogical suggestion or question
Unit 2 Modern Physics: Chapter 10 Nuclear Physics: Section 10.5 Fission	When discussing rare events, such as spontaneous fission of U-238 (Example 10.9) or neutron-induced fission of U-238 (setup of Question 55), the textbook should note that these are *rare* events. Otherwise students do not come away with a clear understanding of the difference between the fissile U-235 and non-fissile U-238 (Question 55 is particularly	Add the word "rare" after the word following in Example 10.9 to clarify.	General/pedagogical suggestion or question

	confusing, given that discussion in the chapter (above Example 10.10) describes U-238 absorbing a neutron resulting in Pu-239, through a chain of beta decays from shorter-lived U-239, rather than fission). When an example or question is based on events that happen rarely (or never), that fact needs to be noted in order to avoid forming false impressions of actual reactions that happen commonly.		
Unit 2 Modern Physics: Chapter 10 Nuclear Physics: Section 10.6 Nuclear Fusion	One of the nuclear reactions includes two arrows, but the first arrow should be a + (marked in red in the attached image).	Revise the first arrow to "+".	Typo
Unit 2 Modern Physics: Chapter 10 Nuclear Physics: Section 10.7 Medical Applications and Biological Effects of Nuclear Radiation	Table 10.2 lists a "Xe-13" as a radiopharmaceutical for lung scan. It's probably "Xe-133"?	Revise to superscript "133".	Typo
Unit 2 Modern Physics: Chapter 11 Particle Physics and	The difference in mass between the long-lived and short-lived neutral K meson states are not as large as listed. PDG lists the difference (http://pdg.lbl.gov/2017/tables	Revise K-short and K-long mesons to have a rest mass of "497.6" instead of 497.7 and 497.0	Other factual inaccuracy in content

Cosmology: Section 11.1 Introduction to Particle Physics	/rpp2017-tab-mesons-strange.pdf) on the order of 10^-12 MeV. Within the given significant figures, simply one mass for neutral K meson can be listed.		
Unit 2 Modern Physics: Chapter 11 Particle Physics and Cosmology: Section 11.2 Particle Conservation Laws	1) The book is not consistent on the symbol used to describe neutrinos. The common symbol used in physics is the Greek letter nu. For example, if you look in the subsection "Lepton Number Conservation", there are 4 decay processes shown that correctly use the nu symbol for the neutrinos-antineutrinos. However, in the subsection "Baryon Number Conservation", Table 11.2 displays the neutrinos with the letter "v". (i.e., look in the 2nd column of the rows for electron neutrino, muon neutrino, and tau neutrino.) I have not carefully looked through the rest of the chapter, but I do know that "v" is once again used for neutrinos in problem 71, which is found in "Additional Problems". 2) In the subsection "Lepton Number Conservation", in the last sentence of the last paragraph before Example 11.2, the text uses "tau-neutrons". This should be "tau neutrinos". 3) In the subsection "Lepton Number Conservation", the second decay process showing the anti-muon (mu-plus particle) decaying into a positron, a neutrino, and an	The "v"s will be revised to the Greek letter nu. Revise "neutrons" to "neutrinos" and also revise the subscript "c" to "e".	Typo

	antineutrino, the subscript for the neutrino is incorrect. Instead of a "c", it should be an "e".		
Unit 2 Modern Physics: Chapter 11 Particle Physics and Cosmology: Section 11.3 Quarks	The last baryon in the table, "charmed bottom" (udb), appears to be misnamed. I believe it should be "bottom lambda". Wikipedia indicates this name for that combination with that mass. Also, in the symbol for the bottom two baryons; shouldn't the charge be superscript?	Revise the last line in the left column to "Bottom lambda". In the next column for this row and the one above, set the charge as superscript.	Other factual inaccuracy in content
Unit 2 Modern Physics: Chapter 11 Particle Physics and Cosmology: Section 11.4 Particle Accelerators and Detectors	The caption of Figure 11.10 displays: "A three-dimensional view of particle fragments in the LHC as seen by the ATLAS detector. (credit: LHC/CERN)" while the figure is actually a three-dimensional view of a heavy-ion collision event in the LHC as seen by the ALICE detector.	Revise the caption to "A three-dimensional view of a heavy-ion collision event in the LHC as seen by the ALICE detector."	Other factual inaccuracy in content
Unit 2 Modern Physics: Chapter 11 Particle Physics and Cosmology: Section 11.5 The Standard Model	In the paragraph titled "Electromagnetic Force", there is a sentence that says, "Virtual photons may violate the law of conservation of energy." It then goes on to say, "To see this, consider ...". However, the original quoted sentence, "Virtual photons may violate the law of conservation of energy" is incorrect, and in fact the explanation that follows	Revise the end of the first paragraph under "Electromagnetic Force" to "A virtual particle is a particle that exists for too short a time to be observable. Since the photon transit time Δt is extremely small, Heisenberg's uncertainty principle states that the uncertainly in the photon's energy, ΔE, may be very large."	Other factual inaccuracy in content

	that sentence does not even support that incorrect sentence. The fact is that virtual particles do NOT violate the law of conservation of energy, and the explanation that follows is not *about* conservation of energy. It is about the energy-time uncertainty principle, which does NOT imply violation of conservation of energy. The explanation following the erroneous sentence is fine. The erroneous sentence should be deleted outright. Then to make the concepts flow right, the beginning of the sentence that follows should be amended to say, "Since the photon transit time Δt is extremely small, ..." The net result is that you will have a pair of sentences that say this: "A virtual particle is a particle that exists for too short a time to be observable. Since the photon transit time Δt is extremely small, Heisenberg's uncertainty principle states that the uncertainly in the photon's energy, ΔE, may be very large." Then that section will be correct. (The idea that virtual particles or the energy-time uncertainty relation violate conservation of energy is a fallacy that has been perpetuated far too long; it is sloppy physics and bad pedagogy. This is a good place to correct that.)		