Author correction grid for reprints

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Those rows that are marked with * in the first column have their text/equations reproduced in the LaTeX supplement (generated by *Scientific Word*)so that they can be copy/pasted for easy typesetting.

Page number	**Line /Eq.# number**	**Search term/**	**Incorrect content / Instructions on how to correct**	**so that the corrected version reads as: " … "**
5	6th and 5th lines above (1.9)	orientations	1. Change "orientations are" to "orientation is"; 2. Insert parentheses in the inline eqn. around $x_j - v_i t$	"… their relative orientation is specified by three angles α,β, and γ, the new coordinates are related to the original ones by $x_i \longrightarrow x_i' = [R]_{ij}(x_j - v_i t)$, where …"
6	(1.11)	**Exercise 1.2**	Remove the minus sign $\mathbf{F} = -G_{\mathrm{N}} \frac{m_A m_B}{r_{AB}^3} \mathbf{r}_{AB}$	$\mathbf{F} = G_{\mathrm{N}} \frac{m_A m_B}{r_{AB}^3} \mathbf{r}_{AB}$
*6	2nd line below (1.11)	separated	Insert the clause "pointing from B to A" after " $\mathbf{r}_{AB} = \mathbf{r}_A - \mathbf{r}_B$, "	"… *separated by* $\mathbf{r}_{AB} = \mathbf{r}_A - \mathbf{r}_B$, *pointing from B to A. The force …*"

7	Sidenote 6		Insert the word "On" in front of "The electrodynamics of …"	so the paper title reads as "On the electrodynamics of …"
*7	3rd line below (1.14)	the speed of light	Replace "… the speed of light was essentially unchanged in a moving frame…"	by "… the speed of light in a moving frame was unchanged to first order in v/c:
9	Sidenote 12	Section	Replace the reference "Section 2.2.1."	by "… Section 2.1.2."
*15	2nd line on top in **Exercise 2.2**		Replace "…as the train passes by with speed v. (b) Show …"	"…as the train of length L in the platform observer's (O) frame passes by with speed v. (b) Show …"
15	3rd line of Section 2.1.2	moves	Insert the phrase "respect to O at" after the words "moves with" in "… moves with a constant velocity v… "	so the new clause reads as "… moves with respect to O at a constant velocity v"
17	2nd line below (2.12)	step	Insert the word "and" and a comma after "step 4 imposed constancy of light speed …"	so it reads as: "and step 4 imposed constancy of light speed, …"
18	The line above (2.20)	(2.13)	Change the reference "(2.13)"	to "(2.14)"

19	line above (2.22)	(2.13)	Change the reference (2.13)	to "(2.14)"
20	line above (2.23)	(2.14)	Change the reference (2.14)	to "(2.13)"
*23	2nd line from the top.	Invariant.	Insert the sentences with inline equations, at the end of the 2nd line from page top, which ends as "… an invariant."	" … an invariant. To show this in detail, consider a clock moving with speed *v*. We can factor dt^2 out of (2.28) to get the differential interval along clock's path: $ds^2 = (v^2 - c^2)dt^2 = -c^2 dt^2/\gamma^2 = -c^2 d\tau^2$. To reach the last equality we have used the time dilation relation $dt = \gamma d\tau$ of (2.22)." INSTRUCTION: If the pagination is an issue, can we typeset the top parts of p.23 to have the same width as the Exercise boxes (*i.e.*, extending the width into the margin space)?
27	The last sentence of **Exercise 2.10**	twin	Change the two words "sees" to "thinks" and "run" to "runs" in "This should be so, even though each twin sees the other's clock run slow."	so that the sentence reads: "This should be so, even though each twin thinks the other's clock runs slow."
27	3rd line from the bottom of **Exercise 2.11** box	**Hint:**	Replace the words "clock readings" by "inferred times" in "The solution involves a comparison of clock readings just before …"	so it will read as: "The solution involves a comparison of inferred times just before…"
29	The line below (2.47)	times	Replace the word "when" by "of" in " … denote the times when the A and B …"	so that it reads as " … denote the times of the A and B …"

44	(3.54)		Insert a minus sign on the right hand side of the 2nd equation	$\frac{\Delta\omega}{\omega} \approx -\frac{\Delta v}{c}$
46	**Exercise 3.9**		1st line: insert the word "inverse" in " …is precisely the transformation …" 4th line: Change reference number from (2.13) to (2.14)	so the 1st line reads: " …is precisely the inverse transformation …" so the 4th line reads: "and the transformation relation (2.14) such as …"
51	**Figure 3.3** caption	O	Replace the last letter "O"	by "P" so the sentence becomes "… with the same absolute time as the origin P."
53	The paragraph below the bullet list	rotates Therefore	4th line: Insert "= $tan^{-1}\beta$" after "+ϑ" in "x' axis rotates by +ϑ relative to …" 6th line: Delete the word "Therefore" in "Therefore the lightcone bisects …."	so that "x' axis rotates by +$\vartheta = tan^{-1}\beta$ relative to …" so the sentence becomes "The lightcone bisects …."
69	**Figure 4.5** (b)		Replace the label "u_2" on clock-2 in the picture on the right	by "u_1"
71	The line above (4.30)		Replace the last word "of"	by the parenthetical remark "(in power expansion)"
*72	2nd line below (4.35)	faster	Insert a new Sidenote 7a at "… run faster[7a] than the clock…"	[7a] Describing time dilation as "clocks run slower or faster" can be confusing. It may be helpful to keep in mind the *equivalence* of "less elapsed time" and "clock runs slow" --- as a slower clock has less elapsed time intervals.

78	Question 8:		2nd line from bottom: Replace the word "from" by "in light of" in "When viewed from later developments,…"	so the sentence reads as "When viewed in light of later developments,…"
78	Question 9		1st line: Insert the verb "is" in "… when the light speed measured…" 2nd line: Replace the word "when" by "and" in "…the gravitational source, and only gravitational time… "	so it reads "… when the light speed is measured…" so it reads "…the gravitational source and only gravitational time… "
*79	The last bullet		Replaced the last sentence "This also clarifies… gravitation."	by "Thus we understands the way Einstein's theory extends Newton's theory of gravitation."
*85	The sentence below (5.12)		Replace the clause after the reference (1.5): "… or the Lorentz transformation (2.12), the transformation matrix element $[\Lambda]^a{}_b$ are position-dependent --…"	by "… or the Lorentz transformation matrix (2.13), the transformation elements $[\Lambda]^a{}_b$ of (5.10) are position-dependent -- … "
86	Sidenote 9		4th line: Insert the word "than" in "(rather *ds*)" 8th line: Replace "… maximized (least negative)…"	So as to have "(rather than *ds*)" by "… minimized (most negative)…"
87	2nd line below the Box 5.1		Insert a clause "for a symmetric metric $g_{\mu\nu} = g_{\nu\mu}$" after "… one can show that"	So that it reads as "… one can show that for a symmetric metric $g_{\mu\nu} = g_{\nu\mu}$ the same Euler-Lagrange …"

*87	1st line below (5.24)		Insert a new Sidenote 9a so as "where[9a] we have used ..." with the new sidenote as	[9a] We display the steps of differentiation in the first equation: Since we will differentiate with respect to x^μ having index μ, we should change the dummy indices in the sum $L(x,\dot{x}) = g_{\mu\nu}\dot{x}^\mu\dot{x}^\nu = g_{\lambda\rho}\dot{x}^\lambda\dot{x}^\rho$, $$\frac{\partial L}{\partial \dot{x}^\mu} = \frac{\partial}{\partial \dot{x}^\mu}[g_{\lambda\rho}\dot{x}^\lambda\dot{x}^\rho]$$ $$= g_{\lambda\rho}\frac{\partial \dot{x}^\lambda}{\partial \dot{x}^\mu}\dot{x}^\rho + g_{\lambda\rho}\dot{x}^\lambda\frac{\partial \dot{x}^\rho}{\partial \dot{x}^\mu}$$ $$= g_{\lambda\rho}\delta^\lambda_\mu\dot{x}^\rho + g_{\lambda\rho}\dot{x}^\lambda\delta^\rho_\mu = 2g_{\mu\nu}\dot{x}^\nu.$$ leading to:
*88	Sidenote 10		The whole sidenote is to be replaced by	[10] As we shall demonstrate in Chapter 11, in particular (11.84), equation (5.29) is a proper tensor equation. Even though $d^2x^\sigma/d\tau^2$ and $\Gamma^\sigma_{\lambda\rho}$ have extra terms in their transformations, these extra terms mutually cancel.
*90	7th line below the **5.1.3** heading	familiar	Replace the two sentences "We are familiar … the flatness theorem."	by "We are familiar from our experience that any curved surface can be approximated locally by a flat plane. The flatness theorem extends this notion to curved spaces in general."
94	1st line below (5.44)	frequency	Insert two words "locally measured" in "… because the frequency is inversely proportional …"	so it will read as "… because the locally measured frequency is inversely proportional …"
*98	Last sentence of	earth's	Delete the parenthetical comment "(acting over distances comparable to the	"… considered weak. (Here we are discussing cases with distances comparable to the earth's radius; over cosmological distance scales, even much weaker fields could be significant.)"

	the text in Chapter 5		earth's radius)" and add a parenthetical sentence at the end	
103	2nd line of **Exercise 6.2** part (iv)	smaller	Replace the letter "n" in "…. Smaller than *2nr* as shown … " by "π"	"…. Smaller than $2\pi r$ as shown … "
108	Sidenote 8	equation	Insert a word "field" and a reference (4.7) in the 2nd sentence "This follows from Newton's equation … "	so it reads as "This follows from Newton's field equation (4.7) … "
*109	Sidenote 9	derivation	Replace the 2nd sentence "To carryout the derivation one would have to use the concept of covariant derivative, which … "	by "The derivation requires covariant derivatives, which … "
109	Sidenote 10	combinatorial	Parts of 2nd and 3rd lines cut out the 4 words "… the combinatorial result showing …	so the sentence reads as "… the reader is invited to verify that out of the total of …"
111	Sidenote 12	end	The last line: replace the 4 words "… at the end of …"	by the word "in" so it reads as "… the Einstein equations in Section 11.3.2."
111	Last line	geometric	Replace the 2 words " … geometric quantity …" by "curvature term"	so it reads as "… and the curvature term on the left hand side …"
112	(6.42)		Insert a minus sign and remove 4π	so as to read $\Box A_\mu = -\frac{1}{c} j_\mu$

*116	The line below (6.52)	cross	Revise the phrase "Now the cross term *dtdr* in (6.50) …"	to read: "When we substitute this into (6.50), the cross term *dtdr* has a coefficient …"
*118	Above **Example 6.1**	performed	Insert a sentence at the end of the paragraph	"… have been performed. We will study in Chapter 7 black holes, compact sources of gravity for which R $\sim r^*$, so that GR correction is not small."
*119	1st paragraph at the top		Replace the entire paragraph "our spherically … … has the same coordinate time)."	by a shortened paragraph (the resultant space will be taken up by the insertion to be discussed in the next erratum): "To set up the coordinates we can first imagine the situation where gravity is absent. For a fixed *t* this spherically symmetric spacetime can be divided into a series of nested 2-spheres with the usual spherical coordinates (r,θ,ϕ), each having a surface area of $4\pi r^2$. The time coordinate *t* is chosen to be perpendicular to the other three so that $g_{i0} = g_{0i} = 0$ as in (6.56). We now discuss the relation between these *r* and *t* coordinates and the proper radial distances and times measured by local observers."
*119	2nd bullet item		Insert these two sentences at the end of paragraph " … the time direction."	"… … the time direction. It must be noted that if $g_{rr} < 0$ and $g_{oo} > 0$, as for $r < r^*$ in the Schwarzschild metric (6.58), the space/time roles of the *r* and *t* coordinates switch. We will explore this more when we discuss black holes in Chapter 7."
*121	Fig 6.7(b) caption		Replace middle part of the caption "(b) In a fictitious… … which truly …"	By "(b) This equatorial plane is warped by gravity. We can picture it as a curved surface in a fictitious 3D embedding space, which truly …"

122	Sidenote 28		In the middle change section number "… Section 4.3.2 …" to	"… Section 4.3.3 …"
130	1st line below Box 6.4		Change section number "In Section 4.3.2 …"	"… Section 4.3.3 …"
133	2nd bullet		The 2nd sentence: replace the 1st word "The" by the word "Its" At the end of the bullet insert the word "coordinates"	So it reads "Its event horizon is … " So it reads " … space and time coordinates."
135	2nd line from top		Replace "(see (6.20) as well as (6.7)),""	by ", see (6.20),""
135	6th line above (7.2)		Delete the reference "Section 6.4.2" after the first word "Recall"	So the sentence reads as "From that for a … "
137	2nd to the last line		Insert the word "coordinates" after the phrase "… of space and time …"	So it will read as "… of space and time coordinates …"
*140	The 2 lines above (7.14)		Replace the part of the sentence "… (i.e., (7.11) is solved) by the vanishing in … parentheses:"	by " … is satisfied (*i*.e., either of the last two expressions in parentheses in (7.11) vanishes) when:"
*141	3rd line in 2nd paragraph	vertical	After the sentence that ends with "… vertical line in Fig. 7.3(a)."	Insert the sentence: "This null path in the advanced time ($c\bar{t}$) direction is normal to the Schwarzschild surface."

*141	**Figure 7.4** caption		Replace the entire caption	**Figure 7.4** An event horizon is a null surface, which is a 3D subspace in spacetime (spanned by $\bar{\boldsymbol{t}}, \boldsymbol{\theta}, \boldsymbol{\phi}$) that is everywhere normal to a lightlike vector. As the lightlike 4-vector $\bar{\boldsymbol{t}}$ (with null length $\bar{\boldsymbol{t}} \cdot \bar{\boldsymbol{t}} = 0$) is perpendicular to the remaining basis vectors $\bar{\boldsymbol{t}} \cdot \boldsymbol{\theta} = \bar{\boldsymbol{t}} \cdot \boldsymbol{\phi} = 0$, it is normal to the 3D surface but also lies in the surface. Thus the lightcones of all the points on the null surface are on one side of the surface. All timelike worldliness (sample shown as arrowed lines) are contained inside lightcones and thus can cross the null surface only in one direction. Therefore, a null surface is a one-way barrier, an event horizon.
142	**Figure 7.5** caption		Delete the subscript 0 in $(l_0/mc)^2$	so the inline equation reads as $(l/mc)^2 \simeq 4.6r^{*2}$
143	3rd and 6th lines below (7.20)		Change the power (superscript) in the 3rd line $l^2/r^3 \to \infty$ and in the 6th line $-l^2/r^4 \to -\infty$	To $l^2/r^2 \to \infty$ and to $-l^2/r^3 \to -\infty$
*150	(7.27)		Insert numerical value to the right hand side	$M_{\mathrm{Pl}} = \left(\frac{\hbar c}{G_{\mathrm{N}}}\right)^{1/2} = 2.18 \times 10^{-8}\ \mathrm{kg}$
156	3rd bullet 2nd and 7th line		2nd line: change the number "0.32" 7th line: change the number "0.27"	to "0,31" to "0.26"
*159	(8.4)		Insert a term $= -\frac{\Delta\omega}{\omega}$ in the middle of the displayed equation to read	$Z = \frac{\Delta\lambda}{\lambda} = -\frac{\Delta\omega}{\omega} \simeq \frac{V}{c},$

160	Eq.(8.8)		Change the value from " $\cong 14.46 \pm 0.16\ Gyr$."	To " $\cong 14.42 \pm 0.16\ Gyr$."
161	4th line above (8.12)		Change the inline equation from $V(t) = D(t)/t$	To $V(t) = dD(t)/dt$
162	**Box 8.1** 5th & 6th line	luminosity	Turn the two words "luminosity" and "period" into plurals: "luminosities" and "periods"	To read as "… luminosities and pulsation periods. "
162	Sidenote 11		Insert five words "and the Robertson-Walker metric"	[11] The cosmological principle and the Robertson-Walker metric will be discussed in Section 8.2.
163	(8.16)		Change the value from "(0.87 ± 0.04)"	To "(0.86 ± 0.2)"
163	(8.17)		Change the value from "$\cong 4.9\ keV/cm^3$."	To "$\cong 4.8\ keV/cm^3$."
163	(8.18)		Change the value from "$\cong 0.005$"	To "$\cong 0.0035$."
*164	Sidenote 13		Change the Sidenote and move its marking in the text to the line below Eq.(8.19) at the word "measurements[13], …"	[13] Another gauge of Ω_B uses the power spectrum of the cosmic microwave background (discussed in Box 9.3 and displayed in Figure

				9.4). The relative heights of the peaks in the spectrum are also sensitive to baryon density.
*164	Paragraph on top, after (8.18)		Revise the paragraph " There is also …" up till the last sentence: "From such considerations we find that"	The revised paragraph reads as "Baryonic matter also exists in the form of interstellar and intergalactic gas (referred to as intergalactic medium, IGM) that does not shine, but is subject to electromagnetic interactions and can thus be detected by its absorption spectra. One can use the IGM's absorption of light from distant bright objects such as quasars to measure its density and composition. This also helps us to measure the total baryonic abundance $\Omega_B = \Omega_{lum} + \Omega_{gas}$, regardless of whether it is now luminous or non-luminous. The theory of big bang nucleosynthesis (cf. Section 9.2) informs us that the abundances of the light elements (deuterium, helium, etc.) produced in the first few minutes after the big bang are sensitive to Ω_B (as shown in Figure 9.1). From such considerations we find that" [displayed Eq.(8.19)]
164	2nd line above (8.20)		Add a phrase at the end of the sentence "… attraction."	"… attraction, including gravitational lensing."
164	(8.20)		Change the numbers "0.27" and "0.32" to "0.26" and "0.31"	So the displayed equation (8.20) reads as $\Omega_M = \Omega_B + \Omega_{DM} \simeq 0.05 + 0.26 \simeq 0.31$
167	(8.22)		Change the number "0.32" to "0.31"	So the displayed equation (8.22) reads as $\Omega_M = \Omega_B + \Omega_{DM} \simeq 0.31$

167	2nd and 3rd lines below (8.24)		2nd line: Change the number "0.32" 3rd line: Change the number "0.27"	to "0.31" to "0.26"
178	3rd line above (8.60)		Add a comma and two words of "it will" at the end of the sentence "… down and recollapse."	"… down, and it will recollapse."
179	7th line from top		Change the word "discuss" in the parentheses	So as to have "(discussed in Section 8.4.1 …)
189	Top line	sidenote	Change the reference of Sidenote 31	To Sidenote 32
196	5th line 6th line		Change "…neutron/proton ration.." Change "… thus constrain.."	T0 "… neutron/proton ratio ..." T0 "… thus constrains ..."
196	3rd line of point 2		Change "…300,000.."	T0 "… 40,000 ..."
196	The line above (9.25)		Change "… 0.5 x 10^{-30} ..."	T0 "… 0.4 x 10^{-30} ..."
196	The line below (9.25)		Change "… Section 8.1.3 ..."	T0 "… Section 8.1.2 ..."

198	2nd line below (9.30)		Change "… trillion times ..."	T0 "… billion times ..."
198	Sidenote 14		Insert a dash	So the sentence ends as "… Section 10.2.2 – in particular (10.32)."
201	6th line in **Box 9.2**		Delete the clause ", when the temperature fell to about $k_B T_\nu \simeq 0.3$ MeV,"	So the sentence ends as "Shortly thereafter they decoupled and become free-streaming."
203	**Exercise 9.2** The end of (a) and 1st line of (b)		(a) At the end of the sentence interchange the subscripts of numerator/denominator "$\Omega_M(t_0)/\ \Omega_R(t_0)$." (b) 1st line: Change the value "3300" 5th line: change the number from "0.32"	(a) T0 "$\Omega_R(t_0)/\ \Omega_M(t_0)$." (b) 1st line : to " 3x10 $^{-4}$ " 5th line: to "0.31"
*204	1st paragraph of **The dipole anisotropy**		Replace the last two sentences "Namely, it shows …isotropic." by	Namely, it shows directly that the solar system is traveling at about 1.237 x 10 $^{-3}$c $\approx$ 370 km/s (see Exercise 9.3) with respect to the frame in which the CMB is isotropic[18]. NOTE: THE NEW PLACEMENT OF SIDENOTE 18.
*205	**Exercise 9.3** 1st two lines		Insert the inline equation: "*T ~ 1/a ~ 1/length*" after "… frequency," and "(3.52)" after ".. the Doppler effect"	So that the first part of Exercise 9.3 reads (after the title line) as "By converting the temperature variation to that of light frequency, *T ~ 1/a ~ 1/length,* show that the Doppler effect (3.52) implies that an observer …"

*208	2 lines above and (9.48)		Replace the last sentence "At peak locations in …" and (9.48) by	In this regime there is the correspondence between the angular separation of adjacent peaks ($\theta_{pk\text{-}to\text{-}pk}$) and multipole number: $l \approx \frac{\pi}{\theta_{pk-to-pk}}$. (9.48)
209	5th line in Question 3		Revise "$n_n/n_p \simeq 1/7$" and add a qualifying clause	To "$n_n/n_p \simeq 1/6$, which subsequently drops to 1/7 by t_{bbn} due to neutron beta decay."
212	9th line below (10.1)	Section	Change the reference "Section 8.1.3"	To "Section 8.1.2"
*212	**Exercise 10.1**		Replace the last sentence "The estimate will depend on …"	by "The estimate will depend on knowing that the scale factor evolves as the inverse of the temperature $a_{RM}/a_{bbn} = T_{bbn}/T_{RM} = O(10^5)$."
216	5th line from bottom	equal	Delete the phrase "equal to the value (10.1)"	
218	The paragraph below (10.7)		2nd line: Insert a comma after "… t_γ" 5th line: insert a comma after "… dark energy"	
219	2nd line below (10.10)		Replace the word "These" of second sentence by the word "This"	

221	1st line below (10.11)		Insert "4π" in the denominator of $r_0 = e^2/m_e c^2$ and add parentheses	so that it reads as "$r_0 = e^2/(4\pi m_e c^2)$"
223	2nd line below (10.14)		Replace "(cf. Section 8.1.2)"	by "(cf. (8.13))"
*226	**Exercise 10.2**		Replace the entire part (a) including three lines of the **Hint;** In part (b) move the word "in" in front of $\rho(a)$ to the beginning of (b) "Put in …"	(a) Insert the present Friedmann equation (8.48) into the general equation (8.42) and then use (8.14) for the critical density to express the epoch-dependent Hubble parameter as $H(a) = H_0[\rho(a)/\rho_{c,0} + (1-\Omega_0)/a^2]^{1/2}$ (b) Put in the scale dependence …
229	Inline eqn above (10.27)		Change the value "14.46"	to "14.42"
230	3rd line below (10.32)		Replace the word "over" by "almost"	So the 3rd line reads as "almost eight billion years…."
*236	The last bullet		Replace the entire b*ullet	• Einstein's field equation can also be derived from the principle of least action. We outline as well the steps leading to the Schwarzschild exterior solution outside a spherically symmetric source.

241	4th line below (11.22)	short	Insert a clause at the end of the paragraph "… (connection, for short)"	"… (connection, for short); cf. Sidenote 6 below."
242	**Exercise 11.1**	after	7th line: Replace the word "After" by "From"	so it reads "(11.29). From this, …"
243	5th line below the heading **11.1.2**	section	Replace the reference "Section 11.3" by	"In Section 11.2.1 (Box11.1), we shall derive…"
*244	Sidenote 6	tangent	Insert a sentence before the last sentence "We will see … " so as to have	"… in its local tangent space. The Christoffel symbols are also called (affine) connection coefficients for their role in this process that maps (connects) tensors from one point to tensors at another point along a path as in (11.36). We will see …"
245	**Exercise 11.2**		Insert the phrase "as in (11.37)" after the parenthesis in the 2nd line	So that "(*i.e.*, the tangent of the geodesic) as in (11;37) is unchanged …"
245	7th line below (11.40)	vanish	Replace "$\partial^2 g = 0$, vanish" by "can vanish everywhere, $\partial^2 g = 0$,"	So that line reads " … However, the second derivatives of the metric can vanish everywhere, $\partial^2 g = 0$, only for …"
246	The paragraph below the heading	90	Insert two sets of parentheses at two separate lines	7th line: insert "(π/2 radians)" after "90°" 11th line: insert "(in radians)" after "angle"

	Angular excess			
247	Sidenote 10	around	2nd to the last line, "σ" should be <u>typeset bold</u>	"… rule around $\boldsymbol{\sigma}$ in the 2D case…"
249	**Exercise 11.3**		<u>Insert the reference</u> ", cf. (11.25)," in front of the parenthesis in the 2nd line above (11.57)	so as to read as "…a mixed tensor, cf. (11.25), (instead of a contravariant vector) will lead to…"
251	(11.67)		*Line above (11.67) <u>insert</u> " s^{λ} "in front of $\frac{dx^{\alpha}}{d\tau}\frac{dx^{\beta}}{d\tau}$ *(11.67) denominator on the left hand side, <u>change "D" to "d"</u> *3rd line below (11.67) <u>insert two words</u> "contraction of" in front of "Riemann" and <u>insert at the end</u> the phrase "with two factors of 4-velocity"	* "Factoring out the common $s^{\lambda}\frac{dx^{\alpha}}{d\tau}\frac{dx^{\beta}}{d\tau}$ yields …" * (11.67) $\frac{D^2 s^{\mu}}{d\tau^2} = -R^{\mu}_{\alpha\lambda\beta}\frac{dx^{\alpha}}{d\tau}\frac{dx^{\beta}}{d\tau}s^{\lambda},$ * "in GR by the contraction of Riemann curvature tensor (11.40) with two factors of 4-velocity."
*252	(11.73) and (11.74)		<u>Insert missing parentheses</u> such as $\left(D_{\lambda}R^{\gamma}_{\ \alpha\mu\nu}\right)A_{\gamma}$	*(11.73) the first term on the right-hand-side $[D_{\lambda},[D_{\mu},D_{\nu}]]A_{\alpha} = -\left(D_{\lambda}R^{\gamma}_{\ \alpha\mu\nu}\right)A_{\gamma} + R^{\gamma}_{\ \lambda\mu\nu}D_{\gamma}A_{\alpha}.$ *(11.74) the 2nd line on the right hand side $= -\left(D_{\lambda}R^{\gamma}_{\ \alpha\mu\nu}\right)A_{\gamma} - \left(D_{\nu}R^{\gamma}_{\ \alpha\lambda\mu}\right)A_{\gamma} - \left(D_{\mu}R^{\gamma}_{\ \alpha\nu\lambda}\right)A_{\gamma}$
257	Sidenote 15		<u>Change the sign</u> in the inline equation	$\mathcal{L}_g = R - 2\Lambda$

260	#2.3	See	Insert the reference "(2.14)" in the sentence "See (2.13) and (2.18)."	so it reads as "See (2.13), (2.14), and (2.18)."
260	#2.7	particular	Insert the reference "(2.28)" in "See Section 2.2.2, in particular (2.31) and Exercise 2.7."	so it reads as "See Section 2.2.2, in particular (2.28), (2.31) and Exercise 2.7."
261	#4.8	observer	The 2nd line: Insert the word "local" in "… distance of the observer…"	so it reads as "… distance of the local observer…"
263	#6.5	covariantly	End of 2nd line: Delete the two words "covariantly constant,"	
*264	#7.4		Replace the first two sentences "A null surface is a 3D subspace in spacetime made up … surface, so it is everywhere tangent to lightcones on one side." Thus …	by "A null surface is a 3D subspace in spacetime that is everywhere normal to (and tangent to) a lightlike null line. It is everywhere tangent to lightcones on one side." Thus …
264	#7.6	1st line	Insert a slash in $-Cl^2 r^3$	so it will read as $-Cl^2/r^3$
*264	#7.10		Rearrange a couple of words around the colon so it will read as	"One finds the following surprising correspondence: surface gravity on the horizon behaves like temperature, and horizon area like entropy."

265	#8.5		Change the values from “0.32”, “0.005” and “0,27” to “0.31”, “0.0035” and “0,26”	So that item 5 reads as $\Omega_{\rm M} \simeq 0.31,\ \Omega_{\rm lum} \lesssim 0.0035,$ and $\Omega_{\rm B} \simeq 0.05.$ Thus $\Omega_{\rm DM} = \Omega_{\rm M} - \Omega_{\rm B} \simeq 0.26.$
*265	#8.6, the first three lines		Insert “looking in any directions” and delete “chosen to be” so the first three lines read as	6. The cosmological principle: at any given instance of cosmic time, the universe appears the same at every point looking in any direction: space is homogeneous and isotropic. Comoving coordinates are a system where the time coordinate is the proper time ….
*266	3rd line from the top	regions	Insert a long clause after the words “… small regions” TO AVOID CHANGE IN PAGINATION ONE CAN CHANGE THE DISPLAYED EQUATION OF #8.14 INTO AN INLINE EQUATION.	so as to read “… small regions, where a Newtonian description should be valid, because the gravity involved is not strong, and space can be approximated by a flat geometry (cf. discussion on p.175). It is only …”
*271	Ex 3.4 two lines above the displayed equation		Replace “the Lorentz … … 4-velocity:” by ”(3.31) which has two components: the time component yields the gamma relation, the spatial the addition of velocities.”	In this way the revised sentence reads as “… the matrix multiplication (3.31) which has two components: the time component yields the gamma relation, the spatial the addition of velocities.”
*271	Ex 3.8		Replace the entire 3.8 by	**3.8** A change of momentum in the direction of propagation changes the speed and hence the gamma factor. A differential change in the transverse momentum does not.
272	Ex 3.10		*1st line: Insert a subscript “ *i* ” in *F* on the left-hand side *2nd line: Insert a part label: (c)	$\gamma F_i = \frac{q}{c}[-E_i(-\gamma c) + \epsilon_{ijk} B_k (\gamma v_j)]$ (c) $K^0 = \gamma \mathbf{F} \cdot \mathbf{v}/c,$ because the dot-product …..

272	Ex 3.13		Insert an explanatory sentence after the equation	"The middle equality uses (3.37)."
272	Ex 4.1		Remove all(4) the subscripts "A"	(a) $a = g\sin\theta(\frac{m_G}{m_I})$; (b) period $P = 2\pi\sqrt{\frac{L}{g}(\frac{m_I}{m_G})}$
273	Ex 5.1		Remove the label "(b)" to the left of the displayed equation.	$\int\sqrt{dx^2+dy^2} = 4\int_0^R dx\sqrt{1+\left(\frac{dy}{dx}\right)^2} = 4R\left[\sin^{-1}\frac{x}{R}\right]_0^R = 2\pi R.$
273	Ex 6.2		The part label "(d)" and the symbols "V_2" and "$\tilde{V}_2$" on the left-hand sides of the two equations	changed to the part label "(v)" and symbols "A_2" and "$\tilde{A}_2$"
*273	Ex 6.3(d)		*1st eq $\frac{d^2u_1}{d\phi^2} + u_1 - \frac{1-\cos 2\phi}{2r_{\min}^2} = 0$ *The last inline equation at the end of the line below $\beta = 1/(6r_{\min}^2)$ *2nd eq $\frac{1}{r} = \frac{\sin\phi}{r_{\min}} + \frac{r^*}{r_{\min}^2}\frac{3+\cos 2\phi}{4}$	*Change the sign in front of cos2ϕ; it becomes $\frac{d^2u_1}{d\phi^2} + u_1 - \frac{1+\cos 2\phi}{2r_{\min}^2} = 0$ *Change the sign so as to read $\beta = -1/(6r_{\min}^2)$ *Change the sign in front of cos2ϕ and change "*sinφ*" to "*cosφ*" it becomes $\frac{1}{r} = \frac{\cos\phi}{r_{\min}} + \frac{r^*}{r_{\min}^2}\frac{3-\cos 2\phi}{4}$
274	Ex 9.2 (b) & (c)		Change the values in (b) "0.04/0.25", "10^9" and "8 x 10^{-5}" In (c) "10^4 years"	To (b) "0.05/0.31", " $10^{10}/6$ " and " 3 x 10^{-4} " To (c) "7.3 x 10^4 years"

274	Ex 10.1		Replace the entire Ex 10.1	**10.1** First show that in the RDU , $\dot{a} \sim a^{-1}$. Thus (1-Ω)∼a⁻²∼a²∼T⁻² leading to $$\begin{aligned} \left|1-\Omega(t_{\mathrm{bbn}})\right| &= \left|1-\Omega(t_{\mathrm{RM}})\right|(T_{RM}^2/T_{bbn}^2) \\ &= O(10^{-4}) \times O(10^{-10}) = O(10^{-14}) \end{aligned}$$
backcover	Year (sidereal)	sidereal	Change the value from "3.15 x 10^7 s"	To "3.16 x 10^7 s"
backcover	Hubble parameter	parameter	Change the value from "0.68 $\pm$ 0.08"	To " 0.678 $\pm$ 0.0081"
backcover	Hubble time	time	Change the value from "9.79 h^{-1}"	To "9.78 h^{-1}"
backcover	Schwarzschild radius of the sun	Schwarzschild	Change the value from "= 2.96 km"	To "= 2.95 km"
backcover	Mass pf the earth		Change the value from "5.98 x 10^{24} kg"	To "5.97 x 10^{24} kg"
backcover	Schwarzschild radius of the Earth		Change the value from "= 0.886 cm"	To "= 0.887 cm"