15 November 2001
Set 2 of Corrections for Jackson's Classical Electrodynamics, 3rd edition,
Prepared by J. D. Jackson

This set consists of corrections and additions (up to February 28, 2001) not included in the 5th printing of March 2000 or the 6th printing of January 2001, but incorporated in the 7th printing of September 2001. If your printing is the seventh, all these corrections should be already incorporated. Check the last number in the list of numbers at the bottom on the back of the title page to see what printing you have.

If your printing is the fifth or sixth, this Set 2 is relevant. If you wish corrections for any of the first four printings, see this set and also Set 1 below.

p. viii - Add Michael A. Lee and Kevin E. Schmidt to the list of names being thanked.

p. 11 - 5 lines up - Replace the equation with $\mathbf{P} = \mathbf{D} - \varepsilon_0\mathbf{E}$

p. 42 - line below (1.57) - Add subscript 1 in the denominator of $\rho = (\mathbf{x} - \mathbf{x}_1)/|\mathbf{x}_1 - \mathbf{x}_2|$.

p. 52 and 53 - Replace Problem 1.14 with

1.14 Consider the electrostatic Green functions of Section 1.10 for Dirichlet and Neumann boundary conditions on the surface S bounding the volume V. Apply Green's theorem (1.35) with integration variable $\boldsymbol{y}$ and $\phi = G(\boldsymbol{x}, \boldsymbol{y})$, $\psi = G(\boldsymbol{x}', \boldsymbol{y})$, with $\nabla^2_y G(\boldsymbol{z}, \boldsymbol{y}) = -4\pi\,\delta(\boldsymbol{y} - \boldsymbol{z})$. Find an expression for the difference $[\,G(\boldsymbol{x}, \boldsymbol{y}) - G(\boldsymbol{x}', \boldsymbol{y})]$ in terms of an integral over the boundary surface S.

(**a**) For Dirichlet boundary conditions on the potential and the associated boundary condition on the Green function, show that $G_D(\boldsymbol{x}, \boldsymbol{x}')$ must be symmetric in $\boldsymbol{x}$ and $\boldsymbol{x}'$.

(**b**) For Neumann boundary conditions, use the boundary condition (1.45) for $G_N(\boldsymbol{x}, \boldsymbol{x}')$ to show that $G_N(\boldsymbol{x}, \boldsymbol{x}')$ is not symmetric in general, but that $G_N(\boldsymbol{x}, \boldsymbol{x}') - F(\boldsymbol{x})$ is symmetric in $\boldsymbol{x}$ and $\boldsymbol{x}'$, where

$$F(\mathbf{x}) = \frac{1}{S}\oint G_N(\mathbf{x},\mathbf{y})\,da_y$$

(**c**) Show that the addition of $F(\boldsymbol{x})$ to the Green function does not affect the potential $\Phi(\boldsymbol{x})$. See problem 3.26 for an example of the Neumann Green function.

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p. 53 - Problem 1.18 (a) - Replace d^3x' by da' in the integral on the right.

p. 54 - Problem 1.20 (c) - At the end, replace "the diameter of the other wire?" with "its diameter?"

p. 88 - Problem 2.11 (d), last line - Replace "the force on the charge." with "the force per unit length on the line charge."

p.94 - Problem 2.30 - Add at the end, "[$\psi = 4\pi\varepsilon_0\Phi$]"

p. 133 - Equation (3.185) - Replace $|z|$ in front of $\tan^{-1}$ with $|z|/a$.

p. 141 - Problem 3.19 (c) - Replace with

3.19 (c) Show that the charge density at $\rho = 0$ can be written as the series

$$\sigma(0) = -\frac{q}{2\pi L^2} \sum_{n>0,\ odd} \left[(n - z_0/L)^{-2} - (n + z_0/L)^{-2} \right]$$

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p. 144 - Problem 3.26 (b) - Replace $\lambda + \mu/r$ on RHS with $f(r)$. Replace "λ and μ are" in the line below with "$f(r)$ is" In the next line replace "λ and μ" with "$f(r)$". At the end of the parenthetical remark, add "with a suitable choice of $f(r)$."

p. 157, line above Figure 4.6 - Replace "polynomials" with "functions"

p. 158, first line - replace "polynomial" with "function"

p. 158, second line - After the word "leads", add "(through the orthogonality of $P^1_\ell = \partial P_\ell/\partial\theta$)

p. 158, line above (4.52) - After "gives", add "(through the orthogonality of P_ℓ)"

p. 162, 3 lines below (4.70) - Replace $(\varepsilon/\varepsilon_0 - 1)(\varepsilon/\varepsilon_0+2)$ with $(\varepsilon/\varepsilon_0 - 1)/(\varepsilon/\varepsilon_0+2)$

p. 217, second last equation - Replace ρ^2_{max} with ρ^3_{max} in right hand expression

p. 227, Problem 5.9, equation for $\mathbf{J}$ - Replace $\hat{\boldsymbol{\phi}}\,\mathbf{I}$ with $\hat{\boldsymbol{\phi}}\,I$ (boldface phi-hat, italic I)

p. 227, Problem 5.9 (b) - Replace "multiple" with "multipole"

p. 231 - Problem 5.25 (c) - In the first line, after the word "plane," add "is parallel to the wire and"

NOTE: In the process of adding this clarification in the seventh printing, the incorrect answer of the first four printings was reintroduced. The correct answer for the interaction energy is

$$W_{12} = \mu_0 I_1 I_2\, d \cdot \mathrm{Re}\left[e^{i\alpha} - \sqrt{e^{2i\alpha} - a^2/d^2} \right]$$

p. 263 - Eq.(6.126a) - Delete the factors of 2 in the two terms on RHS..

p. 263 - Eq.(6.126b) - Insert factors of 1/2 in front of both terms on RHS.

p. 264 - Eq.(6.127) - Delete the factors of 2 in the last two terms on RHS.

p. 281 - line 3 - change "isotopic" to "isotropic"

p. 284 - Problem 6.2 - At the end of the preamble, add "(but $\boldsymbol{R} = \boldsymbol{x} - \boldsymbol{x}'(t')$ inside the delta functions)"

p. 285 - Problem 6.3 (b) - Delete the parenthetical remark at the end.

p. 290 - Problem 6.17 (a) - After the word "force," add "in vacuum". Replace $\mathbf{H}$ and $\mathbf{D}$ by $\mathbf{B}/\mu_o$ and $\varepsilon_0\mathbf{E}$, respectively.

p. 293 - Problem 6.24 (b) - To first order there is no magnetic field outside the solenoid.

Replace the equation for $\mathbf{B}$ with $\mathbf{B} = 0 + O(\partial^2 I/\partial t^2)$. Two lines below the equations, delete "a magnetic field and". Delete the last sentence.

p. 296, line 3 - Add the words "and positive" after "real"

p. 323, line below (7.80) - Replace $1\ \sqrt{2\pi}$ with $1/\sqrt{2\pi}$

p. 326, first footnote - After the first reference, replace the reamining text with "A. Katz and R. R. Alfano, *Phys. Rev. Letters* **49**, 1292 (1982); S. Chu and S. Wong, *ibid.* , 1293."

p. 332, line 3 - Replace $\delta(7.77)$ by $\delta(5.165)$

p. 342 - Problem 7.7 - In second line of preamble, add "nonpermeable" in front of "media"; in part (a), second line, add "smooth and" before "finite".

p. 344 - Problem 7.10 -In the fourth and fifth lines, replace $-\omega t$ with $-i\omega t$

p. 349 - problem 7.24 (a) - Add at the end of (a) "Assume that (7.114) holds for real ω."
p. 349 - Problem 7.26 (b) - Replace "electrostatic" with "scalar"
p. 350 - Problem 7.27 - In part (a) add a comma after "that" in the second line. In part (b), third line below the first equation, delete "*xy*" in front of "plane"
p. 350 - Problem 7.29 - In the third line, add "in vacuum" after the word "wave"
p. 351 - Problem 7.30, second line - Change "(7.11)" to read "(7.8, 7.11)"
p. 373, equation (8.97) - The numbers are a bit off. Replace "0.344" with 0.343" in the numerator and "0.242" with "0.244" in the denominator.
p. 389, six lines below (8.128) - Add "*a*" after ω to make V dimensionless.
p. 396 - Problem 8.1 - In part (a), third line, after the word "surface" add "from the conduction current". Replace part (b) with

"(b) If the magnetic permeability μ outside the surface is different from μ_c , is there an additional magnetic force per unit area? What about electric forces?"

p. 397 - Problem 8.2 - At the end of the preamble, add "Section 8.1 applies."
p. 398 - Problem 8.4 - In second line, replace "brass" with "conductivity σ". In part (a), last line, replace "brass" with "the cylinder" In part (b), first line, replace "constant" with "constants"; second line, add "distinct" before "modes" and replace "it" with "them"
p. 400 - Problem 8.10 (b) - Replace B in both equations with E. (i.e. E_0)
p. 402 - Problem 8.13 - parenthesis in fourth line - replace first "or" with "of" ; In part (a), add a left parenthesis, (, before γ^2 in the first equation, i.e., $[(\gamma^2 - \gamma_0{}^2)N_j \delta_{ji} + ...$
p. 403 - Problem 8.15 (a) - In the third line, after "mode", add ", defined by the symmetry in x of the transverse fields."
p.434, first line - Replace "superpositon" with "superposition"
p. 435, equation (9.146) - Add left parenthesis, (, before $M_x{}^2$
p. 437, two lines above (9.151) - replace "multiple" with "multipole"
p. 439 - line above (9.157) - Replace $\mathbf{H'} = \mathbf{B}/\mathcal{M}_0$ with $\mathbf{H'} = \mathbf{B}/\mu_0$
p. 453, Problem 9.15 (b) - In equation for $\mathbf{H}$ add left parenthesis, (, before $\hat{\mathbf{x}}$
p. 454 - Problem 9.18 - In parts (a) and (b) , delete the final factors in curved parentheses in both equations.
p. 484 - In the first term of the integrand of (10.90), replace k by ω
p. 507, line 17 - Replace *Beugunswelle* with *Beugungswelle*
p. 509 - Problem 10.5 (b) - The correct page number in the edition of Landau and Lifshitz cited in the Bibliography is p. 323.
p. 509 - Problem 10.7 (c) - Replace "$\varepsilon \to \infty$" with "$\varepsilon_r \to \infty$"
p. 572 - Problem 11.16 (c) - Replace "above (7.68)" with "$\mathbf{J} = \sigma(\mathbf{E} + \mathbf{v} \times \mathbf{B})$ (see p. 320)."
p. 578 - Problem 11.31 - In the denominator of the expression for E_ρ , $\omega^2\rho^2$ should read $\omega^2\rho^2/c^2$. On RHS of the equation for V, there should be a factor of c in the denominator.
p. 617 - Problem 12.1 (a) - At the end of the first line, add "(in the sense of Section 12.1 $\mathbf{B}$)"
p. 621 - Problem 12.15 (b) - In second line, after the word "field" add "away from the origin"
p. 628, second line - delete "a" before "consonant"
p. 634, equation (13.35) - The lower limit on the integral should be "*a*"
p. 639, sixth line below Figure 13.4 - Replace "bow shock of a boat in water or the shock front accompanying" with "familiar shock wave (sonic boom) produced by an aircraft in"
p. 668, line 9 - Replace "50 GeV" with "60 GeV"
p. 691 - Figure 14.15 caption - Replace "first harmonic" with "second harmonic"

p. 692, ninth line - replace "first" with "second"
p. 699, Problem 14.3 - Equation for dt/dt′ should read dt/dt′ = 1 - $\boldsymbol{\beta}(t')\cdot\mathbf{n}(t')$
p. 703 - Problem 14.16 - In the denominator of the equation for ρ^2 the dt^2 should be $d\tau^2$.
p. 707 - Problem 14.27 (c) - In the second and last lines, change "first" to "second"
p. 740 - Problem 15.7 (a) - On RHS of the first equation, delete the factor of c in the denominator.
p. 742 - Problem 15.11 (c) - In the third line, replace "$\omega \geq \omega_0$" with "$E > \hbar\omega_0$". In line seven, change "E." to read "E." (roman, not italic)
p. 751, end of line 9 and line 10 - Replace with "Then, if $\mathbf{G}$ is the total electromagnetic momentum, the conservation of momentum reads"
p. 771 - Problem 16.6 (c) - In the square bracket, the exponent of the parenthesis should be -1/2, not 1/2.
p. 771 - Problem 16.9 (a) - Too many τ′s! Replace the factor τ in front with $2e^2/3mc^3$.
p. 780, line 7 - Replace "F/m" with "H/m ".
p. 783, Table 4 - The SI unit of conductivity should be "1 siemens m^{-1}", not "1 mho m^{-1}"

Set 1 of Corrections for Jackson's Classical Electrodynamics, 3rd edition,
[This set is applicable to the any of the first four printings, but not the fifth or subsequent printings. It consists of corrections and additions known up to October 31, 1999. Check the last number in the list at the bottom on the back of the title page to see what printing you have.]

p. viii - add Myron Bander, John Cooper, David J. Griffiths, and Gerald A. Miller to the list of those being thanked.
p. 103 - in last three equations replace q by $q/4\pi\varepsilon_0$.
p. 103, line above the third equation from the bottom - Replace q by $q/4\pi\varepsilon_0$.
p. 104 - first equation, replace q by $q/4\pi\varepsilon_0$.
p. 154, line 2 up - last word should read "charge" not "change."

p. 156 - Fig. 4.5 - reverse the inequality sign below the RH sketch, i.e., $\varepsilon_2 < \varepsilon_1$.

p. 188 - equation (5.63), replace μ_0 on RHS by 4π .

p. 228 - Problem 5.15 (a), on RHS replace I by O .
p. 231 - Answer for the interaction energy in Problem 5.25 (c) should read

$$W_{12} = \mu_0 I_1 I_2 \, d \cdot \mathrm{Re}\left[e^{i\alpha} - \sqrt{e^{2i\alpha} - a^2/d^2} \right]$$

p. 234 - Problem 5.34 (c), insert minus sign on RHS.
p. 287 - Problem 6.7 (b), delete 4π on RHS of display equation
p. 289 - Problem 6.14 (b), delete c^2 from denominator in integral of w_m on RHS.
p. 294 - Problem 6.25 (a), replace "an atom" by "a neutral atom at rest"
p. 298, Equation (7.13) - Add a factor of 1/2 to the right hand side.
p. 410 - a factor of $1/4\pi\varepsilon_0$ is missing on the RHS of the two unnumbered equations for Φ.

p. 439-440 - At the beginning of Section 9.10, the conversion of units led to errors in the equations and text from (9.157) to (9.163).

In the line above (9.157), replace **H** with $\mathbf{H}' = \mathbf{B}/\mu_0$.
In equations (9.157) through (9.163), replace **H** with **H′** .
In the short line above (9.159), replace **H** with **H′** .
At the end of the first sentence below (9.159), add "and **H′** to **H**."
In the eight lines between (9.161) and (9.162), replace all **H** with **H′** .

p. 451 - problem 9.6 (b), at end of expression for **E** a clarifying set of brackets is needed for the triple cross product, i.e., { ..... $\mathbf{n} \times (\mathbf{n} \times \partial^2\mathbf{p}/\partial t^2)$ }

p. 452 - problem 9.10: The current density **J** should be a factor of two smaller, as should the magnetization $\mathcal{M}$ in part (a). Add quotation marks around "$\mathcal{M}$ ".

p. 484 - Eq.(10.90). In the integrand, the factor k should be replaced by ω.

p. 505 - Equation (10.148), remove the parenthesis in front of k', i.e., (Re *k'*, 0)

p. 621 - Problem 12.15 (c), references at the end: Neito should read Nieto.

p. 622 - in Problem 12.18, add the word "constant" before "4-vector" in third line.

p. 643 - Eq.(13.59) - a factor of π is missing in middle expression.

p. 687 - In equation (14.106), replace *c* with c^2 in denominator of middle expression.

p. 688 - Line 6 up, replace the numbers "14.5, 14.7, and 14.8," with "14.12, 14.14, and 14.15,"

<u>The following "corrections" concern rectification of the universal attribution to Hendrik A. Lorentz of those things that should rightly be attributed to Ludvig V. Lorenz.</u>

p. xvii - heading 6.3 - change Lorentz to Lorenz.

p. 240 - line above (6.14) - change to read
"potentials (**A**, Φ) to satisfy the *Lorenz condition* (1867)*,
last line of Section 6.2 - change to read
"respects to the Maxwell equations in vacuum, as observed by Lorenz and others."
title line of Section 6.3 - change "**Lorentz**" to "**Lorenz**"
Sec. 6.3, third line - delete the sentence "The relation (6.14) ... "
Sec. 6.3, fourth line, change Lorentz to Lorenz
line above (6.17), change Lorentz to Lorenz
bottom of p. 240 - add the footnote,
*L. V. Lorenz, Phil. Mag. Ser. 3, **34**, 287 (1867). *See also* p. 294.

p. 241 - lines 3 and 5- change Lorentz to Lorenz.
-lines below (6.20) - change Lorentz to Lorenz (three places).

p. 246 - at end of line below (6.48) - Add the sentence,
"These solutions were first given by Lorenz (op. cit.)."
-4 lines below (6.48) - delete the word "themselves"

p. 281 - line below the unnumbered equation below (6.165b) - change Lorentz to Lorenz.
line below (6.166) - change Lorentz to Lorenz.

p. 294 - add the following note:

Note of explanation: The reader may be startled to find (in all but the earliest printings) the association of Danish physicist Ludvig V. Lorenz's name instead of Dutch physicist Hendrik A. Lorentz's with the relation (6.14) between the scalar and vector potentials. Yet it is a fact that in 1867 Lorenz. in a paper entitled "On the identity of the vibrations of light with electric currents," (op. cit.) exploited the retarded solutions for the potentials, derived (6.14) and equations equivalent to wave equations for the electric field,

and discussed the characteristics of light propagation in conductors and transparent media, contemporaneously with Maxwell. H. A. Lorentz has ample recognition in physics terminology without the mis-attribution of (6.14) to him (by others, beginning around 1900). As Van Bladel* observes, it is up to textbook authors to accord Lorenz his due.†

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*J. Van Bladel, IEEE Antennas and Propagation Magazine **33**, No. 2, 69 (April 1991).
† An earlier author who deplored the lack of recognition of Lorenz's contributions is A. O'Rahilly, *Electromagnetic Theory*, Dover Publications, New York (1965) [originally published as *Electromagnetics*, Longmans, Green and Cork University Press (1938)], footnote, p. 184.

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p. 408 - line 2 - change Lorentz to Lorenz.
p. 450 -Problem 9.5(a), line 2 - change Lorentz to Lorenz.
p. 555 - lines 13, 17, and 24 - change Lorentz to Lorenz. [but not in lines 9 and 21!]
p. 601 - line2 - change Lorentz to Lorenz.
p. 604 - line 6 - change Lorentz to Lorenz.
p. 612 - line 13 - change Lorentz to Lorenz.
p.760 - line 12 - change Lorentz to Lorenz.
p. 799 - Change the entries

Lorentz condition, 240, 555
in covariant form, 555

to read

Lorenz condition, 240, 294, 555
Lorentz condition. *See* Lorenz condition.