A Note from the Author:

Problems 7.7, 7.11, 7.17, 7.19, 8.7, 8.8, 8.19, 8.22, 10.14, 17.25, and 20.16 erroneously cite a private communication with “Prof. M.J. Cohen, University of Pennsylvania”. The correct source of these problems is “Prof. Michael Cohen, University of Pennsylvania”.

4.15. part (a): change the final line to

$$\varphi_Q(\mathbf{r}) = \frac{Q_{ij}}{4\pi \epsilon_0} \frac{3r_ir_j - \delta_{ij}r^2}{r^5} = \frac{3q a^2}{\pi \epsilon_0} \frac{xy}{(x^2 + y^2 + z^2)^{5/2}}$$

4.15. part (d): change the equation to

$$\varphi_Q(\mathbf{r}) = \frac{Q_{ij}}{4\pi \epsilon_0} \frac{3r_ir_j - \delta_{ij}r^2}{r^5} = \frac{1}{4\pi \epsilon_0} \left[ Q_{rr} \frac{2}{r^3} - Q_{\theta \theta} \frac{1}{r^3} - Q_{\phi \phi} \frac{1}{r^3} \right]$$

4.15. part (e): change the two equations to
\[ \varphi_Q(r) = \frac{q a^2}{\pi \varepsilon_0} \frac{1}{r^3} \sin \phi \cos \phi (2 \sin^2 \theta - \cos^2 \theta + 1) \]

and

\[ \varphi_Q(r) = \frac{3qa^2}{\pi \varepsilon_0} \frac{xy}{(x^2 + y^2 + z^2)^{5/2}} \]

5.2. Replace the entire solution by the following:

If the ball is conductor 1 and the shell is conductor 2, use

\[ \varphi_1 = P_{11} Q_1 + P_{12} Q_2 \]
\[ \varphi_2 = P_{12} Q_1 + P_{22} Q_2 \]

When \( Q_1 = 0 \) and \( Q_2 = 1 \), we know that

\[ \varphi_1 = P_{12} = \frac{1}{4\pi \varepsilon_0 b} \]
\[ \varphi_2 = P_{22} = \frac{1}{4\pi \varepsilon_0 b} \]

When \( Q_1 = 1 \) and \( Q_2 = 0 \), we know that

\[ \varphi_1 = P_{11} = \frac{1}{4\pi \varepsilon_0 a} \]
\[ \varphi_2 = P_{21} = \frac{1}{4\pi \varepsilon_0 b} \]

Hence,
\[ 4\pi \varepsilon_0 \varphi_1 = \frac{Q_1}{a} + \frac{Q_2}{b} \]

\[ 4\pi \varepsilon_0 \varphi_2 = \frac{Q_1}{b} + \frac{Q_2}{b} \]

Inverting this gives

\[ Q_1 = \frac{ab}{b-a} \varphi_1 - \frac{ab}{b-a} \varphi_2 \]

\[ Q_2 = -\frac{ab}{b-a} \varphi_1 + \frac{b^2}{b-a} \varphi_2 \]

Therefore, the capacitance matrix is

\[ C = \frac{4\pi \varepsilon_0}{b-a} \begin{pmatrix} ab & -ab \\ -ab & b^2 \end{pmatrix}. \]

Finally,

\[ C_{22} - C_{11} = \frac{4\pi \varepsilon_0}{b-a} (b^2 - ab) = 4\pi \varepsilon_0 b = C_0 \]

We recognize \( C_0 \) as the self-capacitance of the outer shell. Therefore, \( C_{22} = C_{11} + C_0 \) can be regarded as describing two ordinary capacitors in series: one whose ‘plates’ are the ball and the shell and the other whose ‘plates’ are the shell and a conductor at infinity.
7.22. Change the final line to

\[ a = \frac{\kappa_1 \phi_2 V_1 + \kappa_2 \phi_1 V_2}{\kappa_2 \phi_1 + \kappa_1 \phi_2} \quad \text{and} \quad b = \kappa_2 \frac{V_1 - V_2}{\kappa_2 \phi_1 + \kappa_1 \phi_2} \]

9.15 I thank Mark Srednicki (UC Santa Barbara) for pointing out that my specification of conducting electrodes make the boundary conditions Dirichlet (as in Figure 9.5) rather than Neumann. Because \( \alpha \ll 1 \), we have point contacts as in Figure 9.7 except that the current only spreads out inside the sphere. Hence, the total resistance of the sphere is half the contact resistance of Eq. (9.33) on entry in series with the same quantity on exit. Therefore,

\[ \text{resistance} = \frac{1}{2 \sigma \alpha R} \]

because \( \alpha R \) is the radius of each contact.

9.22. Remove the last line of the solution, namely,

\[ = \frac{2n\pi \sigma V^2}{\cos \alpha} \]
14.4. part (a): change “displacement current” to “displacement current density”

14.7. final equation:

\[ \frac{m v_0}{\gamma} \rightarrow \frac{M v_0}{\gamma} \]

19.24(b). Replace everything between ``Cartesian axis” and the equation just before ``a Gaussian solution” with the following:

Looking up the vector Laplacian in cylindrical coordinates, we set \( k_0 = n_0 \omega / c \) and use the fact that \( n(r) = n(\rho) \). In that case, the proposed solution

\[ E = E(\rho) \exp[i(hz - \omega t)] \hat{\phi} \]

simplifies the wave equation above to

\[ \frac{\partial^2 E}{\partial \rho^2} + \frac{1}{\rho} \frac{\partial E}{\partial \rho} - \frac{E}{\rho^2} = [h^2 - k_0^2(1 - 2\alpha^2 \rho^2)]E \]

Replace the last line by:

A physical acceptable solution is \( E(\rho) = A\rho \exp(-\beta^2 \rho^2) \)

where \( k_0^2 = h^2 + 8\beta^2 \) and \( \beta^2 = \alpha k_0 / \sqrt{2} \).