Typos and Corrections for

Modern Electrodynamics June 2014 Solution Manual

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

$$
\phi_Q(r) = \frac{Q_{ij}}{4\pi \epsilon_0} \frac{3r_i r_j - \delta_{ij} r^2}{r^5} = \frac{3qa^2}{4\pi \epsilon_0} \frac{xy}{(x^2 + y^2)^{5/2}}
$$

4.15. part (d): change the equation to

$$
\phi_Q(r) = \frac{Q_{ij}}{4\pi \epsilon_0} \frac{3r_i r_j - \delta_{ij} r^2}{r^5}
$$

$$
= \frac{1}{4\pi \epsilon_0} \left[ Q_{rr} \frac{2}{r^3} - Q_{\theta\theta} \frac{1}{r^3} - Q_{\phi\phi} \frac{1}{r^3} \right]
$$

4.15. part (e): change the two equations to
\[
\varphi_Q(r) = \frac{q a^2}{\pi \epsilon_0 r^3} \sin \phi \cos \phi (2 \sin^2 \theta - \cos^2 \theta + 1)
\]

and

\[
\varphi_Q(r) = \frac{3qa^2}{\pi \epsilon_0} \frac{xy}{(x^2 + y^2)^{5/2}}
\]

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

\[
\varphi_1 = P_{12} = \frac{1}{4\pi \epsilon_0 b} \\
\varphi_2 = P_{22} = \frac{1}{4\pi \epsilon_0 b}
\]

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

\[
\varphi_1 = P_{11} = \frac{1}{4\pi \epsilon_0 a} \\
\varphi_2 = P_{21} = \frac{1}{4\pi \epsilon_0 b}
\]

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

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

9.22. 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:

\[ \frac{mv_0}{\gamma} \rightarrow \frac{Mv_0}{\gamma} \]