1. Griffiths: Problem 3.7
2. Griffiths: Problem 3.10
3. Griffiths: Problem 3.34 (also on the method of images)
5. Griffiths: Problem 3.15
6. Griffiths: Problem 3.17
7. Griffiths: Problem 3.22

Answers:

Problem 3.12:

\[ V(x, y) = \frac{8V_0}{\pi} \sum_{n=2,6,10,\ldots} \frac{1}{n} e^{-n\pi x/a} \sin \left( \frac{n\pi y}{a} \right) = \frac{8V_0}{\pi} \sum_{n=0}^{\infty} \frac{1}{(4n+2)} e^{-(4n+2)\pi x/a} \sin \left( \frac{(4n+2)\pi y}{a} \right) \]

Problem 3.15:

\[ V = \frac{16V_0}{\pi^2} \sum_{m=1,3,5,\ldots} \sum_{n=1,3,5,\ldots} \frac{1}{nm} \frac{\sinh(\pi z \sqrt{n^2+m^2}/a)}{\sinh(\pi \sqrt{n^2+m^2})} \sin \left( \frac{n\pi x}{a} \right) \sin \left( \frac{m\pi y}{a} \right) \]

or, equivalently:

\[ V = \frac{16V_0}{\pi^2} \sum_{m=0}^{\infty} \sum_{n=0}^{\infty} \frac{1}{(2n+1)(2m+1)} \frac{\sinh(\pi z \sqrt{(2n+1)^2+(2m+1)^2}/a)}{\sinh(\pi \sqrt{(2n+1)^2+(2m+1)^2})} \sin \left( \frac{(2n+1)\pi x}{a} \right) \sin \left( \frac{(2m+1)\pi y}{a} \right) \]

Problem 3.22:

Inside of the sphere the potential is

\[ V(r, \theta) = \frac{\sigma_0 r}{2\epsilon_0} \left( P_1(\cos \theta) - \frac{1}{4} \left( \frac{r}{R} \right)^2 P_3(\cos \theta) + \frac{1}{8} \left( \frac{r}{R} \right)^4 P_5(\cos \theta) + \ldots \right). \]

Outside of the sphere the potential is

\[ V(r, \theta) = \frac{\sigma_0 R^3}{2\epsilon_0 r^2} \left( P_1(\cos \theta) - \frac{1}{4} \left( \frac{R}{r} \right)^2 P_3(\cos \theta) + \frac{1}{8} \left( \frac{R}{r} \right)^4 P_5(\cos \theta) + \ldots \right). \]