

Homework 6

Physics 313

Fall 2026

Due Tuesday 20 October 2026, 12:30 PM, as an upload to ELMS
All problems are from Griffiths *Introduction to Electrodynamics* 5th Edition

Exam 1 will be given on Thursday, 22 October, covering Chapters 1 - 3

- 1) Griffiths Problem 3.15 [Potential inside slot with $\pm V_0$ on wall]
- 2) Griffiths Problem 3.19 [Legendre polynomial]
- 3) Griffiths Problem 3.20, part (a) only. [Potential inside the sphere by solving Laplace's equation in spherical coordinates. Note that:
$$\int_0^\pi P_\ell(\cos\theta) \sin\theta d\theta = \int_0^\pi P_0(\cos\theta) P_\ell(\cos\theta) \sin\theta d\theta]$$
- 4) Griffiths Problem 3.23 [Potential outside a charged conducting sphere.
Hint: start with Example 3.8]
- 5) Griffiths Problem 3.29 [Note that the potential is only evaluated on the z-axis. This greatly simplifies the calculation of the angle α .]
- 6) Griffiths Problem 3.31 [Potential due to 4 charges with $Q=0$]
- 7) Griffiths Problem 3.48 [Hint: Use Eq. (3.95) with $\rho d\tau' \rightarrow \lambda dl'$]
- 8) Griffiths Problem 4.1 [Atomic charge displacements]
- 9) Griffiths Problem 4.4 [Attractive force from polarizable atom]

Extra Credit:

A localized distribution of charge has a charge density

$$\rho(\vec{r}) = \frac{1}{64\pi} r^2 e^{-r} \sin^2 \theta$$

Make a multipole expansion of the potential due to this charge density and determine all of the non-zero terms in the expansion. The charge density in this problem is that for the $m = \pm 1$ states of the 2p level in hydrogen. In that case the radial distance is measured in units of the Bohr radius, 0.0529 nm.