

Problems

1. **Practice with Legendre polynomials:** Consider a sphere of radius R (the center is at the origin) where there are no charges inside and outside and any possible charge is on the surface. The potential on the surface is $\phi|_S = V(\cos(\theta))$, θ is the inclination angle, as usual counted from the z -axis.
 - (a) (20 pts) Using the method of separation of variables write down the general solution for the potential inside and outside the sphere as an expansion in Legendre polynomials. Relate the coefficients of the expansion to $\phi|_S$.
 - (b) (15 pts) Find the solution for
$$\phi|_S = V_0 \cos(3\theta).$$
 - (c) (15 pts) Find the electric field at the point $(x = 0, y = 0, z = R/2)$ for the potential in (b).
2. **Summary of course topics (50 pts):** Please compile your *personal summary* of the course topics so far (special relativity and electrostatics up to and including cartesian multipole expansion). This should not just be a list of all possibly useful equations you can find. Your summary should reflect key concepts and the relations between them. Make sure you understand the content of the equations you assemble and how to apply them. (This assignment is intended to support your preparations for the exam. Please try to present a clear view of the topics, but you may want to avoid spending too much time just on perfecting the write-up.)