PHGN361 Exam 1: NAME

1. (a) Using the integral form of Gauss's Law, find the electric field due to a sphere of charge, with radius R and charge density $\rho = Ar$, where A is a constant. Find the field both inside and outside the sphere. (b) Prove that your result is consistent with the differential form of Gauss's Law. Note $\nabla \cdot \vec{v} = \frac{1}{r^2}\frac{\partial}{\partial r}(r^2 v_r) + \frac{1}{r\sin\theta}\frac{\partial}{\partial \theta}(\sin\theta v_\theta) + \frac{1}{r\sin\theta}\frac{\partial}{\partial \phi}v_\phi$

2. A spherical shell of radius R has constant surface charge density $\sigma = \sigma_0 \sin(\theta + \phi)$. Write an **INTEGRAL** expression for the electric field at some arbitrary point $r > R$ due to this charge distribution.

3. **Using separation of variables**, derive an expression for the voltage between an infinite parallel plate capacitor with voltage V_0 on the upper plate and grounded on the lower plate. The plates are separated by distance d. **FOR CREDIT** you need to justify all the steps starting from Laplace's equation. Please put your work on the back of this page.