Eric Du | Physics 110A
Review Questions | Electromagnetism and Optics | May 7, 2023

Chapter 4

- (Griffiths p.189) Book mentions that $\nabla \cdot \mathbf{D} = \rho_f$ and $\nabla \times \mathbf{D} = 0$ only when the space is entirely filled with a homogeneous dielectric – can this argument be extended to say that within a homogeneous dielectric (that is large enough, but E field is nonzero outside), that the same equations hold true?
- (Griffiths p.189) How does $\mathbf{D} = \epsilon_0 \mathbf{E}_{\text{vac}}$ come from the two expressions above it?
- (Griffiths p.192) I thought that ρ_b had to do with polarization, which does not require the presence of free charge. Why must it be the case that if $\rho_f = 0$ then $\rho_b = 0$?
- (Griffiths p.193) Where does the $-E_0 r \cos\theta$ term in Equation 4.45 come from?
  Answer: Comes from the fact that $\mathbf{E} = E_0 \hat{z}$ so therefore using $V = -\int \mathbf{E} \cdot d\mathbf{l}$ you get that $V = -E_0 z = -E_0 r \cos\theta$, since $z = r\cos\theta$.
- (Griffiths p.195) When only given χ_e, should the approach always be to use $\sigma_b = \epsilon_0 \chi_e \mathbf{E}$, then use the $\mathbf{E}$ field at the boundary (due to the bound charge) to solve for σ_b, which then allows us to find $\mathbf{E}$?

Chapter 7

- (Griffiths p.304) Why is it true that if $\sigma = \infty$, then the net force on the charges equals zero? Is this becuase we require $\mathbf{J}$ to be finite and since $\mathbf{J} = \sigma \mathbf{f}$, then if $\sigma = \infty$ then in order for $\mathbf{J}$ to be finite then we require that $\mathbf{f} = 0$?

Chapter 8

- (Griffiths p. 359) Why is it that when $\frac{\mathrm{d}W}{\mathrm{d}t} = 0$, then we can conclude that

$$\int \frac{\partial u}{\partial t} d = -\oint \mathbf{S} \cdot d\mathbf{a}?$$