Warm-Up for February 16th, 2022

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1 Electrostatics

1. (a) Find the electric field $\mathbf{E}$ due to the presence of two charges of strength q, located distances $\pm d/2$ from the origin, at a distance z above the origin. (b) What is the $\mathbf{E}$-field at a position $\mathbf{x}$, where $|\mathbf{x}| > d/2$?

2. Suppose there is an external field $\mathbf{E}_0 = E_0 \hat{z}$. What is the torque on the source charges?

3. (a) Suppose the right charge is negative, and the left charge is positive. What is the new $\mathbf{E}$-field at P? (b) Let $\mathbf{p} = q\mathbf{d}$, where $\mathbf{d}$ points from the positive to the negative charge. Recall that the torque on a system at $\mathbf{r}$, rotated about the origin by a force $\mathbf{F}$ is $\boldsymbol{\tau} = \mathbf{r} \times \mathbf{F}$. Show that the torque on the system is $\boldsymbol{\tau} = \mathbf{p} \times \mathbf{E}_0$.