

Phys. 402

Spring 2010

Qu-Ex 2

A point charge  $q$  makes a simple harmonic motion  $\vec{r}_0(t) = D \cos \omega_0 t \hat{z}$

a) Compute the quadrupole moment

$$Q_{\text{phys}} = \int d\vec{r}' \rho(\vec{r}', t) [3\hat{r}'\hat{r}' - \mathbb{1}r'^2] = \text{Re} [\underline{Q}_0 (1 + e^{-i\omega_0 t})]$$

(15 pts) i) What is  $\omega$ ? (find it in terms of  $\omega_0$ )

(35 pts) ii) What is  $\underline{Q}_0$ ?

(35 pts) b)  $\frac{d\bar{P}}{d\Omega} \Big|_{E2} = \left( \frac{1}{4\pi\epsilon_0} \right) \frac{1}{288\pi} \frac{\omega^6}{c^5} |\vec{Q}_{0\perp}|^2$

with  $\vec{Q}_0 = \underline{Q}_0 \cdot \hat{z}$

compute  $|\vec{Q}_{0\perp}|^2$

(15 pts) c) Why does the computation of  $\frac{d\bar{P}}{d\Omega} \Big|_{E2}$  (ignoring E1) make sense?