Electrostatic equations for Test 2

PHYS 4392
Fall 2012

Deposit these guys in your brain box for safe keeping.

$|e| \simeq 1.60 \times 10^{-19}\,\mathrm{C}$ $\quad$ $\epsilon_0 \simeq 8.85 \times 10^{-12}\,\mathrm{C/m}$ $\quad$ $T_{1year} \simeq \pi \times 10^7\,\mathrm{sec}$

$W = \frac{1}{2}\sum_{i=1}^{n} q_i V(\mathbf{r}_i)$ $\quad$ $W = \frac{1}{2}\int \rho V\, dV'$ $\quad$ $W = \frac{\epsilon_0}{2}\int_{all\ space} E^2\, dV'$

$dW = V\, dq$ $\quad$ capacitor: $W = \frac{1}{2}CV^2$

Potential with azimuthal symmetry:
$V(r,\theta) = \sum_{l=0}^{\infty}\left(A_l r^l + \frac{B_l}{r^{l+1}}\right) P_l(\cos\theta)$

A triplet of legendre polynomials ($x = \cos\theta$):
$P_0(x) = 1 \quad P_1(x) = x \quad P_l(1) = 1$

For points far from the source:
$V(\mathbf{r}) = \frac{1}{4\pi\epsilon_0}\sum_{n=0}^{\infty}\frac{1}{r^{n+1}}\int (r')^n P_n(\cos\theta')\rho(\mathbf{r}')dV'$

Electric dipole moment:
$\mathbf{p} \equiv \int \mathbf{r}'\,\rho(\mathbf{r}')\,dV'$
$V_{\mathrm{dip}}(\mathbf{r}) = \frac{1}{4\pi\epsilon_0}\frac{\mathbf{p}\cdot\hat{\mathbf{r}}}{r^2}$ $\quad$ $\mathbf{E}_{\mathrm{dip}}(\mathbf{r}) = \frac{1}{4\pi\epsilon_0}\frac{1}{r^3}[3(\mathbf{p}\cdot\hat{\mathbf{r}}) - \mathbf{p}]$

$\mathbf{N} = \mathbf{p}\times\mathbf{E}$ $\quad$ $\mathbf{F} = (\mathbf{p}\cdot\nabla)\mathbf{E}$ $\quad$ $U = -\mathbf{p}\cdot\mathbf{E}$

Polarization:
$\sigma_b = \mathbf{P}\cdot\hat{\mathbf{n}}$ $\quad$ $\rho_b = -\nabla\cdot\mathbf{P}$
$\mathbf{D} = \epsilon_0\mathbf{E} + \mathbf{P}$ $\quad$ $\nabla\cdot\mathbf{D} = \rho_f$ $\quad$ $\mathbf{P} = \epsilon_0\chi_e\mathbf{E}$