PHY 207               Practice Test II

Name: _________________________________

Student ID: _____________________________

Answer the first four problems. Partial credits are based on the clarity and the quality of the work you show.

\[ \vec{E} = \frac{kq}{r^2} \hat{r}, \quad k = \frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \text{NM}^2\text{C}^{-2} \]

\[ \vec{F} = q\vec{E} \]

\[ \oint \vec{E} \cdot d\vec{A} = \frac{Q_{in}}{\varepsilon_0} \]

\[ V = \frac{kq}{r}, \quad V = \int \frac{kdq}{r} \]

\[ dV = \frac{du}{q} = -\vec{E} \cdot dl = -(E_x \, dx + E_y \, dy + E_z \, dz), \quad \vec{E} = -\nabla V = -\left( \frac{\partial V}{\partial x} \hat{i} + \frac{\partial V}{\partial y} \hat{j} + \frac{\partial V}{\partial z} \hat{k} \right) \]

\[ V = Ed, C = \frac{Q}{V}, U = \frac{1}{2} \sum q_i V_i, U = \frac{1}{2} CV^2 = \frac{1}{2} \frac{Q^2}{C}, u_e = \frac{1}{2} \varepsilon E^2, \varepsilon = Ke_0 \]

\[ V = IR, P = IV = I^2R, \quad I = \frac{dQ}{dt} = nqvA, \quad J = \frac{I}{A}, \quad E = \rho J, \quad R = \frac{\rho l}{A}, \quad R = R_1 + R_2 + \ldots, \quad \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots \]

\[ I = I_o \exp\left( -\frac{t}{RC} \right) \]

\[ F = qv \times B, \quad dF = Idl \times B, \quad \mu = NIA\hat{n}, \tau = \mu \times B \]

\[ A_{\text{sph}} = 4\pi r^2, \quad V_{\text{sph}} = \frac{4}{3} \pi r^3, \quad dV_{\text{sph}} = 4\pi r^2 \, dr \]

\[ A_{\text{cyl}} = 2\pi rL, \quad A_{\text{cyl}} = \pi r^2, \quad dV_{\text{cyl}} = 2\pi r \, dr \, L \]

\[ dq = \lambda dl = \sigma dA = \rho dV \]
1. The region between two concentric conducting spheres with radii \(a\) and \(b\) is filled with a conducting material of resistivity \(\rho\). A) Find the resistance between the two spheres. 
B) If a current \(I\) flows from the inner sphere to the outer sphere, find the electric field at a given point in between the spheres \((a<r<b)\).
2. In the circuit shown below, find a) the current in the 3.00-Ω resistor; b) the unknown EMFs \( \varepsilon_1 \) and \( \varepsilon_2 \); c) the resistance R. Note the three currents are given.
3. A cylindrical capacitor of length L with inner radius a and outer radius b is charged with +Q on the inner cylinder and −Q on the outer one. A) Find the energy contained within a cylindrical shell of length L with radius r (a<r<b) and thickness dr. B) Find the total electric field energy.
4. A positive charge $q$ and mass $m$ with velocity $v$ enters a region of uniform magnetic field $B$ (into the paper), as shown. If the incident angle is $\theta$. Find the exit angle $\Phi$ and the distance $d$ in terms of given quantities.