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NDU

PHS 212 - Electricity & Magnetism

Faculty of Natural and Applied Sciences Midterm Exam - Spring 2001

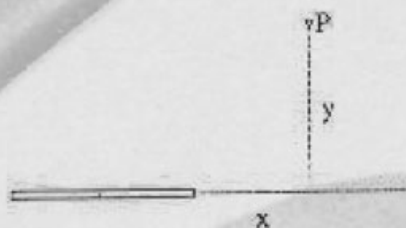
Department of Sciences

Duration: 2 hours

Instructor: Dr. Roger Hajjar

1. (27 pts) A rod of length L carries a uniformly distributed charge q .

- a. Find the potential at point P.
- b. Find the electric field at P.



2. (27 pts) Two capacitors, $C_1 = 450 \mu\text{F}$ and $C_2 = 150 \mu\text{F}$, are charged under potential differences of 100 V and 300 V respectively. Once charged, you disconnect them from the batteries and connect the positive plates together and the negative plates together.

- a. What is the final potential difference between across each capacitor.
- b. Compare the initial (before connection) to the final (after connection) energy stored in the two capacitors. Conclude.
- c. What are the final potential difference and charge for each capacitor if you connect them in the opposite way (positive plate to negative plate)

3. (28 pts) A metal sphere of radius R_1 is surrounded by a concentric dielectric shell of inner radius R_1 and outer radius R_2 . Show that the Capacitance of the metal sphere is

$$C = \frac{4\pi\kappa\epsilon_0 R_1}{1 + (\kappa - 1) \frac{R_1}{R_2}}$$

4. (28 pts) The charge per unit volume ρ in a dielectric sphere of radius R varies according to the relation $\rho = \rho_0(1 - \frac{r}{R})$, where ρ_0 is the charge density at the center of the sphere. Find the magnitude of the electric field for $r \leq R$ and for $r > R$.

$$\oint E dA = \frac{q}{\epsilon_0}$$

$$E 4\pi r^2 = \frac{q}{\epsilon_0}$$



$$E = \frac{q}{4\pi\epsilon_0 r^2} \quad \text{where} \quad q = \int \rho dV = \int_0^r \rho_0(1 - \frac{r}{R}) 4\pi r^2 dr = \dots$$

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