

NDU

Faculty of Natural and Applied Sciences
Department of Sciences

PHS 212 - Electricity & Magnetism

Midterm Exam - Spring 2003

Duration: 2 hours

Instructor: Dr. Roger Hajjar

- ✓ 1. (30pts) A infinite cylinder of radius R is charged with a volume charge density $\rho = \rho_0 r$.
- (8pts) Find the total charge Q inside a radius $r < R$ and length l .
 - (8pts) Find the electric field E inside the cylinder ($r < R$)
 - (6pts) Find the electric field outside of the cylinder ($r > R$)
 - (8pts) Find the potential V inside and outside the cylinder, assuming $V(R) = 0$.
2. (30pts) A conducting spherical shell has inner radius R_1 and outer radius R_2 . A current i is flowing radially outward.
- (15pts) Find the current density j at a radius r , where $R_1 < r < R_2$.
 - (15pts) Find the resistance R of the sphere for the current i .
3. (20 pts) The charge on the surface of a metallic sphere of radius 10 cm is $5 \mu\text{C}$. At the surface of another metallic sphere of radius 20 cm, the charge is also $5 \mu\text{C}$. The spheres are separated by a very large distance. They are then connected by a very thin metallic wire. What is the final charge on each sphere?
4. (25 pts) An air-filled parallel plate capacitor having capacitance $C = 450 \mu\text{F}$ is charged under a potential difference of 200 V. Once charged, the battery is disconnected from the capacitor. A slab of dielectric ($\kappa = 2.5$) of thickness equal to the plate separation is inserted into the capacitor.
- (20pts) Calculate the change in the energy stored in the capacitor.
 - (5pts) Do you have to exert work to insert it or does the capacitor pulls it in?

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$$\epsilon_0 = 8.85 \times 10^{-12} \frac{\text{C}^2}{\text{N} \cdot \text{m}^2}$$