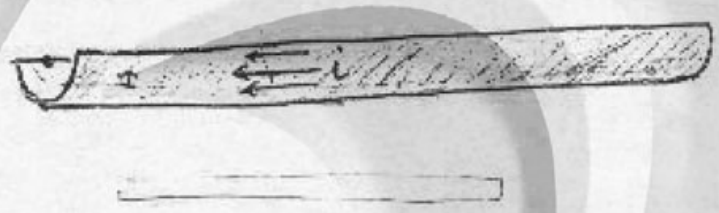
NDU **PHS 212 - Electricity & Magnetism**
Faculty of Natural and Applied Sciences **Final Exam - Spring 2002**
Department of Sciences **Duration: 2 hours**

Instructor: Dr. Roger Hajjar

Solve all problems

1. Three identical charges q are placed on the summit of an equilateral triangle such that two of these charges are located at $(-a,0,0)$ and $(a,0,0)$ (on the x axis), the third is on the z axis at $(0,0,a\sqrt{3})$. Find the potential at a point $P(x,y,z)$ in space. Find the electric field **E** (vector) at point P.

2. An infinite trough has a semicircular cross section of radius R. A current i is uniformely distributed over the cross-section of the trough. Find the direction and magnitude of the magnetic field at the center C of the semi-circular cross-section. (*Hint*: Don't forget that the magnetic field is a vector. Divide your trough into strips that can be considered as infinite wires)



3. An ideal LC circuit oscillates with a frequency of 74 Hz, it is found that at a given time t_1, the current i is equal to 3.5 mA while the charge on the capacitor is 93 μC. At a later time t_2, i=1.2 mA. Find the charge on the capacitor at t_2.

4. A cylindrical wire carries a current with a density $j = j_0(\frac{r^2}{R^2} - 1)$, where R is the radius of the wire. Find the magnetic field **B** at a radius $r < R$.

5. A spherical capacitor carries a charge of 156 μC. Its inner radius is 5 cm and outer radius is 5.12 cm. The inner space is filled with a dielectric having a constant κ=2.6. Find the potential difference across the capacitor.

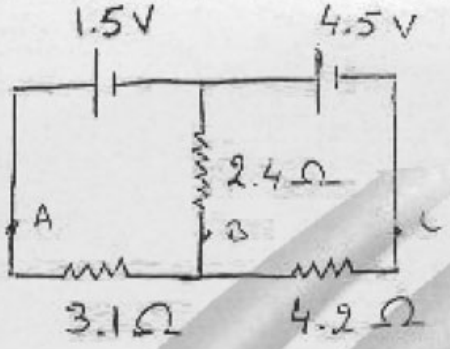
6. For the same situation as problem 5, Find the leakage current through the dielectric if its resistivity is $\rho = 1.2 \times 10^{b}\,\Omega.m$

7. Calculate the different equivalent capacitances that can be obtained from three identical 3μF-capacitors. Draw a diagram for each of the proposed situations.

... the equi... radius ... charge density $\rho = \rho_0(\ldots - 1)$. Find the ... $V(b) = 0$

9. A Toroidal inductor with a square cross-section of inner radius 10 cm and outer radius 11 cm has 1000 loops. The toroid is carrying a current of 5A. What is the fraction of the total energy that is found between the 10 and 10.5 cm radii.

10.(Bonus)Determine the currents at A, B and C. What is the power output of each battery?



$\mu_0 = 4\pi \times 10^{-7} \frac{T.m}{A}$; $\epsilon_0 = 8.85 \times 10^{-12} \frac{C^2}{N.m^2}$; $e = 1.62 \times 10^{-19} C$