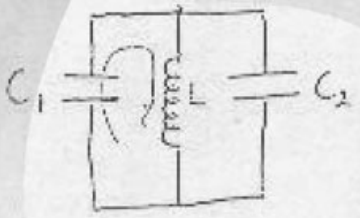
NDU — PHS 212 – Electricity & Magnetism
Faculty of Natural and Applied Sciences — Final Exam – Spring 2001
Department of Sciences — Duration: 2 hours

Instructor: Dr. Roger Hajjar

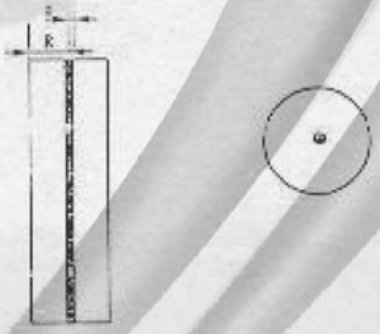
1. A 20–A current flows through a copper plate of thickness 0.52 mm and width 10 mm. A 1.2 T magnetic field is oriented parallel to the thickness, and a Hall voltage of 3.1 μV is measured. Find:
   a. the carrier concentration
   b. the drift speed of the carriers

2. Two charged conducting spheres of unknown radii are placed a large distance from each other. Their total charge is 5μC. They are initially at a potential of +400 V and –400 V. They are then connected by a thin metallic wire. The final potential of the spheres is 100 V. Find their radii.

3. Two capacitors (C_1=6μF and C_2=4μF) are charged under a potential difference of 100V. They are then placed in a LC circuit as shown in the figure. Find the oscillating frequency of the circuit and the maximum emf across the inductor. Take L=1 mH.



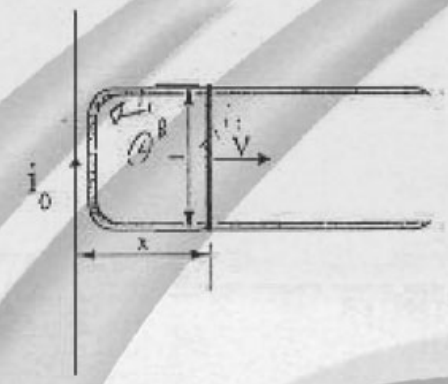
4. Show that the inductance L per unit length of a coaxial cable (shown in the figure) made of two infinite cylinders carrying equal but opposite currents is $\frac{L}{l}=\frac{\mu_0}{2\pi}\ln\left(\frac{R}{a}\right)$



5. A parallel plate capacitor of plate area 30 cm² and separation 0.1 mm is filled with a dielectric of constant 2.3 and resistivity 10^{15} Ω.m. Find the current (known as leakage current) between the two plates if the capacitors is carrying a charge of 0.185 μC.

6. A dielectric cylinder of radius R is carrying charge with a uniform charge density ρ. Find the electric field for $r < R$. If $V(R)=0$, Find the potential $V(r)$ for $r<R$.

7. In the figure shown, a wire of length l and resistance R slides on a U–shaped conductor of negligible resistance. The loop thus formed lies near a long wire that carries a current i_0. Show that the current i_1 in the loop depends on the distance x between the long wire and the moving wire according to the relation $i_1 = \frac{\mu_0 l v i_0}{2\pi R}\frac{1}{x}$.



17 points for each problem