PHYSICS 323 ELECTROMAGNETISM

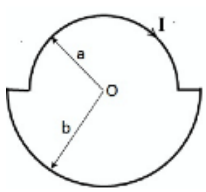
April 26, 2020 Problem Set 4 These 4 problems are due **in Canvas Tuesday, April. 5**

Please put your name and section number on the first page of your solutions.

1. *Charge moving in a circle*

A particle of charge q moves in a circle of radius R at a constant angular velocity ω. The circle lies in the xy plane and at $t = 0$ the particle is at $(0, R)$ on the positive y axis. Find the Lienard-Wiechert potentials for observation points on the positive z axis.

2. *Time-varying planar current path* A planar current path consists of a piece of wire bent into the loop shape shown in the figure.



(a) Determine the magnetic field at the center point O when a constant clockwise current I flows? For (b-d), suppose that I is changing in time as $I(t) = kt$ where k is a positive constant. (b) Calculate the retarded vector potential $\mathbf{A}$ at O.

(c) Use your answer to (b), to find the electric field at O. (d) Is it possible to use your answer to (b) to find the magnetic field at O? Explain.

3. *Electric Flux from uniformly moving point charge*

Consider a point charge, q moving with constant velocity $\mathbf{v}$, and examine the electric flux through a sphere that completely contains the charge at all times.

(a) Does the electric flux leaving the sphere depend on the radius of the sphere? (b) What do you expect the electric flux leaving the sphere to be? Explain. (c) From $\mathbf{E}$ (Griffiths Eqn 10.75), directly evaluate the electric flux leaving the sphere.

4. *Electric Dipole Radiation*

(a) Radio station KUOW-FM broadcasts from the UW campus at a power of 100,000 Watt at a frequency of 94.9 MHz. Estimate the maximum value of the electric field at the position of the Space Needle.

(b) Suppose that in the radiation zone the electric field of an antenna is in the θ direction and is given by $E_\theta = \frac{V_0}{r}\sin\theta\cos\omega(t - r/c)$. Determine the magnetic field.

(c) Use the answer to(b) to determine the total power radiated.