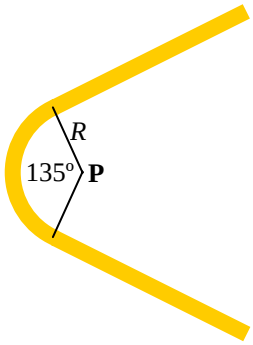
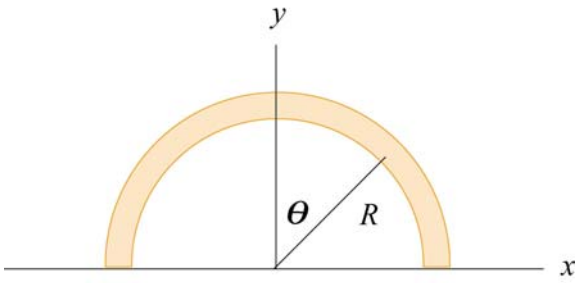
Electric Fields and Continuous Charge Distributions
Challenge Problems

Problem 1:
Two thin, semi-infinite rods lie in the same plane. They make an angle of 45º with each other and they are joined by another thin rod bent along an arc of a circle of radius R, with center at P. All the rods carry a uniform charge distribution of λ [C/m]. Find the electric field at point P.



Problem 2:

A positively charged wire is bent into a semicircle of radius R, as shown in the figure below.



The total charge on the semicircle is Q. However, the charge per unit length along the semicircle is non-uniform and given by $\lambda = \lambda_0 \cos\theta$.

a) What is the relationship between λ_0, R and Q?

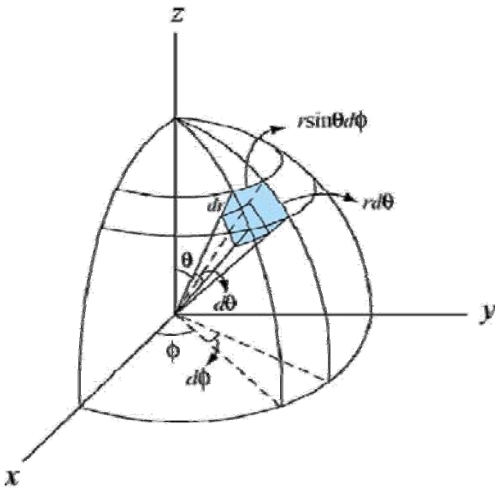
b) If a particle with a charge q is placed at the origin, what is the total force on the particle? Show all your work including setting up and integrating any necessary integrals.

Problem 3:

A cylindrical tube of length L, radius R carries a charge Q uniformly distributed over its outer surface. Find the electric field on the axis of the tube at one of its ends.

Problem 4:

A hemispherical Plexiglas shell of radius *R* carries a charge *Q* uniformly distributed over its surface.



(a) Find the electric field at the "center" of the hemisphere (that is, the center of the sphere from which the hemisphere was cut). HINT: You may be tempted to use the "Ring of Charge" result from class. It's actually much easier to just figure out what d*q* is, parameterizing your location of the hemisphere with θ and ϕ.

8.02SC Physics II: Electricity and Magnetism

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