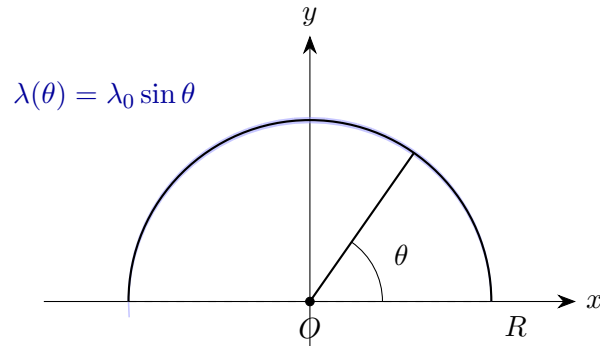


Problem 1: Charged Half Ring

Consider a half ring (semicircular arc) of radius R whose diameter lies along the x -axis. The arc carries a non-uniform linear charge density

$$\lambda(\theta) = \lambda_0 \sin \theta,$$

where θ is measured from the positive x -axis. Find the electric field at the centre of the circle formed by the half ring.

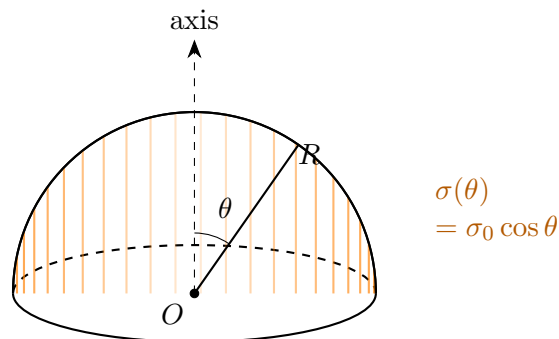


Problem 2: Charged Hemisphere

Consider a hemispherical shell of radius R with a non-uniform surface charge density

$$\sigma(\theta) = \sigma_0 \cos \theta,$$

where θ is the polar angle measured from the symmetry axis of the hemisphere. Find the electric field at the centre of the base (flat circular face) of the hemisphere.



Problem 3: Ring and Rod on Axis

A thin ring of radius R carries a uniform charge $+Q$ and lies in the xy -plane. A thin rod carrying a uniform charge $-Q$, of length $2L$, is placed along the z -axis (perpendicular to the plane of the ring, i.e. along the ring's axis) such that the midpoint of the rod coincides with the centre of the ring.

- (a) Is the equilibrium of the rod at the centre of the ring stable or unstable?
- (b) If it is stable, what is the frequency of small oscillations about the equilibrium position?

