

Week 9, Day 1 Problems

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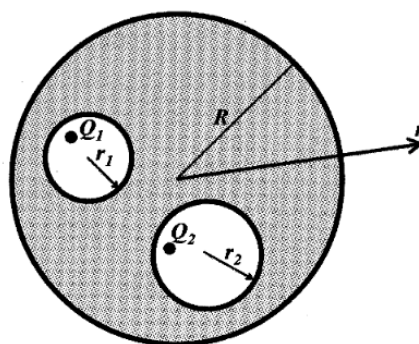
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1 Potential Midterm Potentials

1.1 Conductors

An uncharged solid conducting sphere of radius R , centered at the origin, contains two spherical cavities of radii r_1 and r_2 , respectively. Point charge Q_1 is then placed within the cavity of radius r_1 , and point charge Q_2 is then placed within the cavity of radius r_2 , as shown below. Determine the resulting electric field vector for $r > R$, where r is the distance from the origin.

(Source: Birgeneau Fall 2015 Midterm 2, Problem 2)

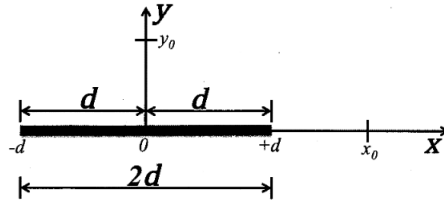


1.2 Rods

Consider a thin rod of length $2d$ centered on the x -axis as shown. The rod has a non-uniform linear charge distribution $\lambda = ax$. Determine the potential V for

- (a) a point along the y -axis at a distance y_0 from the origin
- (b) points along the x -axis outside the rod, at a distance x_0 from the origin

(Source: Birgeneau Fall 2015 Midterm 2, Problem 3)



1.3 Connected Conductors

Two conducting globes (spherical shells) with radii r_1 and r_2 , with $r_2 = 2r_1$, are joined by a long thin wire. +ve charge is steadily added to the system until a faint glow is seen around one of the spheres, a consequence of ionisation of the air nearby. Which is it? (no credit for simply giving the answer without proof).

(Source: Bloxham Summer 2015 Midterm 2, Problem 2)

1.4 The Slab

The figure shows an infinite slab of charge that has a width, d , and within which the charge density, $\rho(x) = \rho_0 \cos\left(\frac{n\pi x}{d}\right)$.

- The electric field is zero for $x \leq 0$ **and** $x \geq d$. What, then, are the possible values of n ?
- Take $V(0) = 0$. Under the conditions in part a, what is the electric potential, $V(x)$, inside the slab (for $0 \leq x \leq d$)? Express it in terms of n , π , ρ_0 , ϵ_0 , d , and x .

(Source: Speliotopoulos Spring 2014 Midterm 2, Problem 2)

