ADVANCED PHYSICS CLUB

MARCH 9, 2025

Useful resources

The updates, homework assignments, and useful links for APC can be found on SchoolNova's web page:
`https://schoolnova.org/nova/classinfo?class_id=adv_phy_club&sem_id=ay2024`
The practical information about the club and contacts can be found on the same web page.

Today's meeting

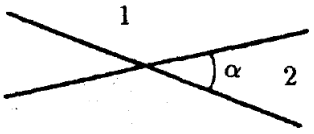
We solved all problems on Coulomb's law. Our next topic is Gauss's law.

Homework

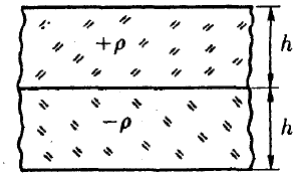
1. Using Gauss's law find the electric field
   (a) of a uniformly charged sphere of radius R with charge Q both inside and outside of the sphere;
   (b) of a uniformly charged straight infinite thread with linear charge density λ;
   (c) of a uniformly charged infinite plane with surface charge density σ;
   (d) of a uniformly charged ball of radius R with volume charge density ρ both inside and outside of the ball.

2. Find the electric field between two infinite planes uniformly charged with surface densities $\pm\sigma$. What is the electric field outside the planes? What if both planes are charged with the same surface density σ?

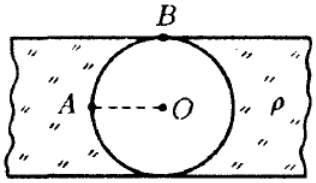
3. Two infinite planes intersect at an angle α. They are uniformly charged with surface densities $\pm\sigma$. Find the electric field strength in regions 1 and 2 ,as shown in the figure.



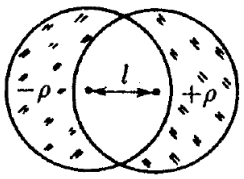
4. Two infinite slabs are uniformly charged with volume densities $\pm\rho$ and are placed next to each other. The thickness of each slab is h. Where is the electric field the strongest? Find the maximum value of the electric field.



5. A spherical region is removed from an infinite slab of thickness h, as shown in the figure. The slab is uniformly charged with volume density ρ. What are the electric field strengths at points A and B? How does electric field depend on the distance from point O as we move along the line OA ?



***6.** a) When two balls of radius R are located at the distance between the centers $l < 2R$ they form two "crescents" (see figure). The "crescents" have uniform volume charge densities $-\rho$ on the left and ρ on the right. Prove that electric field in the intersection region (which is empty) is uniform and find this electric field.
b) By considering a limit such that $l \to 0$, $\rho \to \infty$, $l\rho = const$ find a distribution of charge on the surface of a sphere that produces a uniform electric field inside the sphere.



For the next meeting

IMPORTANT: The next club's meeting is at **2:30pm**, **in person**, on Sunday, **March 16**.