ADVANCED PHYSICS CLUB
APRIL 10, 2022

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=ay2021
The practical information about the club and contacts can be found on the same web page.

TODAY'S MEETING

We continue the discussion about electricity and magnetism. The new assignment is about dielectric materials.

HOMEWORK

1. Initially empty space between the plates of a capacitor was filled with a dielectric material with dielectric constant ε. How did the capacity change because of this?

2. The space between the plates of a parallel plate capacitor is filled with two different dielectric materials in two layers (see the figure). The first material has dielectric constant ε_1 and thickness d_1; the second material has ε_2 and d_2 respectively. The area of the plates is A. Find capacity of this capacitor. What is the charge induced on the interface between the two dielectric materials if the plates are charged with $\pm q$?
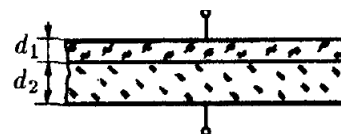
3. A thin plate is made of a dielectric material with the dielectric constant ε. This plate is placed in a uniform electric field E_0 so that the normal to the plate makes angle α with E_0. Find the electric field inside the plate.
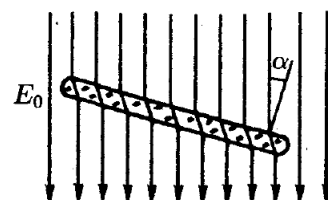
4. A thin plate with area A, thickness d and dielectric constant ε is placed at a distance R from a point charge Q. The plate is perpendicular to the direction towards the charge. R is very large compared to the linear size of the plate. Find the force acting between the plate and the charge. Do they attract or repel each other?

5. A capacitor with capacity C is connected to a battery providing a constant voltage V. How much heat will be released in the capacitor if it is filled with a dielectric material with dielectric constant ε?

*6. A dielectric slab of thickness d and transverse dimensions $a \times b$ $(a, b \gg d)$ is partially inserted in a parallel plate capacitor of the same dimensions. Along the b direction they are fully aligned and along the a direction the slab is inside the capacitor by distance x (see the figure). Dielectric constant of the material is ε, the capacitor plates are charged with $\pm Q$. What is the force acting on the slab? Is it pulled further in the capacitor or pushed out of it by this force?
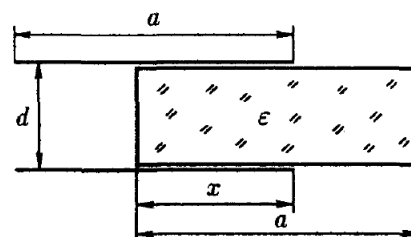
FOR THE NEXT MEETING

IMPORTANT: The next club's meeting is at 3:00pm, via Zoom, on Sunday, **April 24**.