

Unit 9 - Week 8

Course outline

How does an NPTEL online course work?

Week 1

Week 2

Week 3

Week 4

Week 5

Week 6

Week 7

Week 8

Electric polarization and bound charges

Electric displacement vector and Gauss law

Boundary conditions on the displacement vector and linear dielectric materials

Parallel plate capacitors

Energy in dielectric materials

Force on dielectric materials

Quiz : Assignment 8

Week 8 Feedback : Electromagnetism

Week 9

Week 10

Week 11

Week 12

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Lecture materials

Assignment 8

The due date for submitting this assignment has passed. As per our records you have not submitted this assignment.

Due on 2020-03-25, 23:59 IST.

Bound Charges

A sphere of radius R carries a polarization $\vec{P}(\vec{r}) = k\vec{r}$, where k is the constant and \vec{r} is the vector from the center.

1) What is the bound charges σ_b and ρ_b ?

4 points

- $\sigma_b = kR^2, \rho_b = 3kR$
- $\sigma_b = kR, \rho_b = -3k$
- $\sigma_b = kR/4, \rho_b = 3k$
- $\sigma_b = kR, \rho_b = 4k$

No, the answer is incorrect. Score: 0

Accepted Answers:
 $\sigma_b = kR, \rho_b = -3k$

2) Find the field inside and outside the sphere.

5 points

- $r < R, \vec{E} = -\frac{k}{\epsilon_0}\vec{r}$
- $r > R, \vec{E} = 0$
- $r < R, \vec{E} = \frac{k}{\epsilon_0}\vec{r}$
- $r > R, \vec{E} = 0$
- $r < R, \vec{E} = 0$
- $r > R, \vec{E} = \frac{k}{\epsilon_0}\vec{r}$
- $r < R, \vec{E} = -\frac{k}{\epsilon_0}\vec{r}$
- $r > R, \vec{E} = \frac{k}{\epsilon_0}\vec{r}$

No, the answer is incorrect. Score: 0

Accepted Answers:
 $r < R, \vec{E} = -\frac{k}{\epsilon_0}\vec{r}$

$r > R, \vec{E} = 0$

3) Dielectrics

6 points

A sphere of linear dielectric material has embedded in it a uniform free charge density ρ . Find the potential at the center of the sphere (relative to infinity), if its radius is R and its dielectric constant is ϵ_r .

- $V = \frac{\rho R^2}{3\epsilon_0} \left(1 + \frac{1}{2\epsilon_r}\right)$
- $V = \frac{\rho R^2}{\epsilon_0} \left(1 + \frac{1}{\epsilon_r}\right)$
- $V = \frac{\rho R^2}{3\epsilon_0} \left(1 + \frac{1}{\epsilon_r}\right)$
- $V = \frac{\rho R^2}{3\epsilon_0}$

No, the answer is incorrect. Score: 0

Accepted Answers:
 $V = \frac{\rho R^2}{3\epsilon_0} \left(1 + \frac{1}{2\epsilon_r}\right)$

4) Coaxial cable

5 points

A certain coaxial cable consists of a copper wire, radius a , surrounded by a concentric copper tube. The inner and outer radii of the tube is b and c . The space between is partially filled (from b out to c) with material of dielectric constant ϵ_r . Find the capacitance per unit length of this cable.

- $c = \frac{2\pi\epsilon_0}{\exp\left(\frac{b}{a}\right)}$
- $c = \frac{2\pi\epsilon_0}{\ln\left(\frac{b}{a}\right) + \frac{1}{\epsilon_r} \ln\left(\frac{c}{b}\right)}$
- $c = \frac{2\pi\epsilon_0}{\left(\frac{b}{a}\right) + \frac{1}{\epsilon_r} \ln\left(\frac{c}{b}\right)}$
- $c = \frac{2\pi\epsilon_0}{\ln\left(\frac{a}{b}\right)}$

No, the answer is incorrect. Score: 0

Accepted Answers:
 $c = \frac{2\pi\epsilon_0}{\ln\left(\frac{b}{a}\right) + \frac{1}{\epsilon_r} \ln\left(\frac{c}{b}\right)}$