

Unit 5 - Week 4

Course outline

How does an NPTEL online course work?

Week 1

Week 2

Week 3

Week 4

- Tutorial on vector calculus and curvilinear coordinates
- Introduction to electrostatics
- Continuous charge distribution: Line charge
- Electric field due to a line charge distribution
- Electric field lines, Flux, Gauss law
- Application of Gauss law with cylindrical symmetry
- Application of Gauss law on a flat 2D surface

Quiz : Assignment 4

- Week 4 Feedback : Electromagnetism

Week 5

Week 6

Week 7

Week 8

Week 9

Week 10

Week 11

Week 12

Download Videos

Lecture materials

Assignment 4

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

Due on 2020-02-26, 23:59 IST.

Electric field due to line charge distribution

1) The electric field a distance z above one end of a straight line segment of length L that carries a uniform line charge λ may be expressed as **4 points**

$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{\lambda}{z} \left[\left(-1 + \frac{z}{\sqrt{z^2 + L^2}} \right) \hat{x} + \left(\frac{L}{\sqrt{z^2 + L^2}} \right) \hat{z} \right]$

$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{\lambda}{z} \left[\left(1 - \frac{z}{\sqrt{z^2 + L^2}} \right) \hat{x} + \left(\frac{L}{\sqrt{z^2 + L^2}} \right) \hat{z} \right]$

$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{\lambda}{z} \left[\left(1 - \frac{z^2}{\sqrt{z^2 + L^2}} \right) \hat{x} + \left(\frac{L}{\sqrt{z^2 + L^2}} \right) \hat{z} \right]$

$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{\lambda}{z} \left[\left(-1 + \frac{z}{\sqrt{z^2 + L^2}} \right) + \left(\frac{L}{\sqrt{z^2 + L^2}} \right) \right] \hat{z}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{\lambda}{z} \left[\left(-1 + \frac{z}{\sqrt{z^2 + L^2}} \right) \hat{x} + \left(\frac{L}{\sqrt{z^2 + L^2}} \right) \hat{z} \right]$

2) The electric field a distance z above the center of a square loop (side a) carrying uniform line charge λ is given as **5 points**

$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{\lambda a z}{(z^2 + a^2)\sqrt{z^2 + a^2/2}} \hat{z}$

$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{4\lambda a z}{(z^2 + a^2)\sqrt{z^2 + a^2/2}} \hat{z}$

$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{4\lambda a z}{(z^2 + a^2/4)\sqrt{z^2 + a^2/2}} \hat{z}$

$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{4\lambda a z}{(z^2 + a^2/4)\sqrt{z^2 + a^2/4}} \hat{z}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{4\lambda a z}{(z^2 + a^2/4)\sqrt{z^2 + a^2/2}} \hat{z}$

3) The electric field a distance z above the center of a flat circular loop of radius r that carries a uniform line charge is expressed as **5 points**

$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{\lambda r z}{(z^2 + r^2)\sqrt{z^2 + r^2/2}} \hat{z}$

$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{\lambda(2\pi r)z}{r^2 + z^2} \hat{z}$

$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{\lambda(\pi r^2)z}{(r^2 + z^2)^{3/2}} \hat{z}$

$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{\lambda(2\pi r)z}{(r^2 + z^2)^{3/2}} \hat{z}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{\lambda(2\pi r)z}{(r^2 + z^2)^{3/2}} \hat{z}$

Gauss law in spherical coordinate system

Suppose the electric field in some region is found to be $\vec{E} = kr^3\hat{r}$, in spherical coordinates. k is a constant

4) The charge density ρ is **3 points**

$5\epsilon_0kr^2$

ϵ_0kr^2

$5\epsilon_0kr$

$5\epsilon_0kr^3$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$5\epsilon_0kr^2$

5) The total charge contained in a sphere of radius R centered at the origin is **4 points**

$\frac{5}{4}\pi\epsilon_0kR^5$

$4\pi\epsilon_0kR^5$

$\pi\epsilon_0kR^3$

$4\pi\epsilon_0kR^4$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$4\pi\epsilon_0kR^5$

6) Gauss law in sphere :

A sphere of radius R carries a charge density proportional to the distance from the origin: $\rho = kr$, k is a constant. The electric field inside the sphere is **5 points**

$\vec{E} = \frac{1}{4\pi\epsilon_0} \pi k r^3 \hat{r}$

$\vec{E} = \frac{1}{4\pi\epsilon_0} \pi k R^2 \hat{r}$

$\vec{E} = \frac{1}{4\pi\epsilon_0} \pi k r^2 \hat{r}$

$\vec{E} = \frac{1}{4\epsilon_0} k R^4 \hat{r}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$\vec{E} = \frac{1}{4\pi\epsilon_0} \pi k r^2 \hat{r}$

Spherical shell A thick spherical shell carries a charge density

$$\rho = \frac{k}{r^2} \quad (a \leq r \leq b)$$

7) The electric field in the region $r < a$ is **2 points**

$\vec{E} = 0$

$\vec{E} = \frac{1}{4\pi\epsilon_0} \pi k r^3 \hat{r}$

$\vec{E} = \frac{k}{\epsilon_0} \left(\frac{b-a}{r^2} \right) \hat{r}$

$\vec{E} = \frac{k}{\epsilon_0} \left(\frac{r-a}{r^2} \right) \hat{r}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$\vec{E} = 0$

8) The electric field in the region $a < r < b$ is **3 points**

$\vec{E} = 0$

$\vec{E} = \frac{1}{4\pi\epsilon_0} \pi k r^3 \hat{r}$

$\vec{E} = \frac{k}{\epsilon_0} \left(\frac{b-a}{r^2} \right) \hat{r}$

$\vec{E} = \frac{k}{\epsilon_0} \left(\frac{r-a}{r^2} \right) \hat{r}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$\vec{E} = \frac{k}{\epsilon_0} \left(\frac{r-a}{r^2} \right) \hat{r}$

9) The electric field in the region $r > b$ is **3 points**

$\vec{E} = 0$

$\vec{E} = \frac{1}{4\pi\epsilon_0} \pi k r^3 \hat{r}$

$\vec{E} = \frac{k}{\epsilon_0} \left(\frac{b-a}{r^2} \right) \hat{r}$

$\vec{E} = \frac{k}{\epsilon_0} \left(\frac{r-a}{r^2} \right) \hat{r}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$\vec{E} = \frac{k}{\epsilon_0} \left(\frac{b-a}{r^2} \right) \hat{r}$