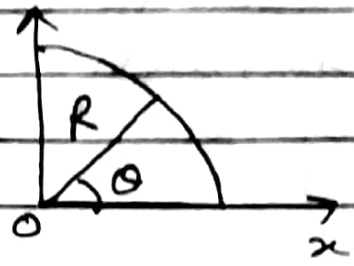
Problem's Electrostatics

Q.1. A segment of circular wire of radius R extending from $\theta = 0$ to $\pi/2$, carries a const linear charge density λ. The electric field at origin O is

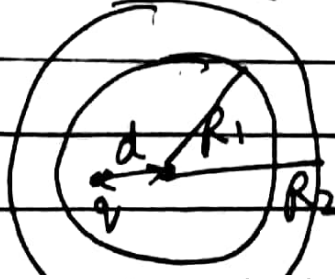


Q.2. An electric field $E(r) = (\alpha \hat{r} + \beta \sin\theta \cos\phi \hat{\phi})$ exists in space. What will be total charge enclosed in sphere of unit radius centered at origin

Q.3 The magnetic field associated with the electric field vector $\vec{E} = E_0 \sin(kz - \omega t)\hat{i}$

Q.4. A ring of radius R carries a linear charge density λ. It is rotating with angular speed ω. Find magnetic field at its centre

Q.5. A hollow, conducting spherical shell of inner radius R_1 and outer radius R_2 encloses a charge q inside, which is located at a distance $d < R_1$ from a centre of sphere. The potential at the centre of shell (determine).



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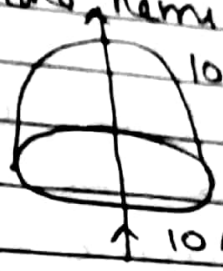
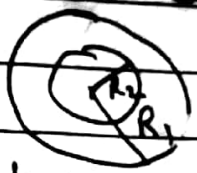
The shape of dielectric lamina is defined by two curves $y=0$, and $y = 1 - x^2$. Charge density of the lamina $\rho = 15y\ C/m^2$. Then the total charge on the lamina will be.

A current $I = 10\ A$ flows in an infinitely long wire along the axis of hemisphere. The value of $\int (\nabla \times B) \cdot ds$ over the hemispherical surface



Consider two single turn, coplanar, concentric coil of radius R_1 and R_2 $R_1 \gg R_2$. The mutual inductance between two coils calculate.



Q.9. The electric field of electromagnetic wave is given by

$$\vec{E} = (2\hat{i} - 3\hat{j}) \times 10^{-3} \sin\left[10^7 (x + 2y + 3z - \beta t)\right]$$

Find the value of β.

Q.10 A sphere of radius R has uniform charge density ρ. A sphere of smaller radius $R/2$ is cut out from original sphere. The centre of sphere cut out lies at $z = R/2$. After the smaller sphere has been cut out. The magnitude of electric field at $z = -R/2$ is $\frac{\rho R}{n\varepsilon_0}$ Find the value of n.

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Q.11. A long solenoid is carrying a time dependent current such that the magnetic field inside has form $B(t) = B_0 t^2 \hat{k}$. Find the displacement current at P.

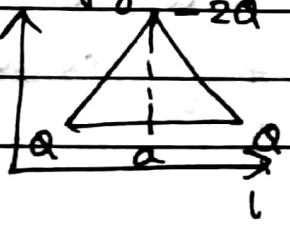
Q.12. Given a spherically symmetric charge density, $\rho(r) = \begin{cases} kr^2 & r < R \\ 0 & r > R \end{cases}$. Find the electric field for $r < R$. Take total charge as Q.

Q.13. A static spherically symmetric charge distribution is given by $\rho(r) = \frac{A}{r} e^{-kr}$

Find the electrostatic potential corresponding to this charge distribution with r.

Q.14. A static charge distribution gives rise to an electric field of the form $\vec{E} = \alpha (1 - e^{r/R}) \frac{\hat{r}}{r^2}$. Find the charge contain with in a sphere of radius R centred at the origin.

Q.15. Charges Q, Q, -2Q are placed on the vertices of an equilateral triangle ABC of side length a. Find the dipole moment of this configuration of charge



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