

B.Sc. (Hon) Physics IInd Sem.
Assignment

Electricity and Magnetism

Q.1 A spherical charge distribution is given by $\rho(r) = \rho_0 \left(1 - \frac{r}{a}\right)$ for $r \leq a$ and $\rho(r) = 0$ for $r \geq a$. Derive an expression for electric field intensity E at a point inside the sphere? For what value of r is $E_{\max}$? ' ρ ' and ' a ' are volume charge density and radius of spherical charge distribution and ' r ' is the distance from its centre?

Q.2 The intensity of electric field at a point is given by $\vec{E} = 6xy\hat{i} + (3x^2 - 3y^2)\hat{j} + 4z\hat{k}$ N/C. Calculate the amount of work done by the field in taking a unit charge from the origin to the point (x, y, z) . if $(x, y, z) = (1, 1, 1)$. Find the work done for a charge of 1 Coulomb?

Q.3 If the potential at any point due to a dipole is $V = \frac{1}{4\pi\epsilon_0} \frac{\vec{P} \cdot \vec{r}}{r^3}$. then prove that electric field,

is
$$\vec{E} = \frac{1}{4\pi\epsilon_0} \left[\frac{3(\vec{P} \cdot \vec{r})\vec{r}}{r^5} - \frac{\vec{P}}{r^3} \right]$$

Also find the value of Electric field on the axis and on the line normal to the axis of the dipole. (using above formula)

Continue.

Q.4(ii) Using Poisson equation, find the charge density in a region of space where electrostatic potential is given by $V = a - b(x^2 + y^2) - c \log(x^2 + y^2)$

(ii) Show that $V = x^2 + y^2 - 2z^2$ satisfies Laplace equation.

Q.5. A point charge $+q$ is placed at a distance ' d ' from the center of earthed conducting sphere of radius R . Applying the method of electrical image to calculate

- (i) Strength of image charge and its position in the sphere
- (ii) Electric field on the sphere
- (iii) Surface density induced on the sphere
- (iv) The force between the charge $+q$ and the induced charge on the sphere?



Dr. Nidhi Tyagi

Assignment

Electricity & Magnetism

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