DPP - 6

Application of Gauss's Law

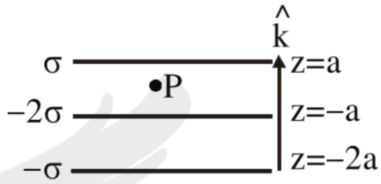
Q.1 A sphere of radius R has charge density given by $\rho = \rho_0\left(1 - \frac{nr}{3R}\right)$, where ρ_0 is a constant, r is distance from centre of sphere. For a spherical gaussian surface of radius R centered at the centre of sphere, the flux is zero. Find ' n '.

Q.2 A sphere of radius R carries charge density proportional to the square of the distance from the center: $\rho = Ar^2$, where A is a positive constant. At a distance of R/2 from the center, the magnitude of the electric field is :-

(A) $A/4\pi\varepsilon_0$ (B) $AR^3/40\varepsilon_0$

(C) $AR^3/24\varepsilon_0$ (D) $AR^3/5\varepsilon_0$

Q.3 Three large parallel plates have uniform surface charge densities as shown in the figure. What is the electric field at P?



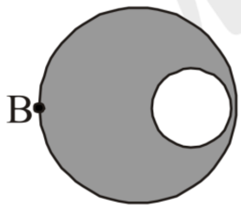
(A) $-\frac{4\sigma}{\epsilon_0}\hat{k}$ (B) $\frac{4\sigma}{\epsilon_0}\hat{k}$

(C) $-\frac{2\sigma}{\epsilon_0}\hat{k}$ (D) $\frac{2\sigma}{\epsilon_0}\hat{k}$

Q.4 A system consists of uniformly charged sphere of radius R and a surrounding medium filled by a charge with the volume density $\rho = \frac{\alpha}{r}$, where α is a positive constant and r is the distance from the centre of the sphere. The charge of the sphere for which electric field intensity E outside the sphere is independent of r is

(A) $\frac{\alpha}{2\epsilon_0}$ (B) $\frac{2}{\alpha\epsilon_0}$ (C) $2\pi\alpha R^2$ (D) αR^2

Q.5 A positively charged sphere of radius r_0 carries a volume charge density ρ_E (Figure). A spherical cavity of radius $r_0/2$ is then scooped out and left empty, as shown. What is the direction and magnitude of the electric field at point B ?



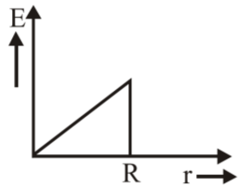
(A) $\frac{17\rho r_0}{54\epsilon_0}$ left

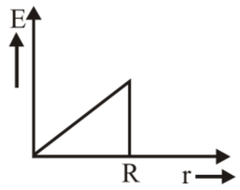
(B) $\frac{\rho r_0}{6\epsilon_0}$ left

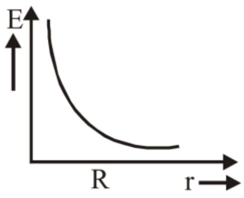
(C) $\frac{17\rho r_0}{54\epsilon_0}$ right

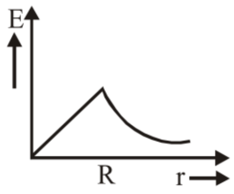
(D) $\frac{\rho r_0}{6\epsilon_0}$ right

Q.6 In a uniformly charged sphere of total charge Q and radius R, the electric field E is plotted as a function of distance from the centre. The graph which would correspond to the above will be :-

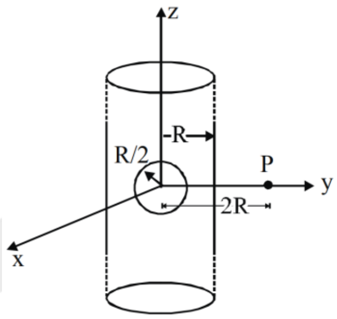
(A) 

(B) 

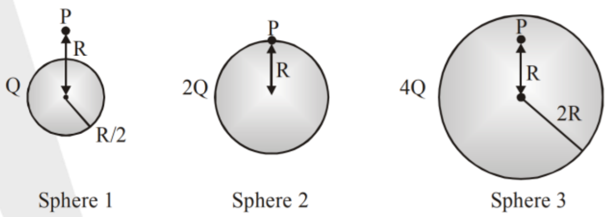
(C) 

(D) 

Q.7 An infinitely long solid cylinder of radius R has a uniform volume charge density ρ. It has a spherical cavity of radius R/2 with its centre on the axis of the cylinder, as shown in the figure. The magnitude of the electric field at the point P, which is at a distance 2R from the axis of the cylinder, is given by the expression $\frac{23\rho R}{16k\varepsilon_0}$. The value of k is



Q.8 Charges Q, 2Q and 4Q are uniformly distributed in three dielectric solid spheres 1,2 and 3 of radii R/ 2, R and 2R respectively, as shown in figure. If magnitudes of the electric fields at point P at a distance R from the centre of spheres 1,2 and 3 are E_1, E_2 and E_2 respectively, then



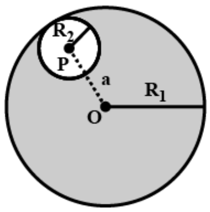
(A) $E_1 > E_2 > E_3$

(B) $E_3 > E_1 > E_2$

(C) $E_2 > E_1 > E_3$

(D) $E_3 > E_2 > E_1$

Q.9 Consider a uniform spherical distribution of radius R_1 centred at the origin O. In this distibution, a spherical cavity of radius R_2, centred at P with distance $OP = a = R_1 - R_2$ (see figure) is made. If the electric field inside the cavity at position $\vec{r}$ is $\vec{E}(\vec{r})$, then the correct statement(s) is(are):



(A) $\vec{E}$ is uniform, its magnitude is independent of R_2 but its direction depends on $\vec{r}$

(B) $\vec{E}$ is uniform, its magnitude depends on R_2 and its direction depends on $\vec{r}$

(C) $\vec{E}$ is uniform, its magnitude is independent of a but its direction depends on $\vec{a}$

(D) $\vec{E}$ is uniform and both its magnitude and direction depend on $\vec{a}$

ANSWER KEY

1.	(4)	**2.**	(B)	**3.**	(C)	**4.**	(C)	**5.**	(A)	**6.**	(4)	**7.**	(6)
8.	(C)	**9.**	(D)										