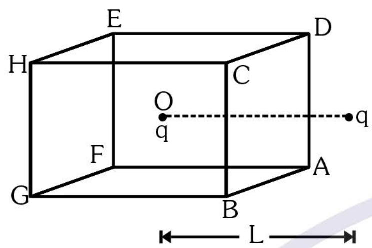
PREVIOUS YEARS' QUESTIONS — EXERCISE-II

1. A charged particle q is placed at the centre O of cube of length L (ABCDEFGH). Another same charge q is placed at a distance L from O. Then the electric flux through ABCD is- **[AIEEE-2002]**



(1) $q/4\pi\epsilon_0 L$ (2) zero

(3) $q/2\pi\epsilon_0 L$ (4) $q/3\pi\epsilon_0 L$

2. A thin spherical conducting shell of radius R has a charge q. Another charge Q is placed at the centre of the shell. The electrostatic potential at a point P at a distance R/2 from the centre of the shell is- **[AIEEE-2003]**

(1) $\frac{2Q}{4\pi\epsilon_0 R}$

(2) $\frac{2Q}{4\pi\epsilon_0 R} - \frac{2q}{4\pi\epsilon_0 R}$

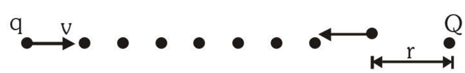
(3) $\frac{2Q}{4\pi\epsilon_0 R} + \frac{q}{4\pi\epsilon_0 R}$

(4) $\frac{(q+Q)}{4\pi\epsilon_0}\frac{2}{R}$

3. Two spherical conductors B and C having equal radii and carrying equal charges in them repel each other with a force F when kept apart at some some distance. A third spherical conductor having same radius as that of B but uncharged, is brought in contact with B, then brought in contact with C and finally removed away from both. The new force of repulsion between B and C is-**[AIEEE-2004]**

(1) $\frac{F}{4}$ (2) $\frac{3F}{4}$ (3) $\frac{F}{8}$ (4) $\frac{3F}{8}$

4. A charged particle q is shot towards another charged particle Q which is fixed, with a speed v. It approaches Q upto a closest distance r and then returns. If q was given a speed 2v, the closest distance of approach would be- **[AIEEE-2004]**



(1) r (2) 2r (3) r/2 (4) r/4

5. Four charges equal to –Q are placed at the four corners of a square and a charge q is at its centre. If the system is in equilibrium, the value of q is- **[AIEEE-2004]**

(1) $-\frac{Q}{4}(1+2\sqrt{2})$ (2) $\frac{Q}{4}(1+2\sqrt{2})$

(3) $-\frac{Q}{2}(1+2\sqrt{2})$ (4) $\frac{Q}{2}(1+2\sqrt{2})$

6. Two point charges + 8q and – 2q are located at x = 0 and x = L respectively. The location of a point on the x-axis at which the net electric field due to these two point charges is zero is- **[AIEEE-2005]**

(1) 2L (2) $\frac{L}{4}$

(3) 8L (4) 4L

7. Two thin wire rings each having a radius R are placed at a distance d apart with their axes coinciding. The charges on the two rings are +q and –q. The potential difference between the centres of the two rings is- **[AIEEE-2005]**

(1) $\frac{qR}{4\pi\epsilon_0 d^2}$

(2) $\frac{q}{2\pi\epsilon_0}\left[\frac{1}{R} - \frac{1}{\sqrt{R^2+d^2}}\right]$

(3) zero

(4) $\frac{q}{4\pi\epsilon_0}\left[\frac{1}{R} - \frac{1}{\sqrt{R^2+d^2}}\right]$

8. An electric dipole is placed at an angle of 30° to a non-uniform electric field. The dipole will experience- **[AIEEE-2006]**

(1) a translational force only in the direction of the field

(2) a translational force only in a direction normal to the direction of the field

(3) a torque as will as a translational force

(4) a torque only

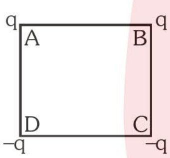
9. Two spherical conductors A and B of radii 1 mm and 2 mm are separated by a distance of 5 cm and are uniformly charged. If the spheres are connected by a conducting wire then in equilibrium condition, the ratio of the magnitude of the electric fields at the surfaces of spheres A and B is- **[AIEEE - 2006]**

(1) 4 : 1 (2) 1 : 2
(3) 2 : 1 (4) 1 : 4

10. An electric charge 10^{-3} μC is placed at the origin (0, 0) of X-Y coordinate system. Two points A and B are situated at $(\sqrt{2}, \sqrt{2})$ and (2, 0) respectively. The potential difference between the points A and B will be- **[AIEEE - 2007]**

(1) 9 V (2) zero
(3) 2V (4) 4.5 V

11. Charges are placed on the vertices of a square as shown. Let $\vec{E}$ be the electric field and V the potential at the centre. If the charges on A and B are interchanged with those on D and C respectively, then- **[AIEEE-2007]**



(1) $\vec{E}$ remains unchanged, V changes

(2) both $\vec{E}$ and V change

(3) $\vec{E}$ and V remain unchanged

(4) $\vec{E}$ changes and V remains unchanged

12. The potential at a point x (measured in μm) due to some charges situated on the x-axis is given by : $V(x) = 20/(x^2 - 4)$ voltThe electric field E at x = 4 μm is given by : **[AIEEE-2007]**

(1) $\frac{5}{3}$ V/μm and in the –ve x direction

(2) $\frac{5}{3}$ V/μm and in the +ve x direction

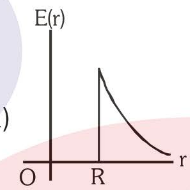
(3) $\frac{10}{9}$ V/μm and in the –ve x direction

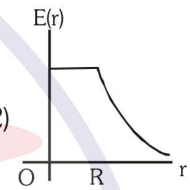
(4) $\frac{10}{9}$ V/μm and in the +ve x direction

13. Consider a neutral conducting sphere. A positive point charge is placed outside the sphere. The net charge on the sphere is then, **[IIT-JEE 2007]**

(1) negative and distributed uniformly over the surface of the sphere
(2) negative and appears only at the point on the sphere closest to the point charge
(3) negative and distributed non-uniformly over the entire surface of the sphere
(4) zero

14. A thin spehrical shell of radius R has a charge Q spread uniformly over its surface. Which of the following graphs most closely represents the electric field E(r) produced by the shell in the range $0 \le r < \infty$, where r is the distance from the centre of the shell? **[AIEEE - 2008]**

(1)


(2)


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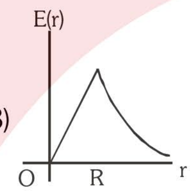

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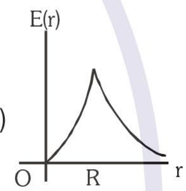


15. A charge Q is placed at each of the opposite corners of a square. A charge q is placed at each of the other two corners. If the net electrical force on Q is zero, then $\frac{Q}{q}$ equals :- **[AIEEE - 2009]**

(1) 1 (2) $-\frac{1}{\sqrt{2}}$ (3) $-2\sqrt{2}$ (4) –1

This question contains Statement–1 and Statement–2. Of the four choices given after the statements, choose the one that best describes the two statements.

16. **Statement–1 :** For a charged particle moving from point P to point Q the net work done by an electrostatic field on the particle is independent of the path connecting point P to point Q.

Statement–2 : The net work done by a conservative force on an object moving along closed loop is zero. **[AIEEE - 2009]**

(1) Statement–1 is true, Statement–2 is true; Statement–2 is not the correct explanation of Statement–1
(2) Statement–1 is false, Statement–2 is true
(3) Statement–1 is true, Statement–2 is false
(4) Statement–1 is true, Statement–2 is true; Statement–2 is the correct explanation of Statement–1

17. Two points P and Q are maintained at the potential of 10V and –4V, respectively. The work done in moving 100 electrons from P to Q is :- **[AIEEE - 2009]**

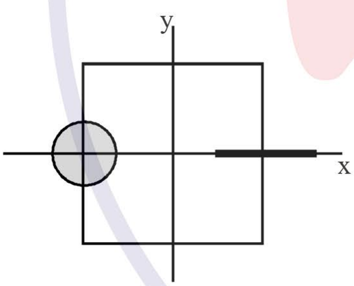
(1) -2.24×10^{-16} J (2) 2.24×10^{-16} J
(3) -9.60×10^{-17} J (4) 9.60×10^{-17} J

18. Let $P(r) = \frac{Q}{\pi R^4} r$ be the charge density distribution for a solid sphere of radius R and total charge Q. For a point 'p' inside the sphere at distance r_1 from the centre of the sphere, the magnitude of electric field is :- **[AIEEE - 2009]**

(1) $\frac{Qr_1^2}{4\pi \epsilon_0 R^4}$ (2) $\frac{Qr_1^2}{3\pi \epsilon_0 R^4}$

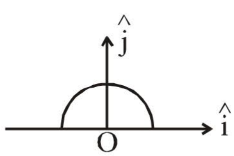
(3) 0 (4) $\frac{Q}{4\pi \epsilon_0 r_1^2}$

19. A disk of radius $a/4$ having a uniformly distributed charge 6C is placed in the x-y plane with its centre at $(-a/2, 0, 0)$. A rod of length a carrying a uniformly distributed charge 8 C is placed on the x-axis from $x = a/4$ to $x = 5a/4$. Two point charges –7 C and 3 C are placed at $(a/4, -a/4, 0)$ and $(-3a/4, 3a/4, 0)$, respectively. Consider a cubical surface formed by six surfaces $x = \pm a/2$, $y = \pm a/2$, $z = \pm a/2$. The electric flux through this cubical surface is **[IIT-JEE 2009]**



(1) $\frac{-2C}{\varepsilon_o}$ (2) $\frac{2C}{\varepsilon_o}$ (3) $\frac{10C}{\varepsilon_o}$ (4) $\frac{12C}{\varepsilon_o}$

20. A thin semi-circular ring of radius r has a positive charge q distributed uniformly over it. The net field $\vec{E}$ at the centre O is :- **[AIEEE - 2010]**



(1) $\frac{q}{2\pi^2\varepsilon_0 r^2}\hat{j}$ (2) $\frac{q}{4\pi^2\varepsilon_0 r^2}\hat{j}$

(3) $-\frac{q}{4\pi^2\varepsilon_0 r^2}\hat{j}$ (4) $-\frac{q}{2\pi^2\varepsilon_0 r^2}\hat{j}$

21. Let there be a spherically symmetric charge distribution with charge density varying as $\rho(r) = \rho_0\left(\frac{5}{4} - \frac{r}{R}\right)$ upto r = R, and $\rho(r) = 0$ for r > R, where r is the distance from the origin. The electric field at a distance r (r < R) from the origion is given by : **[AIEEE - 2010]**

(1) $\frac{\rho_0 r}{3\varepsilon_0}\left(\frac{5}{4} - \frac{r}{R}\right)$ (2) $\frac{4\pi\rho_0 r}{3\varepsilon_0}\left(\frac{5}{3} - \frac{r}{R}\right)$

(3) $\frac{\rho_0 r}{4\varepsilon_0}\left(\frac{5}{3} - \frac{r}{R}\right)$ (4) $\frac{4\rho_0 r}{3\varepsilon_0}\left(\frac{5}{4} - \frac{r}{R}\right)$

22. Two identical charged spheres are suspended by strings of equal lengths. The strings make an angle of 30° with each other. When suspended in a liquid of density 0.8 g cm^{-3}, the angle remains the same. If density of the material of the sphere is 1.6 g cm^{-3}, the dielectric constant of the liquid is : **[AIEEE - 2010]**

(1) 1 (2) 4
(3) 3 (4) 2

23. The electrostatic potential inside a charged spherical ball is given by $\phi = ar^2 + b$ where r is the distance from the centre; a, b are constant. Then the charge density inside the ball is :- **[AIEEE - 2011]**

(1) $-24\pi a\epsilon_0$ (2) $-6 a\epsilon_0$
(3) $-24\pi a\epsilon_0 r$ (4) $-6 a\epsilon_0 r$

24. Two identical charged spheres suspended from a common point by two massless string of length ℓ are initially a distance $d (d << \ell)$ apart because of their mutual repulsion. The charge begins to leak from both the spheres at a constant rate. As a result the charges approach each other with a velocity v. Then as a function of distance x between them :- **[AIEEE - 2011]**

(1) $v \propto x^{1/2}$ (2) $v \propto x$
(3) $v \propto x^{-1/2}$ (4) $v \propto x^{-1}$

25. Two positive charges of magnitude 'q' are placed at the ends of a side (side 1) of a square of side '2a'. Two negative charges of the same magnitude are kept at the other corners. Starting from rest, if a charge Q moves from the middle of side 1 to the centre of square, its kinetic energy at the centre of square is :- **[AIEEE - 2011]**

(1) $\frac{1}{4\pi \epsilon_0}\frac{2qQ}{a}\left(1 - \frac{1}{\sqrt{5}}\right)$

(2) zero

(3) $\frac{1}{4\pi \epsilon_0}\frac{2qQ}{a}\left(1 + \frac{1}{\sqrt{5}}\right)$

(4) $\frac{1}{4\pi \epsilon_0}\frac{2qQ}{a}\left(1 - \frac{2}{\sqrt{5}}\right)$

26. **This question has Statement-1 and Statement-2. Of the four choices given after the statements, choose the one that best describes the two statements.**

An insulating solid sphere of radius R has a uniformaly positive charge density ρ. As a result of this uniform charge distribution there is a finite value of electric potential at the centre of the sphere, at the surface of the sphre and also at a point out side the sphere. The electric potential at infinity is zero.

Statement-1: When a charge 'q' is taken from the centre to the surface of the sphere, its potential energy changes by $\frac{q\rho}{3\in_0}$.

Statement-2 : The electric field at a distance r (r < R) from the centre of the sphere is $\frac{\rho r}{3\in_0}$.

[AIEEE - 2012]

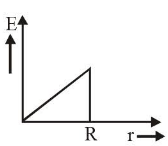
(1) Statement-1 is true, Statement-2 is true and Statement-2 is the correct explanation of Statement-1.

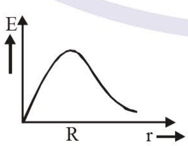
(2) Statement-1 is true, Statement-2 is true and Statement-2 is not the correct explanation of statement-1.

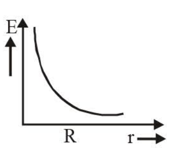
(3) Statement-1 is true, Statement-2 is false

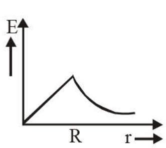
(4) Statement-1 is false, Statement-2 is true.

27. 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 :- **[AIEEE - 2012]**

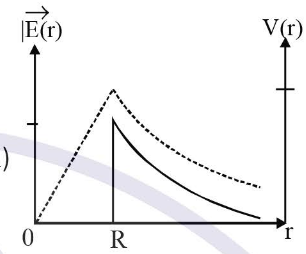
(1) 

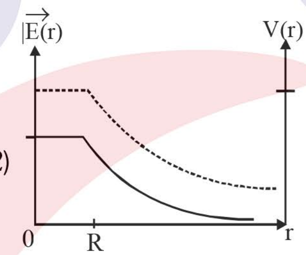
(2) 

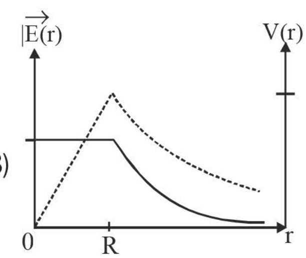
(3) 

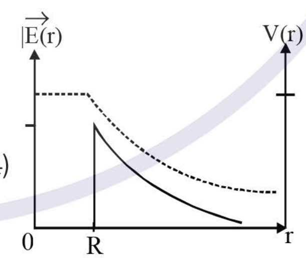
(4) 

28. Consider a thin spherical shell of radius R with its centre at the origin, carrying uniform positive surface charge density. The variation of the magnitude of the electric field $|\vec{E}(r)|$ and the electric potential V(r) with the distance r from the centre, is best represented by which graph? **[IIT-JEE 2012]**

(1) 

(2) 

(3) 

(4) 

29. Let $[\in_0]$ denote the dimensional formula of the permittivity of vacuum. If M = mass, L = Length, T = Time and A = electric current, then :- **[JEE(Main) - 2013]**

(1) $[\in_0]=[M^{-1} L^{-3} T^2 A]$

(2) $[\in_0] = [M^{-1} L^{-3} T^4 A^2]$

(3) $[\in_0]=[M^{-1} L^2 T^{-1} A^{-2}]$

(4) $[\in_0]=[M^{-1} L^2 T^{-1} A]$

30. Two charges, each equal to q, are kept at x = –a and x = a on the x-axis. A particle of mass m and charge $q_0 = \frac{q}{2}$ is placed at the origin. If charge q_0 is given a small displacement (y << a) along the y-axis, the net force acting on the particle is porportional to :- **[JEE(Main) - 2013]**

(1) y (2) –y (3) $\frac{1}{y}$ (4) $-\frac{1}{y}$

31. A charge Q is uniformly distributed over a long rod AB of length L as shown in the figure. The electric potential at the point O lying at a distance L from the end A is :- **[JEE(Main) - 2013]**

(1) $\frac{Q}{8\pi \epsilon_0 L}$

(2) $\frac{3Q}{4\pi \epsilon_0 L}$

(3) $\frac{Q}{4\pi \epsilon_0 L \ln 2}$

(4) $\frac{Q \ln 2}{4\pi \epsilon_0 L}$

32. Assume that an electric field $\vec{E} = 30x^2\hat{i}$ exists in space. Then the potential difference $V_A - V_O$, where V_O is the potential at the origin and V_A the potential at x = 2 m is :- **[JEE(Main) - 2014]**

(1) –80 V (2) 80 V

(3) 120 V (4) –120 V

33. A uniformally charged solid sphere of radius R has potential V_0 (measured with respect to ∞) on its surface. For this sphere the equipotential surfaces with potentials $\frac{3V_0}{2}, \frac{5V_0}{4}, \frac{3V_0}{4}$ and $\frac{V_0}{4}$ have radius R_1 , R_2 , R_3 and R_4 respectively. Then **[JEE(Main) - 2015]**

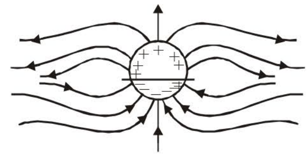
(1) $R_1 = 0$ and $R_2 < (R_4 - R_3)$

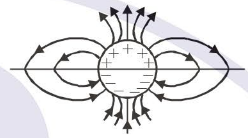
(2) $2R < R_4$

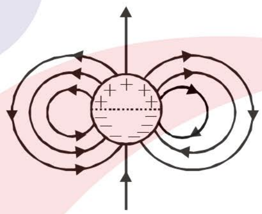
(3) $R_1 = 0$ and $R_2 > (R_4 - R_3)$

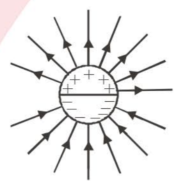
(4) $R_1 \neq 0$ and $(R_2 - R_1) > (R_4 - R_3)$

34. A long cylindrical shell carries positive surface charge σ in the upper half and negative surface charge –σ in the lower half. The electric field lines around the cylinder will look like figure given in : (figures are schematic and not drawn to scale) **[JEE(Main) - 2015]**

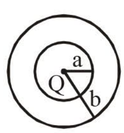
(1) 

(2) 

(3) 

(4) 

35. The region between two concentric spheres of radii 'a' and 'b', respectively (see figure), has volume charge density $\rho = \frac{A}{r}$, where A is a constant and r is the distance from the centre. At the centre of the spheres is a point charge Q. The value of A such that the electric field in the region between the spheres will be constant, is :- **[JEE(Main)-2016]**



(1) $\frac{2Q}{\pi a^2}$ (2) $\frac{Q}{2\pi a^2}$

(3) $\frac{Q}{2\pi(b^2 - a^2)}$ (4) $\frac{2Q}{\pi(a^2 - b^2)}$

36. An electric dipole has a fixed dipole moment $\vec{p}$, which makes angle θ with respect to x-axis. When subjected to an electric field $\vec{E}_1 = E\hat{i}$, it experiences a torque $\vec{T}_1 = \tau\hat{k}$. When subjected to another electric field $\vec{E}_2 = \sqrt{3}E_1\hat{j}$ it experiences torque $\vec{T}_2 = -\vec{T}_1$. The angle θ is : **[JEE-Main-2017]**

(1) 60° (2) 90°
(3) 30° (4) 45°

37. Three concentric metal shells A, B and C of respective radii a, b and c (a < b < c) have surface charge densities $+\sigma$, $-\sigma$ and $+\sigma$ respectively. The potential of shell B is :- **[JEE(Main)-2018]**

(1) $\frac{\sigma}{\varepsilon_0}\left[\frac{a^2-b^2}{b}+c\right]$ (2) $\frac{\sigma}{\varepsilon_0}\left[\frac{b^2-c^2}{b}+a\right]$

(3) $\frac{\sigma}{\varepsilon_0}\left[\frac{b^2-c^2}{c}+a\right]$ (4) $\frac{\sigma}{\varepsilon_0}\left[\frac{a^2-b^2}{a}+c\right]$

PREVIOUS YEARS QUESTIONS				ANSWER KEY					Exercise-II
Que.	1	2	3	4	5	6	7	8	9	10
Ans.	**2**	**3**	**4**	**4**	**2**	**1**	**2**	**3**	**3**	**2**
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	**4**	**4**	**4**	**1**	**3**	**4**	**2**	**1**	**1**	**4**
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	**3**	**4**	**2**	**3**	**1**	**4**	**4**	**4**	**2**	**1**
Que.	31	32	33	34	35	36	37			
Ans.	**4**	**1**	**1,2**	**3**	**2**	**1**	**1**			