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CHAPTER – 1

Electric Charges and Fields

Class - XII

Based on Columb's Law

1. When air is replaced by a dielectric medium of dielectric constant κ, the maximum force of attraction between two charges separated by a distance
(i) decreases κ times
(b) remains unchanged
(c) increases κ times
(c) decreases κ^2 times. [CBSE 1999]

2. An electron is moving round the nucleus of a hydrogen atom in a circular orbit of radius r, The coulomb force $\vec{F}$ between the two is
(a) $-k\frac{e^3}{r^3}\hat{r}$
(b) $k\frac{e^2}{r^3}\vec{r}$
(c) $-k\frac{e^2}{r^3}\vec{r}$
(d) $k\frac{e^2}{r^3}\hat{r}$ [CBSE 2003]

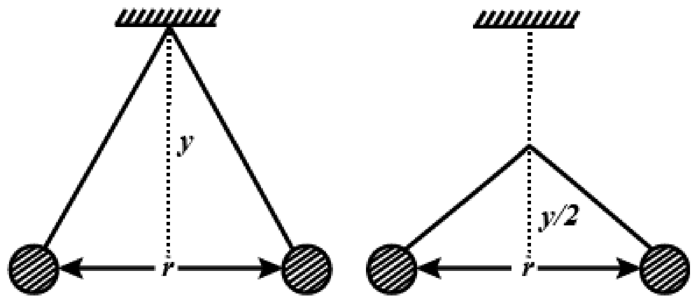
3. Two point charges A and B, having charges $+Q$ and $-Q$ respectively, are placed at certain distance apart and force acting between them is F. If 25% charge of A is transferred to B, then force between the charges becomes [NEET (National) 2019]
(a) $\frac{9F}{16}$
(b) $\frac{16F}{9}$
(c) $\frac{4F}{3}$
(d) F

4. The acceleration of an electron due to the mutual attraction between the electron and a proton when they are 1.6 Å apart is, $(m_e = 9 \times 10^{-31}\ kg, e = 1.6 \times 10^{-19}\ C)$
$(take, \frac{1}{4\pi\varepsilon_0} = 9 \times 10^9\ \mathrm{Nm^2C^{-2}})$ [NEET (Oct.) 2020]
(a) $10^{24}\ m/s^2$
(b) $10^{23}\ m/s^2$
(b) $10^{22}\ m/s^2$
(d) $10^{25}\ m/s^2$

5. Two positive ions, each carrying a charge q, are separated by a distance d. If F is the force of repulsion between the ions, the number of electrons missing from each ion will be (e being the charge on an electron) [CBSE AIPMT 2010]
(a) $\frac{4\pi\varepsilon_0 Fd^2}{e^2}$
(b) $\sqrt{\frac{4\pi\varepsilon_0 Fe^2}{d^2}}$
(c) $\sqrt{\frac{4\pi\varepsilon_0 Fd^2}{e^2}}$
(d) $\frac{4\pi\varepsilon_0 Fd^2}{q^2}$

6. Point charges $+\ 4q, -q$, and $+4q$ are kept on the x-axis at points $x = 0, x = a$ and $x = 2a$, respectively. Then, [CBSE AIPMT 1988]
(a) only $-q$ is in stable equilibrium
(b) None of the charges is in equilibrium
(c) all the charges are in unstable equilibrium
(d) all the charges are in stable equilibrium

7. Two pith balls carrying equal charges are suspended from a common point by strings of equal length, the equilibrium separation between them is r. Now, the strings are rigidly clamped at half the height. The equilibrium separation between the balls now becomes **[NEET 2013]**



(a) $\left(\frac{1}{\sqrt{2}}\right)^2$ (b) $\left(\frac{r}{\sqrt[3]{2}}\right)$

(c) $\left(\frac{2r}{\sqrt{3}}\right)$ (d) $\left(\frac{2r}{3}\right)$

8. Suppose the charge of a proton and an electron differ slightly. One of them is $-e$, the other is $(e + \Delta e)$. If the net of electrostatic force and gravitational force between two hydrogen atoms placed at a distance d (much greater than atomic size) apart is zero, then Δe is of the order of [Given mass of hydrogen $m_h = 1.67 \times 10^{-27}\ kg$]

(a) 10^{-20} C (b) 10^{-23} C

(c) 10^{-37} C (d) 10^{-47} C **[NEET 2017]**

9. Two identical charged spheres suspended from a common point by two massless strings of lengths l, are initially at a distance d $(d << l)$ apart because of their mutual repulsion. The charges begin to leak from both the spheres at a constant rate. As a result, the spheres approach each other with a velocity v. Then, v varies as a function of the distance x between the sphere, as **[NEET 2016]**

(a) $v \propto x^{1/2}$ (b) $v \propto x$

(c) $v \propto x^{-\frac{1}{2}}$ (d) $v \propto x^{-1}$

10. The ratio of Coulomb's electrostatic force to the gravitational force between an electron and a proton separated by some distance is 2.4×10^{39}. The ratio of the proportionality constant, $k = \frac{1}{4\pi\varepsilon_0}$ to the Gravitational constant G is nearly. (Given that the charge of the proton and electron each $= 1.6 \times 10^{-19}$ C, the mass of electron 9.11×10^{-31} kg, the mass of the proton $= 1.67 \times 10^{-27}$kg)

(a) 10^{20} (b) 10^{30}

(c) 10^{40} (d) 10 **[NEET Sept 22]**

Based on Relation between Electric Fields, Electric Charges and Electric Force

11. There is an electric field in the X –direction. If the work done in moving a charge of 0.2 C through a distance of 2 m along a line making an angle of 60° with X – axis is 4 J, then what is the value of E ?

(a) $\sqrt{3}$ NC^{-1} (b) 4 NC^{-1}

(c) 5 NC^{-1} (d) 20 NC^{-1} **[CBSE 1993]**

12. An electron falls from rest through a vertical distance in a uniform and vertically upward directed electric field E. The direction of electric field is now reversed, keeping its magnitude

the same. A proton is allowed to fall from rest in it through the same vertical distance h. The time of fall of the electron, in comparison to the time of fall of the proton, is

(a) Smaller (b) equal

(c) 10 times greater (d) 5 times greater [NEET 18]

Based on Electric Fields of Continuous Charge Distributions

13. A semi-circular arc of radius a is charged uniformly and the charge per unit length is λ. The electric field at the centre is

(a) $\frac{\lambda}{4\pi^2\varepsilon_0 a}$ (b) $\frac{\lambda}{2\pi\varepsilon_0 a^2}$

(c) $\frac{\lambda}{2\pi\varepsilon_0 a}$ (d) $\frac{\lambda^2}{2\pi\varepsilon_0 a}$ [CBSE 2000]

Based on Dipole Moment, Dipole Field and Torque on a Dipole.

14. Three point charges $+q, -2q$ and $+q$ are placed at points $(x = 0, y = a, z = 0), (x = 0, y = 0, z = 0)$ and $(x = a, y = 0, z = 0)$, respectively. The magnitude and direction of the electric dipole moment vector of this charge assembly are [CBSE AIPMT 2007]

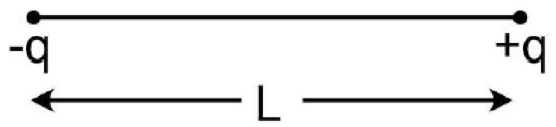
(a) $\sqrt{2}qa$ along the line joining points $(x = 0, y = 0, z = 0)$ and $(x = a, y = a, z = 0)$

(b) qa along the line joining points $(x = 0, y = 0, z = 0), (x = a, y = a, z = 0)$

(c) $\sqrt{2}\,qa$ along $+x$ direction

(d) $\sqrt{2}qa$ along $+y$ direction

15. Two point charges $-q$ and $+q$ are placed at a distance of L, as shown in the figure.



The magnitude of electric field intensity at a distance $R(R \gg L)$ varies as

(a) $\frac{1}{R^2}$ (b) $\frac{1}{R^3}$

(c) $\frac{1}{R^4}$ (d) $\frac{1}{R^6}$ [NEET July 22]

16. The electric field at a point on the equatorial plane at a distance r from the centre of a dipole having dipole moment $\vec{p}$ is given by ($r \gg$ separation of two charges forming the dipole, ε_0 permittivity of free space)

(a) $\vec{E} = -\frac{\vec{p}}{4\pi\varepsilon_0 r^3}$ (b) $\vec{E} = \frac{\vec{p}}{4\pi\varepsilon_0 r^3}$

(c) $\vec{E} = \frac{2\vec{p}}{4\pi\varepsilon_0 r^3}$ (d) $\vec{E} = -\frac{\vec{p}}{4\pi\varepsilon_0 r^2}$ [NEET 20]

17. A point P lies on the perpendicular bisector of an electric dipole of dipole moment p. If the distance of P from the dipole is r (much larger than the size of the dipole), then the electric field at P is proportional to

(a) p^{-1} and r^{-2} (b) p and r^{-2}

(c) p^2 and r^{-3} (d) p and r^{-3} [CBSE 1998]

18. Torque acting on electric dipole of dipole moment $\vec{p}$ placed in uniform electric field $\vec{E}$ is

(a) $\vec{p} \times \vec{E}$ (b) $\vec{p}.\vec{E}$

(c) $\vec{p} \times (\vec{E} \times \vec{p})$ (d) $\vec{E}.\vec{p}/p^2$ [CBSE 2001]

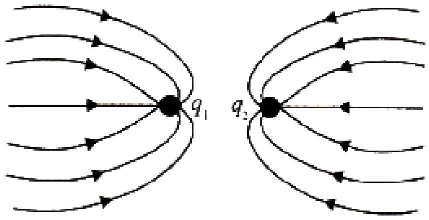
19. An electric dipole is placed at an angle of $30°$ with an electric field intensity 2×10^5 N/C. It experiences a torque equal to 4 Nm. The charge on the dipole, if the dipole length is 2 cm, is

(a) 5 mC (b) 7 μC

(c) 8 mC (d) 2 mC [NEET 16 II]

Based on Electric Field Lines

20. Figure gives electric lines of force due to two charges q_1 and q_2.



[CBSE 1994]

What are the signs of the two charges ?

(i) Both are negative
(b) Both are positive
(c) q_1 is positive but q_2 is negative
(d) q_1 is negative but q_2 is positive.

Based on Gauss's Theorem

21. A point charge $+q$ is placed at the midpoint of a cube of side l. The electric flux emerging from the cube is

(a) Zero
(b) $\frac{q}{\varepsilon_0}$
(c) $\frac{6ql^2}{\varepsilon_0}$
(d) $\frac{q}{6l^2\varepsilon_0}$ [CBSE 1993, 94]

22. A charge q μC is placed at the centre of a cube of side $0.1\ m$. Then the electric flux diverging from each face of this cube is

(a) $\frac{q\times10^{-6}}{\varepsilon_0}$
(b) $\frac{q}{\varepsilon_0}\times10^{-4}$
(c) $\frac{q\times10^{-6}}{6\varepsilon_0}$
(d) $\frac{q\times10^{-4}}{6\varepsilon_0}$ [CBSE 2001]

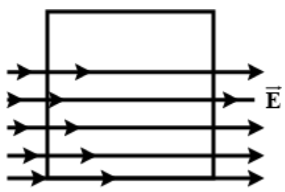
23. A charge Q is placed at the corner of a cube. The electric flux through all the six faces of the cube is

(a) $\frac{Q}{\varepsilon_0}$
(b) $\frac{Q}{6\varepsilon_0}$
(c) $\frac{Q}{8\varepsilon_0}$
(d) $\frac{Q}{3\varepsilon_0}$ [CBSE 2000]

24. An electric charge q is placed at one of the comers of a cube of side a. The electric flux on one of its faces will be

(a) $\frac{q}{a\varepsilon_0}$
(b) $\frac{q}{\varepsilon_0 a^2}$
(c) $\frac{q}{4\pi\varepsilon_0 a^2}$
(d) $\frac{q}{24\varepsilon_0}$ [CBSE 1993]

25. A square surface of side L metres is in the plane of the paper. A uniform electric $\vec{E}$ (volt m^{-1}), also in the plane of the paper, is limited only to the lower half of the square surface as shown in the figure.



The electric flux (in SI units) associated with the surface is

(a) EL^2
(b) $\frac{EL^2}{2\varepsilon_0}$

(c) $\frac{EL^2}{2}$ (d) zero [CBSE 2006]

26. What is the flux through a cube of side $'a'$ if a point charge q is at one of its corners ?

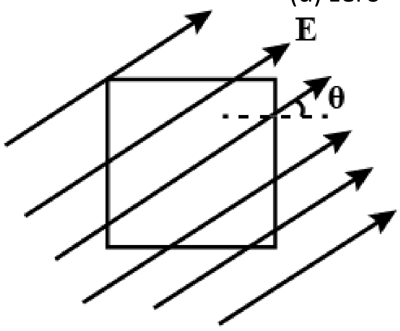
(a) $\frac{2q}{\varepsilon_0}$ (b) $\frac{q}{8\varepsilon_0}$

(c) $\frac{q}{\varepsilon_0}$ (d) $\frac{q}{2\varepsilon_0}6a^2$ [AIPMT 12]

27. A square surface of side L metre in the plane of the paper is placed in a uniform electric field $E\ (volt/m)$ acting along the same plane at an angle θ with the horizontal side of the square as shown in the figure. The electric flux linked to the surface, in units of volt m, is

(a) EL^2 (b) $EL^2\cos\theta$

(c) $EL^2\sin\theta$ (d) zero [CBSE 2010]



28. A charge Q is enclosed by a Gaussian spherical surface of radius R. If the radius is doubled, then the outward electric flux will

(a) Increase four times (b) be reduced to half

(c) remain the same (d) be doubled [CBSE 2011]

29. A hollow cylinder has a charge q coulomb within it. If ϕ is the electric flux in unit of voltmeter associated with the curved surface B, the flux linked with the plane surface A in unit of voltmeter will be [CBSE AIPMT 2007]

(a) $\frac{1}{2}\left(\frac{q}{\varepsilon_0}-\phi\right)$ (b) $\frac{q}{2\varepsilon_0}$

(c) $\frac{\phi}{3}$ (d) $\frac{q}{\varepsilon_0}-\phi$

30. The electric field in a certain region is acting radially outward and is given by $E = Ar$. A charge contained in a sphere of radius 'a' centred at the origin of the field' will be given by [CBSE AIPMT 2015]

(a) $A\varepsilon_0 a^2$ (b) $4\pi\varepsilon_0 Aa^3$

(c) $\varepsilon_0 Aa^3$ (d) $4\pi\varepsilon_0 Aa^2$

Based on Applications of Gauss's Theorem

31. Two parallel infinite line charges with linear charge densities $+\lambda\ C/m$ and $-\lambda\ C/m$ are placed at a distance of $2R$ in free space. What is the electric field mid-way between the two line charges? [NEET (National) 2019]

(a) $\frac{2\lambda}{\pi\varepsilon_0 R}N/C$ (b) $\frac{\lambda}{\pi\varepsilon_0 R}N/C$

(c) $\frac{\lambda}{2\pi\varepsilon_0 R} N/C$ (d) Zero

32. A hollow insulated conducting sphere is given a positive charge of 10 μC What will be the electric field at the centre of the sphere, if its radius is 2 m ?
    (a) Zero (b) $5\mu\text{Cm}^{-2}$
    (c) $20\ \mu\text{Cm}^{-2}$ (d) $32\ \mu\text{Cm}^{-2}$ **[CBSE 1998]**
33. A spherical conductor of radius 10 cm has a charge of $3.2\ \times 10^{-7}$ C distributed uniformly. What is the magnitude of electric field at a point 15 cm from the centre of the sphere ?
    $\left(\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \frac{\text{Nm}^2}{\text{C}^2}\right)$ **[NEET 20]**
    (a) $1.28\ \times 10^5\ \text{NC}^{-1}$ (b) $1.28\ \times 10^6\ \text{NC}^{-1}$
    (b) $1.28 \times 10^7\ \text{NC}^{-1}$ (d) $1.28\ \times 10^5\ \text{NC}^{-1}$
34. A hollow metal sphere of radius R is uniformly charged. The electric field due to the sphere at a distance r from the centre. **[NEET (National) 2019]**
    (a) Zero as r increases for $r < R$, decreases as r increases for $r > R$
    (b) Zero as r decreases for $r < R$, increases as r increases for $r > R$
    (c) Decreases as r increases for $r < R$ and for $r > R$
    (d) Increases as r increases for $r < R$ and $r > R$

Answers:

1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**
(a)	**(c)**	**(a)**	**(d)**	**(c)**	**(c)**	**(b)**	**(c)**	**(c)**	**(a)**
11.	**12.**	**13.**	**14.**	**15.**	**16.**	**17.**	**18.**	**19.**	**20.**
(d)	**(a)**	**(c)**	**(a)**	**(b)**	**(a)**	**(d)**	**(a)**	**(d)**	**(a)**
21.	**22.**	**23.**	**24.**	**25.**	**26.**	**27.**	**28.**	**29.**	**30.**
(b)	**(a)**	**(b)**	**(d)**	**(d)**	**(b)**	**(d)**	**(c)**	**(a)**	**(b)**
31.	**32.**	**33.**	**34.**						
(b)	**(a)**	**(a)**	**(a)**						