Ultimate KCET Crash Course 2026

PHYSICS

DPP: 1

Electric charges and fields

Q1 The sum of two point positive charges separated by a distance of 1.5 m in air is 25C. If the electrostatic force between the two charges is 0.6 N, then the difference between the two charges is

(A) 5μC (B) 8μC
(C) 3μC (D) 6μC

Q2 A particle of mass 0.2 g and charge 2 C is released from rest in a uniform electric field of $20 NC^{-1}$. The kinetic energy of the particle after moving a distance of 20 cm is

(A) 10 J (B) 8 J
(C) 18 J (D) 12 J

Q3 Two charged conducting spheres of radii 5 cm and 10 cm have equal surface charge densities. If the electric field on the surface of the smaller sphere is E, then the electric field on the surface of the larger sphere is

(A) 2 E (B) 4 E
(C) 0.5 E (D) E

Q4 In a region, the electric field is given by $E=\left(3\hat{i}+5\hat{j}+7\hat{k}\right)NC^{-1}$. The electric flux through a surface of area $3\ m^2$ in ys-plane is (in St units)

(A) 21 (B) 15
(C) 12 (D) 9

Q5 The force between two point charges kept with a separation of 9 cm in air is 98 N. If a dielectric slab of constant 4, thickness 6 cm and another dielectric slab of constant 9, thickness 3 cm are introduced between the two charges, then the new force becomes

(A) 18 N (B) 36 N
(C) 49 N (D) 84 N

Q6 The magnitude of an electric field which can just suspend a deuteron of mass 3.2×10^{-27} kg freely in air is

(A) $19.6 \times 10^{-8}\ NC^{-1}$
(B) $196\ NC^{-1}$
(C) $19.6 \times 10^{-10}\ NC^{-1}$
(D) $0.196\ NC^{-1}$

Q7 The electric field intensity E at a distance of 3 m from a uniform long straight wire of linear charge density $0.2\mu\ cm^{-1}$ is

(A) $1.2 \times 10^3\ Vm^{-1}$
(B) $0.6 \times 10^3\ Vm^{-1}$
(C) $0.8 \times 10^3\ Vm^{-1}$
(D) $2.4 \times 10^3\ Vm^{-1}$

Q8 A point charge qC is placed at the centre of a cube of a side length L. Then, the electric flux linked with each face of the cube is

(A) $\frac{q}{\varepsilon_o}$ (B) $\frac{q}{L^2\varepsilon_o}$
(C) $\frac{q}{6L^2\varepsilon_o}$ (D) $\frac{q}{6\varepsilon_o}$

Q9 Three point charges +q,+2q and +4q are placed along a straight line such that the charge +2q lies at equidistant from the other two charges. The ratio of the net electrostatic force on charges +q and +4q is

(A) 1 : 1 (B) 1 : 2
(C) 1 : 4 (D) 1 : 3

Q10 The angle between the electric dipole moment of a dipole and the electric field strength due to it on the equatorial line is

(A) 0° (B) 90°
(C) 180° (D) 270°

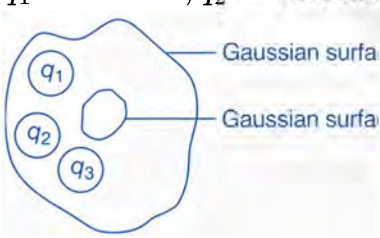
Q11 A large number of positive charges each of magnitude q are placed along the X-axis at the origin and at every 1 cm distance in both the directions. The electric flux through a spherical surface of radius 2.5 cm centred at the origin is

(A) $\frac{5q}{\varepsilon_o}$ (B) $\frac{8q}{\varepsilon_o}$
(C) 0 (D) ∞

Q12 An electric dipole with dipole moment 5×10^{-7} C is in the electric field of 2×10^{4} NC^{-1} an angle of 60° with the direction of the electric field. The torque acting on the dipole is

(A) 9×10^{-3} N-m
(B) 1×10^{-4} N-m
(C) 8.66×10^{-3} N-m
(D) 2.88×10^{-3} N-m

Q13 What is the electric flux for Gaussian surface A that encloses the charged particles in free space?
[Given,
$q_1 = -14nC, q_2 = 78.85nCq_3 = -56nC$]



(A) 10^3 N–m^2C^{-1}
(B) 10^3 C– $N^{-1}m^2$
(C) 632×10^3 N– m^2m^{-1}
(D) 632×10^3 C– $N^{-1}m^{-2}$

Q14 Gauss's law helps in

(A) determination of electric force between point charges
(B) situation where Coulomb's law fails
(C) determination of electric field due to symmetric charge distributions
(D) determining electric potential due to symmetric charge distributions

Q15 Which statement(s) among the following are incorrect?

(i) A negative test charge experiences a force opposite to the direction of the field.
(ii) The tangent drawn to a line of force represents the direction of electric field.
(iii) The electric field lines never intersect.
(iv) The electric field lines form a closed loop

(A) Only (1)
(B) Both (i) and (ii)
(C) Only (iii)
(D) Only (iv)

Q16 A bob of a simple pendulum has a mass of 4 g and a charge of 20μC. If it is at rest in a uniform horizontal electric field of intensity 1000Vm, the angle that the pendulum makes with the vertical at equilibrium is

(A) $\tan^{-1}\frac{1}{2}$ (B) 60°
(C) 30° (D) $\tan^{-1}2$

Q17 A uniformly charged conducting sphere of 0.2 m diameter has a surface charge density of 70μ Cm^{-2}. The electric flux leaving the surface of the sphere is

(A) 9.9×10^5 NC^{-2} m^2
(B) 9.9×10^6 NC^{-1} m^2
(C) 8.9×10^5 NC^{-1} m^2
(D) 8.9×10^6 NC^{-1} m^2

Q18 Two electric dipoles of dipole moments 3.9×10^{-1} Cm and 5.2×10^{-1} Cm are placed in two different uniform electric fields of strengths 16×10^4 NC^{-1}

and 4×10^4 NC^{-1} respectively. What is the ratio of maximum torque experienced by the electric dipoles

(A) 12 : 1 (B) 9 : 1
(C) 1 : 9 (D) 3 : 1

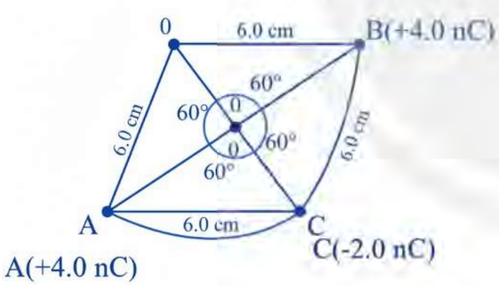
Q19 What is the dimensional formula for electric flux ?

(A) $[M^1L^3T^{-2}A^{-1}]$
(B) $[M^2L^3T^{-3}A^{-1}]$
(C) $[M^1L^2T^{-3}A^{-1}]$
(D) $[M^1L^3T^{-3}A^{-1}]$

Q20 Two point charges M and N having charges +q and-q respectively are placed at a distance apart. Force acting between them is F. If 30% of charge of N is transferred to M, then the force between the charges becomes

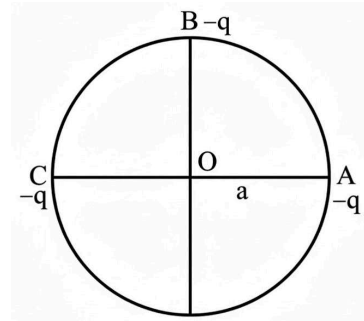
(A) F (B) 100/49 F
(C) 49/100 F (D) 9/16 F

Q21 Three point charges are located on a circular arc at A, B and C as shown in the figure below. The total electric field at the centre of the arc(C) is



(A) 15000 NC^{-1}
(B) 10000 NC^{-1}
(C) 20000 NC^{-1}
(D) 5000 NC^{-1}

Q22 3 point charges each of -q are placed on the circumference of a circle of diameter 2a at A, B and C respectively as shown in figure. The electric field at O is



(A) Zero
(B) $\frac{Kq}{2a}$ towards OC
(C) $\frac{Kq}{a^2}$ towards OB
(D) $\frac{Kq}{a}$ towards OA

Q23 An electron and a proton having mass m_e and m_p respectively, initially at rest, move through the same distance 's' in a uniform electric field E. If the time taken by them to cover that distance is t_e and t_p respectively, then t_e/t_p is equal to

(A) $\sqrt{\left(\frac{m_p}{m_e}\right)}$ (B) $\sqrt{\left(\frac{m_e}{m_p}\right)}$
(C) $\frac{\sqrt{(m_e)}}{m_p}$ (D) $\frac{m_e}{m_p}$

Q24 Two charged spheres of -20μC and 60μC are kept at a certain distance. They are touched and kept again at the same distance. What is the ratio of force experienced before and after

(A) 1 : 3 (B) 3 : 1
(C) 2 : 1 (D) 1 : 2

Q25 What is the electric field near infinite plane sheet of charge density σ?

(A) $\frac{\sigma}{2\varepsilon_o}$
(B) $\frac{\sigma A}{2\varepsilon_o}$
(C) $\frac{\sigma}{2\varepsilon_o A}$
(D) $\frac{\sigma}{\varepsilon_o}$

Q26 A charge of 0.8 C is divided into two charges Q_1 and Q_2. These are kept at a separation of 30 cm. The force on Q_1 is maximum when

(A) $Q_1 = Q_2 = 0.4c$

(B) $Q_1 \approx 0.8c, Q_2 negligible$
(C) Q_1 negligible, $Q_2 \approx 0.8c$
(D) $Q_1 = 0.2c, Q_2 = 0.6C$

Q27 An electric dipole is placed in a uniform electric field with the dipole axis making an angle θ with the direction of the electric field. The orientation of the dipole for stable equilibrium is

(A) $\frac{\pi}{6}$ (B) $\frac{\pi}{3}$
(C) 0 (D) $\frac{\pi}{2}$

Q28 An electric dipole has a pair of equal and opposite point charges q and -q separated by a distance 2z. The axis of the dipole is defined as

(A) direction from positive charge to negative charge
(B) direction from negative charge to positive charge
(C) perpendicular to the line joining the two charges drawn at the centre and pointing upward direction
(D) perpendicular to the line joining the two charges at the centre and pointing downward direction

Q29 Consider a thin spherical shell of radius R. consisting of uniform surface charge density s. The electric field at a point of distance x from its centre and outside the shell is

(A) inversely proportional to s
(B) directly proportional to x^2
(C) directly proportional to R
(D) inversely proportional to x^2

Q30 The force between two electric point charges at rest in air is F_1, When the same arrangernent is kept inside water, the force between them is F_2. Which of the following statement is correct

(A) $F_2 = 0$ (B) $F_2 > F_1$
(C) $F_2 = F_1$ (D) $F_2 < F_1$

Answer Key

Q1	(A)
Q2	(B)
Q3	(D)
Q4	(D)
Q5	(A)
Q6	(A)
Q7	(A)
Q8	(D)
Q9	(D)
Q10	(C)
Q11	(A)
Q12	(C)
Q13	(A)
Q14	(A)
Q15	(D)
Q16	(A)
Q17	(A)
Q18	(D)
Q19	(D)
Q20	(C)
Q21	(D)
Q22	(C)
Q23	(C)
Q24	(B)
Q25	(A)
Q26	(A)
Q27	(C)
Q28	(B)
Q29	(D)
Q30	(D)

Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Text Solution:

Given $q_1 + q_2 = 25\mu\text{C}$

Also $\boldsymbol{F} = \frac{\boldsymbol{k} q_1 q_2}{r^2}$

$\Rightarrow \quad 0.6 = \frac{9\times10^9(q_1 q_2)}{(1.5)^2}$

$\Rightarrow \quad q_1 q_2 = \frac{0.6\times(1.5)^2}{9\times10^9}$

$\Rightarrow q_1 q_2 = 1.5 \times 10^{-10}$

Using $(q_1 - q_2)^2 = (q_1 + q_2)^2 - 4q_1 q_2$

We get

$(q_1 - q_2)^2 = \left(25 \times 10^{-6}\right)^2 - 4 \times 1.5 \times 10^{-10}$

$\Rightarrow (q_1 - q_2)^2 = 625 \times 10^{-12} - 6 \times 10^{-10}$

$= (625 - 600) \times 10^{-12}$

$= 25 \times 10^{-12}$

of $\quad q_1 - q_2 = 5 \times 10^{-6}\text{C} = 5\mu\text{C}$

Video Solution:

Q2 Text Solution:

Force on charge particle in electric field.

$F = qE = 2 \times 20 = 40N$

According to work energy theorem, kinetic energy = W

$F.s = 40 \times 0.2 = 8J$

Video Solution:

Q3 Text Solution:

$\sigma_1 = \sigma_2 = \sigma$

Since $E = \frac{\sigma}{\varepsilon_0}$

For the smaller sphere,

$E_1 = \frac{\sigma_1}{\varepsilon_0} = \frac{\sigma}{\varepsilon_0}$

For the larger sphere,

$E_2 = \frac{\sigma_2}{\varepsilon_0} = \frac{\sigma}{\varepsilon_0}$

Since $\sigma_1 = \sigma_2 = \sigma$

Thus, $\quad E_1 = E_2 = E$

Video Solution:

Q4 Text Solution:

Electric Flux

$\phi = E.A = \left(3\hat{i} + 5\hat{j} + 7\hat{k}\right).\left(3\hat{i}\right)$

$= 9\left(Nm^2/C\right)$

Video Solution:

Q5 Text Solution:

$$F_0 = 98\text{N}$$

$$\text{Using}, \frac{d}{k} = \frac{d_1}{k_1} + \frac{d_2}{k_2}$$

$$\Rightarrow \quad \frac{9}{k} = \frac{6}{4} + \frac{3}{9}$$

$$\Rightarrow \quad k = \frac{54}{11}$$

$$\therefore \text{New force}, F' = \frac{F_0}{k}$$

$$= \frac{98}{\frac{54}{11}} = 98 \times \frac{11}{54} = 19.96\text{N}$$

which is closest to 18 N.

Video Solution:

Q6 Text Solution:

$$qE = mg$$

Solving for E, the magnitude of the electric field:

$$E = \frac{mg}{q} = \frac{3.2 \times 10^{-27} \times 9.8}{1.6 \times 10^{-19}}$$

$$E = \frac{3.2 \times 9.8}{1.6} \times 10^{-8}$$

$$E = 2 \times 9.8 \times 10^{-8} = 19.6 \times 10^{-8}\text{N/C}$$

Therefore, the magnitude of the electric field required is $19.6 \times 10^{-8}\text{N/C}$

Video Solution:

Q7 Text Solution:

The electric field E at a distance r from a long straight wire is calculated using the formula

$$E = \frac{\lambda}{2\pi\varepsilon_o r}$$

Where:

ε_o is the permittivity of free space, approximately 8.85 x 10^{-12} $C^2/N.m^2$

Substitute the given values into the formula:

$$E = \frac{0.2 \times 10^{-6}}{2\pi \times 8.85 \times 10^{-12} \times 3}$$

this calculation results in

$$E \approx 1.2 \times 10^3 V/m$$

Video Solution:

Q8 Text Solution:

We know that the electric flux through a closed surface that encloses a charge q is given by Gauss's Law

$$\phi_t = \frac{q}{\varepsilon_o}$$

Here, ϕ_t represents the total electric flux through the entire surface of the cube. Since a cube has 6 faces, the flux through each individual face, ϕ_f is the total flux divided equally among the six faces

$$\phi_f = \frac{1}{6} \times \phi_t = \frac{1}{6} \times \frac{q}{\varepsilon_o} \times \frac{q}{\varepsilon_o} = \frac{q}{6\varepsilon_o}$$

This shows that the electric flux associated with each face of the cube is $\frac{q}{6\varepsilon_o}$

Video Solution:

Q9 Text Solution:

Electrostatics froce on +q due to + 2q and + 4q

$$E_{q,2q} = \frac{kq(2q)}{d^2} = \frac{2kq^2}{d^2}$$

$$E_{q,4q} = \frac{kq(4q)}{(2d)^2} = \frac{kq^2}{d^2}$$

Total force on +q

$$= \frac{2kq^2}{d^2} + \frac{kq^2}{d^2} = \frac{3kq^2}{d^2}$$

Electrostatics force on +4q due to +2q and +q

$$E_{4q,2q} = \frac{k(2q)(4q)}{d^2} = \frac{8k^2}{d^2}$$

$$E_{4q,q} = \frac{k(4q)(q)}{(2d)^2} = \frac{kq^2}{d^2}$$

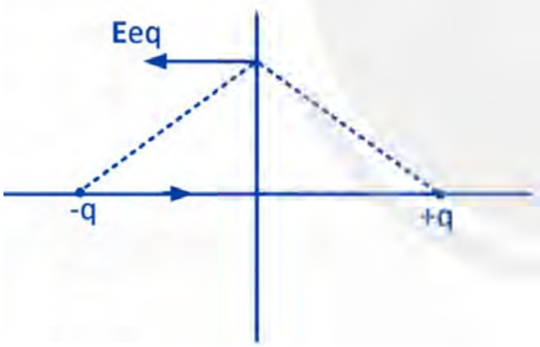
Total force on $+4q = 9\frac{kq^2}{d^2}$

Ratio of net force on q_1 and $+4q$

$$= \frac{3kq^2}{d^2} \times \frac{d^2}{9kq^2} = \frac{3}{9} = 1:3$$

Video Solution:

Q10 Text Solution:

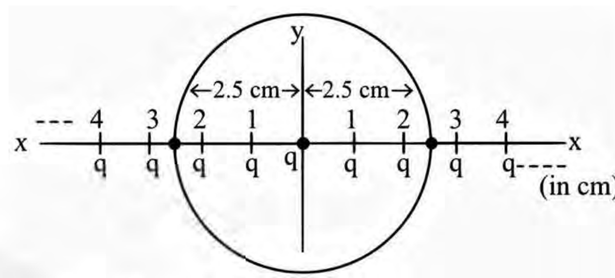


From the above figure, it can be concluded that the dipole moment of a dipole and electric field strength are opposite to each other on equatorial line. Thus, the angle between them is 180°

Video Solution:

Q11 Text Solution:

The given situation is shown below



From the above figure total charge enclosed by the sphere of radius 2.5 cm = 5q According to gauss law, total electric flux passing through spherical surface

$$\phi = \frac{\text{total charge enclosed}}{\varepsilon_o}$$

$$= \frac{5q}{\varepsilon_o}$$

Video Solution:

Q12 Text Solution:

electric dipole moment,

$p = 5 \times 10^{-7}\mathrm{C}$

Angle $\theta = 60^\circ$

Electric field, $E = 2 \times 10^4 \mathrm{N/C}$

Torque

$$\tau = pE\sin\theta$$

$$= 5 \times 10^{-7} \times 2 \times 10^4 \times \sin 60^\circ$$

$$= 10^{-2} \times \frac{\sqrt{3}}{2} = 8.66 \times 10^{-3}\mathrm{N-m}$$

Video Solution:

Q13 Text Solution:

charges q_1, q_2 and q_3 are –14 nC, 78.85 nC and -56 nC. As we know that

$$\text{flux}, \phi = \frac{Q_{\text{enclosed}}}{\varepsilon_0}$$

where, ε_0 is free space permittivity

$$= 8.854 \times 10^{-12} \mathrm{C^2 N^{-1} m^{-2}}$$

$$\therefore \quad \phi_{\text{net}} = \frac{(-14 + 78.85 - 56) \times 10^{-9}}{8.854 \times 10^{-12}}$$

$$= 10^3 \mathrm{N - m^2 C^{-1}}$$

Video Solution:

Q14 Text Solution:

As we know that according to Gauss's law,

$$\oint E.\, ds = \frac{q_{enc}}{\varepsilon_o}$$

Hence, Gauss's law is used to determine electric field due to symmetric charge distribution inside the Gaussian surface.

Video Solution:

Q15 Text Solution:

Electric field lines emerge from the positive charge and converge to negative charge. Tangent drawn at any point on the field line gives the direction of electric field at that point. Electric field lines do not intersect each other. If they do, so there will be two directions of force at a single point which is not possible. Hence, statement (d) is incorrect

Video Solution:

Q16 Text Solution:

Electric force:

F_e = qE (20 × 10^{-6}c) (1000 V/m) = 0.02 N. Weight

Weight:

W = mg = (0.004 kg) (9.8 m/s^2) = 0.0392 N

At angle θ, equilibrium requires

$$\tan\theta = \frac{F_e}{W} = \frac{0.02}{0.0392} \approx 0.51 \approx \frac{1}{2}$$

Hence

$$\theta = \tan^{-1}\frac{1}{2}$$

Which is options A.

Video Solution:

Q17 Text Solution:

To find the flux through the sphere, apply Gauss's law

$$\Phi = \frac{Q}{\varepsilon_0}$$

where Q is the total charge on the sphere and

$\varepsilon_0 = 8.85 \times 10^{-12} \mathrm{C}^2 / (\mathrm{N} \cdot \mathrm{m}^2)$

Compute the radius

$R = \frac{d}{2} = \frac{0.2\mathrm{m}}{2} = 0.1\mathrm{m}.$

Find the total charge Q

$Q = \sigma \times 4\pi R^2 = 70 \times 10^{-6} \frac{\mathrm{C}}{\mathrm{m}^2}$

$\times 4\pi (0.1\mathrm{m})^2 = 2.8\pi \times 10^{-6}\mathrm{C} \approx 8.80$

$\times 10^{-6}\mathrm{C}.$

Apply Gauss's law:

$\Phi = \frac{Q}{\varepsilon_0} = \frac{2.8\pi \times 10^{-6}}{8.85 \times 10^{-12}} \approx 9.94 \times 10^5 \mathrm{N} \cdot \mathrm{m}^2/\mathrm{C}$

So the flux is about 9.9 × 10^5 Nm^2/C which matches Option A.

Video Solution:

Q18 **Text Solution:**

Let's use the fact that the maximum torque on a dipole is

$\tau_{\max} = pE.$

So for the two dipoles

Dipole 1:

$\cdot p_1 = 3.9 \times 10^{-30}$ Cm

$\cdot E_1 = 16 \times 10^4 \mathrm{N/C} = 1.6 \times 10^5 \mathrm{N/C}$

$\cdot \tau_1 = p_1 E_1 = (3.9 \times 10^{-30})(1.6 \times 10^5)$

$= 6.24 \times 10^{-25}$ Nm

Dipole 2

$\cdot p_2 = 5.2 \times 10^{-30}$ Cm

$\cdot E_2 = 4 \times 10^4 \mathrm{N/C}$

$\cdot \tau_2 = p_2 E_2 = (5.2 \times 10^{-30})(4 \times 10^4)$

$= 2.08 \times 10^{-25}$ Nm

Ratio

$\frac{\tau_1}{\tau_2} = \frac{6.24 \times 10^{-25}}{2.08 \times 10^{-25}} = 3:1$

Video Solution:

Q19 **Text Solution:**

$E = \frac{F}{q}$

with

$-Force : [F] = MLT^{-1}$

$-Charge : [q] = AT$

So

$[E] = \frac{MLT^{-2}}{AT} = MLT^{-3}A^{-1}$

Flux

$\phi = E \times A$

With area $[A] = L^2$ gives

$[\phi] = (MLT^{-3}A^{-1}) \times L^2$

$= ML^3T^{-3}A^{-1}$

that matches option D.

Video Solution:

Q20 **Text Solution:**

49/100 F

Video Solution:

Q21 Text Solution:

5000 NC^{-1}

Video Solution:

Q22 Text Solution:

$\frac{Kq}{a^2}$ towards OB

Video Solution:

Q23 Text Solution:

Since both particles start from rest and move under uniform acceleration, we can use the equation of motion

$s = ut + \frac{1}{2}at^2$

Given that the initial velocity u = 0 they start from rest), this simplifies to

$s = \frac{1}{2}at^2$

Substituting $a = \frac{eE}{m} gives$

$s = \frac{1}{2}\left(\frac{eE}{m}\right)t^2$

Thus, solving for t^2 we get

$t^2 = \frac{2ms}{eE}$

which implies that

$t = \sqrt{\frac{2ms}{eE}}$

We can now write the times for the electron (t_e) and the proton (t_p) using their respective masses (m_e) for electron and m_p for proton)

$t_e = \sqrt{\frac{2m_e s}{eE}}$

$t_p = \sqrt{\frac{2m_p s}{eE}}$

The question asks us for the ratio t_e / t_p which can be calculated as follows

$\frac{t_e}{t_p} = \frac{\sqrt{\frac{2m_e s}{eE}}}{\sqrt{\frac{2m_p s}{eE}}} = \sqrt{\frac{m_e}{m_p}}$

Video Solution:

Q24 Text Solution:

$\text{Given}, q_1 = -20\mu\text{C} = -2 \times 10^{-5}\text{C}$

$q_2 = 60\mu\text{C} = 6 \times 10^{-5}\text{C}$

Force of attraction between the both charges, kept at a certain distance r,

$F_1 = \frac{Kq_1q_2}{r^2}$

$= \frac{K \times 2 \times 10^{-5} \times 6 \times 10^{-5}}{r^2}$

$= \frac{12 \times 10^{-10}K}{r^2}$

When both charges are touched, then new charge on both spheres

$q_1' = q_2' = \frac{q_1 + q_2}{2} = \frac{-20+60}{2} = 20\mu\text{C}$

$= 2 \times 10^{-5}\text{C}$

Force between the two spheres,

$F_2 = \frac{Kq_1' \cdot q_2'}{r^2}$

$= \frac{K \cdot 2 \times 10^{-5} \times 2 \times 10^{-5}}{r^2}$

$= \frac{4 \times 10^{-10}}{r^2}K$

$\therefore \frac{F_1}{F_2} = \frac{\frac{12 \times 10^{-10}K}{r^2}}{\frac{4 \times 10^{-10}}{r^2}} = \frac{12}{4} = \frac{3}{1}$

$\therefore F_1 : F_2 = 3 : 1$

Video Solution:

Q25 Text Solution:

As, the lines of force are parallel to the current surface of cylinder, the flux passing through the curved surface is zero. The flux through the plane-end faces of the cylinder is

$\phi_E = EA + EA = 2EA$

Bu Gauss' Law

$\phi_E = \int E \cdot ds = \frac{q}{\varepsilon_0} \Rightarrow 2EA = \frac{\sigma A}{\varepsilon_0} \Rightarrow E$
$= \frac{\sigma}{2\varepsilon_0}$

Video Solution:

Q26 Text Solution:

Given $Q_1 + Q_2 = 0.8\mathrm{c}$

$r = 30\mathrm{cm} = 0.3\mathrm{m}$

According to Coulomb's Law

$F = k\frac{Q_1 Q_2}{r^2}$

$\Rightarrow F = k\frac{Q_1(0.8 - Q_1)}{r^2}$

The force on Q_1 will be maximum if

$\frac{dF}{dQ_1} = 0$

$\Rightarrow \frac{d}{dQ} k\frac{Q_1(0.8 - Q_1)}{r^2} = 0$

$0.8 - 2Q_1 = 0$

$\Rightarrow Q_1 = 0.4\mathrm{C}$

$\therefore Q_2 = 0.8 - Q_1$

$= 0.8 - 0.4 = 0.4\mathrm{C}$

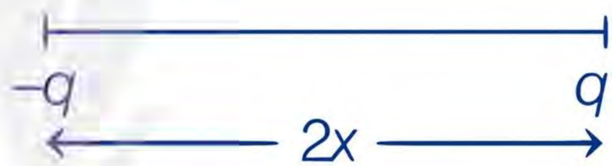
Video Solution:

Q27 Text Solution:

The orientation of the dipole for the stable equilibrium $\theta = 0$

Video Solution:

Q28 Text Solution:



The axis of the electric dipole is directed along the direction of dipole moment and the direction of electric dipole moment is taken from negative charge to positive charge

Video Solution:

Q29 Text Solution:

Electric field due to thin spherical shell to a distance x outside from the centre is given as

$E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{x^2} \cdots\cdots \left(i\right)$

$where\ Q = s.\, A$

$= s \times 4\pi R^2$

$From\ Eq.\ \left(i\right)\ We\ get$

$E = \frac{1}{4\pi\varepsilon_0} \cdot \frac{s \times 4\pi R^2}{x^2} = \frac{sR^2}{\varepsilon_0 x^2}$

$\therefore E \propto \frac{1}{x^2}$

Video Solution:

Q30 Text Solution:

$F = k\frac{|q_1 q_2|}{r^2}$

where:

F is the magnitude of the force between the charges,

g_1 and g_2 are the magnitudes of the charges,

r is the distance between the charges,

k is Coulomb's constant (approximately 8.987 × 10^9 $Nm^2/(c^2)$ vacuum or air).

When the same arrangement of charges is placed in a medium such as water, the force between the charges is affected by the dielectric constant $\left(\varepsilon_r\right)$ of the medium. The equation for the force in a mediurn becomes

$F' = \frac{k}{\varepsilon_r}\frac{|q_1 q_2|}{r^2}$

where ε_r, is the relative permittivity (dielectric constant) of the medium. For water, ε_e, is approximately 80 at room temperature. Because $\varepsilon_r > 1$ for any medium other than vacuum, the effect of this is to reduce the force between the charges:

$F_2 = \frac{F_1}{\varepsilon_r}$

Given that $\varepsilon_r > 1$ for water, this implies that $\frac{1}{\varepsilon_r} > 1$ hence $F_2 < F_1$. Therefore, the correct statement is: Option D: $F_2 < F_1$

Video Solution: