Ultimate KCET Crash Course 2026

PHYSICS

DPP: 2

Electric charges and fields

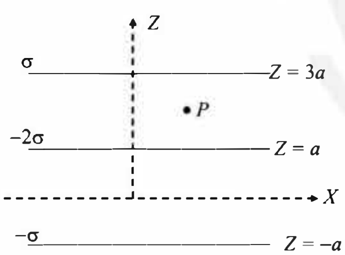
Q1 A charged conductor produces an electric field of intensity 10^3 V/m just outside its surface in vacuum. Then, it produces the electric field of intensity E just outside its surface, when it is placed in a medium of dielectric constant 4. The value of E will be

(A) 400 V/m (B) 450 V/m
(C) 250 V/m (D) 150 V/m

Q2 Surface density of charge on a charged conducting sphere of radius R in terms of electric field intensity E' at a distance r in free space is (r > R,$\in_o =$ permittivity of free space)

(A) $\varepsilon_o E\left(\frac{R}{r}\right)^2$ (B) $\varepsilon_o E\frac{r}{R}$
(C) $\varepsilon_o E\left(\frac{r}{R}\right)^2$ (D) $\varepsilon_o E\frac{r}{R}$

Q3 Three infinitely long charge sheets are placed as shown in figure. The electric field at point P is



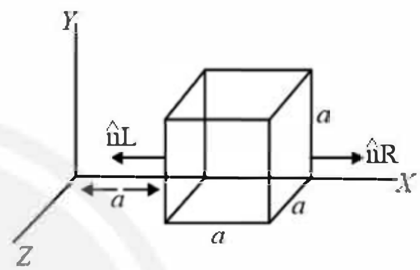
(A) $\frac{2\sigma}{\varepsilon_0}\hat{k}$
(B) $\frac{4\sigma}{\varepsilon_0}\hat{k}$
(C) $-\frac{2\sigma}{\varepsilon_0}\hat{k}$
(D) $-\frac{4\sigma}{\varepsilon_0}\hat{k}$

Q4 Electric field strength due to a point charge of 9μC at a distance of 90 cm from the charge is:

(A) 9×10^4 N/C
(B) 1×10^5 N/C
(C) 5×10^4 N/C
(D) 1×10^4 N/C

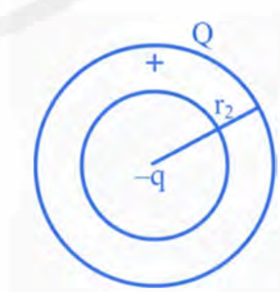
Q5

The electric field components in the given figures are in $E_x = ax^{1/2}, E_y = E_x = 0$ which $\alpha = 800NC^{-1}m^{-1/2}$. If net flux through the cube is 1.05 Nm^2C^{-1}(assume a = 0.1m), The charge within the cube is



(A) 9.27×10^{-12} C
(B) 9.27×10^{12} C
(C) 6.67×10^{-12} C
(D) 6.97×10^{12} C

Q6 A spherical conducting shell of inner radius 'r_1'and outer radius 'r_2' has a charge 'Q'. A charge-q is placed at the centre of the shell. The surface charge density on the inner and outer surface of the shell will be



(A) $\frac{q}{4\pi r_1^2}$ and $\frac{Q-q}{4\pi r_2^2}$
(B) $\frac{q}{4\pi r_1^2}$ *and* $\frac{Q}{4\pi r_2^2}$
(C) $\frac{-q}{4\pi r_1^2}$ *and* $\frac{Q+q}{4\pi r_2^2}$
(D) Zero and $\frac{Q-q}{4\pi r_2^2}$

Q7

F is the force between the two identical charged particles placed at a distance Y from each other. If the distance between the charges is reduced to half the previous distance then force between them becomes

(A) F/4 (B) 4 F
(C) 2 F (D) F/2

Q8 An electron of mass 'm' and charge 'q is accelerated from rest in a uniform electric field of strength E. The velocity acquired by the electron when it travels a distance L'is

(A) $\sqrt{\frac{2qE}{mL}}$ (B) $\sqrt{\frac{2Em}{qL}}$
(C) $\sqrt{\frac{2qEL}{m}}$ (D) $\times\sqrt{\frac{qE}{mL}}$

Q9 A point charge Q is placed at the centre of the line joining two equal point charges +q and +q. The value of Q if the system of the charges is in equilibrium, is

(A) $\frac{-q}{2}$ (B) $-\frac{q}{4}$
(C) $\frac{+q}{4}$ (D) $\frac{+q}{2}$

Q10 When a piece of polythene is rubbed with wool, a negative charge 4×10^{-7} C is developed on the polythene. The number of electrons transferred from wool to polythene is [e = 1.6×10^{-19} C]

(A) 1.5×10^{12}
(B) 3.5×10^{13}
(C) 2.5×10^{13}
(D) 2.5×10^{12}

Q11 In hydrogen atom an electron revolves around a proton (in nucleus) at a distance 'r 'm. the intensity of electric field due to the proton at distance 'r' is 5×10^{11} NC^{-1} the magnitude of force between the electron and proton is (charge on electron = 1.6×10^{-19} C]

(A) 4×10^{8} N
(B) 8×10^{8} N
(C) 4×10^{-8} N
(D) 8×10^{-8} N

Q12 Two point charges +3μC and +8μC repel each other with a force of 40 N. If a charge of -5μC is added to each of them, then force between them will become

(A) –10N
(B) 10 N
(C) 20 N
(D) –20 N

Q13 Three equal charges q_1, q_2 and 'qs are placed on the three corners of a square of side 'a'. If the force between q_1 and q_2 is F_{12} and that between q_1 and q_3 is 'F_{13}, then the ratio of magnitudes $\left(\frac{F_{12}}{F_{13}}\right)$ is

(A) 1/2 (B) $\sqrt{2}$
(C) $\frac{1}{\sqrt{2}}$ (D) 2

Q14 Three charges each of +1μC are placed at the comers of an equilateral triangle. If the repulsive force between any two charges is F, then the net force on either charge will be [cos 60° 0.5]

(A) 2 F (B) 3 F
(C) $\sqrt{2}F$ (D) $\sqrt{3}F$

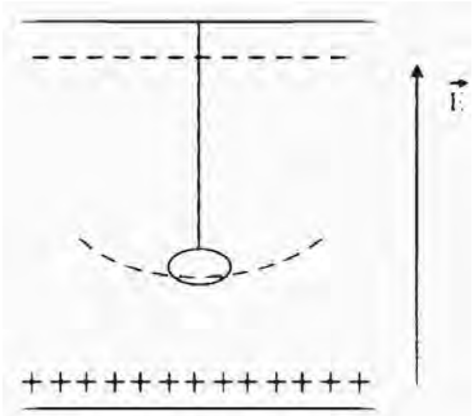
Q15 The electric field intensity on the surface of a charged solid sphere of radius' and volume charge density 'p' is given by (ε_o= permittivity of free space

(A) Zero
(B) $\frac{\rho\pi}{3\varepsilon_o}$
(C) $\frac{1}{4\pi\varepsilon_o}\frac{\rho}{r}$
(D) $\frac{5\pi}{6\varepsilon_o}$

Q16 If the radius of the spherical gaussian surface is increased then the electric flux due to a point charge enclosed by the surface

(A) increases
(B) remains unchanged
(C) decreases
(D) zero

Q17 The bob of a simple pendulum of length "I' has a mass m' and charge q. The pendulum is suspended between the plates of a charged parallel plate capacition The direction of electric field is shown in figure. The period of oscillations of the simple pendulum is (acceleration due to gravity > qE / m)



(A) $2\pi\sqrt{\frac{L}{8}}$

(B) $2\pi\left[\frac{L}{\frac{qE}{m}-g}\right]^{\frac{1}{2}}$

(C) $2\pi\left[\frac{L}{g-\frac{qE}{m}}\right]^{\frac{1}{2}}$

(D) $2\pi\left[\frac{L}{g+\frac{qE}{m}}\right]^{\frac{1}{2}}$

Q18 An electric dipole consisting of two opposite charges of 2×10^{-6} C separated by a distance of 3 cm placed in an electric field of 2×10^{5} N/C then the maximum torque acting on dipole is

(A) 12×10^{-1} N – m

(B) 24×10^{-3} N – m

(C) 12×10^{-3} N – m

(D) 24×10^{-1} N – m

Q19 Select the correct statement from the following.

(A) Gravitational force is stronger than electrostatic force

(B) Gravitational as well as electrostatic force always attractive.

(C) Gravitational as well as electrostatic force always act along the line joining the two objects.

(D) Inverse square law $\left(F \propto \frac{1}{r^2}\right)$ is not obeyed by electrostatic force

Q20 Two electric dipoles of moment P and 27P are placed on a line with their centres 24 cm apart. Their dipole moments are in opposite direction. At which point the electric field will be zero between the dipoles from the centre of dipole of moment P?

(A) 6 cm (B) 8 cm

(C) 10 cm (D) 12 cm

Q21 If the magnitude of intensity of electric field at a distance 'r_1 on an axial line and at a distance 'r_2' on an equatorial line due to a given short dipole are equal then : $r_1 : r_2$ is

(A) $\sqrt[3]{2} : 1$ (B) $\sqrt{2} : 1$

(C) 1 : 2 (D) $1 : \sqrt[3]{2}$

Q22 A charge 17.7×10^{-4} C is distributed uniformly over a large sheet of area 200 m^2. The electric field intensity at a distance 20 cm from it in air will be $\left[\varepsilon_o = 8.85 \times 10^{-12} c^2/Nm^2\right]$

(A) $5 \times 10^5 N/C$ (B) $6 \times 10^5 N/C$

(C) $7 \times 10^5 N/C$ (D) $8 \times 10^5 N/C$

Q23 A uniformly charged conducting sphere of diameter 14 cm has surface charge density of 40 μ Cm^{-2}. The total electric flux leaving the surface of the sphere is nearly (Permittivity of free space 8.85×10^{-12} St unit)

(A) 40 kWb (B) 140 kWb

(C) 240 kWb (D) 280 kWb

Q24 Two charged particles each having charge' q' and mass' m' are held at rest while their separation is r. The speed of the particles when their separation is will be r/2(ε_0 =permittivity of the medium

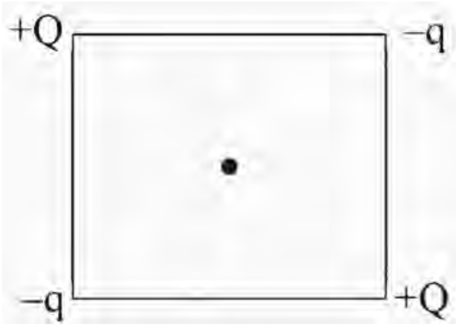
(A) $\frac{q}{4\pi\varepsilon_o mr}$

(B) $\frac{q}{2\pi\varepsilon_o mr}$

(C) $\frac{q}{\sqrt{4\pi\varepsilon_o mr}}$

(D) $\frac{q^2}{4\pi\varepsilon_o mr}$

Q25 A charge +Q is placed at each of the diagonally opposite comers of a square. A charge -q is placed at each of the other diagonally opposite comers as shown. If the net electrical force on +Q is zero, then Q/–q is equal to



(A) +1 (B) $+2\sqrt{2}$

(C) $\frac{+1}{\sqrt{2}}$ (D) $-2\sqrt{2}$

Q26 If the electric flux entering and leaving an enclosed surface are ϕ_1 and ϕ_2 respectively, the electric charge inside the surface will be

(A) $\frac{\phi_2-\phi_1}{\varepsilon_o}$

(B) $\frac{\phi_1+\phi_2}{\varepsilon_o}$

(C) $\varepsilon_o\left(\phi_1-\phi_2\right)$

(D) $\varepsilon_o\left(\phi_2-\phi_1\right)$

Q27 A spherical rubber balloon carries a charge, uniformly distributed over the surface. As the balloon is blown up and increases in size, the total electric flux coming out the surface

(A) becomes zero

(B) decreases

(C) increases

(D) remains unchanged

Q28 Charges 3Q, q and Q are placed along x-axis at positions x=0, x = 1/3 and x = 1 respectively. When the force on charge Q is zero, the value of q is

(A) Q/3 (B) –Q/3

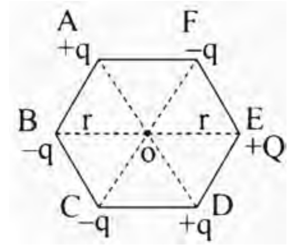
(C) 4/3 Q (D) –4/3 Q

Q29 Two point charges (A and B) + 4g and-4q are placed along a line separated by a distance I'. Force acting between them is F. If 25% of charge from point A is transferred to that at point 8, the force between the charges now becomes

(A) 3/4 F (B) 4/3 F

(C) 9/19 F (D) 16/9 F

Q30 The point charges +q, q, q, q,+Q and-q are placed at the vertices of a regular hexagon ABCDEF as shown in figure. The electric field at the centre of hexagon O due to the five charges at A, B, C, D and F' is thrice the electric field at centre O' due to charge Q at E alone. The value of Q is



(A) $\frac{+q}{3}$ (B) $\frac{+q}{5}$

(C) $\frac{+q}{6}$ (D) +6q

Answer Key

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

Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Text Solution:

Given that a charged conductor produces an electric field intensity of 10^3 V/m just outside its surface in a vacuum, we need to determine the electric field E when the conductor is placed in a medium with a dielectric constant of 4.

The electric field in a medium with a dielectric constant K is given by:

$$E = \frac{E_o}{K}$$

E-Substituting the given values:

$$E = \frac{10^3}{4} = 250V/m$$

Thus, the electric field intensity just outside the surface of the conductor when placed in the medium is 250 V/m

Video Solution:

Q2 Text Solution:

The electric field intensity at a distance r from the conducting sphere is

$$E = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}$$

The surface charge density of sphere is

$$\sigma = \frac{Q}{4\pi R^2}$$

Dividing Eqs. (ii) by (i), we get

$$\frac{\sigma}{E} = \frac{Q}{4\pi R^2} \times \frac{4\pi\varepsilon_0 r^2}{Q} = \varepsilon_0\left(\frac{r}{R}\right)^2$$

$$\sigma = \varepsilon_0 E\left(\frac{r}{R}\right)^2$$

Video Solution:

Q3 Text Solution:

All the three charge sheets will produce electric field at *P*. The field will be along negative *Z*-axis.

Hence

$$\vec{E} = \left[\frac{\sigma}{2\varepsilon_0} + \frac{2\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0}\right]\left(-\hat{k}\right) \text{ or } \vec{E} = -\frac{2\sigma}{\varepsilon_0}\hat{k}$$

Video Solution:

Q4 Text Solution:

(2)

$$E = \frac{9\times10^9\times9\times10^{-6}}{\left(90\times10^{-2}\right)^2}$$

$$\Rightarrow E = 1 \times 10^5 \text{ N/C}$$

Video Solution:

Q5 Text Solution:

(1)

By Gauss's law

$$\phi = \frac{q}{\epsilon_0}$$

or $q = \phi \epsilon_0$

$$= 1.05 \times 8.854 \times 10^{-12}C = 9.27 \times 10^{-12}C$$

Video Solution:

Q6 Text Solution:

Due to charge-q at the centre of the shell, a charge q will be induced on the inner surface and -q on the outer surface. The charge on outer surface will become Q-q. Hence, surface change densities will be

$\frac{q}{4\pi r_1^2}$ and $\frac{Q-q}{4\pi r_2^2}$

Video Solution:

Q7 Text Solution:

$$F = \frac{1}{4\pi\varepsilon_0}\cdot\frac{q^2}{r^2}$$

$$\therefore \quad \frac{F_2}{F_1} = \left(\frac{r_1}{r_2}\right)^2 = \left(2\right)^2 = 4$$

$$\therefore \quad F_2 = 4F_1$$

Video Solution:

Q8 Text Solution:

$W = F.L = qEL$

According to the principle of conservation of energy, the work done by the electric field is converted into kinetic energy (K) of the electron. The kinetic energy of an object with mass m and velocity v is given by

$K = \frac{1}{2}mv^2$ Therefore, we equate the work done to the kinetic energy to find the velocity

$qEL = \frac{1}{2}mv^2$

Solving this equation for to find the velocity of the electron after traversing the distance & yields

$= \sqrt{\frac{2qEL}{m}}$

Hence, the correct answer is C

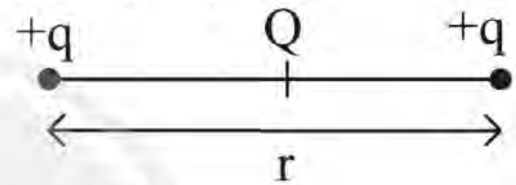
Video Solution:

Q9 Text Solution:

Force on +-q due to the other two charges should also be equal and opposite. Their magnitudes will be equal if

$$\frac{1}{4\pi\varepsilon_0}\cdot\frac{q^2}{r^2} = \frac{1}{4\pi\varepsilon_0}\cdot\frac{qQ}{\left(\frac{r}{2}\right)^2} = \frac{1}{4\pi\varepsilon_0}\cdot\frac{4qQ}{r^2}$$

$\therefore q = 4Q \quad \text{or} Q = \frac{q}{4}$



$\therefore q = 4Q$

$\text{or} Q = \frac{q}{4}$

Q and q should have opposite signs so that the two forces are opposite in direction

$\therefore Q = -\frac{q}{4}$

Video Solution:

Q10 Text Solution:

$q = 4\times10^{-7}$

$q = Ne$

$N = \frac{q}{e} = \frac{4\times10^{-7}}{1.6\times10^{-19}} = 2.5\times10^{12}$

Video Solution:

Q11 Text Solution:

F = qE

Here, the electric field intensity due to the proton at distance r is given as:

$E = 5 \times 10^{11}\ NC^{-1}$

The charge on the electron is:

$q = 1.6 \times 10^{-19}$ C

Substituting these values into the equation for the force

$F = (1.6 \times 10^{-19}\ C) \times (5 \times 10^{11}\ NC^{-1})$

$F = 8 \times 10^{-8}$ N

Therefore, the magnitude of the force between the electron and proton is: 8×10^{-8} N

Video Solution:

Q12 Text Solution:

Redistribution of charges takes place

$q_1 = 3\mu C$ and charge $q_2 = 8\mu C$

When third charge $q_3 = -5\mu C$ is added to each, then new charges on q_1 and q_2 will be

$q_1 = 3 - 5 = -2\mu C$

and $q_2 = 8 - 5 = 3\mu C$

Now,

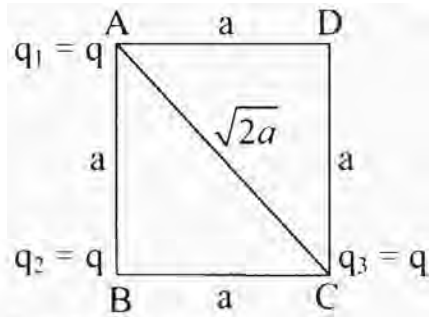
Case I $40 = \frac{1}{4\pi\varepsilon_0} \cdot \frac{3\times8}{r^2}$

Case II $F = \frac{1}{4\pi\varepsilon_0} \times \frac{(-2\times3)}{r^2}$

$\therefore \frac{F}{40} = \frac{-2\times3}{3\times8} \Rightarrow F = -10N$

Video Solution:

Q13 Text Solution:



Three equal charges are kept at the corners A, B, C of a square ABCD.

Therefore The force between q_1 and q_2 is F_{12}

and $\mathbf{F}_{12} = \frac{1}{4\pi\varepsilon_0}\frac{\mathbf{q}\times\mathbf{q}}{\mathbf{a}^2} = \frac{1}{4\pi\varepsilon_0}\frac{\mathbf{q}^2}{\mathbf{a}^2}$

and the force between q_1 and q_3 at A and C is

$F_{13} = \frac{1}{4\pi\varepsilon_0}\frac{q^2}{2a^2}$

$\therefore \frac{F_{12}}{F_{13}} = \frac{q^2}{a^2} \times \frac{2a^2}{q^2} = 2(\text{in magnitude})$

Video Solution:

Q14 Text Solution:

The force on any charge due to each of the other two charges has magnitude F The angle between the two forces is 60° Hence the resultant force is given by

$R = \sqrt{F^2 + F^2 + 2F^2\cos 60^\circ} = \sqrt{3}F$

Video Solution:

Q15 Text Solution:

The electric field intensity on the surface is given by

$E=\frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}\cdot\cdot$ .....(1)

But $\mathrm{q}=\frac{4}{3}\pi\mathrm{r}^3\rho$

Putting this value of q in Eq.(1) and simplifying we get

$\mathrm{E}=\frac{\rho\Gamma}{3\varepsilon_0}$

Video Solution:

Q16 Text Solution:

If the radius of the spherical Gaussian surface is increased, then the electric flux due to a point charge enclosed by the surface remains constant. Flux depends only on the enclosed charge. It does not depend upon the size or shape of the Gaussian surface

Video Solution:

Q17 Text Solution:

Electric force, $F_{electric}$ = qE The effective force

$\mathrm{mg_{eff}}=\mathrm{mg}-\mathrm{F_{electric}}$

$\mathrm{g_{eff}}=\mathrm{g}-\frac{\mathrm{qE}}{\mathrm{m}}$

The period of oscillation for a simple pendulum,

$\mathrm{T}=2\pi\sqrt{\frac{\mathrm{L}}{\mathrm{g}}}$

Time period when pendulum is suspended between the plates,

$\mathrm{T}=2\pi\sqrt{\frac{\mathrm{L}}{\mathrm{g_{eff}}}}$

$\mathrm{T}=2\pi\left[\frac{\mathrm{L}}{\mathrm{g}-\frac{\mathrm{qE}}{\mathrm{m}}}\right]^{\frac{1}{2}}$

Video Solution:

Q18 Text Solution:

$$\text{Dipole moment} \mathrm{p}=\mathrm{q}\times 2\mathrm{l}=2\times 10^{-6}\times 3\times 10^{-2}$$

$$=6\times 10^{-8}\ \mathrm{Cm}$$

$$\therefore\quad \tau_{\max}=\rho E\sin\theta=\mathrm{pE}\sin 90^{\circ}$$

$$=6\times 10^{-8}\times 2\times 10^{5}\times 1$$

$$=12\times 10^{-3}\ \mathrm{Nm}$$

Video Solution:

Q19 Text Solution:

Option A is incorrect because gravitational force is actually much weaker than the electrostatic force. The gravitational force between two particles is given by Newton's law of gravitation:

$F_{\text{gravity}}=G\frac{m_1m_2}{r^2}$

where G is the gravitational constant, my and me are the masses of the particles, and is the distance between their centers. On the other hand, the electrostatic force is given by Coulomb's law

$F_{\text{electrostatic}}=k\frac{|q_1q_2|}{r^2}$

where k is Coulomb's constant, and g_1 and g_1 are the electric charges of the particles. The electrostatic force is much stronger than the gravitational force because the gravitational constant G is a much smaller number than Coulomb's constant k.

Option B is incorrect because the electrostatic force can be either attractive or repulsive, depending on whether the charges are opposite (attractive) or like charges (repulsive). However, the gravitational force is always attractive, as it always acts to pull masses together.

Option C is correct. Both gravitational and electrostatic forces act along the straight line joining the centers of the two masses or charges, respectively. This line is known as the line of action for these forces.

Option D is incorrect because the electrostatic force does indeed obey an inverse square law, just like the gravitational force. Both forces diminish in strength with the square of the distance between the two objects, as is reflected in the equations for both forces (Newton's law of gravitation and Coulomb's law

Video Solution:

Q20 Text Solution:

$$\text{At N, } |\text{E. F. due to dipole 1}| = |\text{E. F. due to dipole 2}|$$

$$\therefore \quad \frac{1}{4\pi\varepsilon_0} \cdot \frac{2\text{p}}{\text{x}^3} = \frac{1}{4\pi\varepsilon_0} \cdot \frac{2(27\text{p})}{(24-\text{x})^3}$$

$$\therefore \quad \frac{1}{\text{x}^3} = \frac{27}{(24-\text{x})^3} \Rightarrow \text{x} = 6\,\text{cm}$$

Video Solution:

Q21 Text Solution:

$$E_{\text{axial}} = E_{\text{equatorial}} \quad \Rightarrow k\frac{2p}{r_1^3} = \frac{kp}{r_2^3}$$

$$\Rightarrow \frac{r_1}{r_2} = \frac{2^{1/3}}{1} = \sqrt[3]{2} : 1$$

Video Solution:

Q22 Text Solution:

The surface charge density is given by

$$\sigma = \frac{\text{q}}{\text{A}} = \frac{17.7\times10^{-4}}{200} = 8.85 \times 10^{-6}\text{C/m}^2$$

The electric field intensity at a distance of 20 cm in air is

$$\text{E} = \frac{\sigma}{2\varepsilon_0} = \frac{8.85\times10^{-6}}{2\times8.85\times10^{-12}} = 5 \times 10^5\text{N/C}$$

Hence, option (A)

Video Solution:

Q23 Text Solution:

$$\text{Electric flux}\phi = \frac{\text{q}}{\varepsilon_0} = \frac{4\pi\text{r}^2\sigma}{\varepsilon_0}$$

$$= \frac{4\times3.14\times\left(7\times10^{-2}\right)^2\times40\times10^{-6}}{8.85\times10^{-12}}$$

$$= \frac{4\times3.14\times49\times10^{-4}\times4\times10^{-5}}{8.85\times10^{-12}}$$

$$= \frac{4\times3.14\times49\times4\times10^{3}}{8.85}$$

$$= 278 \times 10^3 \approx 280 \times 10^3\text{ Wb}$$

$$= 280\,\text{kWb}$$

Video Solution:

Q24 Text Solution:

According to the conservation of energy principle:

(Initial K.E. + Initial P.E.) = (Final K.E. + Final P.E.)

Substituting the expressions for the initial and final energies

$\frac{1}{4\pi\varepsilon_0}\cdot\frac{q^2}{r}=mv^2+\frac{1}{4\pi\varepsilon_0}\cdot\frac{2q^2}{r}$

Rearranging terms to solve for mv^2

$mv^2=\frac{1}{4\pi\varepsilon_0}\left(\frac{2q^2}{r}-\frac{q^2}{r}\right)=\frac{q^2}{4\pi\varepsilon_0}\cdot\frac{1}{r}$

then

$mv^2=\frac{q^2}{4\pi\varepsilon_0}\cdot\frac{1}{r}$

Solving for v

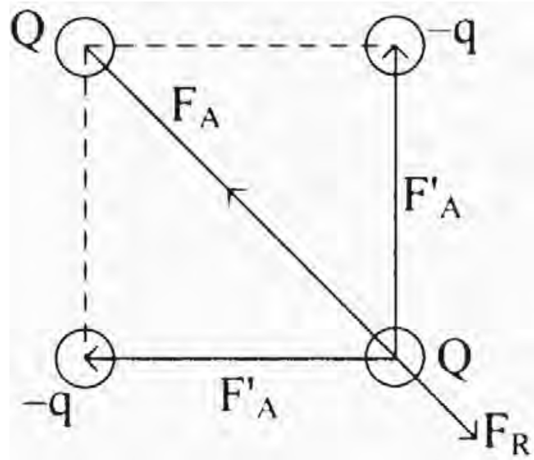
$v=\frac{q}{\sqrt{4\pi\varepsilon_0 mr}}$

Thus, the speed of the particles when their separation is reduced to r/2 is given by

$v=\frac{q}{\sqrt{4\pi\varepsilon_0 mr}}$

Video Solution:

Q25 Text Solution:



From the daigram

$$(F_A)^2=(F_R)^2\Rightarrow 2\left(F_A'\right)^2=F_R^2$$

$\therefore\quad \sqrt{2}\left(F_A'\right)=F_R$

$\therefore\quad \frac{1}{4\pi\varepsilon_0}\frac{\sqrt{2}Q(-q)}{a^2}=\frac{1}{4\pi\varepsilon_0}\frac{Q^2}{2a^2}$

$\therefore\quad Q=-2\sqrt{2}q$

$\therefore\quad \frac{Q}{q}=\frac{-2\sqrt{2}}{1}$

$\frac{Q}{-q}=2\sqrt{2}$

Video Solution:

Q26 Text Solution:

We can solve this using Gauss's Law, which states that

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

Here's a step-by-step explanation: The flux leaving the surface contributes positively with a value of $2, while the flux entering the surface contributes negatively with a value of 1. Thus, the net electric flux is

$\phi_{ney}=\phi_2-\phi_1$

Applying Gauss's Law

$\phi_{ney}=\frac{q_{enc}}{\varepsilon_o}$

Substituting for the net flux

$\phi_2-\phi_1=\frac{q_{enc}}{\varepsilon_o}$

Solving for the enclosed charge gene q_{enc}

Thus, the correct answer is: Option D

Video Solution:

Q27 Text Solution:

According to Gauss's law, the net electric flux through any closed surface is given by 4

$\Phi_E = \frac{q_{enc}}{\varepsilon_o}$

Φ_E is the electric flux,

q_{enc} is the total enclosed charge, and to ε_o is the permittivity of free space. In our case, the balloon carries a total charge Q which is uniformly distributed over its surface. When you blow up the balloon, its size increases, but the total charge Q remains the same.

Because the net flux depends only on the total enclosed charge and not on the size or shape of the surface, the total electric flux will remain unchanged.

Thus, the correct answer is: Option D: remains unchanged

Video Solution:

Q28 Text Solution:

Force F_1 due to Charge 3Q on Q will be

$F_1 = \frac{1}{4\pi\varepsilon_0}\frac{3Q^2}{\Gamma^2}$

Force F_2 due to charge q on chare Q will be

$\mathrm{F}_2 = \frac{1}{4\pi\varepsilon_0}\frac{\mathrm{Qq}}{\left(\frac{2}{3}\right)^2}$

$\therefore \quad \mathrm{F}_2 = \frac{1}{4\pi\varepsilon_0}\frac{9\ \mathrm{Qq}}{4\Omega^2}$

For the force on chage Q to be zero

$\mathrm{F}_1 + \mathrm{F}_2 = 0\mathrm{or}\mathrm{F}_1 = -\mathrm{F}_2$

$\therefore \quad \frac{3\mathrm{Q}^2}{\mathrm{P}^2} = -\frac{9\ \mathrm{Qq}}{4l^2}$

$\therefore \quad \mathrm{Q} = -\frac{3\mathrm{q}}{4}$

$\therefore \quad \mathrm{q} = -\frac{4}{3}\mathrm{Q}$

Video Solution:

Q29 Text Solution:

When the charges +4g and - 4q are placed along a line separated by a distance r, the initial force between them is given by:

$F = \frac{-16q^2}{4\pi\varepsilon_0 r^2}$ .....(i)

If 25% of the charge from point A is transferred to point B, the charges change as follows: Charge at point A becomes

Charge at point A becomes:

$q_1 = +4q - 0.25(+4q) = +3q$

Charge at point B becomes:

$q_2 = -4q + 0.25(+4q) = -3q$

Thus, the new force between points A and B is:

$F' = \frac{(3q)\times(-3q)}{4\pi\varepsilon_0 r^2} = \frac{-9q^2}{4\pi\varepsilon_0 r^2}$

By multiplying and dividing by 16 to compare with the initial force F. we get

$F' = \frac{9}{16} \times \left(\frac{-16q^2}{4\pi\varepsilon_0 r^2}\right) = \frac{9}{16}F \quad [\text{From (i)}]$

Video Solution:

Q30 Text Solution:

Electric field at O' due to charge Q' is given by,

$E = \frac{kQ}{r^2}$

Electric field at O' due to charges +q at A and Dare equal and opposite and hence they will cancel each other. Similarly electric field at O' due to charges -q at Fand C will also cancel each other Electric field at 'O' due to charge-qat B is given by

$E' = \frac{kq}{r^2}$

$\mathrm{Now}, \mathrm{E}' = 3\mathrm{E}$

$\therefore \quad \frac{\mathrm{kq}}{\mathrm{r}^2} = \frac{3\,\mathrm{kQ}}{\mathrm{r}^2} \Rightarrow \mathrm{Q} = \frac{\mathrm{q}}{3}$

Video Solution: