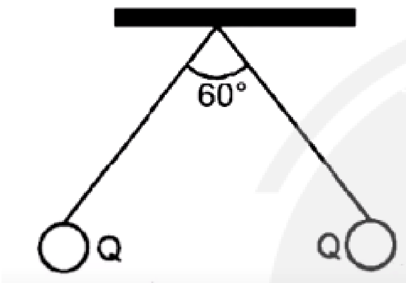
Parishram (2025)

Physics

Electric Charges and Fields

DPP : 4

Q1 Two small spherical balls each carrying a charge $Q = 10\mu C$ (10 micro-coulomb) are suspended by two insulating threads of equal lengths $1\ m$ each, from a point fixed in the ceiling. It is found that in equilibrium threads are separated by an angle 60° between them, as shown in the figure. What is the tension in the threads?



(Given: $\frac{1}{(4\pi\varepsilon_0)} = 9 \times 10^9\ Nm/C^2$)

(A) $18\ N$
(B) $1.8\ N$
(C) $0.18\ N$
(D) None of these

Q2 Point charges $+4q, -q$ and $+4q$ are kept on the x-axis at points $x = 0, x = a$ and $x = 2$ respectively, then:

(A) only -q is in stable equilibrium
(B) none of the charges are in equilibrium
(C) all the charges are in unstable equilibrium
(D) all the charges are in the stable equilibrium

Q3 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:

(A) $-\frac{Q}{4}(1+2\sqrt{2})$
(B) $\frac{Q}{4}(1+2\sqrt{2})$
(C) $-\frac{Q}{2}(1+2\sqrt{2})$
(D) $\frac{Q}{2}(1+2\sqrt{2})$

Q4 A charge Q is placed at two 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 the Q/q equals

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

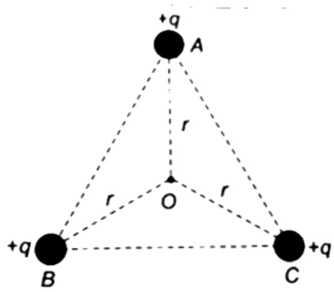
Q5 Three identical charges are placed at the corners of an equilateral triangle. If the force between any two charges is F, then the net force on each will be:

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

Q6 Three charges each of magnitude q are placed at the corners of an equilateral triangle, the electrostatic force on the charge placed at the centre is (each side of triangle is L):

(A) Zero
(B) $\frac{1}{4\pi\varepsilon_0} \cdot \frac{q^2}{L^2}$
(C) $\frac{1}{4\pi\varepsilon_0} \cdot \frac{3q^2}{L^2}$
(D) $\frac{1}{12\pi\varepsilon_0} \cdot \frac{q^2}{L^2}$

Q7 ABC is an equilateral triangle. Charge $+q$ are placed at each corner. The electric intensity at O will be:



(A) $\frac{1}{4\pi\varepsilon_0} \frac{q}{r^2}$
(B) $\frac{1}{4\pi\varepsilon_0} \frac{q}{r}$
(C) zero
(D) $\frac{1}{4\pi\varepsilon_0} \frac{3q}{r^2}$

Q8 The magnitude of electric field intensity E is such that, an electron placed in it would experience an electrical force equal to its weight, is given by

(A) mge (B) $\frac{mg}{e}$

(C) $\frac{e}{mg}$ (D) $\frac{e^2}{m^2}g$

Q9 An electron and a proton are in a uniform electric field, the ratio of their accelerations will be

(A) Zero

(B) unity

(C) The ratio of masses of proton and electron

(D) the ratio of the masses of electron and proton

Q10 The distance between the two charges $25\mu C$ and $36\mu C$ is $11\ cm$. At what point on the line joining the two, the electric field intensity will be zero

(A) At a distance of $5\ cm$ from $25\mu C$

(B) At a distance of $5\ cm$ from $36\mu C$

(C) At a distance of $10\ cm$ from $25\mu C$

(D) At a distance of $11\ cm$ from $36\mu C$

Q11 The intensity of electric field required to balance a proton of mass $1.7 \times 10^{-27}\ kg$ and charge $1.6 \times 10^{-19} C$ is nearly:

(A) $1 \times 10^{-7}\ V/m$

(B) $1 \times 10^{-5}\ V/m$

(C) $2 \times 10^{-7}\ V/m$

(D) $2 \times 10^{5}\ V/m$

Q12 Two point charges Q and $-3Q$ are placed at some distance apart. If the electric field at the location of Q is $\vec{E}$, then at the location of $-3Q$ it is:

(A) $-\vec{E}$ (B) $\vec{E}/3$

(C) $-3\vec{E}$ (D) $-\vec{E}/3$

Q13 Equal charges q are placed at the vertices A and B of an equilateral triangle ABC of side a. The magnitude of electric field at the point C is:

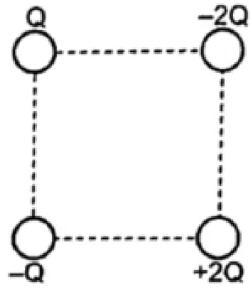
(A) $\frac{q}{4\pi\varepsilon_0 a^2}$

(B) $\frac{\sqrt{2}q}{4\pi\varepsilon_0 a^2}$

(C) $\frac{\sqrt{3}q}{4\pi\varepsilon_0 a^2}$

(D) $\frac{q}{2\pi\varepsilon_0 a^2}$

Q14 Four charges are placed on corners of a square as shown in figure having side of $5\ cm$. If Q is one micro coulomb, then electric field intensity at centre will be:



(A) $1.02 \times 10^7\ N/C$ upwards

(B) $2.04 \times 10^7\ N/C$ downwards

(C) $2.04 \times 10^7\ N/C$ upwards

(D) $1.02 \times 10^7\ N/C$ downwards

Q15 Two unlike charges of the same magnitude Q are placed at a distance d. The intensity of the electric field at the middle point in the line joining the two charges:

(A) Zero

(B) $\frac{8Q}{4\pi\varepsilon_0 d^2}$

(C) $\frac{6Q}{4\pi\varepsilon_0 d^2}$

(D) $\frac{4Q}{4\pi\varepsilon_0 d^2}$

Answer Key

Q1	(B)
Q2	(C)
Q3	(B)
Q4	(A)
Q5	(C)
Q6	(A)
Q7	(C)
Q8	(B)
Q9	(C)
Q10	(A)
Q11	(A)
Q12	(B)
Q13	(C)
Q14	(A)
Q15	(B)

Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Video Solution:

Q2 Video Solution:

Q3 Video Solution:

Q4 Video Solution:

Q5 Video Solution:

Q6 Video Solution:

Q7 Text Solution:

1. Find the resultant of electric field intensity at the centroid exerted by the any two charges and compare it with the electric field intensity at the centroid by the third charge.
2. ABC is an equilateral triangle and O is the centroid.
3. Charges $+q$ are placed at each corner of triangle ABC
4. Find the resultant force at centroid due to charge on point B and point C.
5. Electric field intensity at a point due to a charge ' q ' at ' r ' distance from the point is given by,
6. $E=\frac{q}{4\pi\varepsilon_0\mathrm{r}^2}$, where q is the point charge and r is the distance between them.
7. $E_A=\frac{q}{4\pi\varepsilon_0\mathrm{r}^2}$, where $E_A$is the electric field intensity at point O due to charge q at point A.
8. $E_B=\frac{q}{4\pi\varepsilon_0\mathrm{r}^2}$, where E_B is the electric field intensity at point O due to charge q at point B.
9. $E_c=\frac{q}{4\pi\varepsilon_0\mathrm{r}^2}$,where E_c is the electric field intensity at point O due to charge q at point C.
10. Resultant of E_B and E_c is given by ,

$$E_R=\sqrt{(EB)^2+(EC)^2+2\,(EB)\,(EC)\cos\theta}$$

$$=\sqrt{\left(\frac{q}{4\pi\varepsilon_0\mathrm{r}^2}\right)^2+\left(\frac{q}{4\pi\varepsilon_0\mathrm{r}^2}\right)^2+2\left(\frac{q}{4\pi\varepsilon_0\mathrm{r}^2}\right)\left(\frac{q}{4\pi\varepsilon_0\mathrm{r}^2}\right)}$$

$$=\sqrt{\left(\frac{q}{4\pi\varepsilon_0\mathrm{r}^2}\right)^2}=\sqrt{(E_A)^2}=E_A$$

11. We can observe from the graph that E_A and E_R are pointing in opposite directions and have the same magnitude.
12. As a result, the electric field strengths E_A and E_R cancel each other out.
13. As a result, the electric field strength at the triangle's centroid is zero.

Video Solution:

Q8 Video Solution:

Q9 Video Solution:

Q10 Video Solution:

Q11 Video Solution:

Q12 Video Solution:

Q13 Video Solution:

Q14 Video Solution:

Q15 Text Solution:

Here, the two charges are unlike and the distance between two charges is d.

Electric field due to + Q is

$$E_1 = \frac{kQ}{\left(\frac{d}{2}\right)^2}$$

Similarly, the electric field due to - Q is

$$E_2 = \frac{kQ}{\left(\frac{d}{2}\right)^2}$$

So, the net electric field at the mid point is

$$E_{net} = E_1 + E_2$$

$$E_{net} = \frac{kQ}{\left(\frac{d}{2}\right)^2} + \frac{kQ}{\left(\frac{d}{2}\right)^2}$$

$$E_{net} = \frac{8\,kQ}{d^2} = \frac{8Q}{4\pi\varepsilon_o d^2}$$

Video Solution: