Parishram (2025)

Physics

Electrostatic Potential and Capacitance

DPP: 2

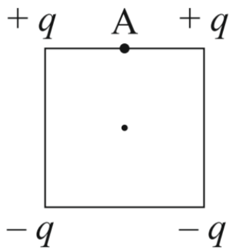
Q1 On rotating a point charge having a charge q around a charge Q in a circle of radius r, the work done will be

(A) $q \times 2\pi \mathrm{r}$
(B) $\frac{q \times 2\pi Q}{r}$
(C) Zero
(D) $\frac{Q}{2\varepsilon_0 r}$

Q2 Four point charges $-Q, -q, 2q$ and $2Q$ are placed, one at each corner of the square. The relation between Q and q for which the potential at the centre of the square is zero is

(A) $Q = -q$
(B) $Q = -\frac{1}{q}$
(C) $Q = q$
(D) $Q = \frac{1}{q}$

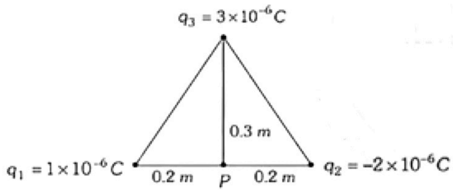
Q3 Four electric charges $+q, +q, -q$ and $-q$ are placed at the corners of a square of side $2L$ (see figure). The electric potential at point A, midway between the two charges $+q$:



(A) 0
(B) $\frac{1}{4\pi\varepsilon_0}\frac{2q}{L}(1+\sqrt{5})$
(C) $\frac{1}{4\pi\varepsilon_0}\frac{2q}{L}\left(1+\frac{1}{\sqrt{5}}\right)$
(D) $\frac{1}{4\pi\varepsilon_0}\frac{2q}{L}\left(1-\frac{1}{\sqrt{5}}\right)$

Q4 Figure shows a triangular array of three point charges. The electric potential V of these source charges at the midpoint P of the base of the triangle

$\left[\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9\ \mathrm{Nm}^2\ \mathrm{C}^{-2}\right]$



(A) $55\ \mathrm{kV}$
(B) $45\ \mathrm{kV}$
(C) $63\ \mathrm{kV}$
(D) $49\ \mathrm{kV}$

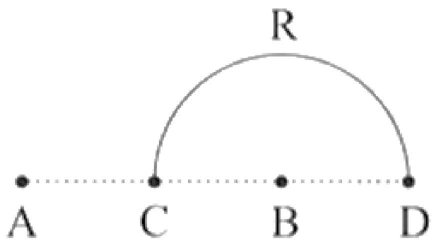
Q5 Two point charges $-q$ and $+q$ are located at points $(0,0,-a)$ and $(0,0,a)$ respectively. The potential at a point $(0,0,z)$ where $z > a$ is

(A) $\frac{qa}{4\pi\varepsilon_0 z^2}$
(B) $\frac{q}{4\pi\varepsilon_0 a}$
(C) $\frac{2qa}{4\pi\varepsilon_0(z^2-a^2)}$
(D) $\frac{2qa}{4\pi\varepsilon_0(z^2+a^2)}$

Q6 Four identical charges $+50\mu\mathrm{C}$ each are placed, one at each corner of a square of side $2\ \mathrm{m}$. How much external energy is required to bring another charge of $+50\mu\mathrm{C}$ from infinity to the centre of the square?

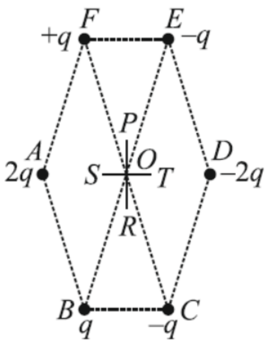
(A) $64\ \mathrm{J}$
(B) $41\ \mathrm{J}$
(C) $16\ \mathrm{J}$
(D) $10\ \mathrm{J}$

Q7 Charges $+q$ and $-q$ are placed at points A and B respectively which are a distance $2\ \mathrm{L}$ apart, C is the mid-point between A and B, The work done in moving a charge $+\mathrm{Q}$ along the semicircle CRD is



(A) $\frac{qQ}{4\pi\varepsilon_0 L}$
(B) $-\frac{qQ}{4\pi\varepsilon_0 L}$
(C) $\frac{qQ}{6\pi\varepsilon_0 L}$
(D) $-\frac{qQ}{6\pi\varepsilon_0 L}$

Q8 Six point charges are kept at the vertices of a regular hexagon of side L and centre O, as shown in the figure. Given that $\mathrm{K}=\frac{1}{4\pi\varepsilon_0 L^2}$, which of the following statement is wrong?



(A) The electric field at O is $6\ \mathrm{K}$ along OD
(B) The potential at O is zero
(C) The potential at all points on the line PR is same
(D) The potential at all points on the line ST is same

Q9 A particle A has charge $+q$ and a particle B has charge $+4q$ with each of them having the same mass m. When allowed to fall from rest through the same electric potential difference, the ratio of their speed $\frac{v_A}{v_B}$ will become

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

Q10 Three point charges $q, -2q$ and $-2q$ are placed at the vertices of an equilateral triangle of side a. The work done by some external force to increase their separation to $2a$ will be

(A) $\frac{1}{2\pi\varepsilon_0}\frac{2q^2}{a}$
(B) $\frac{1}{4\pi\varepsilon_0}\frac{q^2}{2a}$
(C) $\frac{1}{4\pi\varepsilon_0}\frac{8q}{a^2}$
(D) Zero

Answer Key

Q1	(C)
Q2	(A)
Q3	(D)
Q4	(B)
Q5	(C)
Q6	(A)
Q7	(D)
Q8	(D)
Q9	(B)
Q10	(D)

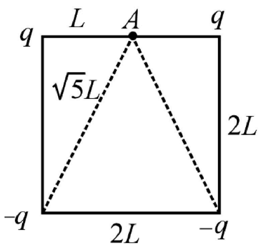
Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Video Solution:

Q2 Video Solution:

Q3 Text Solution:

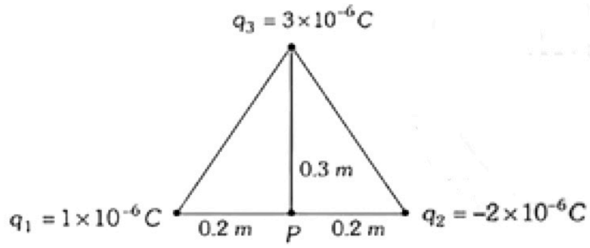


$$V_A = k\frac{q}{L} + k\frac{q}{L}$$
$$-k\frac{q}{\sqrt{5}L} - k\frac{q}{\sqrt{5}L}$$
$$V_A = \frac{2kq}{L}\left(1 - \frac{1}{\sqrt{5}}\right)$$
$$\because K = \frac{1}{4\pi\epsilon_0}$$
$$V_A = \frac{1}{4\pi\epsilon_0}\frac{2q}{L}\left(1 - \frac{1}{\sqrt{5}}\right)$$

Video Solution:

Q4 Text Solution:

The three point charges at the vertices of the given traingle, as shown below;



The Electric Potential at the point 'P'

$$= \frac{1}{4\pi\varepsilon_0}\left(\frac{1\times10^{-6}}{0.2} + \frac{3\times10^{-6}}{0.3} - \frac{2\times10^{-6}}{0.2}\right)$$
$$= 9\times10^9\left(\frac{3\times10^{-6}}{0.3} - \frac{1\times10^{-6}}{0.2}\right)$$
$$= 9\times10^9\times10^{-6}\left(\frac{3\times10}{3} - \frac{1\times10}{2}\right)$$
$$= 9\times10^3\left(10 - 5\right)$$
$$= 45\times10^3 = 45\ kV$$

Video Solution:

Q5 Video Solution:

Q6 Video Solution:

Q7 Video Solution:

Q8 Video Solution:

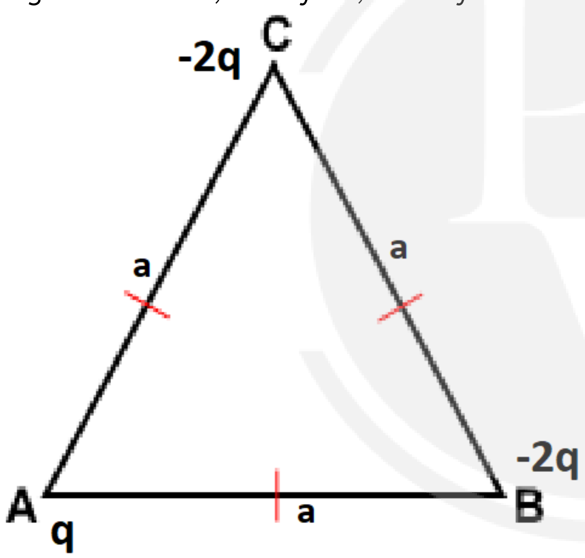
Q9 Video Solution:

Q10 Text Solution:

Let the charges $q, \ -2q, \ and \ -2q$ kept at the vertices of an equilateral traingle A, B and C respectively;

the each sides of the triangle $= a,$ as shown below:

length of the sides, initially = a, & finally = $2a$



we have to calculate the work required to increase the length of the sides to $2a$.

$$Since\ the\ workdone\ \left(W\right)\ =\ change\ in$$

$$potential\ energy\ of\ the\ system\ \left(\triangle U\right)$$

$$= U_f - U_i$$

$$= k\left(\frac{-2q^2}{2a} + \frac{4q^2}{2a} - \frac{2q^2}{2a}\right) - k\left(\frac{-2q^2}{a} + \frac{4q^2}{a} - \frac{2q^2}{a}\right)$$

$$= 0 \ - \ 0$$

$$= 0$$

Video Solution: