Q1. 21 January Shift 1

A point charge of 10^{-8}C is placed at origin. The work done in moving a point charge 2μC from point $A(4,4,2)$m to $B(2,2,1)$m is ____ J. $\left(\frac{1}{4\pi\epsilon_o} = 9\times10^9 \text{ in SI units }\right)$

(1) 45×10^{-6} (2) 15×10^{-6} (3) 0 (4) 30×10^{-6}

Q2. 21 January Shift 2

Consider two identical metallic spheres of radius R each having charge Q and mass m. Their centers have an initial separation of $4R$. Both the spheres are given an initial speed of u towards each other. The minimum value of u, so that they can just touch each other is :

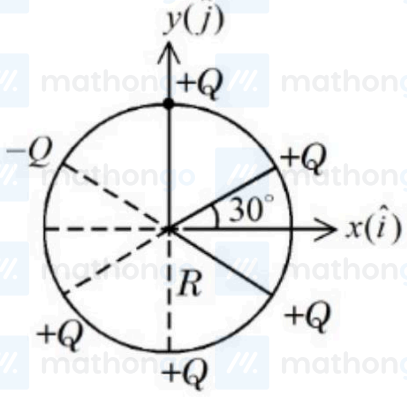
(Take $k = \frac{1}{4\pi\epsilon_0}$ and assume $kQ^2 > Gm^2$ where G is the Gravitational constant)

(1) $\sqrt{\frac{kQ^2}{2mR}\left(1-\frac{Gm^2}{kQ^2}\right)}$ (2) $\sqrt{\frac{kQ^2}{4mR}\left(1-\frac{Gm^2}{kQ^2}\right)}$

(3) $\sqrt{\frac{kQ^2}{2mR}\left(1-\frac{Gm^2}{2kQ^2}\right)}$ (4) $\sqrt{\frac{kQ^2}{4mR}\left(1+\frac{Gm^2}{kQ^2}\right)}$

Q3. 22 January Shift 1

Six point charges are kept 60° apart from each other on the circumference of a circle of radius R as shown in figure. The net electric field at the center of the circle is ____. (ϵ_0 is permittivity of free space)



(1) $\frac{Q}{4\pi\in_o R^2}(\sqrt{3}\hat{i}-\hat{j})$ (2) $-\frac{5Q}{8\pi\epsilon_o R^2}(\hat{i}+\sqrt{3}\hat{j})$

(3) $-\left(\frac{5Q}{8\pi\epsilon_o R^2}\right)(\hat{i}-3\hat{j})$ (4) $-\frac{Q}{4\pi\epsilon_o R^2}(\sqrt{3}\hat{i}-\hat{j})$

Q4. 22 January Shift 1

A simple pendulum has a bob with mass m and charge q. The pendulum string has negligible mass. When a uniform and horizontal electric field $\vec{E}$ is applied, the tension in the string changes. The final tension in the string, when pendulum attains an equilibrium position is ____. (g: acceleration due to gravity)

(1) $\sqrt{m^2g^2+q^2E^2}$ (2) $m\,g+qE$ (3) $mg-qE$ (4) $\sqrt{m^2g^2-q^2E^2}$

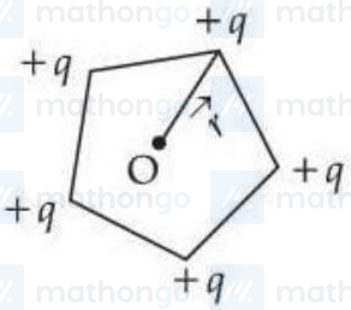
Q5. 22 January Shift 1

Electric field in a region is given by $\vec{E} = Ax\hat{i} + By\hat{j}$, where $A = 10\ \text{V/m}^2$ and $B = 5\ \text{V/m}^2$. If the electric potential at a point $(10, 20)$ is 500 V, then the electric potential at origin is ____ V.

(1) 0 (2) 2000 (3) 500 (4) 1000

Q6. 22 January Shift 2

Five positive charges each having charge q are placed at the vertices of a pentagon as shown in the figure. The electric potential (V) and the electric field $(\vec{E})$ at the center O of the pentagon due to these five positive charges are:



(1) $V = \frac{5q}{4\pi\varepsilon_o r}$ and $\vec{E} = \frac{5\sqrt{3}q}{8\pi\varepsilon_o r^2}\hat{r}$ (2) $V = \frac{5q}{4\pi\varepsilon_o r}$ and $\vec{E} = 0$

(3) $V = 0$ and $\vec{E} = 0$ (4) $V = \frac{5q}{4\pi\varepsilon_o r}$ and $\vec{E} = \frac{5q}{4\pi\varepsilon_o r^2}\hat{r}$

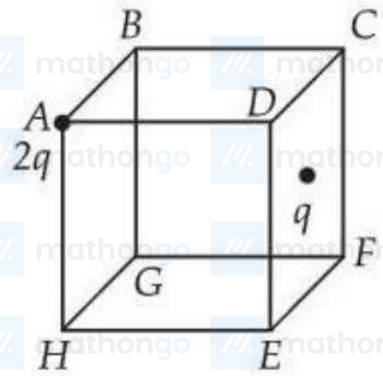
Q7. 22 January Shift 2

Three small identical bubbles of water having same charge on each coalesce to form a bigger bubble. Then the ratio of the potentials on one initial bubble and that on the resultant bigger bubble is :

(1) $3^{2/3} : 1$ (2) $1 : 2^{2/3}$ (3) $1 : 3^{2/3}$ (4) $1 : 3^{1/3}$

Q8. 23 January Shift 1

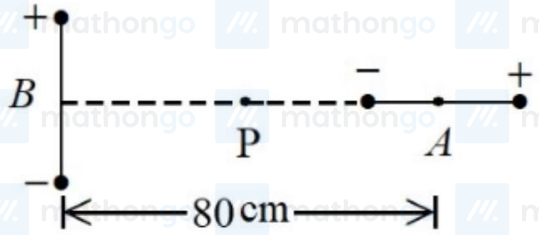
Two point charges $2q$ and q are placed at vertex A and centre of face $CDEF$ of the cube as shown in figure. The electric flux passing through the cube is :



(1) $\frac{3q}{2\epsilon_0}$ (2) $\frac{3q}{4\epsilon_0}$ (3) $\frac{q}{\epsilon_0}$ (4) $\frac{3q}{\epsilon_0}$

Q9. 23 January Shift 2

Two shorts dipoles (A, B), A having charges $\pm 2\mu$C and length 1 cm and B having charges $\pm 4\mu$C and length 1 cm are placed with their centres 80 cm apart as shown in the figure. The electric field at a point P, equi-distant from the centres of both dipoles is ____ N/C.



(1) $\frac{9}{16}\sqrt{2} \times 10^4$ (2) $9\sqrt{2} \times 10^4$ (3) $4.5\sqrt{2} \times 10^4$ (4) $\frac{9}{16}\sqrt{2} \times 10^5$

Q10. 23 January Shift 2

Two charges 7μC and -2μC are placed at $(-9, 0, 0)$cm and $(9, 0, 0)$cm respectively in an external field $E = \frac{A}{r^2}\hat{r}$, where $A = 9 \times 10^5$ N/C. m^2. Considering the potential at infinity is 0, the electrostatic energy of the configuration is ____ J.

(1) 49.3 (2) -90.7 (3) 24.3 (4) 1.4

Q11. 24 January Shift 1

There are three co-centric conducting spherical shells A, B and C of radii a, b and c respectively $(c > b > a)$ and they are charged with charge q_1, q_2 and q_3 respectively. The potentials of the spheres A, B and C respectively, are :

(1) $\frac{1}{4\pi\epsilon_o}\left(\frac{q_1+q_2+q_3}{a}\right), \frac{1}{4\pi\epsilon_o}\left(\frac{q_1+q_2+q_3}{b}\right), \frac{1}{4\pi\epsilon_o}\left(\frac{q_1+q_2+q_3}{c}\right)$

(2) $\frac{1}{4\pi\epsilon_o}\left(\frac{q_1}{a}+\frac{q_2}{b}+\frac{q_3}{c}\right), \frac{1}{4\pi\epsilon_o}\left(\frac{q_1+q_2+q_3}{b}\right), \frac{1}{4\pi\epsilon_o}\left(\frac{q_1+q_2+q_3}{c}\right)$

(3) $\frac{1}{4\pi\epsilon_o}\left(\frac{q_1}{a}+\frac{q_2}{b}+\frac{q_3}{c}\right), \frac{1}{4\pi\epsilon_o}\left(\frac{q_1+q_2}{b}+\frac{q_3}{c}\right), \frac{1}{4\pi\epsilon_o}\left(\frac{q_1+q_2+q_3}{c}\right)$

(4) $\frac{1}{4\pi\epsilon_o}\left(\frac{q_1+q_2+q_3}{a}\right), \frac{1}{4\pi\epsilon_o}\left(\frac{q_1+q_2}{b}+\frac{q_3}{c}\right), \frac{1}{4\pi\epsilon_o}\left(\frac{q_1}{a}+\frac{q_2}{b}+\frac{q_3}{c}\right)$

Q12. 24 January Shift 1

Three charges $+2q, +3q$ and $-4q$ are situated at $(0, -3a), (2a, 0)$ and $(-2a, 0)$ respectively in the xy plane. The resultant dipole moment about origin is ____.

(1) $2qa(7\hat{i} - 3\hat{j})$ (2) $2qa(3\hat{j} - \hat{i})$ (3) $2qa(3\hat{i} - 7\hat{j})$ (4) $2qa(3\hat{j} - 7\hat{i})$

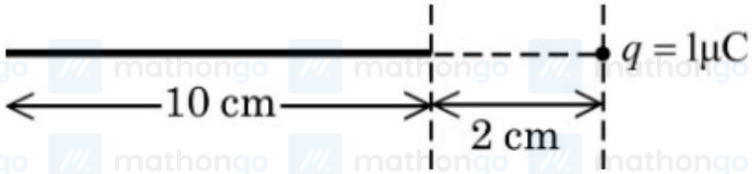
Q13. 24 January Shift 1

The electrostatic potential in a charged spherical region of radius r varies as $V = ar^3 + b$, where a and b are constants. The total charge in the sphere of unit radius is $\alpha \times \pi a \in_o$. The value of α is ____.
(permittivity of vacuum is ϵ_0)

(1) -9 (2) -12 (3) -8 (4) -6

Q14. 24 January Shift 2

A point charge $q = 1\mu C$ is located at a distance 2 cm from one end of a thin insulating wire of length 10 cm having a charge $Q = 24\mu C$, distributed uniformly along its length, as shown in figure. Force between q and wire is ____ N.



(Use : $\frac{1}{4\pi\epsilon_o} = 9 \times 10^9\ \text{N.m}^2/\text{C}^2$)

Q15. 28 January Shift 1

Two point charges of 1 nC and 2 nC are placed at the two corners of equilateral triangle of side 3 cm. The work done in bringing a charge of 3 nC from infinity to the third corner of the triangle is ____ μJ.

$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9\ \text{N.m}^2/\text{C}^2$

(1) 27 (2) 5.4 (3) 2.7 (4) 3.3

Q16. 28 January Shift 2

Identify the correct statements :

A. Electrostatic field lines form closed loops.

B. The electric field lines point radially outward when charge is greater than zero.

C. The Gauss - Law is valid only for inverse - square force.

D. The workdone in moving a charged particle in a static electric field around a closed path is zero.

E. The motion of a particle under Coulomb's force must take place in a plane.

Choose the correct answer from the options given below :

(1) A, B, D, E Only (2) A, C, E Only (3) A, B, C, D Only (4) B, C, D, E Only

ANSWER KEYS

1. (4)	**2.** (2)	**3.** (4)	**4.** (1)	**5.** (2)	**6.** (2)	**7.** (3)	**8.** (4)
9. (1)	**10.** (1)	**11.** (3)	**12.** (1)	**13.** (2)	**14.** 90	**15.** (3)	**16.** (4)