ELECTROSTATICS, HOME WORK SHEET-1

1. Using mass (M), length (L), time (T) and current (A) as fundamental quantities, the dimentson of permititivity is:
(A) $ML^{-2}T^2A$ (B) $M^{-1}L^{-3}T^4A^2$ (C) $MLT^{-2}A$ (D)$ML^2T^{-1}A^2$

2. Two point charges +9e and +e are kept 16cm. apart from each other. Where should a third charge q be placed between them so that the system is in equilibrium state :
(A) 6 cm from + 9e (B) 12 cm from +9e (C) 6 cm from + e (D) 12 cm from + e

3. The ratio of the forces between two small spheres with constant charge (a) in air (b) in a medium of dielectric constant K is
(A) 1 : K (B) L : 1 (C) 1 : K^2 (D) K^2 : 1

4. A total charge Q is broken in two parts Q_1 and Q_2 and they are placed at a distance R from each other. The maximum force of repuision between them will occur, when
(A) $Q_2 = \frac{Q}{R}, Q_1 = Q - \frac{Q}{R}$ (B) $Q_2 = \frac{Q}{R}, Q_1 = Q - \frac{2Q}{3}$ (C) $Q_2 = \frac{Q}{4}, Q_1 = \frac{3Q}{4}$ (D) $Q_1 = \frac{Q}{2}, Q_2 = \frac{Q}{2}$

5. Three charges 4q, Q and q are in a straight line in the position of 0, *l*/2 and *l* respectively. The resultant force on q will be zero, if Q =
(A) –q (B) –2q (C) –q/2 (D) 4q

6. ABC is right angled triangle in which AB = 3cm and BC = 4cm. And $\angle ABC = \pi / 2.$ The three charges + 15, + 12 and – 20e.s.u. are placed respectively on A, B and C. The force acting on B is
(A) 125 dynes (B) 35 dynes (C) 25 dynes (D) Zero

7. Two similar spheres having +q and –q charge ar kept at a certain distance. F force acts between the two. If in the middle of two sphers, another similar sphere having +q charge is kept, then it experience a force in magnitude and direction as
(A) Zero having no direction (B) 8F towards + q charge
(C) 8F towards –q charge (D) 4F towards + q charge

8. Two particle of equal mass m and charge q are placed at a distance of 16 cm. They do not experience any force. the value of q/m is
(A) *l* (B) $\sqrt{\frac{\pi\varepsilon_0}{G}}$ (C) $\sqrt{\frac{G}{4\pi\varepsilon_0}}$ (D) $\sqrt{4\pi\varepsilon_0 G}$

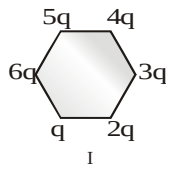
ANSWERS

HOME WORK SHEET-1

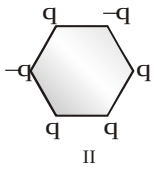
1. (B) **2.** (B) **3.** (B) **4.** (D) **5.** (A) **6.** (C) 7. (C) **8.** (D)

ELECTROSTATICS, HOME WORK SHEET-2

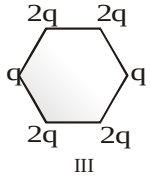
1. Figures below show regula hexagon, the charges are placed at the vertices. In which of the following cases the electric field at the centr is zero.



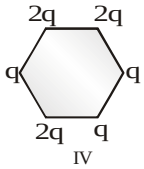
I



II



III



IV

(A) IV (B) III (C) I (D) II

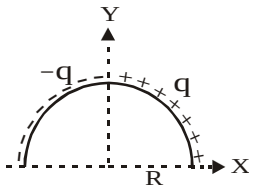
2. A solid metallic sphere has a charge + 3Q. Concentric with this sphere is a conducting spherical shell having charge –Q. The radius of the sphere is a and that of the spherical shell is b (b > a). What is the electric field at a distance R (a < R < b) from the centre ?

(A) $\frac{4Q}{2\pi\varepsilon_0 R^2}$ (B) $\frac{3Q}{4\pi\varepsilon_0 R^2}$ (C) $\frac{3Q}{2\pi\varepsilon_0 R^2}$ (D) $\frac{Q}{2\pi\varepsilon_0 R}$

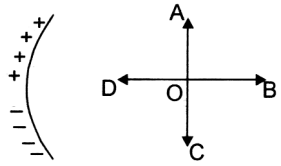
3. Equal charges q are placed at the four comes A,B,C,D of a square of length q. The magnitude of the force of the charge at B will be

(A) $\frac{3q^2}{4\pi\varepsilon_0 a^2}$ (B) $\frac{4q^2}{4\pi\varepsilon_0 a^2}$ (C) $\left(\frac{1+2\sqrt{2}}{2}\right)\frac{q^2}{4\pi\varepsilon_0 a^2}$ (D) $\left(2+\frac{1}{\sqrt{2}}\right)\frac{q^2}{4\pi\varepsilon_0 a^2}$

4. Find the electric field at centre of semicircular ring shown in figure (charge distribution is uniform)

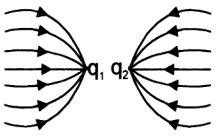


5. The linear charge density on upper half of a segment of rign is λ and at lowe half, it is $-\lambda$. The direction of electric field at centre O of ring is :



(A) along OA (B) along OB (C) along OC (D) along OD

6. The given figure gives electric lines of force due to two charges q_1 and q_2. What are the signs of the two charges?



(A) Both are negative (B) Both are positive
(C) q_1 is positive but q_2 is negative (D) q_1 is negative but q_2 is positive

7. A rod of length L has a total charge Q distributed uniformly along its length. It is bent in the shape of a semicircle. Find the magnitude of the electric field at the centre of curvature of the semicircle.

8. A charge q is placed at the centre of the line joining two equal charges Q. The system of the three charges will be in equilibrium, if q is equal to

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

ANSWERS

HOME WORK SHEET-2

1. (B) **2.** (B) **3.** (C) **4.** $-\frac{4kq}{\pi R^2}\hat{i}$ **5.** (C) **6.** (A) 7. $\frac{Q}{2\varepsilon_0 L^2}$ **8.** (B)

ELECTROSTATICS, HOME WORK SHEET-3

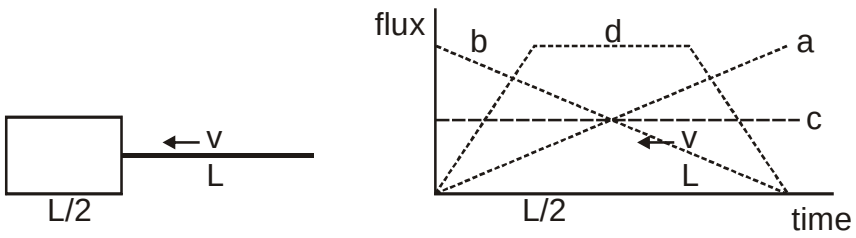
1. A sphere of radius R and charge Q is placed inside an imaginary sphere of radius 2R whose centre coincides with the given sphere. The flux related to imaginary sphere is

(A) $\frac{Q}{\epsilon_0}$ (B) $\frac{Q}{2\epsilon_0}$ (C) $\frac{4Q}{\epsilon_0}$ (D) $\frac{2Q}{\epsilon_0}$

2. The length of each side of a cubical closed surface is l. If charge q is situated on one of the vertices of the cube, then find the flux passing through shaded face of the cube.

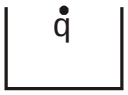
3. Electric charges are distributed in a small volume. The flux of the electric field throught a spherical surface of radius 10 cm surronding the total charges is 25V–m. The flux over a concentric sphere of radius 20 cm will be
(A) 25 V-m (B) 50 V-m (C) 100 V-m (D) 200 V-m

4. Figure shows an imaginary cube of edge L/2. A uniformly charged rod of length L moves towards left at a small but constant speed u. At t = 0, the left end just touches the center of the face of the cube oppositei it. Which of the graphs shown in figure (30-Q2b) represents the flux of the electric field through the cube as the rod goes through it ?



(a) (b)

5. A charge q is placed at the center of the open end of a cylinderical esel (figure). The flux of the electric field throught the surface of the vaessel is



(A) zero (B) q/ε_0 (C) $q/2\varepsilon_0$ (D) $4q/\varepsilon_0$

6. Mark the correct options :
(A) Gauss's law is valid only for symmetrical charge diatribuitions.
(B) Gauss's law is valid only for charges placed in vacuum.
(C) The electric field calculated by Gauss;s law is the field due to the charges inside the Gaussian surface.
(D) The flux of the electric field throught a closed surface due to tall the charges is equal to the flux due to the charges enclosed by the surface.

7. A positive point charge Q is brought near an isolated metal cube.
(A) The cube becomes negatively charged.
(B) The cube becomes positively charged.
(C) The interior becomes positively charged and the surface becomes negatively charged.
(D) The interior remains charge free and the surface gets nonuniform charge distrbution.

8. A cylinder of radius R and length L iplaced in a uniform electric field E parallel to the cylinder axis. The total flux for the surface of the cylinder is given by

(A) $2\pi R^2 E$ (B) $\pi R^2 E$ (C) $(\pi R^2 - \pi R)/E$ (D) zero

ANSWERS

HOME WORK SHEET-3

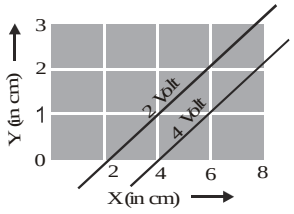
1. (A) **2.** $\frac{q}{24\varepsilon_0}$ **3.** (A) **4.** (D) **5.** (C) **6.** (D) 7. (D) **8.** (D)

ELECTROSTATICS, HOME WORK SHEET-4

1. Uniform electric field of magnitude 100 V/m in space is directed along the line y=3 +x. Find the potential difference between point A (3,1) & B(1,3) :

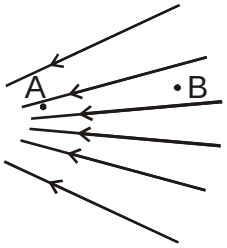
(A) 100 V (B) 200 $\sqrt{2}$ V (C) 200V (D) 0

2. The figure below shows two equipotential lines in XY plane for an electric field. The scales are marked. The X–component E_x and Y–component E_y of the electric field in the space between these equipotential lines are respectively :



(A) +100 V/m, –200 V/m (B) +200 V/m, +100 V/m
(C) –100 V/m, +200 V/m (D) –200 V/m, –100 V/m

3. Which of the following is true for the figure showing electric lines of force?



(A) $E_A > E_B$ (B) $E_B > E_A$ (C) $V_A > V_B$ (D) $V_B > V_A$

4. The electrostatic potential V at any point (x, y, z) in space is given by $V = 4x^2$. Then

(A) the y-and z-component of the electrostaic field at any point are zero

(B) the x-component of electric field at a point is given by $(-8x\hat{i})$

(C) the x-component of electric field at a point (1, 0, 2) is $(-8\hat{i})$

(D) the y- and z-components of the electric field ar non-zero constant in magnitude.

5. There are 27 identical drops of a conducting fluid. Each has a radius r and they are charged to a potneital V_0. They are then combined to form a bigger drop. Find its potential.

6. There charrges 2q, –q, –q are located at the vertices of an equilateral triangle. At the centre of the triangle.

(A) The field is zero but potential is non-zero (B) The field is non-zero but potnetial si zero
(C) Both field and potnetial are zero (D) Both field and potential are non-zero

7. 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 rati f their speed $\frac{v_A}{v_B}$ will become

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

8. In Millikan's oil drop experiment an oil drop carrying a charge Q is held stationary by a potential difference 2400 V between the plates. To keep a drop of half the radius stationary the potnetial difference had to be made 600V. What is the charge on the second drop.
(A) Q/4 (B) Q/2 (C) Q (D) 3Q/2

9. A charge 3 coulomb experiences a force 300 N when placed in a uniform electric field. The potential difference between two points separated by a distance of 10 cm along the field line is :
(A) 10 V (B) 90 V (C) 1000 V (D) 9000 V

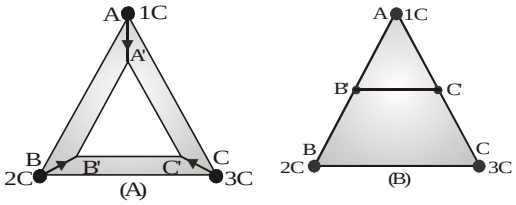
ANSWERS

HOME WORK SHEET-4

1. (D) **2.** (C) **3.** (AD) **4.** (ABC) **5.** $9V_0$ **6.** (B) 7. (B) **8.** (B)
9. (A)

ELECTROSTATICS, HOME WORK SHEET-5

1. Three point charges 1C, 2C and 3C are placed at the corners of an equilateral triangle of side 1m. The work required to move these charges to the corners of a smaller equilateral triangle of side 0.5m in two different ways as in fig. (A) and fig. (B) are W_a and W_b then:

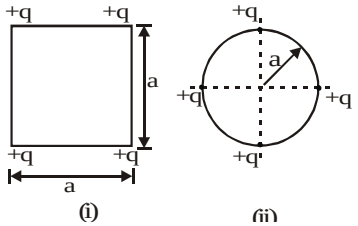


(A) $W_a > W_b$ (B) $W_a < W_b$ (C) $W_a = W_b$ (D) $W_a = 0$ and $W_b = 0$

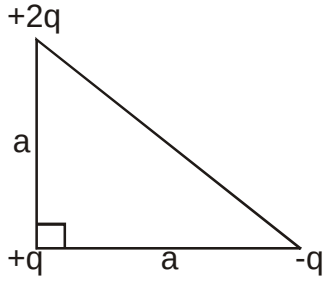
2. Two isolated sphereical shell having charges Q_1 and Q_2 and radii r_1 and r_2 are kept at very large separation. If they are joined by a conducting wire, then choose incorrect statement.

(A) Electrostatic potential energy of system must decrease.
(B) Electrostatic potential energy of system may decrease.
(C) If $Q_1 r_2 = Q_2 r_1$, then no charge flow throught the conducting wire.
(D) If $Q_1 r_2 = Q_2 r_1$, then electrostatic potential energy of system already minimum.

3. Consider the configuration of a system of four charges each of value +q. Find the work done by external agent in changing the configuration of the system from figure (i) to figure. (ii) very slowly.



4. Three charges +q, –q, and +2q are placed at the vertices of a right angled triangle (isosceles triangle) as shown. The net electrostatic energy of the configuration is :

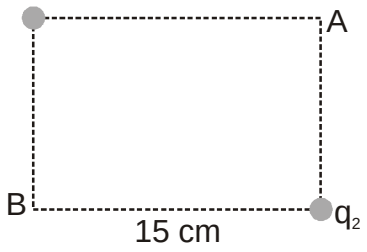


(A) $-\frac{Kq^2}{a}(\sqrt{2}+1)$ (B) $\frac{Kq^2}{a}(\sqrt{2}+1)$ (C) $-\frac{Kq^2}{a}(\sqrt{2}-1)$ (D) None of these

5. You are given an arrangement of three point charges q, 2q and $\frac{-Xq}{3}$ separated by equal finite distances so that electric potential energy of the system is zero. Calculate the value of x.

6. A sphere of radis 1 cm has potential of 8000 V, then energy density near its surface will be
(A) 64×10^5 J/m^3 (B) 8×10^3 J/m^3 (C) 32 J/m^3 (D) 2.83 J/m^3

7. In the rectangle, shown below, the two corners have charges q_1 = 5μC and q_2 = +2.0μC. The work done in moving a charge + 3.0 μC from B to A is (take $1/4\pi\varepsilon_0 = 10^{10}$ N - m^2/C^2)



(A) 2.8 J (B) 3.5 J (C) 4.5 J (D) 5.5 J

8. A charge (–q) and another charge (+Q) are kept at two points A and B respectively. Keeping the charge (+Q) fixed at B, the charge (–q) at A is moved to another point C such that ABC forms an equilateral triangle of side *l*. The net work done in moving the charge (–q) is

(A) $\frac{1}{4\pi\varepsilon_0}\frac{Qq}{l}$ (B) $\frac{1}{4\pi\varepsilon_0}\frac{Qq}{l^2}$ (C) $\frac{1}{4\pi\varepsilon_0}Qql$ (D) zero

ANSWERS

HOME WORK SHEET-5

1. (C) **2.** (A) **3.** $\frac{-Kq^2}{a}\left(3-\sqrt{2}\right)$ **4.** (C) **5.** 2 **6.** (D) 7. (A) **8.** (D)

ELECTROSTATICS, HOME WORK SHEET-6

Electric Dipole

1. The work done in rotating an electric dipole of dipole moment p in an electric field E through an angle θ from the direction of electric field, is :

(A) pE (1–cosθ) (B) pE (C) zero (D) –pE cosθ

2. An electric dipole moment $\vec{p} = (2.0\hat{i} + 3.0\hat{j})\mu C.$ m is placed in a uniform electric field $\vec{E} = (3.0\hat{i} + 0.0\hat{k}) \times 10^5 \text{ NC}^{-1}.$

(A) The torque that $\vec{E}$ exerts on $\vec{p}$ is $(0.6\hat{i} - 0.4\hat{j} - 0.9\hat{k})Nm.$

(B) The potential energy of the dipole us –0.6 J.

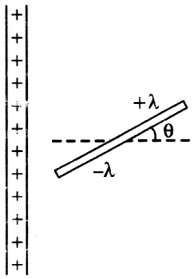
(C) The potential energy of the dipole is 0.6 J.

(D) None of these

3. The dipole moment of a system of charge +q distributed uniformly on an arc of radius R subtending an angle $\pi/2$ at its centre where another charge -q is placed is :

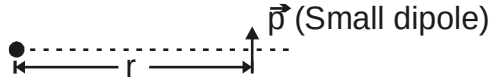
(A) $\frac{2\sqrt{2}qR}{\pi}$ (B) $\frac{\sqrt{2}qR}{\pi}$ (C) $\frac{qR}{\pi}$ (D) $\frac{2qR}{\pi}$

4. A large sheet carries uniform surface charge density σ. A rod of length $2l$ has a linear charge density λ on one half and $-\lambda$ on the second half. The rod is hinged at mid point O and makes an angle θ with the normal to the sheet. The torque experienced by the rod is



(A) 0 (B) $\frac{\sigma\lambda l^2}{2\varepsilon_0}\sin\theta$ (C) $\frac{\sigma\lambda l^2}{\varepsilon_0}\sin\theta$ (D) $\frac{\sigma\lambda l}{2\varepsilon_0}$

5. For the situation shown in the figure below (assume r >> length of dipole) mark out the correct statement(s).



(A) Force acting on the dipole is zero

(B) Torque acting on the diple is $\frac{pQ}{4\pi\varepsilon_0 r^3}$ and is acting upward

(C) Torque acting on the diple is $\frac{pQ}{4\pi\varepsilon_0 r^2}$ in clockwise direction

(D) Torque acting on the diple is $\frac{pQ}{4\pi\varepsilon_0 r^2}$ in anti-clockwise direction

6. An electric diple consisting of two opposite charges of 2×10^{-6}C each separated by a distance of 3cm is placed in an electric field of 2×10^{5} N/C. The maximum torque on the dipole will be
(A) 12×10^{-1} Nm (B) 12×10^{-3} Nm (C) 24×10^{-1} Nm (D) 12×10^{-3} Nm

7. An electric diple of moment $\vec{p}$ is placed normal to the lines of force of electric intensity $\vec{E}$, then the work done in deflecting it through an angle of 180º is
(A) pE (B) +2pE (C) –2pE (D) zero

8. The distance between the two charges +q and –q of a diple is r. On the axial line at a distance d from the centre of diple, the intensity is proportional to
(A) $\frac{q}{d^2}$ (B) $\frac{qr}{d^2}$ (C) $\frac{q}{d^3}$ (D) $\frac{qr}{d^3}$

ANSWERS

HOME WORK SHEET-6

1. (A) **2.** (A), (B) **3.** (A) **4.** (B) **5.** (B),(C) **6.** (B) 7. (D) **8.** (D)

ELECTROSTATICS, HOME WORK SHEET-7

Conductors and its Properties

1. A solid conducting sphere having a charge Q is surrounded by an uncharged concentric conducting hollow spherical shell. Let the potential difference between the surface of the solid sphere and that of the outer surface of the hollow shell be V. If the shell is now given a charge of –3Q, the new potnetial difference between the same two surface is :

(A) V (B) 2V (C) 4V (D) –2V

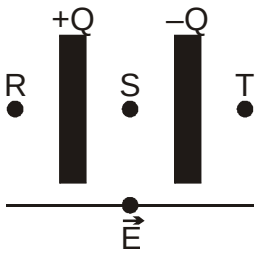
2. A cube of metal is given a charge (+Q), which of the following statements is true :

(A) Potential at the surface of cube is zero
(B) Potential within the cube is zero
(C) Electric field is normal to the surface of the cube
(D) Electric field varies within the cube

3. A hollow closed conductor of irregular shape is given some charge. Which of the following statements are correct?

(A) The entire charge will appear on its outer surace.
(B) All point on the conductor will have the same potential.
(C) All point on its surface will have the same charge density
(D) All points near its surface and outside it will have the same electric intensity.

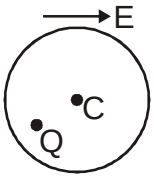
4. Two large thin conducting plates with small gap in between are placed in a uniform electric field 'E' (perpendicular to the plates). Area of each plate is A and charges +Q and –Q are given to these plates as shown in the figure. If point R, S and T as shown in the figure are three points in space, then the



(A) field at point R is E (B) field at point S is E

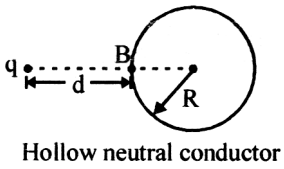
(C) field at point T is $\left(E+\frac{Q}{\epsilon_0 A}\right)$ (D) field at point S is $\left(E+\frac{Q}{A\epsilon_0}\right)$

5. A positive point charge Q is kept (as shown in the figure) inside a neutral conductign shell whose centre is at C. An external uniform electric field E is aplied. Then :



(A) Force on Q due to E is zero
(B) Net force on Q is zero
(C) Net force acting on Q and conducting shell considered as a sysgem is zero
(D) Net force acting on the shell due to E is zer.

6. For the situation shown in the figure below, mark out the correct statement(s)



Hollow neutral conductor

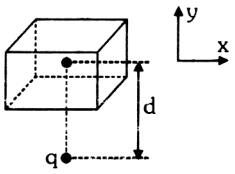
(A) Potential of the conductor is $\frac{q}{4\pi\varepsilon_0(d+R)}$

(B) Potential of the conductor is $\frac{q}{4\pi\varepsilon_0 d}$

(C) Potential of the conductor can't be determined as nature of distribution of induced charges is not known

(D) Potential at point B due to induced charges is $\frac{-qR}{4\pi\varepsilon_0(d+R)d}$

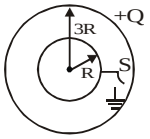
7. A charge +q is placed at a distance 'd' from the centre of the uncharged metallic cube of side 'a'. The electric field at the centre of the cube due to induced charges on the cube will be



(A) zero (B) $\frac{q}{4\pi\varepsilon_0 d^2}\left(-\hat{j}\right)$ (C) $\frac{q}{4\pi\varepsilon_0 d^2}\left(\hat{j}\right)$ (D) $\frac{q}{4\pi\varepsilon_0\left(d-\frac{a}{2}\right)}\left(-\hat{j}\right)$

8. A charge Q is distributed over two concentric hollow spheres of radii r and R (R > r) such that the surface densities are equal. Find the potential at the common centre.

9. Two thin conducting shells of radii R and 3R are shown in figure. The outer shell carries a charge +Q and the inner shell is neutral. The inner shell is earthed with the help of switch S. Find the charge attained by the inner shell.



ANSWERS

HOME WORK SHEET-7

1. (A) **2.** (C) **3.** A,(B) **4.** (A),(D) **5.** (D) **6.** (A),(D) 7. (B)

8. $\frac{Q(R+r)}{4\pi\varepsilon_0(R^2+R^2)}$ **9.** $\frac{-Q}{3}$