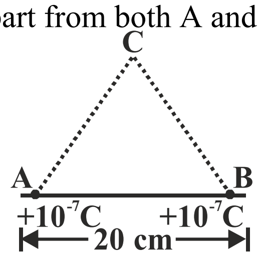
1. Four charges equal to – Q are placed at the four corners of a square and a charge q is at its centre. If the system is in equilibrium, the value of q is

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

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

2. Two point charges $+10^{-7}$ C and -10^{-7} C are placed at A and B, 20 cm apart as shown in the figure. Calculate the electric field at C, 20 cm apart from both A and B.



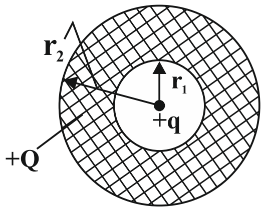
(A) $1.5\times10^{-5}\,NC^{-1}$

(B) $2.2\times10^{4}\,NC^{-1}$

(C) $3.5\times10^{6}\,NC^{-1}$

(D) $3.0\times10^{5}\,NC^{-1}$

3. A thick metallic spherical 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 charge per unit area on the outer surface is.



(A) $\frac{(Q-q)}{4\pi\left(r_2^2-r_1^2\right)}$ (B) $\frac{(Q-q)}{4\pi r_2^2}$

(C) $\frac{(Q+q)}{4\pi r_2^2}$ (D) $\frac{(Q+q)}{4\pi\left(r_2^2+r_1^2\right)}$

4. A point dipole is located at the origin in some orientation. The electric field at the point (10 cm, 10 cm) on the *x-y* plane is measured to have a magnitude 1.0×10^{-3} Vm^{-1}. What will be the magnitude of the electric field at the point (20 cm, 20 cm)?

(A) 5.0×10^{-4} Vm^{-1} (B) 2.5×10^{-4} Vm^{-1}

(C) It will depend on the orientation of the dipole

(D) 1.25×10^{-4} Vm^{-1}

5. Which of the following is false for electric lines of force?

(A) They always start from positive charges and terminate on negative charges.

(B) They are always perpendicular to the surface of a charged conductor.

(C) They always form closed loops.

(D) They are parallel and equally spaced in a region of uniform electric field.

6. Two equal point charges each of 3 μC are separated by a certain distance in metres. If they are located at $\left(\hat{i}+\hat{j}+k\right)$ and $\left(2\hat{i}+3\hat{j}+3k\right)$, the electrostatic force between them is

(A) $9\times10^{3}\,N$ (B) $9\times10^{-3}\,N$

(C) $10^{-3}\,N$ (D) $9\times10^{-2}\,N$

(E) $3\times10^{-3}\,N$

7. In the uniform electric field of $E=1\times10^{4}\,NC^{-1}$, an electron is accelerated from rest. The velocity of the electron when it has travelled a distance of 2×10^{-2} m is nearly … m/s^{-1}

$\left(\frac{e}{m}\, of\ electron=1.5\times10^{11}\,C\,kg^{-1}\right)$

(A) 1.6×10^{6} (B) 0.85×10^{6}

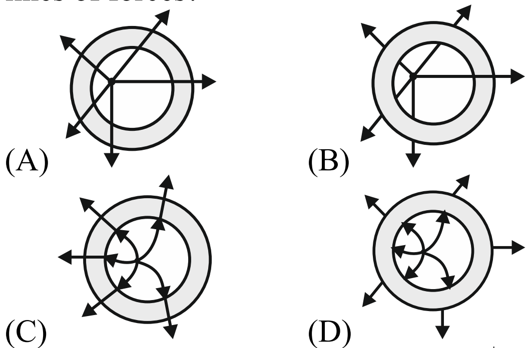
(C) 0.425×10^{6} (D) 8.5×10^{6}

8. A charged particle of mass m and charge q is released from rest in an uniform electric field E. The kinetic energy of the particle after time t is

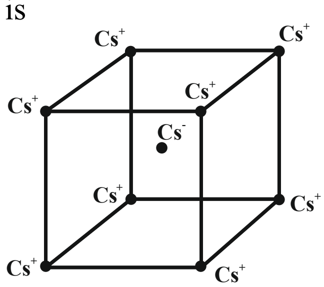
(A) $\frac{E^2q^2t^2}{2m}$ (B) $\frac{2E^2t^2}{mq}$

(C) $\frac{Eqm}{2t}$ (D) $\frac{Eq^2m}{2t^2}$

9. A metallic shell has a point charge 'q' kept inside its cavity. Which one of the following diagrams correctly represents the electric lines of forces?



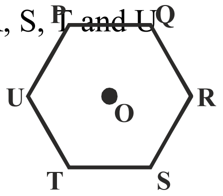
10. In the basic CsCl crystal structure, Cs^+ and Cl^- ins are arranged in a be configuration s shown in the figure. The net electrostic force exerted by the eight Cs^- ions on the Cl^- ion is



(A) $\frac{1}{4\pi E_0}\frac{4e^2}{3a^2}$ (B) $\frac{1}{4\pi E_0}\frac{16e^2}{3a^2}$

(C) $\frac{1}{4\pi E_0}\frac{32e^2}{3a^2}$ (D) Zero

11. Six charges, three positive and three negative of equal magnitude, are to be place at the vertices of regular hexagon such that the electric field at O is double the electric field when only one positive charge of same magnitude is placed at R. which of the following arrangements of charges is possible for P, Q. R, S, T and U respectively?



(A) +,–,+,–,–,+
(B) +,–,+,–,+,–
(C) +,+,–,+,–,–
(D) –,+,+,–,+,–

12. Two point charges + 8q and –2q are located at $x = 8$ and $x = L$ respectively. the location of a point on the x–axis at which the net electric field due to these two point charges is zero is

(A) 8L (B) 4 L (C) 2 L (D) $\frac{L}{4}$

13. An electric dipole is placed at an angle of 30º to a non-uniform electric field. The dipole will experience

(A) A torque as well as a translational force.
(B) A torque only.
(C) A translational force only in the direction of the field.
(D) A translational force only in a direction normal to the direction of the field.

14. A simple pendulum has a length l and the mass of the bob is m. the bob is given a charge q coulomb. The pendulum is suspended between the vertical plates of a charged parallel plate capacitor. If E is the electric field strength between the plates, the time period of the pendulum is given by

(A) $2\pi\sqrt{\frac{l}{g}}$ (B) $\sqrt{\sqrt{\frac{l}{g+\frac{qE}{m}}}}$

(C) $\sqrt{\sqrt{\frac{l}{g-\frac{qE}{m}}}}$ (D) $2\pi\sqrt{\sqrt{\frac{l}{g^2+\left(\frac{qE}{m}\right)^2}}}$

15. An electron is moving round the nucleus of a hydrogen atom is a circular orbit of radius r. the Coulomb force $\vec{F}$ between the two is

(A) $k\frac{e^2}{r^2}\hat{r}$ (B) $-k\frac{e^2}{r^3}\hat{r}$

(C) $k\frac{e^2}{r^3}\vec{r}$ (D) $-k\frac{e^2}{r^3}\vec{r}$

16. Consider a neutral conductive sphere. A positive point charge is placed outside the sphere. The net charge on the sphere is then

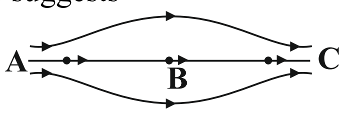
(A) Negative and distributed uniformly over the surface of the sphere.
(B) Negative and appears only at the point on the sphere closest to the point charge.
(C) Negative and distributed non–uniformly over the entire surface of the sphere
(D) Zero

Electrostatic force and field:–

17. An electric dipole is placed in an electric field generated by a point charge.

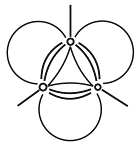
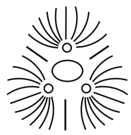
(A) The net electric force on the dipole must be zero
(B) The net electric force on the dipole may be zero.
(C) The torque on the dipole due to the field must be zero
(D) The torque on the dipole due to the field may be zero.

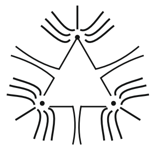
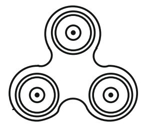
18. The figure shows some of the electric field lines corresponding to an electric field. The figure suggests



(A) $E_A > E_B > E_C$ (B) $E_A = E_B = E_C$
(C) $E_A = E_C > E_B$ (D) $E_A = E_C < E_B$

19. Three positive charges of equal value q are placed at the vertices of an equilateral triangle. The resulting lines of force should be sketched as in

(A)  (B) 

(C)  (D) 

20. Let $\{\varepsilon_0)$ denote the dimensional formula of the permittivity of vacuum. If M= mass, L = length, T = time and I = electric current, then:

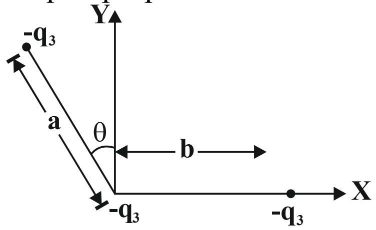
(A) $|E_0| = \left[M^{-1}L^{-3}T^2I\right]$

(B) $[E_0] = \left[M^{-1}L^{-3}T^1I^2\right]$

(C) $[E_0] = \left[M^{-1}L^2T^{-1}I^{-2}\right]$

(D) $[E_0] = \left[M^{-1}L^2T^{-1}I\right]$

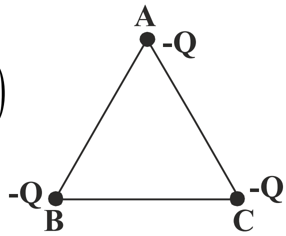
21. Three charges $-q_{2+}$ $+q_2$ and $-q_3$ are place on shown in the figure. The x-component of force on $-q_1$ is proportional to



(A) $\frac{q_2}{b^2}+\frac{q_3}{a^2}\cos\theta$ (B) $\frac{q_2}{b^2}-\frac{q_3}{a^2}\sin\theta$

(C) $\frac{q_2}{b^2}-\frac{q_3}{a^2}\cos\theta$ (D) $\frac{q_2}{b^2}+\frac{q_3}{a^2}\sin\theta$

22. Three charges are placed at the vertices of an equilateral triangle of side 'a' as shown in the following figure. The force experienced by the charge placed at the vertex A in a direction normal to BC is



(A) $Q^2 l\left(4\pi\in_0 a^2\right)$

(B) $-Q^2\left(4\pi\in_0 a^2\right)$

(C) Zero

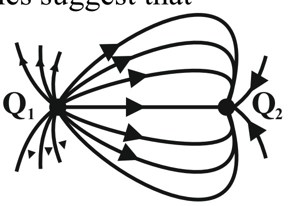
(D) $Q^2 l\left(2\pi\in_0 a^2\right)$

23. How should a charge q be divided into tow parts so that the force of repulsion between the two parts is maximum?

(A) $\frac{q}{4}$ and $\frac{3q}{4}$ (B) $\frac{q}{3}$ and $\frac{2q}{3}$

(C) $\frac{q}{5}$ and $\frac{4q}{5}$ (D) $\frac{q}{2}$ and $\frac{q}{2}$

24. A few electric field lines for a system of two charges Q_1 and Q_2 fixed at two different points on the *x*-axis are shown in the figure. These lines suggest that



(A) $|Q_1|>|Q_2|$ (B) $|Q_1|<|Q_2|$

(C) At a finite distance to the left of Q_1, the electric field is zero

(D) At a finite distance to the right of Q_2, the electric field is zero

25. A tiny spherical oil drop carrying a net charge q is balanced in still air with a vertical uniform electric field of strength $\frac{81\pi}{7}\times10^5\,Vm^{-1}$, When the field is switched off, the drop is observed to fall with terminal velocity

(A) 1.6×10^{-19} C (B) 3.2×10^{-19} C

(C) 4.8×10^{-19} C (D) 8.0×10^{-19} C

26. A negatively charged oil drop is prevented from falling under gravity by applying a vertical electric field 100 Vm^{-1}, if the mass of the drop is 1.6×10^{-3} g, the number of electrons carried by the drop is ($g = 10\ ms^{-2}$)

(A) 10^{18} (B) 10^{15} (C) 10^{6} (D) 10^{5}
(E) 10^{12}

27. Two identical conducting balls A and B have positive charges q_1 and q_2 respectively. But $q_1 \neq q_2$. The balls are brought together so that they touch each other and then kept in their original positions. The force between them is

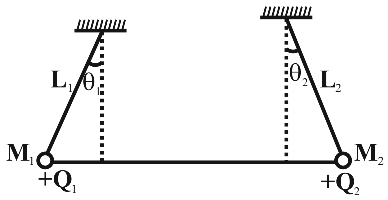
(A) Less than that before the balls touched.

(B) Greater than that before the balls touched.

(C) Same as that before the balls touched

(D) Zero

28. Two small spheres of masses M_1 and M_2 are suspended by heightless threads of lengths L_1 and L_2. The spheres carry charges Q_1 and Q_2 respectively. The spheres are suspended such that they are in level with one another and the threads are inclined to the vertical of angles of θ_1 and θ_2 as shown. Which one of the following conditions is essential, if $\theta_1 = \theta_1$



(A) $M_1 \neq M_2$ but $Q_1 = Q_2$

(B) $M_1 = M_2$

(C) $Q_1 = Q_2$ (D) $L_1 = L_2$

29. Two identical charged spheres suspended from a common point by two massless strings of length *l* are initially a distance $d\left(d << l\right)$ apart because of their mutual repulsion. The charge begins to lack from back the spheres at a constant rate. As a result, the charges approach each other with a velocity *v*. then as a function of distance x between then.

(A) $v \propto x^{-1/2}$ (B) $v \propto x^{-1}$

(C) $v \propto x^{1/2}$ (D) $v \propto x$

30. If $q_1 + q_2 = q$, then the value of the ratio $\frac{q_1}{q}$, for which the force between q_1 and q_2 is maximum is

(A) 0.25 (B) 0.75 (C) 1 (D) 0.5
(E) 1.5

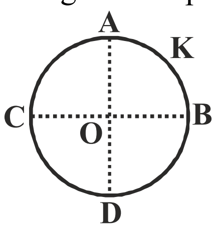
31. If a charge q is placed at the centre of the line joining two equal charges Q such that the system is in equilibrium, then the value of q is

(A) Q/2 (B) –Q/2
(C) Q/4 (D) –Q/4

32. Two charges of magnitude 10 units and 20 units are separated by certain distance. Now both the charges are brought to contact and again separated to initial position. What will be the ratio of initial and find force?

(A) $\frac{9}{8}$ (B) $\frac{4}{3}$
(C) $\frac{3}{2}$ (D) $\frac{8}{9}$

33. A thin conducting ring of radius R is given a charge +Q. the electric field at the centre O of the ring due to the charge on the part AKB of the ring is E. The electric field at the centre due to the charge on the part ABCD of the ring is



(A) E along KO
(B) 3E along OK
(C) 3E along KO
(D) E along OK

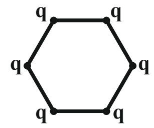
34. Three point charge +q, -2q and +q are placed at points $(x=0, y=a, z=0)$, $(x=0, y=0, z=0)$ and $(x=a, y=0, z=0)$ respectively. the magnitude and direction of the electric dipole moment vector of this charge assembly are:

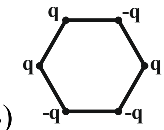
(A) $\sqrt{2}qa$ along the joining points $(x=0, y=0, z=0)$ and $(x=a, y=a, z=0)$
(B) qa along the line joining points $(x=0, y=0, z=0)$ and $(x=a, y=a, z=0)$.
(C) $\sqrt{2}$ qa along +x direction
(D) $\sqrt{2}$ qa along +y direction

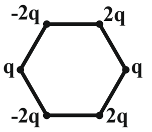
35. Charge q is uniformly distributed over a thin half ring of radius R. the electric field at the centre of the ring is

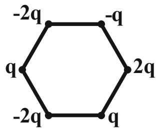
(A) $\frac{q}{2\pi^2\varepsilon_0 R^2}$ (B) $\frac{q}{4\pi^2\varepsilon_0 R^2}$
(C) $\frac{q}{4\pi\varepsilon_0 R^2}$ (D) $\frac{q}{2\pi\varepsilon_0 R^2}$

36. Figure below shown regular hexagons, with charges at the vertices. In which case is the electric field at the centre zero?

(A) 

(B) 

(C) 

(D) 

37. Two spherical conductors B and C having equal radii and carrying equal charges in them repel each other with a force F when kept apart at some distance. A third spherical conductor having some radius as that of B but uncharged is brought in contact with B, then brought in contact with C and finally removed away from both. The new force of repulsion between B and C is

(A) F/4 (B) 3F/4
(C) F/8 (D) 3F/8

38. Two identical metal spheres charged with $+12\mu C$ and $-8\mu C$ are kept at certain distance in air. They are brought into contact and then kept at the some distance. The ratio of the magnitudes of electrostatic force between them before and after contact is

(A) 12:1 (B) 8:1
(C) 24:1 (D) 4:1

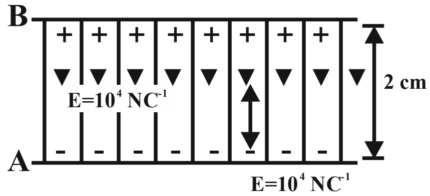
39. A charge Q is placed at each of the opposite corners of a square. A charge q is placed at each of the other two corners. If the net electrical force an Q is zero, then Q/q equals.

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

40. Let $\rho(r)=\frac{Q}{\pi R^4}r$ be the charge density distribution for a solid sphere of radius R and total charge Q. for a point 'P' inside the sphere at distance r_1 from the centre of the sphere, the magnitude of electric field is:

(A) 0 (B) $\frac{Q}{4\pi\varepsilon_0 r_1^2}$
(C) $\frac{Q r_1^2}{4\pi\varepsilon_0 R^4}$ (D) $\frac{Q r_1^2}{8\pi\varepsilon_0 R^4}$

41. An electron is released from the bottom plate A as shown in the figure $\left(E=10^4 NC^{-1}\right)$. The velocity of the electron when it renches plate B will be nearly equal to $\left(\frac{e}{m}=1.76\times10^{11} C\,kg^{-1}\right)$



(A) 0.84×10^7 m s$^{-1$ (B) 1.0×10^7 m s^{-1}
(C) 1.25×10^7 m s^{-1} (D) 1.65×10^7 m s^{-1}

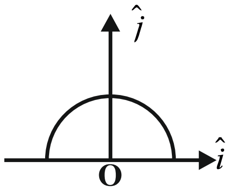
42. An α -particle of mass 6.4×10^{27} kg and charge 3.2×10^{-19} C is situated in a uniform electric field of 1.6×10^3 Vm^{-1}. The velocity of the particle at the end of 2×10^2 m path when it starts from rest is

(A) $2\sqrt{3}\times10^3\,ms^{-1}$ (B) $8\times10^3\,ms^{-1}$
(C) $16\times10^5\,ms^{-1}$ (D) $4\sqrt{2}\times10^5\,ms^{-1}$

43. When a soap bubble is given an electric charge,
(A) It contracts (B) It expands
(C) Its size remains the same.
(D) It expands or contracts depending upon whether the charge is positive or negative

44. Two identical charged sphere are suspended by strings of equal length. The strings make an angle of 30° with each other, when suspended in a liquid of density 0.8 g cm^{-3}, the angle remains the same, if density of the material of the sphere is 1.6 g cm^{-3}, the dielectric constant of the liquid is
(A) 1 (B) 4
(C) 3 (D) 2

45. A thin semi-circular ring of radius r has a positive charge q distributed uniformly over it. The net field $\vec{E}$ at the centre O is



(A) $\frac{q}{2\pi^2\varepsilon_0 r^2}\hat{j}$ (B) $\frac{q}{4\pi^2\varepsilon_0 r^2}\hat{j}$
(C) $-\frac{q}{4\pi^2\varepsilon_0 r^2}\hat{j}$ (D) $-\frac{q}{2\pi^2\varepsilon_0 r^2}\hat{j}$

46. Two positive ions, each carrying a charge q, are separated by a distance d, if F is the force of repulsion between the ions, the number of electrons missing from each ion will be (e being the charge on an electron)

(A) $\frac{4\pi\varepsilon_0 Fd^2}{e^2}$ (B) $\sqrt{\frac{4\pi\varepsilon_0 Fe^2}{d^2}}$
(C) $\sqrt{\frac{4\pi\varepsilon_0 Fd^2}{e^2}}$ (D) $\frac{4\pi\varepsilon_0 Fd^2}{q^2}$

47. An electron initially at rest falls a distance of 1.5 cm in a uniform electric field of magnitude 2×10^4 NC^{-1}. The time taken by the electron to fall this distance is
(A) 1.3×10^2 s (B) 2.1×10^{-12} s
(C) 1.6×10^{-10} s (D) 2.9×10^{-9} s

48. Under the action of a given Coulombic force, the acceleration of an electron is 2.5×10^{22} m s^{-2}. Then the magnitude of the acceleration of a proton under the action of same force is nearly
(A) 1.6×10^{-19} m s^{-2} (B) 9.1×10^{31} m s^{-2}
(C) 1.5×10^{19} m s^{-2} (D) 1.6×10^{27} m s^{-2}

49. A ball with charge –50e is placed at the centre of a hollow spherical shell which has a net charge of –50e. What is the charge on the shell's outer surface
(A) –50e (B) Zero
(C) –100e (D) +100e

50. Two charges mq and nq where $\frac{m}{n}=-\frac{3}{5}$ are placed at two different points. If the electric field at the point of charge mq is $\vec{E}$, then what is the electric field at the point of charge nq?

(A) $\frac{3\cdot\vec{E}}{5}$ (B) $\frac{-3\vec{E}}{5}$
(C) $\frac{5\vec{E}}{3}$ (D) $\frac{-5\vec{E}}{3}$