ELECTROSTATICS

Introduction:

Charge:

- Study of characterstics of electri charges at rest is known as electrostatics.
- Charge is fundamental property of matter and never found free.
- The excess or deficiency of electrons in a body gives the concept of charge. There are two types of charges namely positive and negative charges. The excess of electrons on a body is known as negative charge.
- The deficiency of electrons on a body is known as positive charge.
- If a body gets positive charge, its mass slightly decreases.
- Ifa body is given negative charge, its mass slightly increases.
- Charge is quantised. The minimum charge possible is $1.6\times10^{-19}C$. The charge on any body is an integral multiple of the minimum charge or electron charge, i.e if q is the charge then $q=\pm ne$ where n is an integer.
- Charge is conserved. It can neither be created nor destroyed. It can only be transformed from one object to other.

Properties of Charges:

- Like charges repel each other and unlike charges attract each other.
- Charge always resides on the outer surface of a charged body. It accumulates more at sharp points.
- Charge is a scalar. S.I. unit of charge is coulomb. Charge is a derived physical quantity with dimensions [AT].
- The total charge on a body is algebric sum of the charges located at different points on the body.
- Charge on a body does not change what ever be its speed.
- Repulsion is the sure test of electrification.

Electrifiction:

- A body can be charged by friction, conduction and induction.
- **Friction:** When two bodies are rubbed together, equal and opposite charges are produced on both the bodies.
- **Conduction:** An unharged body acquiring charge when kept in contact with a charged body is called conduction. Conduction preceeds repulsion.
- **Induction:** If a charged body is brought near a neutral body, the charged body will attract opposite charge and repel similar charge present in the neutral body. Opposite charge is induced at the near end and similar charge at the farther end. Inducing body neither gains nor loses charge. Induction always preceeds attraction.

Surface Charge Density:

- The ratio of charge on a body to its surface area is known as surface charge density. It is denoted by σ.

$$\sigma=\frac{a}{A}Cm^{-2}$$

- σ is inversely proportional to the square of the radius of curventure of the surface.
- Therefore charges accmulate at the pointed ends, edges and corners of the surface.

Coulomb's Inverse square low.

- $$F=\frac{1}{4\pi\in_0\in_r}\frac{q_1q_2}{d^2}$$

$\in_0$ - permttivity of free space or vacuum or air.

$\in_r$ - Relative permittivity or dielectric constant of the medium in which the charges are situated.

- $\in_0=8.857\times10^{-12}\frac{C^2}{Nm^2}$ or $\frac{farad}{metre},\frac{1}{4\pi\in_0}=9\times10^9 Nm^2/C^2$
- The relative permittivity isthe ratio of permittivity of the medium to the permittivity of the absolute free space $\in_r=\frac{\in}{\in_0}$

no dimensional $M^oL^oT^oA^o$

- And also

$$\in_r=\frac{\text{Force between two charges in air}}{\text{Force between the same two charges in the medium at same distant}}$$

$$=\frac{F_{air}}{F_{medium}}$$

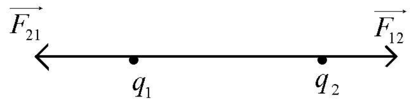
- For air $k=1$

$k>1$ for any dielectric medium;

$k=\infty$ for conducting medium.

Coulomb's law in vector form:

- $\vec{F}_{12}=\frac{1}{4\pi\in_0}\frac{q_1q_2}{r_2^2}\hat{r}_{12}$ $\quad \vec{F}_{21}=-\vec{F}_{12}$



Here F_{12} is force exerted by q_1 on q_2

and F_{21} is force enerted by q_2 on q_1

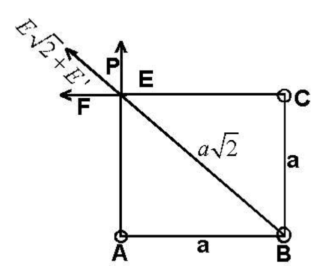
- Coulomb's law holds for stationary charges only which are point sized.
- Force on a charged particle due to a number of point charges is the resultant of forces due to individual point charges
$\vec{F} = \vec{F_1} + \vec{F_2} + \vec{F_3} + ...$
- If the force between two charges in different media is the same for different seperations
$F = \frac{1}{k}\frac{1}{4\pi \in_0}\frac{q_1 q_2}{d^2} =$ constant. $kd^2 =$ constant or $k_1 d_1^2 = k_2 d_2^2$
- Two point sized identical spheres carrying charges q_1 and q_2 on them are seperated by a certain distance. The mutual force between them is F. These two are brought in contact and kept at the same seperation. Now, the force between them is F^1. Then $\frac{F^1}{F} = \frac{(q_1+q_2)^2}{4q_1 q_2}$.

Electric FIeld:

- The space around the elelctric charge upto which its influence is felt is known as electric field.
- The force experienced by a unit positive charge placed at a point in the electrifield gives the intensity of electric field at that point both in magnitude and direction.
- Intensity of electric field is a vector quantity. Its direction is always away from the positive charge and towards the negative charge.
- Intensity of electrifield at a point which is at a distance $'d'$ from the point charge $'Q'$ is $\frac{1}{4\pi \in_0}\frac{Q}{d^2}$. ie. $E_0 = \frac{1}{4\pi \in_0}\frac{Q}{d^2}$ and in a medium $E = \frac{1}{k}\frac{1}{4\pi \in_0}\frac{Q}{d^2} = E_0 / k$.
- S.I unit is newton/coulomb or volt/metre. Dimensional formula $MLT^{-3}A^{-1}$
- Force experienced by a charge $'q'$ in an electric field of uniform intensity E is gvien by $F = Eq$
- A charge in an electried field experiences aforce whether it is at rest or moving.
- The electric force is independent of mass and velocity of the charged particle. It depends upon the charge.
- If insted of a single charge, field is produced by a charge distribution, by principle of super position $\vec{E} = \vec{E_1} + \vec{E_2} + \vec{E} + ...$
- Two charges q_1 and q_2 are seperated by a distance $'d'$. Then the point of zero intensity lies at a distance of $x = \frac{d}{\sqrt{\frac{q_2}{q_1}} \pm 1}$ from the weaker charge of q_1 and q_2. +Ve sign for like charges - Ve sign for unlike charges.

APPLICATIONS:

- Two charges +Q and -Q are separated by a distance 'd'. The intensity of electric field at the mid-point of the line joining the charges is $\frac{1}{4\pi \in_0}\frac{8Q}{d^2}$
- Two charges +Q coulomb each are separated by a distance 'd'. The intensity of electric field at the mid piont of the line joining the charges is zero.
- Two charges +Q coulomb each are placed at the two vertices of an equilateral triangle of side a. The intensity of electric field at the third vertex is $\sqrt{3}\frac{1}{4\pi \in_0}Q/a^2$.
- Two charges +Q coulombs -Q coulomb are placed at the two vertices of an equilateral triangle of side 'a', then the intensity of electric field at the third vertex is $\frac{1}{4\pi \in_0}Q/a^2$.
- If three charges +Q coulomb each are placed at the three vertices of an equilateral triangle of side a then the intensity of electric field at the centroid is zero.
- If three charge +q coulomb each are placed at the three corners of a square of side 'a' as shown in figure.



Intensity of electric field at the fourth corner $= \sqrt{2}E + E'$. Where $E = \frac{1}{4\pi \in_0}\frac{Q}{a^2}$ and $E' = \frac{1}{4\pi \in_0}\frac{Q}{2a^2} = \frac{E}{2}$. Hence the intensity of electric field at the fourth corner $= E\left(\sqrt{2} + \frac{1}{2}\right)$

MOTION OF A CHARGED PARTICLE IN AN

ELECTRIC FIELD:

- If a charged particle of charge Q is placed in an electric field of strength E, the force experienced by the charged particle = EQ.
- The acceleration of the charged particle in the electric field, $a = \frac{EQ}{m}$.
- The velocity of the charged particle after time 't', is $\left.\begin{aligned} V &= at \\ &= \left(\frac{EQ}{m}\right)t \end{aligned}\right\}$ if the initial velocity is zero
- The distance travelled by the charged particle, is
  $\left.\begin{aligned} S &= \frac{1}{2}at^2 \\ &= \frac{1}{2}\left(\frac{EQ}{m}\right)t^2 \end{aligned}\right\}$ if the initial velocity is zero
- When a charged particle of mass m and charge Q remains suspended in an electric field then mg=EQ.
- When a charged particle of mass m and charge Q remains suspended in an electric field, the number of fundamental charges on the charged particle,
  $$Mg = EQ$$
  $$= E(ne)$$
  $$n = \frac{Mg}{Ee}$$
- The bob of a simple pendulum is given a +ve charge and it is made to oscillate in a vertically upward electric field, then the time period of oscillation is
  $$2\pi\sqrt{\frac{l}{g - \frac{EQ}{m}}}$$
- In the above case, if the bob is given a -ve charge then the time period is given by $2\pi\sqrt{\frac{l}{g + \frac{EQ}{m}}}$
- A charged particle of charge $\pm Q$ is projected with an initial velocity u in a vertically upward electric field making an angle θ to the horizontal. Then

  a. Time of flight $= \frac{2u\sin\theta}{g \mp \frac{EQ}{m}}$

  b. Maximum height $= \frac{u^2\sin^2\theta}{2\left(g \mp \frac{EQ}{m}\right)}$

  c. Range $= \frac{u^2\sin 2\theta}{g \mp \frac{EQ}{m}}$
- Density of electric field inside a charged hollow conducting sphere is zero.
- A hollow sphere of radius r is given a charge Q.
  - Intensity of electric field at any point inside it is zero.
  - Intensity of electric field on the surface of the sphere is $\frac{1}{4\pi\epsilon_0}\frac{Q}{r^2}$
  - Intensity of electric field at any point outside the sphere is (at a distance 'x' from the centre) $\frac{1}{4\pi\epsilon_0}\frac{Q}{x^2}$
- A sphere is given a charge of 'Q' and is suspended in a horizontal electric field. The angle made by the string with the vertical is, $\theta = \tan^{-1}\left(\frac{EQ}{mg}\right)$
- The tension in the string is $\sqrt{(EQ)^2 + (mg)^2}$
- A bob carrying a +ve charge is suspended by a silk thread in a vertically upward electric field, then the tension in the string is, $T = mg - EQ$.
- If the bob carries -ve charge, tension in the string is mg+EQ.
- The intensity of electric field above a charge conductor is directed normal to it.

LINES OF FORCE:

- Line of force is an imaginary path along which a unit +ve charge would tend to move in an electric field.
- Lines of force start from +ve charge and end at -ve charge.
- Lines of force in the case of isolated +ve charge are radially outwards and in the case of isolated -ve charge are radially inwards.
- The difference between electric lines of force and magnetic lines of force is magnetic lines of force are closed curves where as electric lines of force are open lobes.
- The tangent at any point to the curve gives the direction of electric field at that point.
- Lines of force do not intersect.
- Lines of force tend to contract longitudinally and expand laterally.
- Lines of force won't pass through a conductor.
- The electric lines of force are perpendicular to equipotential surface.

ELECTRIC POTENTIAL:

- It is the work done to bring a unit positive charge from infinity distance to a point in the electric field is called electric potential at that point.
- It represents the electrical condition or state of the body and it is similar to temperature in heat.
- +vely charged body is considered to be at higher potential and -vely charged body is considered to be at lower potential.
- Potential at a point due to a point charge $=\frac{1}{4\pi\epsilon_0}\frac{Q}{d}$
- Potential due to group of charges is the algebric sum of their individual potentials.
- Two charges +Q and -Q are separated by a distance d, the potential on the perpendicular bisector of the line joining the charges is zero.
- When a charged particle is accelerated from rest through a p.d. 'v' work done,

  $W=Vq=\frac{1}{2}mv^2\ (or)\ v=\sqrt{\frac{2Vq}{m}}$
- The work done in moving a charge of q coulomb between two points separated by p.d. V_2-V_1 is $q(V_2-V_1)$.
- The work done in moving a charge from one point to another point on an equipotential surface is zero.
- A hollow sphere of radius R is given a charge Q the potential at a distance x from the centre is $\frac{1}{4\pi\epsilon_0}.\frac{Q}{R}(x\le R)$
- The potential at a distance when x>R is $\frac{1}{4\pi\epsilon_0}.\frac{Q}{x}$.
- A sphere is charged to a potential. The potential at any point inside the sphere is same as that of the surface.
- Relation among E, V and d in a uniform electric field is $E=\frac{V}{d}$ (or) $E=-\frac{dv}{dx}$
- Inside a hollow conducting spherical shell, E=0, $V\neq 0$.

P.E. OF SYSTEM OF CHARGES:

- Two charges Q_1 and Q_2 are separated by a distance 'd'. The P.E. of the system of charges is $\frac{1}{4\pi\epsilon_0}.\frac{Q_1Q_2}{d}$
- Three charges Q_1,Q_2,Q_3 are placed at the three vertices of an equilateral triangle of side 'a'. The P.E. of the system of charges is $\frac{1}{4\pi\epsilon_0}\left[\frac{Q_1Q_2}{a}+\frac{Q_2Q_3}{a}+\frac{Q_3Q_1}{a}\right]$.
- A charged particle of charge Q_2 is held at rest at a distance 'd' from a stationary charge Q_1. When the charge is released, the K.E. of the charge Q_2 at infinity is $\frac{1}{4\pi\epsilon_0}.\frac{Q_1Q_2}{d}$.

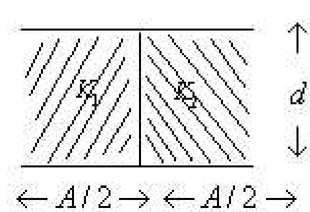
ELECTRIC CAPACITY:

- The ratio of charge to potential of a conductor is called its capacity. $C=\frac{Q}{V}$

  Unit : farad (F)
- **PARALLEL PLATE CAPACITOR:** If two plates each of area A are seperated by a distance 'd' then its capacity $=\frac{\varepsilon_0 A}{d}$ (air as medium) $=\frac{k\varepsilon_0 A}{d}$ (dielectric medium)

  When a dielectric medium is introduced between the plates of a parallel plate capacitor, its capacity increases to 'k' times the original capacity.
- When a dielectric slab of thickness 't' is introduced between the plates of a parallel plate capacitor,

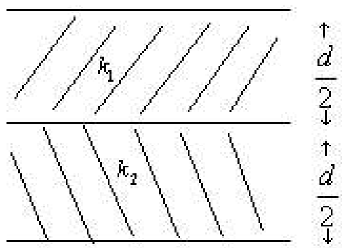
  $new\ capacity=\frac{\varepsilon_0 A}{d-t\left(1-\frac{1}{k}\right)}=\frac{\epsilon_0 A}{(d-t)+\frac{t}{k}}$
- When a metal slab of thickness 't' is introduced between the plates of a parallel plate capacitor, $new\ capacity=\frac{\varepsilon_0 A}{d-t}$.
- A dielectric slab of thickness 't' is introduced between the plates. To restore the original capacity if the distance between the plates is increased by x, then $x=t\left(1-\frac{1}{k}\right)$.
- Two dielectric slabs of equal thickness are introduced between the plates of a capacitor as shown in figure, then new capacity $=\frac{C}{2}(K_1+K_2)$.



If the two dielectrics are of different face areas A_1

and A_2 but of same thickness then capacity, $C = \frac{\epsilon_0}{d}\left(K_1A_1 + K_2A_2\right)$

- If two dielectric slabs of constants k_1 and k_2 are introduced into the slab as shown in figure, new capacity $= \frac{2k_1k_2}{(k_1+k_2)}.c$



- If number of dielectric slabs of thicknesses $t_1, t_2, t_3, ...t_n$ and constants $k_1, k_2.......k_n$ are introduced between the plates, effective capacity $= \frac{\varepsilon_0 A}{d-(t_1+t_2+.....t_{3n})+\left(\frac{t_1}{k_1}+......+\frac{t_n}{k_n}\right)}$
- In the above case if the dielectric media are completely filled between the plates, effective capacity $= \frac{\varepsilon_0 A}{\left(\frac{t_1}{k_1}+.....\frac{t_n}{k_n}\right)}$
- The capacity of a parallel plate capacitor is independent of the charge on it, potential difference between the plates and the nature of plate material.
- In a capacitor, the energy is stored in the electric field between the two plates.
- Capacity of a spherical conductor $= 4\pi \in_0 r$, where r is the radius of the sphere.

GROUPING OF CAPACITORS:

- If capacitors are connected in series, the reciprocal of effective capacity = sum of reciprocals of individual capacity.
  $\frac{1}{c} = \frac{1}{c_1} + \frac{1}{c_2} + ...$
- When capacitors are connected in series, the charge on the plates of the capacitors remains same. But 'v' is divided in the inverse ratio of capacities.
  $V_1 : V_2 : V_3 = \frac{1}{C_1} : \frac{1}{C_2} : \frac{1}{C_3}$
- When capacitors are connected in parallel, $C = C_1 + C_2 + ...$
- If capacitors are connected in parallel, the potential difference between the plates of the capacitors remains same but the charge is divided in the ratio of capacities.
  $Q_1 : Q_2 : Q_3 = C_1 : C_2 : C_3$
- If 'n' identical capacitors are given, we can get 2^{n-1} different capacitances (by using all the capacitors).
- If 'n' different capacitors are given, we can get 2^n different capacitances provided n>2 (by using all the capacitors).
  Ex: By using 3 identical capacitors we can get $2^{3-1} = 4$ different capacities.
  By using 3 different capacitors we can get 8 different capacities.
- The capacity of a capacitor with 'n' plates and air or vacuum between the plates is $\frac{(n-1)\varepsilon_0 A}{d}$. With a dielectric medium between the plates capacity is $\frac{k(n-1)\varepsilon_0 A}{d}$
- If 'n' identical condensers each of capacity C are connected in series, effective capacity $= \frac{C}{n}$
  In parallel, effective capacity = nC.

EFFECT OF DIELECTRIC:

- A parallel plate capacitor is fully charged to a potential V. Without disconnecting the battery if the gap between the plates is completely filled by a dielectric medium,
  - capacity increases to k times the original capacity.
  - p.d. between the plates remains same.
  - charge on the plates increases to k times the original charge.
  - energy stored in the capacitors increases to k times the original energy.
- After disconnecting the battery if the gap between the plates of the capacitor is filled by a dielectric medium,
  - capacity increases to k times the original capacity.
  - p.d. between the plates decreases to $\frac{1}{k}$ times the original potential.
  - charge on the plates remains same.
  - energy stored in the capacitors decre-ases to

$\frac{1}{k}$ times the original energy.

- A capacitor is fully charged to a potential 'v'. After disconnecting the battery, the distance between the plates of capacitors is increased by means of insulating handles. Potential difference between the plates increases. ($V = \frac{Q}{C}$, Q remains same, and C decreases)
- A capacitor with a dielectric is fully charged. Without disconnecting the battery if the dielectric slab is removed, then some charge flows back to the battery.

MIXED GROUPING OF CAPACITORS:

- Number of capacitors in a row

$$n = \frac{desired\ potential}{given\ potential}$$

- Number of such rows $m = \frac{desired\ capacity}{original\ capacity} \times n$
- Total number of capacitors = $m \times n$.

CONCEPTUAL QUESTIONS

s1. The minimum charge on an object is
1. One coulomb 2. One stat coulomb 3. 1.6×10^{-20} coulomb 4. 1.6×10^{-19} coulomb

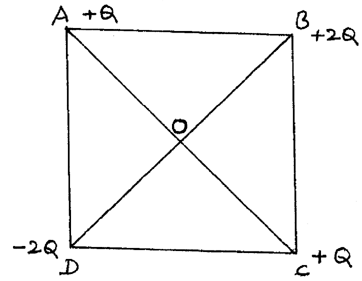
2. Other unit for the quantity having the units $\frac{C^2}{Nm^2}$ is
1. farad 2. $\frac{farad}{m^2}$ 3. $\frac{farad}{m}$ 4. $\frac{m}{farad}$

3. 1 coulomb of charge contains ..... number of electrons
1. 6.25×10^{18} 2. 3.125×10^{18}
3. 6.25×10^{12} 4. 3.125×10^{12}

4. Two charges are placed at a distance apart. If a glass slab is placed between them force between them will
1. Be zero 2. Increase
3. Decrease 4. Remains the same

5. A negatively charged particle is situated on a straight line joining two other stationary particles each having charge +q. The direction of the motion of the negatively charged particle will depend on
1. The magnitude of charge
2. The position at which it is situated
3. Both magnitude of charge and its position 4. The magnitude of +q

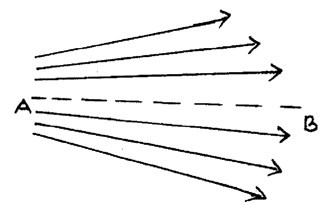
6. Four charges are arranged at the corners of a square ABCD as shown in the figure. The force on the charge kept at the centre 'O' is



1. Zero 2. Along the diagonal AC
3. Along the diagonal BD
4. Perpendicular to side AB

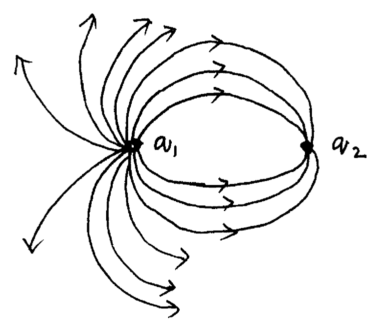
7. Two identical +ve charges are at the ends of a straight line AB. Another identical +ve charge is placed at 'C' such that AB=BC. A, B and C being on the same line. Now the force on 'A'
1. Increases 2. Decreases
3. Remains same 4. We cannot say

8. Figure shows the electric lines of force emerging from a charged body. If the electric field at 'A' and 'B' are E_A and E_B respectively and if the displacement between 'A' and 'B' is 'r' then



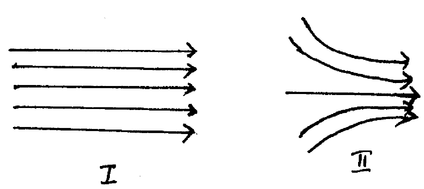
1. $E_A > E_B$ 2. $E_A < E_B$ 3. $E_A = \frac{E_B}{r}$ 4. $E_A = \frac{E_B}{r^2}$

9. Figure shows lines of force for a system of two point charges. The possible choice for the charges is



1. $q_1 = 4\mu C, q_2 = -1.0\mu C$ 2. $q_1 = 1\mu C, q_2 = -4\mu C$
3. $q_1 = -2\mu C, q_2 = +4\mu C$ 4. $q_1 = 3\mu C, q_2 = 2\mu C$

10. Drawings I and II show two samples of electric field lines



1. The electric fields in both I and II are produced. by negative charge located some where on the left and positive charges located some where on the right
2. In both I and II the electric field is the same every where
3. In both cases the field becomes stronger on moving from left to right
4. The electric field in I is the same every where, but in II the electric field becomes stronger on moving from left to right

11. Potential at the point of a pointed conductor is
1. Maximum 2. Minimum
3. Zero 4. Same as at any other point

12. An equipotential line and a line of force are
1. Perpendicular to each other
2. Parallel to each other
3. In any direction 4. At an angle of 45^0

13. When a charged conductor is placed near an earth connected conductor, its potential
1. Always increases 2. Always decreases
3. May increase or decrease
4. Remains the same

14. If a unit charge is taken from one point to another over an equipotential surface, then
1. Work is done on the charge
2. Work is done by the charge
3. Work on the charge is constant
4. No work is done

15. A condenser stores
1. Potential 2. Charge
3. Current 4. All the above

16. Two identical metallic spheres A and B of exactly equal masses are given equal positive and negative charges respectively. Then
1. Mass of A > Mass of B
2. Mass of A < Mass of B
3. Mass of A = Mass of B
4. Mass of A $\frac{\geq}{<}$ Mass of B

17. An electron is projected with certain velocity into an electric field in a direction opposite to the field. Then it is
1) accelerated 2) retarted
3) neither accelerated nor retarted
4) either accelerated or retarted

18 The acceleration of a charged particle in a uniform electric field is
1) Proportional to its charge only
2) Inversely proportional to its mass only
3) Proportional to its specific charge
4) None of the above.

19. An electron and proton are placed in an electric field. The forces acting on them are F_1 and F_2 and their acceleration are a_1 and a_2 respectively then
1) $\overline{F_1} = \overline{F_2}$ 2) $\overline{F_1} + \overline{F_2} = 0$
3) $|\overline{a_1}| = |\overline{a_2}|$ 4) $|\overline{a_1}| \geq |\overline{a_2}|$

20. The bob of a pendulum is positively charged. Another identical charge is placed at the point of suspension of the pendulum. The time period of pendulum
1) increases 2) decreases
3) becomes zero 4) remains same.

21. Electric potential at some point in space is zero. Then at that point
1) electric intensity is necessarily zero
2) electric intensity is necessarily non zero.
3) electric intensity may or may not be zero
4) electric intensity is necessarily infinite.

22. When an electron approaches a proton, their electro static potential energy
1) dcreases 2) increases
3) remains unchanged 4) all the above.

23. An electron and a proton move through apotential difference of 200V. Then
1) electron gains more energy
2) proton gains more energy
3) both gain same energy4) none gain energy

24. The condenser used in the tuning circuit of radio receiver is
1) Paper condenser 2) electrolytic condenser
3) ley den jar 4) gang condenser

25. Out of the following statement
A) The capacity of a conductor is affected due to the presence of an uncharged isolated conductor
B) A conductor can hold more charge at the same potential if it is surrounded by dielctric medium.
1) Both A and B are correct
2) Both A and B are wrong
3) A is correct and B is wrong
4) A is wrong and B is correct

26. Space between the plates of a parallel capacitor is filled with a dielectric slab. The capacitor is charged and then supply dis connected to it. If the slab is now taken out then
1) Work is not done to take out the slab
2) Energy stored in the capacitor reduces
3) Potential difference across the capacitor is decreased
4) Potential difference across the capacitor is increased

27. If an earthed plate is brought near positive charged plate, the potential and capacity of charged plate
1) increases, decreases
2) decreases, increases
3) decreases, decreases
4) increases, increases

28. A paralle plate condenser is charged by a connecting it to a battery. The battery is disconnectd and a glas slab is introduced between the plates. Then
1) Potential increases 2)electric intensity incrases
3) energy decreases 4)capacity decreaases

29. A parallel plate condenser is charged by connecting it to a battery. Without discon necting the battery, the space between the plates is completely filled with a medium dielectric onstant k. Then
1) potential becomes 1/k times
2) charge becomes k times
3) energy becomes 1/k times
4) electric intensity becomes k times.

30. The plates of charged condenser are connected by a conducting wire. The quantity of heat produced in the wire is
1) Proportional to the capacity of the condenser.
2) proportional to the square of the potential +of the condenser.
3) Proportional to the length of the wire
4) independent of the resistance of the wire

31. A capacitor works in
1) A.C. circuits
2) D.C. circuits
3) both the circuits
4) neither A.C. nor in D.C. circuit.

KEY

1. 4	2. 3	3. 1	4. 3	5. 2
6. 3	7. 1	8. 1	9. 1	10. 4
11. 4	12. 1	13. 2	14. 4	15. 2
16. 2	17.1	18.3	19.2	20.2
21.3	22.1	23.3	24.4	25.1
26.4	27.2	28.3	29.2	30.4
31.3				

LEVEL-I

COULOMB'S LAW:

1. One million electrons are added to a glass rod. The total charge on the rod is
1. $10^{-13}C$ 2. $1.6\times10^{-13}C$
3. $1.6\times10^{-12}C$ 4. $10^{-12}C$

2. If 10 million electrons are removed from a neutral body, then the charge on the body is
1. $1.2\times10^{-12}C$ 2. $1.6\times10^{-12}C$
3. $1.6\times10^{-13}C$ 4. $10^{-12}C$

3. The number of electrons to be removed from a glass rod in order that it acquire a charge of $1\mu C$ is
1. 6.25×10^{12} 2. 10^{12}
3. 6.25×10^{13} 4. 10^{13}

4. Can a body have a charge of 9.6×10^{-20} coulomb?
1. Yes 2. No
3. may (or) may not 4. Data not sufficient

5. Can a body have a charge of 6.4×10^{-19} coulomb?
1. Yes 2. No
3. may (or) may not 4. Data not sufficient

6. 10^{20} electrons are removed from a conductor. The nature and magnitude of the charge developed on it is
1. + 16C 2. - 16C 3. + 10C 4. - 10 C

7. A metal sphere of radius 10 cm has a charge of 12.56×10^{-6} coulomb. The surface charge density on the sphere is
1. $1\,C/m^2$ 2. $10^{-6}\,C/m^2$
3. $10^{-4}\,C/m^2$ 4. $10^{-5}\,C/m^2$

8. Two point charges $-q$ and $+2q$ are placed at a certain distance apart. Where should a third point charge be placed so that it is in equilibrium.
1) on the line joining the two charges on theright of $+2q$
2) on the line joining the two charges on the left of $-q$
3) between $-q$ and $+2q$
4) at any point on the right bisector of the line joining $-q$ and $+2q$.

9. A force of 4N is acting between two charges in air. If the space between them be completely filled with glass $(\varepsilon_r = 8)$, then the new force will be
1. 2N 2. 5N 3. 0.2N 4. 0.5N

10. Two unlike charges attract each other with a force of 10N. If the distance between them is doubled, the force between them is
1. 40N 2. 20N 3. 5N 4. 2.5N

11. Two equally charged pith balls 3 cm apart repel each other with a force of 4×10^{-5} newton. The charge on each ball is

1. $2\times10^{9}N$ 2. $2\times10^{-9}N$

3. $\frac{2}{3}\times10^{9}N$ 4. $\frac{2}{3}\times10^{-9}N$

12. Two identical metal spheres possess +60C and -20C of charges. They are brought in contact and then separated by 10 cm. The force between them is

1. $36\times10^{13}N$ 2. $36\times10^{14}N$

3. $36\times10^{12}N$ 4. $3.6\times10^{12}N$

13. A charge Q is divided into two parts q_1 and q_2 such that they experience maximum force of repulsion when separated by certain distance. The ratio of Q, q_1 and q_2 is

1. 1 : 1 : 2 2. 1 : 2 : 2 3. 2 : 2 : 1 4. 2 : 1 : 1

14. How do you divide a charge of 10 units so that force between the two charges is maximum when placed 2 cm apart?

1. 6, 4 2. 3, 7 3. 1, 9 4. 5, 5

15. Two charges $1\,\mu C$ and $4\,\mu C$ are separated by 12m. Where should a unit charge be placed along the line joining the two changes so that the resultant force on it is zero?

1. 4m from $4\,\mu C$ 2. 8m from $1\,\mu C$

3. 4m from $1\,\mu C$ 4. 3m from $1\,\mu C$

16. A force 'F' is acting between two charges in air. If the space between them be completely filled with a medium K=4, the force will be

1. F 2. 4F 3. F/4 4. 2F

17. Two charges each of 100 micro coulomb are separated in a medium of relative permittivity 2 by a distance of 5 cm. The force between them is

1. $0.36\times10^{5}N$ 2. $3.6\times10^{5}N$

3. $1.8\times10^{4}\,dyne$ 4. $1.8\times10^{4}N$

18. Two point charges of +2 μ C and +6 μ C repel each other with a force of 12 newton. If a charge of -4 μ C is given to each of these charges the force will be now

1. Zero 2. 4N attractive

3. 8N repulsive 4. 4N repulsive

19. A charged spherical conductor has a surface density of 0.7 C/m^2. When its charge is increased by 0.44C, the charge density changes by 0.14 C/m^2. The radius of the sphere is

1. 5 cm 2. 1 0 m 3. 0.5 m 4. 5 m

20. The ratio of the electrical force of attraction to the gravitational force between the proton and electron of the hydrogen atom is of the order of

1. 10^{39} 2. 10^{-39} 3. 10^{8} 4. 10^{-8}

21. A charge 'q' is placed exactly mid way between two charges 'Q' and 'Q' separated by a distance 2r in air. The force on the charge 'q' is

1. $\frac{2Q}{4\pi\epsilon_0 r^2}$ 2. $\frac{Q}{4\pi\epsilon_0 r^2}$ 3. Zero 4. None

ELECTRIC FIELD INTENSITY:

22. An electron $(mass = 9.1\times10^{-31}kg)$ is sent into an electric field of intensity 9.1×10^{6} newton/coulomb. The acceleration produced is

1. $1.6\times10^{18}\,m/s^2$ 2. $1.6\times10^{6}\,m/s^2$

3. $1.6\times10^{-18}\,m/s^2$ 4. $1.6\times10^{-6}\,m/s^2$

23. An electron and proton are sent into an electric field. The ratio of force experienced by them is

1. 1 : 1 2. 1 : 1840 3. 1840 : 1 4. 1 : 9.11

24. Two charges of $50\,\mu C$ and $100\,\mu C$ are separated by a distance of 0.6m. The intensity of electric field at a point midway between them is

1. $50\times10^{6}\,V/m$ 2. $5\times10^{6}\,V/m$

3. $10\times10^{6}\,V/m$ 4. $10\times10^{-6}\,V/m$

25. An $\alpha-$ particle and a $\beta-$particle are projected into the same electric field. The ratio of forces on them is

1. 2 : 1 2. 1 : 2 3. 2 : 3 4. 3 : 2

26. An electron is placed at the centre of a sphere of radius 0.2 metre having a charge 5×10^{-2} coulomb. The force on the electron is

1. zero 2. $11\times10^{9}N$ 3. $22.5\times10^{9}N$ 4. $2.5\times10^{9}N$

27. Four identical charges each of $1\mu C$ are placed at the corners of a square of side 10 cm. The resultant field strength at the centre is

1. $36\times10^{5}\,v/m$ 2. $3.6\times10^{5}\,v/m$

3. $18\times10^{5}\,v/m$ 4. Zero

28. An electron revolves around the nucleus of hydrogen atom in a circle of radius $5\times10^{-11}m$. The intensity of electric field at a point in the orbit of the electron is

1. $5.76\times10^{11}\,N/C$ 2. $9.216\times10^{-8}\,N/C$

3. Zero 4. $4\,N/C$

29. A particle of mass m carrying a charge q is placed in a vertical electric field so that it is suspended in air in equilibrium against gravity. The intensity of elctric field is

1. $\frac{q}{mg}$ 2. $\frac{qg}{m}$ 3. $\frac{mg}{q}$ 4. $\frac{mq}{g}$

30. A mass m carrying a charge q is suspended from a string and placed in a uniform horizontal electric field of intensity E. The angle made by the string with the vertical in the equilibrium position is

1. $\theta = \tan^{-1}\frac{mg}{Eq}$ 2. $\theta = \tan^{-1}\frac{m}{Eq}$

3. $\theta = \tan^{-1}\frac{Eq}{m}$ 4. $\theta = \tan^{-1}\frac{Eq}{mg}$

31. A charge q_1 exerts a force of 45N on a test charge $q_2 = 10^{-5}C$ located at a point 0.2m from q_1. The magnitude of q_1 is

1. $4\times10^{-8}C$ 2. $2\times10^{-5}C$ 3. $3\times10^{-6}C$ 4. $5\times10^{-8}C$

32. Two charges of 10 μC and -90 μC are separated by a distance of 24 cm. Electrostatic field strength from the smaller charge is zero at a distance of

1. 12 cm 2. 24 cm 3. 36 cm 4. 48 cm

33. The force acting on a charge of $10^{-10}C$ placed in an electric field of intensity 600 V/m is

1. $6\times10^{12}N$ 2. $6\times10^{-8}N$

3. $6\times10^{-12}N$ 4. $6\times10^{8}N$

34. A charge of 4 μC is placed in a uniform electric field of intensity 100 N/C. The force acting on the charge is

1. $25\times10^{6}N$ 2. $4\times10^{-4}N$

3. $4\times10^{4}N$ 4. $25\times10^{-6}N$

35. A proton and a deutron are sent into an electric field. The ratio between the accelerations of proton and deutron is

1. 2 : 1 2. 1 : 2 3. 1 : 1 4. 4 : 1

36. Two point charges $Q_1 = 8\times10^{-9}C$ and $Q_2 = -6\times10^{-9}C$ are separated by 10cm in air. The intensity of electric field at the mid point between the point charges is

1. $72\times10^{2}V/m$ 2. $5.04\times10^{4}V/m$

3. $2.16\times10^{4}V/m$ 4. $2.44\times10^{4}V/m$

37. Two like charges in the ratio 1:4 are 30cm apart. The resultant field strength vanishes at distance ..... from the smaller charge.

1. 20cm 2. 10cm 3. 5cm 4. 25cm

38. If an electron experiences a force equal to its weight when placed in an electric field, the intensity of the electric field is (Mass of electron = $9\times10^{-31}kg$, $g = 10ms^{-2}$)

1. $5.62\times10^{-11}N/C$ 2. $5.62\times10^{11}N/C$

3. $5.62\times10^{-9}N/C$ 4. $5.62\times10^{9}N/C$

39. The field due to a charge at a distance 'x' from it is ' E'. When the distance is doubled, the intensity of the field is

1. $\frac{E}{8}$ 2. E 3. 2E 4. $\frac{E}{4}$

40. A proton of mass 'm' charge 'e' is released from rest in a uniform electric field of strength 'E'. The time taken by it to travel a distance 'd' in the field is

1. $\sqrt{\frac{2de}{mE}}$ 2. $\sqrt{\frac{2dm}{Ee}}$ 3. $\sqrt{\frac{2dE}{me}}$ 4. $\sqrt{\frac{2Ee}{dm}}$

ELECTRIC POTENTIAL :

41. The potential difference between two parallel plates 1cm apart is 100V. The electric field strength between them is

1. 100 V/m 2. 1000 V/m 3. 10^4 V/m 4. 50 V/m

42. The p.d. between two plates separated by a distance of 1 mm is 100 V. The force on an electron placed in between the plates is

1. $10^{5}N$ 2. $1.6\times10^{-24}N$

3. $1.6\times10^{-14}N$ 4. $1.6\times10^{-19}N$

43. 100J of work is done when $2\ \mu C$ charge is moved in an electric field between two points. The p.d. between the points is

1. $2\times10^{-4}V$ 2. $2\times10^{-8}V$ 3. $2\times10^{-6}V$ 4. $5\times10^{7}V$

44. A cloud is at potential of $8\times10^{9}V$ relative to the ground. A charge of 40C is transferred in a lighting stroke between the cloud and the earth. The energy released is

1. $3.2\times10^{11}J$ 2. $5\times10^{9}J$

3. $2\times10^{8}J$ 4. $32\times10^{12}J$

45. A sphere has a charge of + 50C. The absolute potential at a point at distance of $10^{-12}m$ from the sphere is

1. 4500 V 2. 45×10^{23} V

3. $4.5\times10^{23}V$ 4. $45\times10^{24}V$

46. A spark is produced between two insulated surfaces maintained at a potential difference of 5×10^{6} volt. If the energy output is $10^{-5}J$, the charge transferred during the spark is

1. $5\times10^{11}C$ 2. $5\times10^{-11}C$ 3. $2\times10^{12}C$ 4. $2\times10^{-12}C$

47. Twenty seven identical mercury drops each charged to 10V, are allowed to form a big drop. The potential of the big drop is

1. 90 V 2. 9 V 3. 900 V 4. 270 V

48. An infinite number of charges each equal to 'q' are placed along the X-axis at x = 1, x = 2, x = 4, x = 8 ..... The potential at the point x = 0 due to this set of charges is

1. $\frac{Q}{4\pi\epsilon_o}$ 2. $\frac{2Q}{4\pi\epsilon_o}$ 3. $\frac{3Q}{4\pi\epsilon_o}$ 4. $\frac{Q}{\pi\epsilon_o}$

49. Two charges of $10\ \mu C$ and $-20\ \mu C$ are separated by a distance of 20 cm. The distance of the point from smaller charge where electric potential is zero if it lies between them is

1. $\frac{3}{20}cm$ 2. 6.67 cm 3. 10 cm 4. 16 cm

50. The potential difference between two parallel plates is 10^4 volt. If the plates are separated by 0.5 cm, the force on an electron between the plates is

1. $2\times10^4\ N$ 2. $3.2\times10^{-13}\ N$
3. 20 N 4. $32\times10^{12}\ N$

51. A conductor A of capacity $4\mu F$ has a charge $20\mu C$ and another condenser B of capacity $10\mu F$ has a charge $40\mu C$. If they are connected parallel, then
1) charge flows from B to A till the charges on them are equal.
2) charge flows from B to A till common poten tial is reached
3) charge flows from A to B pill common potential is reached
4) charge flows from A to B till charges on them are equal.

52. A, B, C are three points on a circle of radius 1 cm. These points form the corners of an equilateral triangle. A charge 2C is placed at the centre of the circle. The work done in carrying a charge of $0.1\ \mu C$ from A to B is

1. Zero 2. $18\times10^{11}J$ 3. $1.8\times10^{11}J$ 4. $54\times10^{11}J$

53. Charges +50, +20, +30 and -100 nano coulomb are placed at the four corners of a square of side $5\sqrt{2}$ cm. The potential at the intersection of diagonals is

1. $1.8\sqrt{2}\times10^4\ V$ 2. $3.6\times10^4\ V$
3. $1.8\times10^4\ V$ 4. Zero

54. Charge 6, 12 and 24 nano coulomb are placed on the corners of a square of side $10\sqrt{2}$ cm. The charge that must be placed at the fourth corner so that the potential at the centre of the square may be zero is
1. 42 nC 2. 36 nC 3. -42 nC 4. 30 nC

55. A charge of 2C is moved from a point 2m away from a charge of 1C to a point 1m away from that charge. The work done is
1. $10^9 J$ 2. $10^6 J$ 3. $9\times10^9 J$ 4. $10^{10} J$

56. The work done in carrying a charge 'q' once round a circle of radius 'r' with a charge 'Q' at the centre is

1. $\frac{1}{4\pi\epsilon_0}.\frac{qQ}{r}$ 2. $\frac{1}{4\pi\epsilon_0}.\frac{qQ}{\pi r}$

3. $\frac{1}{4\pi\epsilon_0}.\frac{qQ}{2\pi r}$ 4. Zero

57. Two charges $q_1 = 12\times10^{-9}C$ and $q_2 = -12\times10^{-9}C$ are placed 10cm apart. The potential at a point 6cm from q_1 on the line joining the two charges is
1. 3500 Volt 2. 900 Volt
3. 1800 Volt 4. -900 Volt

58. Two parallel metal plates are 3mm apart and have a uniform electric field strength 500 Vm^{-1} between them. The potential difference between the plates is
1. 15 Volt 2. 166.7 Volt
3. 16.67 Volt 4. 1.5 Volt

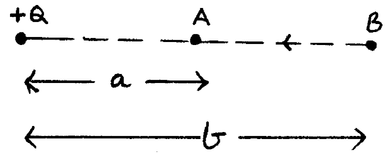
59. A hollow metal sphere of radius 5cm is charged such that the potential on its surface is 10V. The potential at the centre of the sphere is
1. 0 V 2. 10 V
3. Same as at point 5cm away from the surface
4. Same as at point 25cm from the surface

60. The work done (in Joule) in carrying a charge of 100 coulomb between two points having a potential difference of 10 volt is
1. 0.1 2. 10 3. 100 4. 1000

61. The potential difference between two parallel plates is 10^4 volt. If the plates are separated by 0.5cm, the force on an electron between the plates is
1. $3.2\times10^{-15}N$ 2. $6.4\times10^{-13}N$
3. $3.2\times10^{-13}N$ 4. $6.4\times10^{-15}N$

62. The p.d. between two plates separated by 1mm is 1000V. The force on an electron placed between the plates is
1. $1.6\times10^{-13}N$ 2. $1.6\times10^{-19}N$
3. $1.6\times10^{-14}N$ 4. $1.6\times10^{-10}N$

63. A positive point charge 'q' is carried from a point 'B' to a point 'A' in the electric field of a point charge +Q. If the permittivity of free space is ϵ_0, the work done in the process is given by



1. $\frac{qQ}{4\pi\epsilon_0}\left[\frac{1}{a}-\frac{1}{b}\right]$ 2. $\frac{qQ}{4\pi\epsilon_0}\left[\frac{1}{a}+\frac{1}{b}\right]$
3. $\frac{qQ}{4\pi\epsilon_0}\left[\frac{1}{a^2}-\frac{1}{b^2}\right]$ 4. $\frac{qQ}{4\pi\epsilon_0}\left[\frac{1}{a^2}+\frac{1}{b^2}\right]$

64. An electron of mass 'M' kg and charge 'e' coulomb travels from rest through a potential difference of 'V' volt. The final velocity of the electron is (in m/s)
1. $\frac{2eV}{M}$ 2. $\frac{2MV}{e}$ 3. $\sqrt{\frac{2eV}{M}}$ 4. $\sqrt{\frac{2MV}{e}}$

65. In a typical lightning flash, a charge 30C is transferred between two points at a potential difference of 10^9 volt. If all the energy released could be used to melt ice at 0^0C, the amount of ice melted in grams is
1. 8.93×10^7 2. 9×10^7 3. 6.02×10^7 4. 4.16×10^7

66. The potential energy of a proton is $3.2\times10^{-18}J$ at a particular point. The electric potential at this point is
1. 5V 2. 10V 3. 20V 4. 15V

67. Charges +q, -4q and +2q are arranged at the corners of an equilateral triangle of side 0.15m. If q=1 μ C, their mutual potential energy is
1. 0.4J 2. 0.5J 3. 0.6J 4. 0. 8J

68. An isolated metal sphere of radius 'r' is given a charge 'q'. The potential energy of the sphere is
1. $\frac{q^2}{4\pi\epsilon_0 r}$ 2. $\frac{q}{4\pi\epsilon_0 r}$ 3. $\frac{q}{8\pi\epsilon_0 r}$ 4. $\frac{q^2}{8\pi\epsilon_0 r}$

69. When 'n' small drops are made to combine to form a big drop, then the big drop's
1. Potential increases to $n^{1/3}$ times original potential and the charge density decreases to $n^{1/3}$ times original charge
2. Potential increases to $n^{2/3}$ times original potential and charge density increases to $n^{\frac{1}{3}}$ times original charge density
3. Potential and charge density decrease to $n^{1/3}$ times original values
4. Potential and charge density increases to 'n' times original values

ELECTRIC CAPACITY:

70. The charge stored in a capacitor is $20\mu C$ and the potential difference across the plates is 500 V. Its capacity is
1. $0.04\mu F$ 2. $10^{-2}\mu F$
3. $2\times10^{-6}\mu F$ 4. $250\mu F$

71. A capacitor of 8 micro farad is charged to a potential of 1000V. The energy stored in the capactor is
1. 8 J 2. 12 J 3. 2 J 4. 4 J

72. The capacity of a parallel plate condenser consisting of two plates each 10 cm square and are seperated by a distance of 2 mm is (Take air as the medium between the plate)
1. $8.85\times10^{-13}F$ 2. $4.42\times10^{-11}F$
3. $44.25\times10^{+12}F$ 4. $88.5\times10^{-13}F$

73. The capacity of a parallel plate air condenser is $2\mu F$. If a dielectric of dielectric constant 4 is introduced between the plates, its new capacity is
1. $1.5\mu F$ 2. $0.5\mu F$ 3. $8\mu F$ 4. $6\mu F$

74. An oil condenser has a capacity of $100\mu F$. The oil has dielectric constant 2. When the oil leaksout its new capacity is
1. $200\mu F$ 2. $0.02\mu F$ 3. $50\mu F$ 4. $0.5\mu F$

75. The ratio of the resultant capacities when three capacitors of $2\mu F$, $4\mu F$ and $6\mu F$ are connected first in series and then in parallel is
1. 1 : 11 2. 11 : 1 3. 12 : 1 4. 1 : 12

76. Two parallel plate air capacitors have the same separation. The plates of the first are squares of side 10 cm. The plates of the second are squares of side 20 cm. The ratio of the capacities is
1. 2 : 1 2. 1 : 2 3. 4 : 1 4. 1 : 4

77. A capacitor of $50\mu F$ is connected across a 200 volt supply. The charge that it would take is
1. 1 C 2. 2 C 3. 8 C 4. 0.01 C

78. Four charges $+3\mu C$, $-1\mu C$, $+5\mu C$ and $-7\mu C$ are arranged on the circumference of a circle of radius 0.5 m. The potential at the centre is
1. Zero 2. 18×10^4V 3. -18×10^4V 4. 288×10^3V

79. Sixty four spherical drops each of radius 2 cm and carrying 5C charge combine to form a bigger drop. Its capacity is
1. $\frac{8}{9}\times10^{-11}F$ 2. $90\times10^{-11}F$
3. $1.1\times10^{-11}F$ 4. $9\times10^{11}F$

80. Two spheres of radii 12 cm and 16 cm have equal charge. The ratio of their energies is
1. 3 : 4 2. 4 : 3 3. 1 : 2 4. 2 : 1

81. A number of identical condensers are first connected in parallel and then in series. The equivalent capacities are found to be in the ratio 9:1. The number of condensers used is
1. 9 2. 81 3. 3 4. 100

82. A condensor of $1\mu F$ is charged to a potential of 1000 volt. The energy stored in the condenser is
1. 1 J 2. $10^{-3} J$ 3. 0.5 J 4. $10^{-6} J$

83. In the above problem if a dielectric slab of dielectric constant 5 is introduced between the plates of the condenser, the loss in the energy of the condenser is
1. 0.1 J 2. 2.5 J 3. 0.4 J 4. 5 J

84. Three condensers $1\mu F,\ 2\mu F$ and $3\mu F$ are connected in series to a p.d. of 330 volt. The PD across the plates of $3\mu F$ is
1. 180 V 2. 300 V 3. 60 V 4. 270 V

85. The radius of the earth is 6381 km. The capacitance of the earth is
1. $709\times10^{9} F$ 2. $709\times10^{-9} F$
3. $709\times10^{-12} F$ 4. $709\times10^{-6} F$

86. A capacitor of $30\mu F$ charged to 100 V is connected in parallel to capacitor of $20\mu F$ charged to 50 volt. The common potential is
1. 75 V 2. 150 V 3. 50 V 4. 80 V

87. Three capacitors $2\mu F, 3\mu F$ and $6\mu F$ are connected in series. The effective capacitance of the combination is
1. $11\mu F$ 2. $1\mu F$ 3. $1.2\mu F$ 4. $2\mu F$

88. Three capacitors $2\mu F,\ 3\mu F$ and $5\mu F$ are connected in parallel. The capacitance of the combination.
1. $\frac{30}{31}\mu F$ 2. $\frac{31}{30}\mu F$ 3. $10\mu F$ 4. $2.5\mu F$

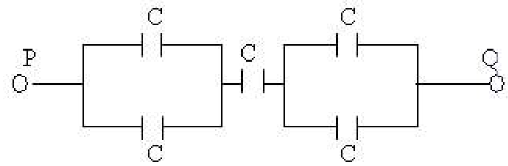
89. A parallel plate air condenser consists of two circular plates of diameter 8 cm. At what distance should the plates be placed so as to have the same capacity as that of a sphere of diameter 20 cm?
1. 2 mm 2. 4 mm 3. 2 cm 4. 4 cm

90. When two capacitors are joined in series the resultance capacity is $2.4\mu F$ and when the same two are joined in parallel the resultant capacity is $10\mu F$. Their individual capacities are
1. $7\mu F, 3\mu F$ 2. $1\mu F, 9\mu F$
3. $6\mu F, 4\mu F$ 4. $8\mu F, 2\mu F$

91. Three capacitors each of $6\mu F$ are connected together in series and then connected in series with the parallel combination of three capacitors of $2\mu F, 4\mu F$ and $2\mu F$. The total combined capacity is
1. $2\mu F$ 2. $10\mu F$ 3. $12\mu F$ 4. $1.6\mu F$

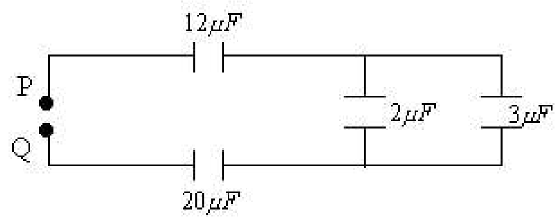
92. The maximum and the minimum resultant capacity that can be obtained with $2\mu F, 3\mu F$ and $6\mu F$ are respectively
1. $11\mu F, 1\mu F$ 2. $11\mu F, 6\mu F$
3. $11\mu F, 2\mu F$ 4. $11\mu F, 4\mu F$

93. The equivalent capacitance between P and Q of the given figure is (the capacitance of each capacitor is $1\mu F$)



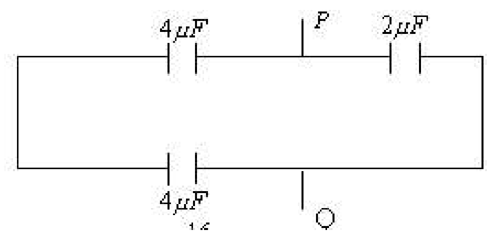
1. $2\mu F$ 2. $0.5\mu F$ 3. $5\mu F$ 4. $0.2\mu F$

94. The resultance capacity between the terminals P and Q of the given figure is



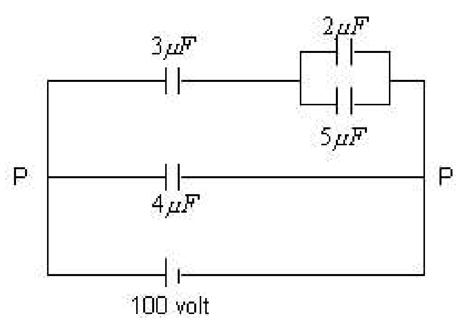
1. $37\mu F$ 2. $\frac{15}{7}\mu F$ 3. $3\mu F$ 4. $\frac{30}{9}\mu F$

95. The resultant capacity between the points P and Q of the given figure is

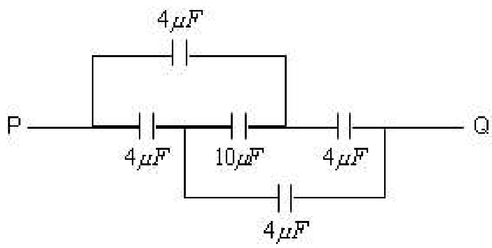


1. $4\mu F$ 2. $\frac{16}{3}\mu F$ 3. $1.6\mu F$ 4. $1\mu F$

96. The charge on the condenser having a capacity of $5\mu F$ in the given figure is

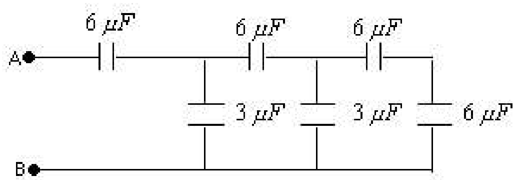


97. The effective capacitance between the point P and Q in the given figure is



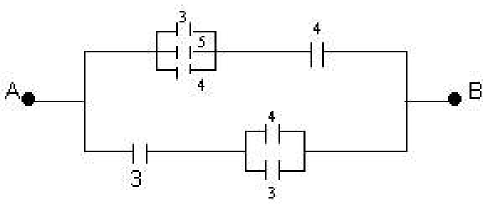
1. $4\,\mu F$ 2. $16\,\mu F$ 3. $26\,\mu F$ 4. $10\,\mu F$

98. The equivalent capacitance across the terminals A and B is



1. $12\,\mu F$ 2. $3\,\mu F$ 3. $6\,\mu F$ 4. $9\,\mu F$

99. The capacitant of all the capacitors shown in the figure below are in microfarad, the equivalent capacitance between A and B is



1. $3\,\mu F$ 2. $2.1\,\mu F$ 3. $4.6\,\mu F$ 4. $5.1\,\mu F$

100. A $1\,\mu F$ capacitor is charged to 200 V and then connected in parallel (+ve to +ve) with a $4\,\mu F$ capacitor charged to 100 V. The resultant potential difference is

1. 120 V 2. 60 V 3. 180 V 4. 150 V

101. The capacity of each mercury drop is $10\,\mu F$. 64 drops are combined to form a single drop. Its resultant capacity is

1. $10\,\mu F$ 2. $20\,\mu F$ 3. $160\,\mu F$ 4. $40\,\mu F$

102. A condenser is charged to a p.d. of 120 volt. Its energy is 1×10^{-5} *joule*. If the battery is there and the space between plates is filled up with a dielectric medium $(\varepsilon_r = 5)$, its new energy is

1. $10^{-5} J$ 2. $2\times10^{-5} J$ 3. $3\times10^{-5} J$ 4. $5\times10^{-5} J$

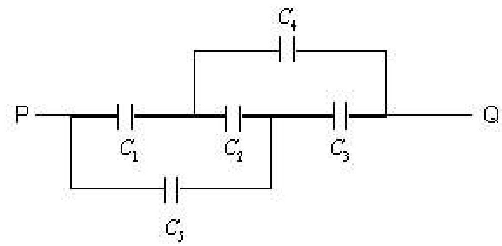
103. The capacity between two adjacent plates of parallel plate condenser is $5\,\mu F$. How many plates should be used if we want to get a capacity of $40\,\mu F$?(Alternate plates are connected together)

1. 8 2. 9 3. 7 4. 10

104. The effective capacitance between P and Q of the figure below is

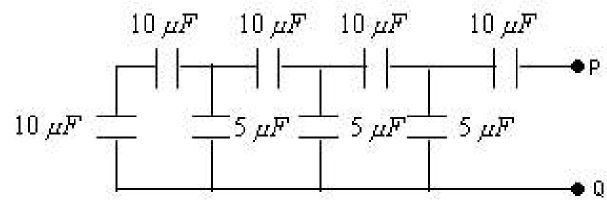
$C_1 = C_3 = C_3 = C_3 = 10\mu F$

$C_2 = 100\,\mu F$



1. $10\,\mu F$ 2. $40\,\mu F$ 3. $5\,\mu F$ 4. $20\,\mu F$

105. The equivalent capacitance between P and Q is



1. $10\,\mu F$ 2. $20\,\mu F$ 3. $5\,\mu F$ 4. $15\,\mu F$

106. A radio capacitor of variable capacitance is made of n parallel plates each of area A and separated from each other by a distance d. The alternate plates are connected together. The capacitance of the combination is

1. $\frac{n A \epsilon_o}{d}$ 2. $\frac{(n-1) A \epsilon_o}{d}$

3. $\frac{(2n-1) A \epsilon_o}{d}$ 4. $\frac{(n-2) A \epsilon_o}{d}$

107. Two condensers of capacities 10 μ F and 20 μ F have potential differences of 20V and 10V respectively. The total charge is

1. 200 μ C 2. 600 μ C
3. 400 μ C 4. Zero

108. A capacitor of capacitance 2 micro farad is charged to a voltage of 6 volt. The charge on its plates is

1) $1.2\times10^{-5} C$ 2) $3\times10^{-6} C$ 3) $\frac{1}{3}\times10^{-6} C$ 4) $\frac{1}{12}\times10^{-6} C$

109. In order to increase the capacity of a parallel plate condenser one should introduce between the plates a sheet of (assume that the space is completely filled)

1. Mica 2. Tin
3. Copper 4. Stainless steel

110. 4 μF, 6 μF and 12 μF condensers are in series across 90V. The p.d. across 12 μF condenser is
1. 30V 2. 90V 3. 15V 4. 45V

111. Two condensers of capacities 4 μF and 5 μF are joined in series. The potential difference across 5 μF is 10V then the potential difference across 4 μF condenser is
1. 22.5V 2. 10V 3. 12.5V 4. 25V

112. A condenser of capacity 2 μF is charged to a potential of 200V. It is now connected to an uncharged condenser of capacity 3 μF. The common potential is
1. 200 V 2. 100 V 3. 80 V 4. 40 V

113. The capacitance of a sphere of radius 10cm situated in air is approximately
1. $11\times10^{-6}F$ 2. 11×10^{-9}F
3. 11×10^{-12}F 4. Zero

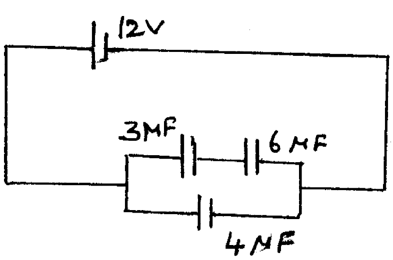
114. A highly conducting sheet of aluminium foil of negligible thickness is placed between the plates of a parallel plate capacitor. The foil is parallel to the plates. If the capacitance before the insertion of foil was 10 μF, its value after the insertion of foil will be
1. 20 μF 2. 10 μF 3. 5 μF 4. Zero

115. The capacity between the adjacent plates of a parallel plate capacitor is 10 μF. If we want a capacity of 50 μF, the number of plates to be used is
1. 5 2. 50 3. 6 4. 4

116. Three capacitors each of capacitance 1 μF are connected in parallel. To this combination, a fourth capacitor of capacitance 1 μF is connected in series. The resultant capacity of the system is
1. 4 μF 2. 2 μF 3. $\frac{4}{3}\mu F$ 4. $\frac{3}{4}\mu F$

117. There are 10 condensers each of capacity 5 μF. The ratio of minimum to maximum capacity obtained from these condensers will be
1. 50:1 2. 1:50 3. 100:1 4. 1:100

118. Charge 'Q' taken from the batteryof 12V in the circuit is



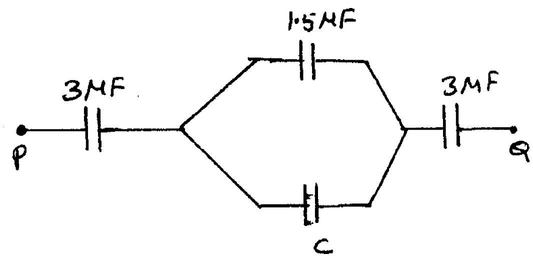
1. 72 μC 2. 36 μC 3. 156 μC 4. 20 μC

119. A condenser of capacity 10 μF is charged to a potential of 500 V. Its terminals are then connected to those of an uncharged condenser of capacity 40 μF. The loss of energy in connecting them together is
1. 1J 2. 2.5J 3. 10J 4. 12 J

120. Two capacitors of 0.5 μF and 1 μF are connected in parallel across a battery. If the charge on 0.5 μF is 50 μC, the charge on the other capacitor is
1. 100 μC 2. 50 μC 3. 25 μC 4. Zero

121. A parallel plate capacitor with air as medium between the plates has a capacitance of 10 μF. The area of the capacitor is divided into two equal halves and filled with two media having dielectric constant $K_1 = 2$ and $K_2 = 4$. The capacitance will now be
1. 10 μF 2. 20 μF 3. 30 μF 4. 40 μF

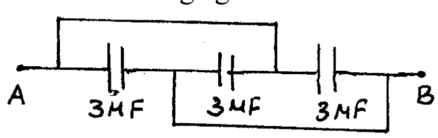
122. The equivalent capacitance of the network given below is 1 μF. The value of 'C' is



1. 3 μF 2. 1.5 μF 3. 2.5 μF 4. 1 μF

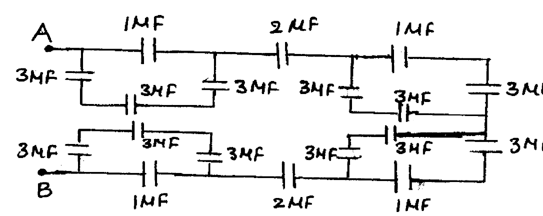
123. The energy stored in a sphere of 10cm radius when the sphere is charged to a potential of 300 volt is
1. $5\times10^{-7}J$ 2. $2\times10^{-6}J$ 3. $4\times10^{-7}J$ 4. $3\times10^{-6}J$

124. The equivalent capacity between the points 'A' and 'B' in the following figure will be



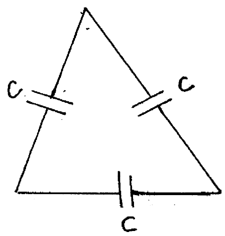
1. 9 μF 2. 1 μF 3. 4.5 μF 4. 6 μF

125. The effective capacitance between 'A' and 'B' is



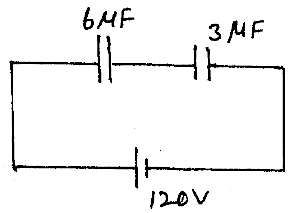
1. $\frac{1}{3}\mu F$ 2. $44\mu F$ 3. $7.6\mu F$ 4. $6.7\mu F$

126. Three equal condensers of capacity 'C' each are connected to form a triangle. The effective capacity across any side is



1. $\frac{3C}{2}$ 2. $3C$ 3. $\frac{C}{3}$ 4. $\frac{C}{2}$

127. The potential difference across 3 μF condenser is



1. 40 Volt 2. 60 Volt 3. 80 Volt 4.120 Volt

KEY

1. 2	02. 2	03. 1	04. 2	05. 1
06. 1	07. 3	08. 2	09. 4	10. 4
11. 2	12. 1	13. 4	14. 4	15. 3
16. 3	17. 4	18. 2	19. 3	20. 1
21. 3	22. 1	23. 1	24. 2	25. 1
26. 1	27. 4	28. 1	29. 3	30. 4
31. 2	32. 1	33. 2	34. 2	35. 1
36. 2	37. 2	38. 1	39. 4	40. 2
41. 3	42. 3	43. 4	44. 1	45. 3
46. 4	47. 1	48. 2	49. 2	50. 2
51. 3	52. 1	53. 4	54. 3	55. 3
56. 4	57. 4	58. 4	59. 2	60. 4
61. 3	62. 1	63. 1	64. 3	65. 1
66. 3	67. 3	68. 4	69. 2	70. 1
71. 4	72. 2	73. 3	74. 3	75. 1
76. 4	77. 4	78. 1	79. 1	80. 2
81. 3	82. 3	83. 3	84. 3	85. 4
86. 4	87. 2	88. 3	89. 2	90. 3
91. 4	92. 1	93. 2	94. 3	95. 1
96. 2	97. 1	98. 2	99. 4	100. 1
101. 4	102. 4	103. 2	104. 1	105. 3
106. 2	107. 3	108. 1	109. 1	110. 3
111. 3	112. 3	113. 3	114. 2	115. 3
116. 4	117. 4	118. 1	119. 1	120. 1
121. 3	122. 2	123. 1	124. 1	125. 1
126. 1	127. 3			

LEVEL-II

COULOMB'S LAW:

1. Two equally charged identical metal spheres A and B repel each other with a force F. Another identical uncharged sphere C is touched to A and then placed midway between A and B. The net force on C is in the direction
   1. F towards A 2. F towards B
   3. 2F towards A 4. 2F towards B
2. Two charges when kept at a distance of 1m apart in vacuum has some force of repulsion. If the force of repulsion between these two charges be same, when placed in an oil of dielectric constant 4, the distance of separation is
   1. 0.25m 2. 0.4m 3. 0.5m 4. 0.6m
3. Two point charges +4e and +e are 'x' distance apart. At what distance a charge 'q' must be placed from charge +e so that it is in equilibrium.
   1. $\frac{x}{2}$ 2. $\frac{2x}{3}$ 3. $\frac{x}{3}$ 4. $\frac{x}{6}$
4. Q_1, Q_2 charges are separated by distance 'd'. F is the force between them. The value of Q_2 is halved. To have the same force between the charges, the distance of separation should be
   1. d 2. $\frac{d}{2}$ 3. $\frac{d}{\sqrt{2}}$ 4. $2d$
5. Two unlike charges seperated by a distance of 1m. attract each other with a force of $0.108N$. If the charges are in the ratio $1:3$, the weak charge is
   1) $2\mu C$ 2) $4\mu C$ 3) $6\mu C$ 4) $5\mu C$
6. Two point charges $+4C$ and $+6C$ repel each other with a force F. If a charge $-5C$ is given to each of these charges, the force becomes
   1) repulsive force of $\frac{F}{24}$ 2) attract force of $\frac{F}{24}$
   3) repulsive force $24F$ 4) attractive force $24F$
7. Three charges each equal to $10^{-9}C$ are placed at the corners of equllateral triangle of side 1m. The force on one of the charges is
   1) $9\times10^{-9}N$ 2) $9\sqrt{3}\times10^{-9}N$
   3) $27\times10^{-9}N$ 4) $18\times10^{-9}N$
8. Two point charges of 2C and - 6C attract each other with a force of 12N. A negative charge of 2C is added to - 6C charge now the force between them is
   1) 12N 2) 16N 3) 32N 4) 24N

9. Two particles each of mass $'m'$ and carrying charge $'Q'$ are seperated by same distance. If they are in equilibrium under mutual gravita tional and electro static forces, then Q/m (in c/Kg) is of the order of

1) 10^{-5} 2) 10^{-10} 3) 10^{-15} 4) 10^{-20}

10. Two identical pendulums A and B are suspended from the some point. Both are given positive cahrge, with A having more charge than B. They diverge and reach equilibrium with the suspension of A and B making angles θ_1 and θ_2 with the vertical respectively.

1) $\theta_1 > \theta_2$ 2) $\theta_1 < \theta_2$ 3) $\theta_1 = \theta_2$

4)The tension in A is greater than that in B

11. The excess (equal in number) in number of electons that must be placed on each of two small spheres spaced 3 cm apart with force of repulsion between the spheres to be $10^{-19} N$ is

1) 25 2) 225 3) 625 4) 1250

12. A particle of charge $-q$ and mass m moves in a circular orbit of radius r about a fixed charge $+Q$. The relation between the radius of the orbit r and the time period T is

1) $r = \frac{Qq}{16\pi^2 \in_0 m} T^3$ 2) $r^3 = \frac{Qq}{16\pi^3 \in_0 m} T^2$

3) $r^2 = \frac{Qq}{16\pi^3 \in_0 m} T^3$ 4) $r^2 = \frac{Qq}{16\pi \in_0 m} T^3$

13 (A) Assertion : Force between two point charges at rest is not changed by the presence of third point charge them.

(R) Reason: Force depends on the magnitude o f the first two charges and seperation between them

1) A is true but R is false 2) R is true but A is false

3) Both A and R are true and R is correct explanation of A

4) Both A and R are true and R is not correct explanation of A.

14. The point charges $+1C, +1C$ and $-1C$ are placed at the vertices A, B and C of an equilateral triangle of side 1m. Then

(A) The force acting on the charge at A is $9\times10^9 N$

B) The electric field strength at A is $9\times10^9 NC^{-1}$

1) A is correct but B is wrong
2) B is correct but A is wrong
3) Both A and B are wrong
4) Both A and B are correct

15. A. charge cannot exist without mass but mass can exist without charge.

B. Charge is invariant but mass is veriant with velocity

C. Charge is conserved but mass alone my not be conserved.

1) A, B, C are true
2) A, B, C are is true
3) A, B are true
4) A, B are false, C is true

16. Match the following:

a) Electric intensitiy	e) $M^{-1}L^{-2}T^4A^2$
b) Electric potential	f) M^0L^0TA
c) Electric capacity	g) $ML^2L^{-3}A^{-1}$
d) Electric charge	h) $MLT^{-3}A^{-1}$

1) $a-e, b-g, c-h, d-f$
2) $a-h, b-g, c-e, d-f$
3) $a-g, b-h, c-e, d-f$
4) $a-h, b-g, c-f, d-e$

17. Match the following:

a) mass	e) invariant
b) charge	f) only attractive
c) Coulomb force	g) may be variant
d) gravitational force	h) may be repulsion

1) $a-f, b-g, c-h, d-e$
2) $a-g, b-e, c-f, d-h$
3) $a-g, b-e, c-h, d-f$
4) $a-g, b-h, c-e, d-f$

18. Two identical tiny metal balls carry charges of +3nC and -12nC. They are 3cm apart. The balls are now touched together and then separated to 3cm. The force on them is

1. $20.25\times10^{-4} N$ 2. $2.025\times10^{-3} N$
3. $2.025\times10^{-4} N$ 4. $2025N$

19. Two identical charged spheres are suspended by strings of equal length and the strings make certain angle with each other. When suspended in a liquid of density 400 kg/m^3, the angle between the threads remains the same. If the density of the material of the sphere is 1600 kg/m^3, the dielectric constant of the liquid is

1. 1.3 2. 2 3. 3.1 4. 5

20. Two small conducting spheres each of mass $9\times10^{-4} kg$ kg are suspended from the same point

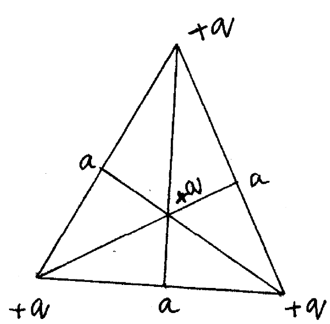
by non conducting strings of length 100 cm. They are given equal and similar charges until the strings are equally inclined at 45^0 each to the vertical. The charge on each sphere is ..... coulomb

1. 1.4×10^{-6} 2. 1.6×10^{-6}
3. 2×10^{-6} 4. 1.96×10^{-6}

21. Charges of 40, -40 and 10 μC are placed in air at the corners A, B and C respectively of an equilateral triangle of side 2cm long. The resultant force on the charge at 'C' is
1. 9000 N 2. 900 N 3. 4500 N 4. 450 N

22. Two charged balls of the same radius and weight suspended on threads of equal length are immersed into a liquid having density of d_1 and a dielectric constant 'K'. The density 'd' of the material of the balls for the angles of divergene of the threads in the air and in the dielectric to be the same is
1. $\frac{Kd_1}{K-1}$ 2. $\frac{K-1}{Kd_1}$ 3. $\frac{d_1}{K-1}$ 4. $\frac{K-1}{d_1}$

23. Three charges +q, +q and +q are placed at the corners of an equilateral triangle of side 'a'. The resultant electric force on a charge +q placed at the centre of the triangle is



1. $\frac{1}{4\pi\in_0}.\frac{3Q^2}{a^2}$ 2. $\frac{1}{4\pi\in_0}.\frac{3Q^2}{a}$
3. $\frac{1}{4\pi\in_0}.\frac{3\sqrt{3}Q^2}{a^2}$ 4. Zero

ELECTRIC FIELD INTENSITY:

24. Three electric charges +q each are placed at the three corners of a square of side d. The intensity of electric field at the fourth corner is
1. $\frac{1}{4\pi\in_o}\frac{q}{d^2}\left(2+\frac{1}{\sqrt{2}}\right)$ 2. $\frac{1}{4\pi\in_o}\frac{q}{d^2}\left(\sqrt{2}+\frac{1}{2}\right)$
3. $\frac{1}{4\pi\in_o}\frac{2Q}{d^2}$ 4. $\frac{1}{4\pi\in_o}\frac{\sqrt{2}q}{d^2}$

25. The breakdown electric intensity for air is 3×10^6 V/m. The maximum charge that can be held by a sphere of radius 1 mm is
1. 0.33 C 2. 0.33 nC 3. 3.3 C 4. 3.3 μC

26. A proton (mass = M) and a deuteron (mass = 2M) are sent into an electric field. The ratio of accelerations of the proton and deuteron is
1. 1 : 1 2. 1 : 2 3. 2 : 1 4. 4 : 1

27. Strength of the electric field in which an electron will experience a force equal to its weight is
1. $5.625\times10^{-11}\ N/C$ 2. $2\times10^{-12}\ N/C$
3. $4\times10^{-12}\ N/C$ 4. $4\times10^{-11}\ N/C$

28. Charges 20, 30, -40 and 50μC are at the corners of a square of 10 cm. The field at the point of intersection of the diagonals is
1. $360\sqrt{10}\times10^5\frac{N}{C}$ 2. $360\times10^5\frac{N}{C}$
3. $360\times10^6\frac{N}{C}$ 4. $36\sqrt{10}\times10^5\frac{N}{C}$

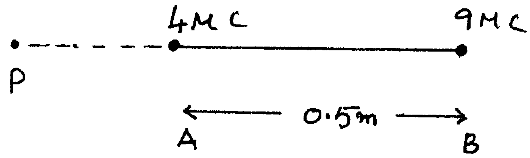
29. The vertices of an equilateral triangle lie on the circumference of a circle of radius 6 cm. Charges each of 3C are placed at the vertices. If a charge of 1C is placed at the centre of the circle, the force acting on it is
1. $0.75\times10^{13}N$ 2. $1.5\times10^{13}N$
3. $2.25\times10^{13}N$ 4. Zero

30. An infinite number of charges each equal to q are placed along the x-axis at x = 1, x = 2, x = 4, x = 8 meter .... The electric field at the point x = 0 due to this set of charges is
1. $\frac{Q}{4\pi\in_o}$ 2. $\frac{Q}{3\pi\in_o}$ 3. $\frac{Q}{2\pi\in_o}$ 4. $\frac{Q}{\pi\in_o}$

31. Two charged particles of masses m and 3 m have charges 3q and q respectively. They are kept in a uniform electric field and allowed to move for the same time. The ratio of their kinetic energies is
1. 1 : 9 2. 1 : 27 3. 9 : 1 4. 27 : 1

32. A pendulum bob of mass 30 mg carrying a charge of $2.0\times10^{-8}C$ is at rest in a uniform horizontal electric field of 20000 N/C. The tension in the thread of the pendulum is $\left(g=10\ m/s^2\right)$
1. $5\times10^{-4}N$ 2. $4\times10^{-4}N$
3. $3\times10^{-4}N$ 4. $2\times10^{-4}N$

33. Two point charges of magnitude 4 μC and -9 μC are 0.5m apart. The electric intensity is zero at a distance 'x' m from 'A' and 'y' m from 'B'. 'x' and 'y' are respectively



1. 0.5m, 1.0m 2. 1.0m, 1.5m
3. 2.0m, 1.5m 4. 1.5m, 2.0m

34. 'n' charges Q, 4Q, 9Q, 16Q ..... are placed at distances of 1, 2, 3 ..... metre from a point '0' on the same straight line. The electric intensity at '0' is

1. $\frac{Q}{4\pi\epsilon_0 n^2}$ 2. $\frac{Q}{4\pi\epsilon_0 n}$ 3. Infinity 4. $\frac{nQ}{4\pi\epsilon_0}$

35. If the electric field between the plates of a cathode ray oscilloscope be $1.2\times10^4 N/C$, the deflection that an electron will experience if it enters at right angles to the field with kinetic energy 2000 eV is (The deflection assembly is 1.5cm long.)

1. 0.34 cm 2. 3.4 cm
3. 0.034 mm 4. 0.34 mm

36. Charges of +10 μC each are placed at two opposite corners of a square of side $\sqrt{2}$ m and -10 μC each at the remaining 2 corners. The electric intensity at the centre of the square is

1. $90\times10^3 N/C$ 2. $180\times10^3 N/C$
3. Zero 4. $60\times10^3 N/C$

37. 'n' charges Q, -4Q, 9Q, -16Q are placed at distances of 1, 2, 3 ..... metres from a point 'O' on the same straight line. Then field at 'O' is

1. Zero 2. $\frac{Q}{4\pi\epsilon_0}$

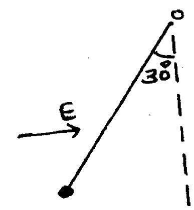
3. Zero (or) $\frac{Q}{4\pi\epsilon_0}$ according as 'n' is even (or) odd respectively

4. We cannot say

38. An electron moving along positive x axis with a speed of $3\times10^6 m/s$ enters the region of a uniform electric field. The electron stops after travelling a distance of 90mm in the field. The electric field strength is (charge on electron = $1.6\times10^{-19}C$, Mass of electron = $9.1\times10^{-31}kg$)

1. 2.84 $KV\ m^{-1}$, along -ve x-axis
2. 0.284 $KV\ m^{-1}$ along -ve x axis
3. 0.284 $KV\ m^{-1}$ alon +ve x axis
4. 28.4 $KV\ m^{-1}$ along +ve x axis

39. A small ball having charge 'q' is suspended from a weightless, inextensible string. It is placed in a region of uniform electric field $E = 3\times10^2 N/C$ as shown in figure. In equilibrium, the string is making an angle of 30^0 with the vertical. If the mass of the ball is $3\sqrt{3}$ g, the charge on it is $\left(g = 10ms^{-2}\right)$



1. $+\frac{\sqrt{3}}{2}\mu C$ 2. $-\frac{\sqrt{3}}{2}\mu C$ 3. $+100\mu C$ 4. $-100\mu C$

40. The mass of the sphere is $3.2\times10^{-14}kg$ and it carries a net charge equal to that of 10 electrons. If the electronic charge is $-1.6\times10^{-19}C$ and the acceleration of free fall is $10ms^{-2}$ the field required to keep the sphere stationary is

1) $5\times10^{-6}V/m$ 2) $5\times10^{-5}V/m$
3) $2\times10^{5}V/m$ 4) $2\times10^{-4}V/m$

41. A particle mass m and charge Q is placed at rest in a uniform electric field E and then released. The K. E. attained by the particle after moving distance Y is

1) QEY^2 2) QE^2Y 3) QEY 4) Q^2EY

42. There are n electrons of charge e in a drop of oil of density ρ. It is in equilibrium in an electric field E. Then the radius of drop is

1) $\left(\frac{2neE}{4\pi\rho g}\right)^{1/2}$ 2) $\left(\frac{neE}{\rho g}\right)^{1/2}$

3) $\left(\frac{3neE}{4\pi\rho g}\right)^{1/3}$ 4) $\left(\frac{2neE}{\pi\rho g}\right)^{1/3}$

43. The dielectric strength air is $3\times10^6 Vm^{-1}$. The maximum charge that can be given to a conducting sphere of radius 2m is

1) $1.33\times10^{-3}C$ 2) $2.66\times10^{-3}C$
3) $3\times10^{-3}C$ 4) infinite.

44. Two charges 10^{-8} and $-10^{-8}C$ are placed at two corners of an equilateral triangle of side 20cm. Electric intensity at the third corner is

1) $\sqrt{3}\times2250NC^{-1}$ 2) $\sqrt{2}\times2250NC^{-1}$
3) $450NC^{-1}$ 4) $2250NC^{-1}$

45. An electron is projected into an electric field of intensity $9\times10^{6}NC^{-1}$ in the direction of the field acting towards east. Its acceleration is
1) $1.6\times10^{18}ms^{-2}$ towards west
2) $1.6\times10^{18}ms^{-2}$ towards east
3) $9\times10^{18}ms^{-2}$ towards west
4) $9\times10^{18}ms^{-2}$ towards east

46. Two electric charges Q and $4Q$ are seperated by a certain distance. If the electric intensity at Q is E, the electric intensity at the other charge is
1) 4E 2) $E/4$ 3) $E/2$ 4) 2E

47. Point charges of $3\times10^{-9}C$ are situated at each of three corners of a square whose side is 15 cm. The magnitude and direction of elec tric field at the vacant corner of the square is
1) 2296 V/m along the diagonal
2) 9622 V/m along the diagonal
3) 22.0 V/m along the diagonal
4) zero.

48. Two point charges $-q$ and $+q/2$ are situated at the origin and at the point $(a,0,0)$ respectively. The point along the x-axis where the electric field vanishes is
1) $x=\frac{a}{\sqrt{2}}$ 2) $x=\sqrt{2}a$
3) $x=\frac{\sqrt{2}a}{\sqrt{2}-1}$ 4) $x=\frac{\sqrt{2}a}{\sqrt{2}+1}$

49. A electric field of $1.5\times10^{4}NC^{-1}$ exists between two parallel plates of length 2 cm. An electron enters the region between the plates at right angles to the field with a kinetic energy of $E_k=2000eV$. The deflection that the electron experiences at the deflecting plates is
1) 0.34 mm 2) 0.57 mm
3) 7.5 mm 4) 0.75 mm

50. Match the following :

a) Electric field outside a conducting charged sphere	e) Constant
b) Electric potential out side the conducting charged sphere	f) directly propor national to distance from centre
c) Electric field inside a non-conducting charged sphere	g) inversely propor tional to the distance
d) Electric potential in side a charged conducting sphere	h) inversely propor tional to the square of the distance

1) $a-h,\ b-g,\ c-e,\ d-f$
2) $a-e,\ b-f,\ c-h,\ d-g$
3) $a-h,\ b-g,\ c-f,\ d-e$
4) $a-g,\ b-h,\ c-f,\ d-e$

51. Assertion (A) The dielectric medium between the plates of a parallel plate capacitor lowers the potential difference between the plates without a battery.
Reason (R): The maximum electric field that a dielectric can with stand without causing it to break down is electric strength.
1) Both A and R are true, R is not correct explanation of A
2) Both A and R are true, R is correct explanation of A.
3) A is false, R is true 4) A is true, R is false

ELECTRIC POTENTIAL

52. A ball of mass 5 g and charge 10^{-7} C moves from point A whose potential is 500 V to a point B whose potential is zero. The velocity of the ball at the point B, if its velocity at the point A is zero, is
1. 0.1414 cms^{-1} 2.0.1414ms^{-1}
3.1.414 cms^{-1} 4.1. 414ms^{-1}

53. Two positive charges of $12\mu C$ and $8\mu C$ are respectively are separated by 10 cm apart in air. The work to be done to decrease the distance by 4 cm is
1. Zero 2. 3.8J 3. 4.8J 4. 5.76J

54. Two concentric, thin metallic spherical shells of radii R_1 and $R_2\left(R_1>R_2\right)$ bear charges Q_1 and Q_2 respectively. Then the potential at radius 'r' between R_1 and R_2 will be $\frac{1}{4\pi\epsilon_0}$ times
1. $\frac{Q_1+Q_2}{r}$ 2. $\frac{Q_1}{R_1}+\frac{Q_2}{r}$ 3. $\frac{Q_1}{R_1}+\frac{Q_2}{R_2}$ 4. $\frac{Q_1}{R_2}+\frac{Q_2}{R_2}$

55. The velocity of electrons accelerated by a potential difference of 1000 V is
1. $18.86\times10^{7}m/s$ 2. $0.1886\times10^{7}m/s$
3. $1.886\times10^{7}cm/s$ 4. $1.886\times10^{7}m/s$

56. An oil drop carrying charge 'Q' is held in equilibrium by a potential difference of 600V between the horizontal plates. In order to hold

another drop of twice the radius in equilibrium a potential drop of 1600V had to be maintained. The charge on the second drop is

1. $\frac{Q}{2}$ 2. 2Q 3. $\frac{3Q}{2}$ 4. 3Q

57. 1000 small water drops each of radius 'r' and charge 'q' coalesce to form one spherical drop. The potential of big drop is larger than that of smaller ones by a factor

1. 1000 2. 100 3. 10 4. 1

58. A charge of $6.25\mu C$ in an electric field is acted upon by a force $2.5N$. The potential gradient at this point is

1) $4\times10^{5}V/m$ 2) $4\times10^{6}V/m$

3) $2.5\times10^{-6}V/m$ 4) none

59. A cloud carries a charge of $1000C$ at a potential of 5 K.V. If the cloud discharge, the amount of energy released

1) $5\times10^{6}J$ 2) $2.5\times10^{6}J$

3) $10^{7}J$ 4) $5\times10^{3}J$

60. If the electric potential at a certain distance from a point charge is 900V and electric intensity is $225.Vm^{-1}$. The charge is

1) $4\times10^{-7}C$ 2) $2\times10^{-7}C$

3) $4\times10^{-3}C$ 4) $2\times10^{-5}C$

61. An electric cell does 5 joules of work in carrying 10 Coulomb's of charge around a closed circuit. The emf of the cell is

2) 2V 2) 0.5V 3) 4V 4) 1V

62. Four identical charges each of charge q are placed at the corners of a square. Then at the centre of the square the resultant electric intensity E and the net electric potential V are

1) $E\neq0, V=0$ 2) $E=0, V=0$

3) $E=0, V\neq0$ 4) $E\neq0, V\neq0$

63. Two positive charges q and q are placed at the diagonally opposite corners of a square and two negative charges $-q$ and $-q$ are placed at the other two corners of the square. Then at the centre of the square the resultant electric intensity E and the net electric potential V are

1) $E\neq0, V=0$ 2) $E=0, V=0$

3) $E=0, V\neq0$ 4) $E\neq0, V\neq0$

64. An infinite number of charges each equal to Q are placed along the $X-$ axis at $X=4, X=8$ and so on. The potential at the point $X=0$ due to net of charges is

1) $\frac{2Q}{4\pi\in_0}$ 2) $\frac{Q}{3\pi\in_0}$

3) $\frac{1}{4\pi\in_0}\frac{2}{3}Q$ 4) $\frac{1}{4\pi\in_0}\frac{Q}{3}$

65. Three charges each $20\mu C$ are placed at the corners of equilateral triangle of side of $0.4m$. The potential energy of the system is

1) $18\times10^{-6}J$ 2) $9J$

3) $9\times10^{-6}J$ 4) $27J$

66. Two charges $5\mu C$ and $4\mu C$ are seperated by a distance 20cm in air. Work to be done to decrease the distance to 10 cm is

1) $1.8J$ 2) $0.45J$ 3) $2.7J$ 4) $0.9J$

67. At the corners of an equilateral triangle of side 25cm charges $1\mu C$, $2\mu C$ and $3\mu C$ are placed. The electro static potential energy of the system is

1) $396\times10^{-3}J$ 2) $132\times10^{-3}J$

3) $396\times10^{3}J$ 4) $132\times10^{3}J$

68. A charge $-2\mu C$ at the origin, $-1\mu C$ at $+7cm$ and $1\mu C$ at $-7cm$ are placed on $X-$ axis. The mutual potential energy of the system is

1) $-0.51J$ 2) $-0.45J$

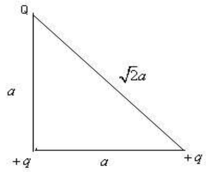
3) $0.45J$ 4) zero

69. At the four corners of a square of side 1 m four identical charges each $10^{-4}C$ are placed. The electric potential energy of the system is

1) 360 J 2) 180J

3) $180\left(2+\frac{1}{\sqrt{2}}\right)J$ 4) $360\sqrt{2}J$.

70 Three charges Q and q and $+q$ are placed a t the vertices of right angled isosceles trianlge as shown in the figure. The net electrostatic energy of the configuration is zero if Q is equal to



1) $\frac{-q}{1+\sqrt{2}}$ 2) $\frac{-\sqrt{2}\,q}{1+\sqrt{2}}$

3) $-2q$ 4) $+q$

71. Four equal charges Q are placed at the four corners of a square of side $'a'$ each. Work done in removing a charge $-Q$ from its centre to infinity is

1) zero 2) $\sqrt{2}Q^2/4\pi\epsilon_0 a$

3) $\sqrt{2}Q^2/\pi\epsilon_0 a$ 4) $Q^2/2\pi\epsilon_0 a$

72. An infinite number of charges each equal to q are placed along the $x-$axis at $x=1$, $x=2$, $x=4$, $x=8$ .... and so on. What is the potential and field respectively due to this set of charges at the origin.

1) $\frac{q}{3\pi\epsilon_0}$ and $\frac{q}{2\pi\epsilon_0}$ 2) $\frac{q}{2\pi\epsilon_0}$ a and $\frac{q}{3\pi\epsilon_0}$

3) $\frac{q}{4\pi\epsilon_0}$ and $\frac{q}{3\pi\epsilon_0}$ 4) $\frac{q}{2\pi\epsilon_0}$ and $\frac{q}{4\pi\epsilon_0}$

73. What will be respectively the potential and electric field in the above set up if the consecutive charges have opposite sign?

1) $\frac{q}{6\pi\epsilon_0}$ and $\frac{q}{5\pi\epsilon_0}$ 2) $\frac{q}{6\pi\epsilon_0}$ and $\frac{q}{4\pi\epsilon_0}$

3) $\frac{q}{5\pi\epsilon_0}$ and $\frac{q}{6\pi\epsilon_0}$ 4) $\frac{q}{4\pi\epsilon_0}$ and $\frac{q}{6\pi\epsilon_0}$

74. Assertion (A): Negative charges always move from a higher potential to lower potential point Reason (R): Electric potential is vector
1) A is true but R is false
2) R is true but A is false
3) Both A and R false
4) Both A and R are true

75. Assertion: (A) Work done by electric force is path independent.
Reason: (R) Electric force is consersation
1) A is correct, R is wrong
2) A is wrong, R is correct
3) A and R are correct, R is correct explanation of A
4) A and R are correct and R is not correct explanation of A.

76. Choose the wrong statement
a) Work done in moving a charge on equipotential surface is zero.
b) Electric lines of force are always normal to equipotential surface
c) When two like charges are brought nearer, then electrostatic potential energy of the system is decreased.
d) Electric lines of force diverge at positive charge and converge towards negative charge.
1) a 2) b 3) c 4) d

77. A charge is moved against repulsion. Then we are
A) decreasing its kinetic energy
B) increasing its potential energy
C) increasing both the energies
D) decreasing both the energies.
1) A, B, C, D are true 2) A, B, C are true
3) A, B are true 4) A only true

ELECTRIC CAPACITY

78. Two identical parallel plate capacitors are joined in series to $100V$ battery. Now a dielectric with $K=4$ is introduced between the plates of second capacitor. The potential difference on capacitors.
1) $60V, 40V$ 2) $70V, 30V$
3) $75V, 25V$ 4) $80V, 20V$

79. A parallel plate condenser has initially air medium between the plates. If a slab of dieletric constant 5 having thickness half the difference of seperation between the plates is introduced, the percentage in crease in its capacity is
1) 33.3% 2) 66.7% 3) 50% 4) 75%