Electric charges and field

Multiple choice –

1. Two conduction spheres of radii r_1 and r_2 have equal surface charge density. The ratio of their charges is:
   (a) (r_1^2/r_2^2) (b) (r_2^2/r_1^2) (c) (r_1/r_2) (d) (r_2/r_1) Ans-c
2. Two small identical sphere having charges +10μC attract each other with a force of F newton. If they are kept in contact and then separated by the same distance, the new force between them is:
   (a) F/6 (b) 16F (c) 16F/9 (d) 9F Ans-c
3. Three charges +4q, Q and q are placed in a straight line of length l at distance 0, (l/2) and l respectively. What should be Q in order to make the net force on q to be zero?
   (a) -q (b) -2q (c) -q/2 (d) 4q Ans-a
4. Three equal charges each +q are placed on the corners of an equilateral triangle of side a. Then the coulomb forced experienced by one charge due to the rest of the two is:
   (a) Kq^2/a^2 (b) $2Kq^2/a^2$ (c) $\sqrt{3}Kq^2/a^2$ (d) zero Ans-c
5. A charge q is placed at the mid-point of the line joining two equal charges Q. The system of three charges will be in equilibrium when q has the value:
   (a) Q/4 (b) Q/2 (c) -Q/4 (d) -Q/2 Ans-c
6. An electric dipole is placed in a non-uniform electric field. Then net:
   (a) force experienced is zero while torque is not zero
   (b) force experienced is zero and torque is also zero
   (c) both force and torque are not zero
   (d) force experienced is not zero while torque is zero Ans-c
7. The total electric flux leaving spherical surface of radius 1cm and surrounding an electric dipole is:
   (a) q/ε_0 (b) zero (c) $2q/\varepsilon_0$ (d) $8\pi r^2 q/\varepsilon_0$ Ans-b
8. Two particles of masses m and 2m with charge 2q and 2q are placed in a uniform electric field E and allowed to move for the same time. The ratio of their kinetic energies will be:
   (a) 2 : 1 (b) 8 : 1 (c) 4 : 1 (d) 1 : 4 Ans-a
9. Electric charges q , q, -2q are placed at the corners of an equilateral triangle ABC of side l. The magnitude of electric dipole moment of the system is:
   (a) ql (b) 2ql (c) $\sqrt{3}$ql (d) 4ql Ans-c
10. A particle of mass m and charge q is placed at rest in a uniform electric field E and then released. The KE attained by the particle after moving a distance y is:
    (a) qEy^2 (b) qE^2y (c) qEy (d) q^2Ey Ans-c
11. Eight dipoles of charges of magnitude e are placed inside a cube. The total electric flux coming out of the cube will be:
    (a) $8e/\varepsilon_0$ (b) $16e/\varepsilon_0$ (c) e/ε_0 (d) zero Ans-d
12. A charge Q is placed at each of the two opposite corners of a square. A charge q is placed at each of the two other opposite corners of the square. If the resultant electric force field on Q is zero, then how Q and q are related?
    (a) $Q = -q/2\sqrt{2}$ (b) $Q = -2\sqrt{2}q$ (c) $Q = -2q$ (d) $Q = 2\sqrt{2}q$ Ans-b

13. A uniform vertical electric field E is established in the space between two large parallel plates. A small conduction sphere of mass m is suspended in the field from a string of length L. If the sphere is given a + q charge and the lower plate is charged positively, the period of oscillation of this pendulum is:

(a) $2\pi\sqrt{L/g}$ (b) $2\pi\sqrt{L/g + (qE/m)}$ (c) $2\pi\sqrt{L/g - (qE/m)}$ (d) $2\pi\sqrt{L/[g^2 + (qE/m)^2]^{1/2}}$ Ans-c

14. The ratio of electric fields on the axis and at equator of an electric dipole will be:

(a) 1 : 1 (b) 2 : 1 (c) 4 : 1 (d) 1 : 4 Ans-b

15. Two point charges exert on each other a force F when they are placed r distance apart in air. When they are placed R distance apart in a medium of dielectric constant K, they exert the same force. The distance R equals:

(a) $r/\sqrt{K}$ (b) r/K (c) rK (d) $r\sqrt{K}$ Ans-a

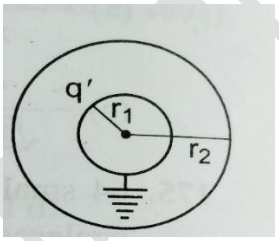
16. Electric field intensity at a point in between two parallel sheets with like charges of same surface charge densities (σ) is:

(a) zero (b) σ/ε_0 (c) $\sigma/2\varepsilon_0$ (d) $2\sigma/\varepsilon_0$ Ans-a

17. A charged q is located at the centre of a cube the electric flux through any face is:

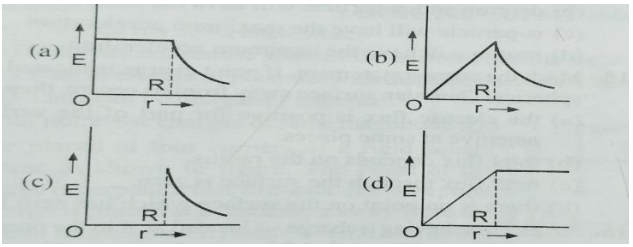
(a) $4\pi q/6(4\pi\varepsilon_0)$ (b) $\pi q/6(4\pi\varepsilon_0)$ (c) $q/6(4\pi\varepsilon_0)$ (d) $2\pi q/6(4\pi\varepsilon_0)$ Ans-a

18. The concentric sphere are of radii r_1 and r_2. The outer sphere is given a charge q. The charge q' on the inner sphere will be (inner sphere is grounded):



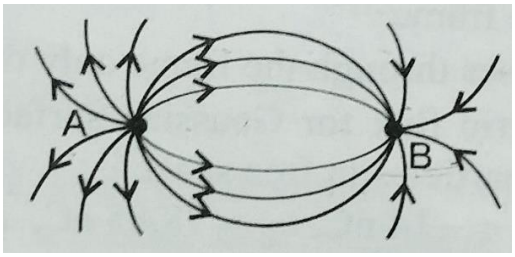
(a) q (b) -q (c) $-q\ r_1/r_2$ (d) zero Ans-c

19. The electric field due to a uniformly charged non-conduction sphere of radius R as a function of the distance from its centre is represented graphically by:



Ans-b

20. The spatial distribution of the electric field due to two charges (A and B) is shown in figure. Which one of the following statements is correct?



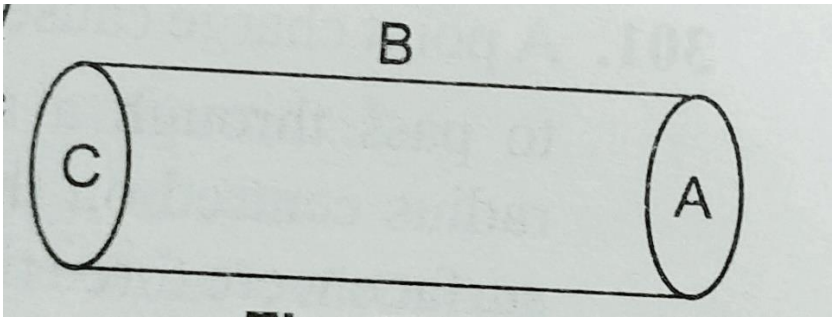
(a) A is + ve and B is – ve and $|A| > |B|$

(b) A is - ve and B is + ve and $|A| = |B|$

(c) Both are + ve but A > B.

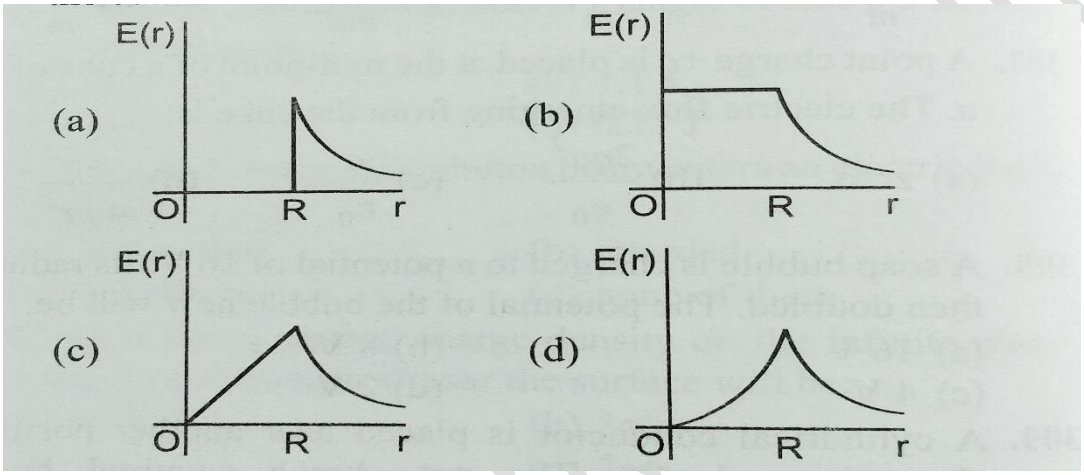
(d) Both are - ve but A > B. Ans-a

21. A hollow cylinder has a charge q coulomb within it. If ϕ is the electric flux in units of V-m associated with the curved surface B, the flux linked with the plane surface A in unit of V-m will be:



(a) $q/2\varepsilon_0$ (b) $\phi/3$ (c) $q/\varepsilon_0 - \phi$ (d) $1/2(q/\varepsilon_0 - \phi)$ Ans-d

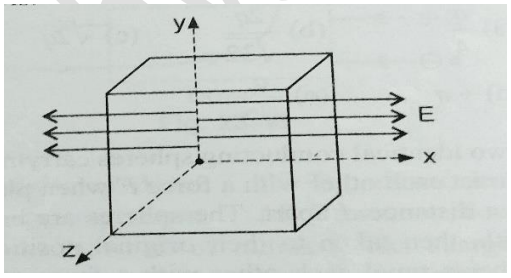
22. A thin spherical shell of radius R has charge Q spread uniformly over its surface. Which of the following graphs most closely represents the electric field E (r) produced by the shell in the range $0 \le r < \infty$, where r is the distance from the centre of the shell?



Ans-a

23. Eight charges, each of magnitude q are placed at the vertices of a cube due to this system of charges is:
(ε_0 is permittivity of vacuum and a is length of each side of the cube)
(a) $2q/\pi\varepsilon_0 a$ (b) $4q/\sqrt{3}\pi\varepsilon_0 a$ (c) zero (d) $\sqrt{3}q/\pi\varepsilon_0 a$ Ans-b

24. Electric field at x = 10 cm is 100 V/m and at x = -10 cm is -100 V/m. The magnitude of charge enclosed by the cube of side 20 m is: (figure)



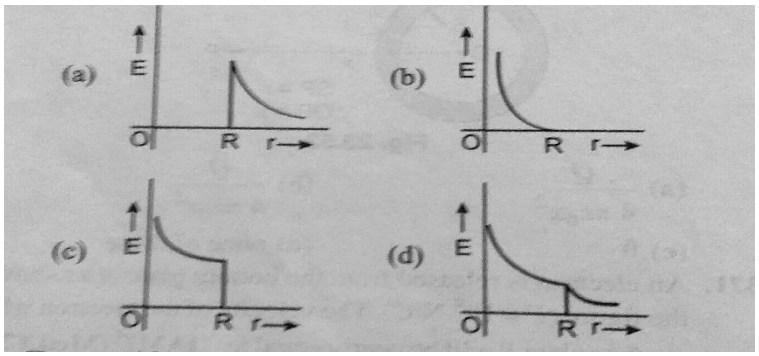
(a) $8\ \varepsilon_0$ (b) $2\ \varepsilon_0$ (c) $3\ \varepsilon_0$ (d) $5\ \varepsilon_0$ Ans-a

25. Let $P(r) = Q/\pi R^4\ r$ 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) zero (b) $Q/4\pi\varepsilon_0 r_1^2$ (c) $Q\ r_1^2/4\pi\varepsilon_0 R^4$ (d) $Q\ r_1^2/3\pi\varepsilon_0 R^4$ Ans-c

26. An infinitely long thin straight wire has uniform linear charge density of $1/3 cm^{-1}$. Then, the magnitude of the electric intensity at a point 18 cm away is:
(Given $\varepsilon_0 = 8.8 \times 10^{-12} C^2 N m^{-2}$)

(a) 0.33×10^{11} NC^{-1} (b) 3×10^{11} NC^{-1} (c) 0.66×10^{11} NC^{-1} (d) 1.32×10^{11} NC^{-1} Ans-a

27. A metallic spherical shell of radius R has a charge -Q on it. A point charge + Q is placed at the centre of the shell. Which of the graphs shown below may correctly represent the variation of the electric field E with distance r from the centre of the shell?



Ans-b

28. Two parallel metal plates having charges + Q and -Q face each other at a certain distance between them. If the plates are now dipped in kerosene oil tank, the electric field between the plates will:

(a) become zero (b) increase (c) decrease (d) remain same Ans-c

29. A dipole of electric dipole moment p is placed in a uniform electric field of strength E. If Θ is the angle between positive directions of p and E, then the potential energy of the electric dipole is largest when Θ is:

(a) π/4 (b) π/2 (c) π (d) zero (e) 2/3π Ans-c

30. If $q_1 + q_2 = q$, then the value of the ratio q_1/q_2 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 Ans-d

Fill in the blanks-

1. The expression $q = ne$ is due to_____of electriccharge.

Ans. Quantisation

2. A silk cloth rubbed with a glass rod has a charge $(q = -1.6 \times 10^{-19}\, C)$, then the charge on the Glass rod will be_____C.

Ans. $(+1.6 \times 10^{-19})$

3. A charge Q is enclosed by a Gaussian spherical surface of radius R. If the radius is doubled, then the electric...._____will remain same.

Ans. Flux

4. An electricdipoleis placed inside uniformelectric field.Whenitis rotated from unstable equilibrium to stable equilibrium in a uniform electric field, its potential energy _____.

Ans. Decreases

5. S.I. Unit of electricfield is_____.

Ans. (N/C)

6. Two point charges are separated bysomedistanceinsidevacuum.Whenspacebetweenthe chargesisfilled bysomedielectric,theforcebetweentwo pointcharges_____?

Ans. Decreases

7. Net electrostatic field inside apositivelycharged conductor is_____.

Ans. Zero

8. Electric flux is a_____quantity.

Ans. Scalar

9. Two pointy charges, one Coulomb each are separated by vacuum and placed 1 meter apart from each other. The force acting between them is_____.

Ans. $(9\times10^9\ N)$

10. Electric field lines never_____each other

Ans. Intersect

11. Net electric flux from a closed surface does not depends upon distribution of_____ inside the surface.

Ans. Charges

12. Direction of electric field intensity due to a dipole on equatorial point is_____to the direction of dipole moment.

Ans. Opposite

13. The unit of electric flux is_____volt × meter.

Ans. Electric flux

14. Net charge within an isolated system always remains constant. It is called as law of _____of charge.

Ans. Conservation

15. Net Electric field inside the charged spherical shell is_____.

Ans. Zero

16. Electric force acting between two charges also depends upon the _____between them.

Ans. Medium

17. An electric dipole is placed inside uniform electric field. Net_____on it is always zero.

Ans. Force

18. Two unequalcharges exerts_____magnitude force on each other.

Ans. Equal

19. Electricdipolemomentisa_____quantity.

Ans. Vector

20. A sphere of radius 100 cm has a charge of $(2\pi/3)\mu C$. Its surface density of charge is _____.

Ans. $1.67\times10^{-7}\ C/m^2$ **(**$\sigma = \frac{Q}{4\pi R^2} = \frac{(2\pi/3)\times10^{-6}}{4\pi\times(1)^2} = 1.67\times10^{-7}\ C/m^2$ **)**

21. A proton and an alpha particle enter into a region of uniform electricfield.The ratio of the forceon the proton to that on the alpha particle is_____.

Ans. 1 : 2 ($\frac{F_p}{F\alpha} = \frac{eE}{(2e)E} = 1:2$**)**

22. Two equal and opposite charges of magnitude $0.2\times10^{-6}\ C$ are 15 cm apart, the magnitude and direction of the resultant electric intensity E at a point midway between the charge is _____.

Ans. $6.4\times10^5\ N/C$**, towards the –vecharge**

Very short answer type questions (1 marks)-

1.Define dipole moment of an electric dipole. Is it a scaler or vector quantity?

2.Draw a plot showing the variation of electric field (E) with distance r due to a point charge Q.

3.Why do electric field line not form a closed loop?

4.Why most electric field be normal to the surface at every point of a charged conductor?

5.In which orientation a dipole placed in a uniform electric field is (1) in stable (2) in unstable equilibrium and (3) also write the condition when torque experienced by the dipole is maximum and minimum.
6.Plot a graph showing the variation of coulombs force ''F'' vs $1/r^2$ where r is the distance.
7.An electric field line can't be discontinuous , why?
8.Sketch electric line of force for two point charges q1 and q2 for q1=q2 , for q1>q2, separated by distance d .
9.define dielectric constant of a medium . what is its SI unit ?
10. Distinguish between a dielectric and a conductor .
11. A charge Q is placed at the centre of a cube of side l , what is the electric flux passing through each face of the cube ?
12. Define electric flux. Write its unit and dimension .
13. A metallic sphere is placed in uniform electric field as shown in figure. Which path is followed by electric field line ,why?

14. If the radius of the of the enclosing surface is halved , how does the electric flux through Gaussion surface change?
15.A charge Q is placed at the centre of a cube. What would be the flux through one face?
16. An arbitrary surface encloses a dipole, what is the electric flux through the surface?

Short answer type questions (2 marks)-

1. Two insulated charged copper sphere a and b of identical size have charges q_A and q_B respectively. A third sphere c of the same size but uncharged is brought in contact with the first then with second and finally removed from both . what are the new charges on A and B? Also find the ratio of force in these cases.

2.Two charges q and -3q are placed fixed on x-axis separated by distance d where should the third charge 2q be placed such that it will not experience any force.

3. A thin infinitely straight long conducting wire having charge density λ is enclosed by a cylindrical surface of radios r and length l , its axis coinciding with the length of the wire . Find the expression for the electric flux through the of the cylinder.

4. Show that the electric field at the surface of a charged conductor is given by $E= \sigma/\epsilon_0$, where σ is the surface charge density.

5. Using Gauss,s law derive an expression for the electric field between two uniformly charged parallel sheets of charge density σ and -σ respectively

6.Auniform electric field $E=E_x i^{\wedge}$ N/C for x>0,and $E=-EI^{\wedge}$ N/C for x<0 are given.A right circular cylinder of length l cm and radius r cm has its centre at the origin and its axis along the X-axis , find out the net outward flux . Using Gauss's law write the expression for the net charge within the cylinder.

7. Two charged conducting sphere of radii r1 and r2 connected to each other by a wire ,find the ratio of electric field at the surface of two spheres .

8. Deduce the expression for the electric field E due to a system of two charges q_1 and q_2 with position vector r_1 and r_2 at a point r with respect to common origin.

9. two charges +q and-q are kept at $(-X_1,0)$ and $(X_2,0)$respectively in the X-Y plane find the magnitude and direction of the net electric field at the origin (0,0).

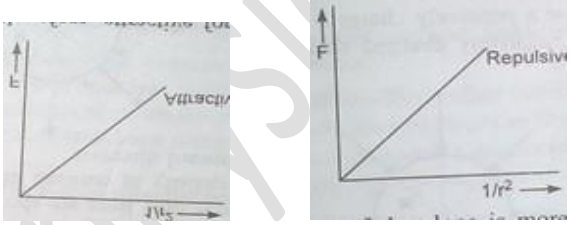
10. A positive point charge +q is kept in the vicinity of an uncharged conducting plate , sketch electric field lines origination from the point on the surface of the plate .

11.Define dielectric constant for a medium , what is the value of dielectric constant for a metal?

12.Define electric field intensity . write its SI unit . write the magnitude and direction of electric field intensity due to an electric dipole of length 2a at the mid- point of the line joining the two charges .

13. An electric dipole is free to move in uniform electric field . explain its motion when it is placed (1)parallel to electric field (2) perpendicular to electric field.

14. The two graphs shown , show that the variation of electric force (F) with $1/r^2$ (r is the distance between two charged particle) for two charged particle q1 and q2 . what is the sign of two charges in both cases



15.. A charge q is placed at the center of the line joining two equal charges Q. Show that the system of three charges will be in the equilibrium if $q = -\frac{Q}{4}$.

16. Two charges q and -3q are placed fixed at x-axis separated by the distance d. Where should a third charge 2q be placed such that it will not experience any force?

17. Two small identical electrical dipoles AB and CD, each of dipole moment 'p' are kept at an angle of 120° as shown in the figure. What is the resultant dipole moment of this combination? If this system is subjected to electric field ($\underset{E}{\rightarrow}$) directed along + X direction, what will the magnitude and direction of the torque acting on this?

18. Define electric dipole moment. Is it a scaler or a vector quantity? What are its SI unit?

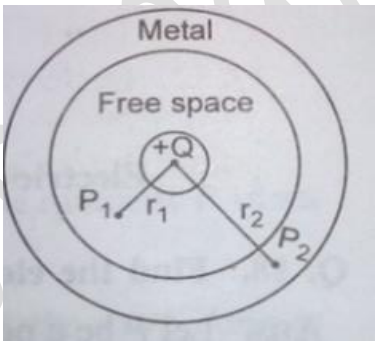
19. The force between two point charges kept at it distance r apart in air is F. If the same charges are in water at the same distance, how does the force between them change?

20. What is electrostatic shielding? How is this property use in actual practice? Is the potential in the cavity of charts conduct zero?

Long answer type questions (3 and 5 marks)-

1. State Gauss's law . Using this law derive an expression for the electric field due to a (1) uniformly charged infinite charged plane sheet, (2) charged spherical shell, (3) infinite long charged wire of linear charge density λ.

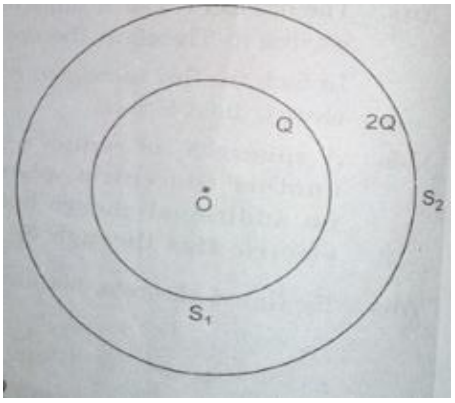
2. A small metal sphere carrying charge +Q is located at the centre of a spherical cavity in a large uncharged metal sphere as shown in fig . Use Gauss's theorem to find electric field at points p1 , p2.



Also draw the pattern of electric field lines in this arrangement.

3. Two small identical electrical dipole AB and CD , each of dipole moment 'P' are kept at an angle of 120^o , what is the resultant dipole moment of this combination ? If the system is subjected to electric field (E) directed along +X direction , what will be the magnitude and direction of the torque acting on it?

4. S1 and s2 are two hollow concentric spheres enclosing charges Q and 2Q respectively as shown in fig. (1) what is the ratio of electric flux through s1 and s2 . (2) How will the electric flux through s1 chenges if a medium of dielectric constant 5 is introduced in the space inside s1 in place of air.



5. A spherical conducting 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 .(a) what is the surface charge density on the(1)inner surface(2) outer surface of the shell? (b) write expression for the electric field at a point $x>r_2$ from the centre of the shell.

6. A dipole with its charge -q and +q located at the point (0,-b,0) and (0,+b,0)is present in the uniform electric field E . The equipotential surfaces of this field are planes parallel to the YZ planes . (1) what is the direction if the electric field E . (2)How much torque would the dipole experience in this field?

7. Define the term electric dipole moment . is it a scaler or vector? Deduce an expression for the electric field at the point on the (i) equatorial and (ii)axial line , of the dipole of length 2a.

8. An early model of an atom considered it two have a positively charged point nucleus of charge +Ze surrounded by a uniform density of negative charge up to a radius R . The atom as a whole is neutral . For this model , what is the electric field at a distance r from the nucleus when (i) r<R (ii) r = R and (iii) r> R ? use Gauss's theorem .

9. A particle of mass m and charge -q enters the region between the two charged plates initially moving along X -axis with speed V_x . the length of the plate is L and uniform electric field E is maintained between the plates . then find the expression for the vertical deflection when particle just come out of the plates.

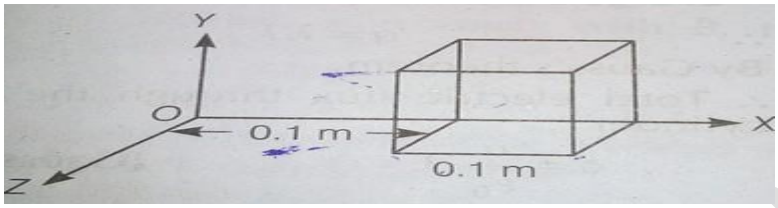
Numericals-

1. (i)Two point charges 4Q and Q are separated by 1m in air at what point on the line joining the two charges the electric field intensity is zero. (ii) Two identical metallic sphere A and B having charges +4Q and -10Q are kept at a certain distance apart . A third identical uncharged sphere C is first placed in contact with sphere A and then with sphere B . Spheres A and B are then brought in contact and then separated . Find the charges on the sphere A and B .

2.Calculate the amount of work done in turning an electric dipole of dipole moment $3x10^8$ C-m from its position of unstable equilibrium to stable equilibrium, in a uniform electric field of intensity 10^3N/c.

3.The sum of two point charges is 7μc they repel each other with a force of 1N when kept 30 cm apart in free space , calculate the value of each charge.

4.(1)Define electric flux , write its SI unit . (2)The electric field components due to a charge inside the cube of side 0.1m are shown below $E_x=\alpha x$, where α =500N/C-m $E_Y=0, E_Z=0$



Calculate (a) The flux through the cube (b)the charge inside the cube

5. A uniformly charged conducting sphere of 2.5 m in diameter has a surface charge density of 100μC/m^2 . Calculate the (a) charge on the surface and (b)Total electric flux through the surface.

6. Two large, thin metal plates are parallel and close to each other. On their inner faces, the plates have surface charges densities of opposite signs and of magnitude 17.0 x 10^{-22} C/m^2. What is electric field strength E: (a) in the outer region of the first plate, (b) in the outer region of the second plate, and (c) between the plates?

7. (a) Two insulated charged copper spheres A and B have their centres separated by a distance of 50 cm. What is the mutual force of electrostatic repulsion if the charge on each is 6.5 x 10^{-7} C? The radii of A and B are negligible compared to the distance of separation.

(b) What is the force of repulsion if each sphere is charged double the above amount, and the distance between them is halved?

8. A spherical conductor of radius 12 cm has a charge of 1.6 x 10^{-7} C distributed uniformly on its surface . What is the electric field (a) inside the sphere (b) on the surface of the sphere and (c) at a point 18 cm from the centre of the sphere ?

9. Find the ratio of gravitational and electrostatics force when electrons and protons are kept at some distance ‘d’ apart .

10. A tiny particle of mass 10μg is kept over a large horizontal sheet of charge density 4 x 10^{-6} C /m . What charge should be given to the particle so that if released it doesn’t fall down ?

Hots –

1. Two protons placed in vacuum, a certain distance apart exert a force F on each other. What will be the force between two alpha particles placed at same distance? Calculate the ratio of accelerations produced by the corresponding forces in proton and alpha particle.

2. An α-particle placed a certain distance apart from another α-particle experiences a Coulambic repulsion producing an acceleration of X m/s^2. If the particle is replaced by a proton, what will be the acceleration produced in it.

3. Calculate the total number of electric filed lines starting from a proton.

4. Describe a method to distinguish between a conductor and an insulator.

Ans: Hold the material in your hand and rub it with cat-skin. If the material is found to acquire charge (tested by a gold leaf electroscope); it is an insulator. If the material does not effect the leaves of gold leaf electroscope, it is a conductor because the frictional electricity developed in the material is passed on the earth through our body.

5. A charge q when placed at the mid point of the line joining two equal charges of magnitude Q each brings the system in equilibrium. Obtain a relation between q and Q.

6. Two conductors A and B carry equal amount of charge. If the two are interconnected by a copper wire, will there be any transfer of electric charge between them. If yes, state the parameter which governs the direction of flow of charge.

Ans: The charge may flow between the bodies even if they carry equal initial charges. The direction of flow of charge is governed by their potentials. The positive charge flows from the conductor having higher value of electrostatic potential to the conductor at lower potential.

7. Two point charges q_1 and q_2 are placed a distance 'r' apart. Represent graphically the variation of force F on q_2 with (i) magnitude of q_2 (ii) distance r from q_1 (iii) $1/r^2$.

8. Two identical metal plates shown carry equal charge. Will the charge density have equal values at P_1 and P_2? Justify your answer.

9. Given $V = x^2y + yz$ Calculate (i) X - component of electric field at point (1, 3, 1). (ii) Magnitude of E at (1, 3, 1).

10. Show that an electrostatic field with configuration as shown is not possible.

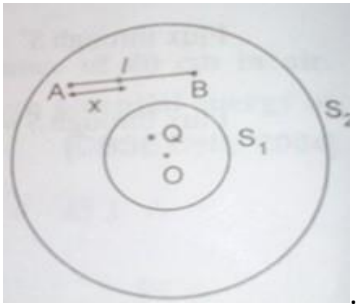
16. Two point charges q_1 and q_2 are placed as shown. Represents graphically the variation of(a) X-component of F_{21} v/s Θ (b) X-component of F_{21} v/s sin Θ as Θ changes from 0 to 90°.

11. A charged spherical shell carries a charge 'q' and has a radius R. The variation of electric filed and potential due to the charged shell with distance 'r' from the centre, were plotted taking r along X-axis and E or V along Y-axis.

12. A uniformly charged rod with linear charge density λ Cm^{-1} of length 'l' is inserted in the cube with constant velocity 'v' and moves out of the opposite face. Represent graphically the variation of electric flux through the cube with time.

13. Draw the above graph if the length of the rod is 2l. What is the maximum flux through the cube?

14. In the fig. shown , calculate the total flux of the electrostatic field through the spheres S1 and S2 . The wire shown here has a linier charge density λ given by λ=kx where x is the distance measured along the wire , from the end A



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15. A spherical conducting shell of inner radius r_1 and other radius r_2 has a charge 'Q'. A charge 'q' is placed at the centre of the shell.(a) What is the surface charge density on the (i) inner surface (ii) outer surface of the shell?(b) Wright expression for the electric field at a point $x > r_2$ from the center of the shell.

16. A thin metallic spherical shell of radius R carries a charge Q on its surface. A point charge $\frac{Q}{2}$ is placed at the center C and another charge +2Q is placed outside the shell at A at a distance x from the centre as shown in the figure.(i) Find electric flux through the shell.(ii) State the law used.(iii) Find the force on the charges at the centre C of the shell and at the point A.

17. (a) A point charges (+Q) is kept in the vicinity of uncharged conducting plate. Sketch electric field lines between the charge and the plate.(b) Two infinitely large plane thin parallel sheets having surface charge density σ_1 and σ_2 ($\sigma_1 > \sigma_2$) are shown in the figure. Write the magnitudes and direction of the net fields in the regions marked II and III.

18. It is now believed that protons and neutrons are themselves built out of more elementary units called quarks . A proton and neutron consists of three quarks each . Two types of quarks , the so called 'up' quark (denoted by u) of charge +2e/3 , and the 'down' quark (denoted by d) of charge -1e/3 , together with electrons build up ordinary matter . Suggest a possible quark composition of a proton and a neutron .