Electric Fields

01. The electric potential at 0.1 m from a point charge is 50 V. What is the magnitude of the charge ?

02. If 100 joule of work must be done to move electric charge equal to 4 C from a place where potential is -10 V to another place where potential is V volt, find the value of V.

03. The electric field at a point due to a point charge is 20 NC^{-1} and the electric potential at that point is 10 JC^{-1}. Calculate the distance of the point from the charge and the magnitude of the charge.

04. Calculate the potential at the centre of square ABCD of each side $\sqrt{2}$ m due to charges 2, -2, -3 and 6 μC at four corners of it.

05. Calculate the voltage needed to balance an oil drop carrying 10 electrons, when located between the plates of a capacitor, which are 5 mm apart. Given mass of the drop = 3×10^{-16} kg, charge = 1.6×10^{-19} C, g = 9.8 m/s^2.

06. The electric potential V(x) in a region along the x-axis varies with distance x (in metre) according to the relation $V(x) = 4x^2$. Calculate the force experienced by a 1 μC charge placed at point x = 1 m.

07. A point charge of 8 mC is located at the origin. Calculate the work done in taking a small charge of -2×10^{-9} C from a point A(0, 0, 3 cm) to point B(0, 4 cm, 0) via a point C(0, 6 cm, 9 cm).

08. A regular hexagon of side 10 cm has a charge 5 μC at each of its vertices. Calculate the potential at the centre of the hexagon.

09. Calculate the kinetic energy acquired by an alpha particle accelerated through a potential difference of one million volt ?

10. The radius of the first orbit of hydrogen atom is 5.29×10^{-11} m. What is the potential energy of the electron-proton system of the hydrogen atom ?

11. Two charges 3×10^{-8} C and -2×10^{-8} C are located at 15 cm apart. At what point of the line joining the two charges is the electrical potential zero ? Take the potential at infinity to be zero.

12. At a point due to a point charge, the values of electric field intensity and potential are 32 NC^{-1} and 16 JC^{-1} respectively. Calculate the magnitude of charge and distance of the charge from the point of observation.

13. An electron is circulating around the nucleus of a hydrogen atom in a circular orbit of radius 5.3×10^{-11} m. Calculate (a) the electric potential at the radius (b) the electric potential energy of the atom in eV. What would be the electric potential due to a helium nucleus at the same radius. $e=1.6 \times 10^{-19}$ C.

14. 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. (a) Find the potential at the point $x=0$, due to this set of charges. (*b*) What will be the potential, if in the above set up the consecutive charges have opposite sign ?

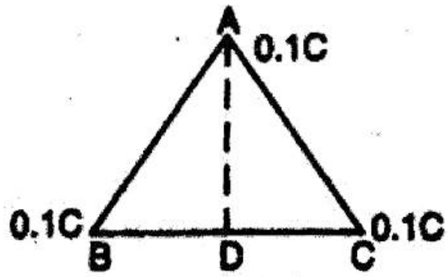


Fig. 1.3.59

15. An electric dipole of length 2 cm is placed with its axis making an angle of 30° to a uniform electric field of 10^5 NC^{-1}. If it experiences a torque of $10\sqrt{3}$ Nm, calculate (i) the magnitude of the charge on the dipole and the potential energy of the dipole.

16. An infinite thin plane sheet of charge density 10^{-8} C m^{-2} is held in air. How far apart are two equipotential surface whose potential differ by 5.0 V.?

17. Two point charges A and B of values +15 μC and +9 μC are kept 18 cm apart in air. Calculate the work done when the charge B is moved by 3 cm towards A.

18. Three charges of +0.1 C each are placed at the comers of an equilateral triangle as shown in Fig. 1.3.59. If the energy is supplied at the rate of 1 KW, how many days would be required to move this charge at A to a point D which is the mid point of the line BC?

19. A charge of 8 mC is located at the origin. Calculate the work done in taking a small change of -2×10^{-9} C from a point A(0, 0, 0.03 m) to a point B(0, 0.04 m, 0) via a point C(0, .06 m, 0.09 m).

20. Two isolated metallic solid spheres of radii R and 2R are charged such that both of these have same charge density σ. The spheres are located far away from each other. What is the new charge density on the bigger sphere when the given spheres are connected by a thin conducting wire.?

21. Calculate the capacitance of earth assuming it to be a spherical conductor of radius 6400 km.

22. A metal sphere of radius of 1 cm cannot hold a charge of 1 coulomb. Why ?

23. A parallel plate capacitor has two plates of sides 0.055 m and 0.04 m. Their distance apart is 0.7 mm. The dielectric constant of the medium in between is 4. Find the capacity of the capacitor.

24. Two parallel plate air capacitors have their plate areas 100 and 500 cm^2 respectively. If they have the same charge and potential and the distance between the plates of the first capacitor is 0.5 mm, what is the distance between the plates of the second capacitor ?

25. A parallel plate capacitor is made of 101 plates separated by par affined paper 0.001 cm thick of relative permittivity 2.5. The effective size of each plate is 15 x 30 cm. What is the capacitance of this capacitor ?

26. Three capacitors of capacitance 1 μF, 2μF and 3μF are connected in series and a p.d. of 220 V is applied to the combination. Calculate the potential difference across each capacitor.

27. Three capacitors each of 0.003 μF capacitance are connected together in series and are also connected in series with three other similar capacitors which are grouped together in parallel. [See Fig. 1.4.53] Calculate the total capacitance.

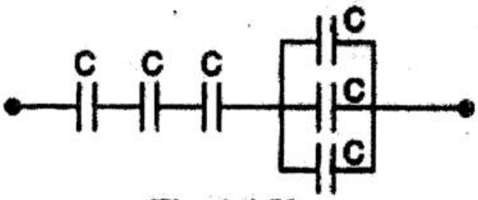


Fig. 1.4.53

28. The effective capacitance of two capacitors C1 and C2 when connected in series is 3.73 μF and 15 μF when connected in parallel. Calculate their individual capacitance.

29. A 5 μF capacitor is charged by a 220 V supply. It is then disconnected from the supply and is connected to another uncharged 2.5 μF capacitor. How much electrostatic energy of the first capacitor is lost in the form of heat and electromagnetic radiation ?

30. A parallel plate capacitor is to be designed with a voltage rating 1 kV, using a material of dielectric constant 3 and dielectric strength about 10^7 V/m. For safety we should like the field never to exceed say 10% of the dielectric strength. What minimum area of the plate is required to have a capacitance of 50 pF ?

31. Three capacitors of capacitances 1 μF, 2μF and 3 μF are connected in parallel to a 100 V battery. Calculate the total energy stored in the capacitor.

32. A parallel plate capacitor has two plates 10 cm x 7 cm separated by a glass plate 0.7 mm thick of dielectric constant 6. Find (i) the capacity of the capacitor (ii) the energy stored if a potential of 200V is applied, and (iii) the energy density of the medium.

33. A capacitor is charged through a potential difference of 200V, when 0.1 C charge is stored in it. How much energy will it release, when it is discharged ?

34. What should be the capacitance of a capacitor capable of storing one joule of energy when used with 100V d.c. supply ?

35. Two identical plates are given charges q_1, and $q_2 < q_1$ respectively. If they are now brought close together to form a parallel plate capacitor with capacitance C, what will be the potential difference between the plates ?

36. Four similar metal plates of area A each are placed parallel to each other such that the distance between the consecutive plates is d, as shown in Fig. 1.4.54 (a). The two outer plates are connected to the point A and the two inner plates to the point B. Calculate the equivalent capacitance between A and B.

37.

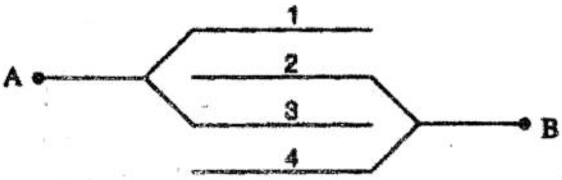


Fig. 1.4.54 (a)

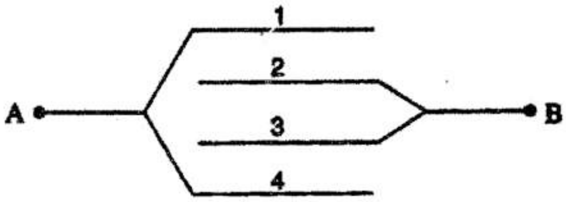


Fig. 1.4.54 (b)

38. If the same metal plates in the above question (number 17) are connected as shown in Fig. 1.4.54 (b) then what is the equivalent capacitance between the two points A and B.

39. The space between the plates of a parallel plate capacitor is filled with two dielectrics (K1 and K2) as shown in Fig. (a) and Fig. (b). What is the capacitance of the capacitor in each case?

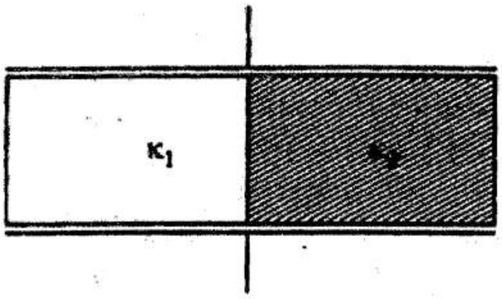


Fig. (a)

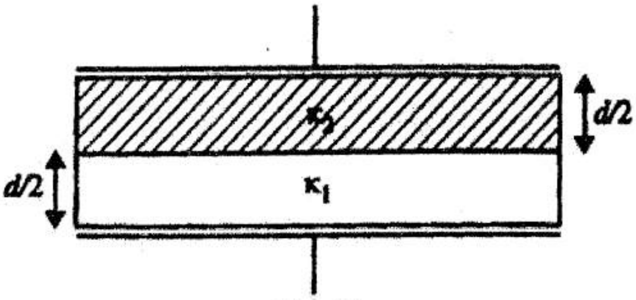


Fig. (b)

40. A parallel plate capacitor is constructed using three different dielectric materials as shown in Fig. (c). The parallel plates across which a potential difference is applied are of area A and are separated by a distance d. Find the capacitance' across A and B.

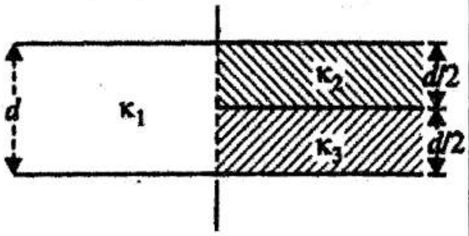


Fig. (c)

41. A capacitor is made of a flat plate of area A and a second plate having a stair-like structure as shown is Fig. (d). If the width of each stair is $A/3$ and the height is d, find the capacitance of the arrangement.

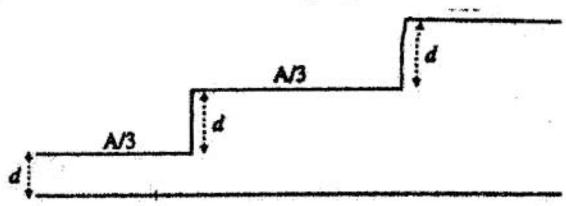


Fig. (d)

42. A parallel plate capacitor of area A, plate separation d and capacitance C is filled with different dielectric materials having dielectric constants K_1, K_2 and i as shown in Fig. *(i)*. If a single dielectric material K is to be used to have the same capacitance C in this capacitor, then what is the value of K ?

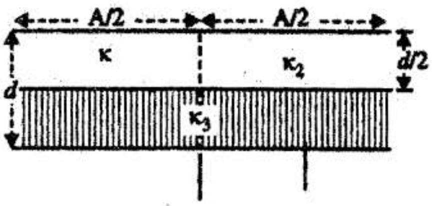


Fig. (i)

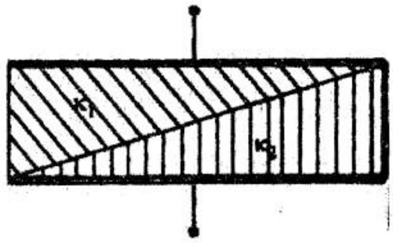


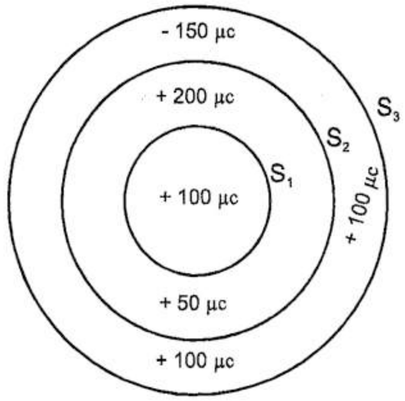
Fig. (ii)

43. The capacitance of a parallel pate capacitor with plate area A and separation d is C. The sp between the plates is filled with two wedges of dielectric constants k_1 and k_2 respectively, fii the capcitance of the resulting capacitor. [See Fig.*[ii]*

Gauss Theorem

01. A circular plate of radius 8cm is placed at an angle 30° to an electric field of intensity 600 NC^{-1}. Find the electric flux?

02.



Find the electric flux through

1) S_1 2) S_2 3) S_3

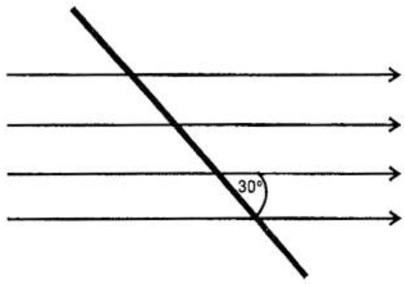
4) For the electric flux of S_1 and S_2 to be equal the charge which should be

a) Inside S_1 b) Between S_1 & S_2

5) If the flux S_1 should be double than S_2 the charge in

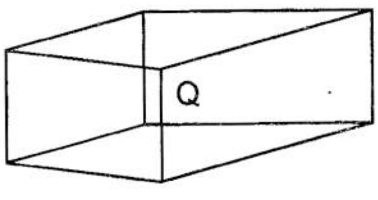
a) Surface S_1 b) Between S_1 & S_2

03.



A plate of dimensions 4 x6 cm^2 placed in an electric field 600 NC^{-1}. Find the electric flux.

04. A Charge is placed at the centre of a tube what is the



1) Total electric flux
2) Electric flux through surface

05. The line charge density on a long conductor is show that the each field straight at a distance at is

$$E = \frac{\rho}{2\pi\varepsilon_0 d}$$

06. A spherical region of radius a has a charge Q uniformly distribution through out it. find the electric field straight

i) $r < a$ $\quad E = \frac{Qr}{4\pi\varepsilon_0 a^3}$

ii) $r > a$ $\quad E = \frac{Q}{4\pi\varepsilon_0 r^2}$

07. A non - conducting cylinder of radius R has a charge uniformly distributed through out its volume, such that the change density is p, find the electric field straight

1) inside the cylinder

2) at a distance r tran the axis out of the cylinder $(r > R)$

08. a) using gauss theorem show that an infinitely large conducting plate has a electric field strength of $\frac{\sigma}{\varepsilon_0}$

b) If a mass 2×10^{-5} kg and charge 10^{-9} c is connected to an insulating string and placed closed to the plate it comes to equilibrium at an angle 30° to the vertical find the surface charge density in the plate.

c) If another plate having the same charge density but oppositely charge is placed such that the ball is between the two plates what is the angle the ball makes with the vertical.

d) If the 2nd plate was placed between the 1st placed and the ball the angle made with the vertical.

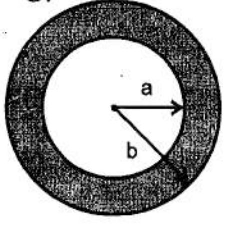
09. A sphere of charge + Q is placed inside a yellow sphere of internal radius a and external radius b.

Find the electric field strengths at

1) $r < a$ $\quad$ 2) $a < r < b$ $\quad$ 3) $r > b$

4) Match variation of electric field straight with distance

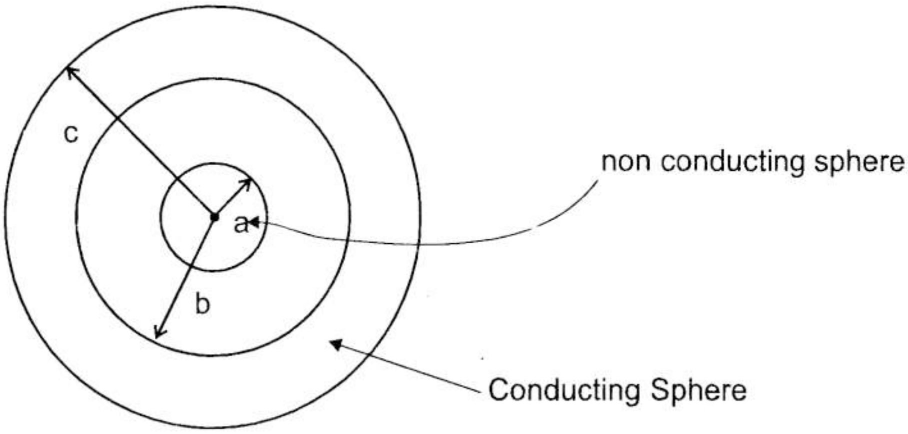
10. A neutron is made such that it has a spherical positirely charged centre which is surrounded with a spherical shell negatively charged the positive charge is 1.6×10^{-19} C and negative charge is 1.6×10^{-19} C.



$a = 0.5 \times 10^{-15}$ m
$b = 1 \times 10^{-15}$ m

Find the electric field Strength

i) $r = 1.5 \times 10^{-15}$ m $\quad$ ii) 0.75×10^{-15} m $\quad$ iii) 0.25×10^{-15} m



[ii] a = 5cm , b = 20 cm, c = 25 cm

at a distance 10 cm from th centre the electric field strength is 3600 Nc^{-1} at a distance 50 cm the electric field strength 200 Nc^{-1}. find the charge

1) In the non - conducting sphere
2) Conducting spherical shell
3) Inner surface of spherical shell
4) Enter surface of spherical shell

Eletric Field

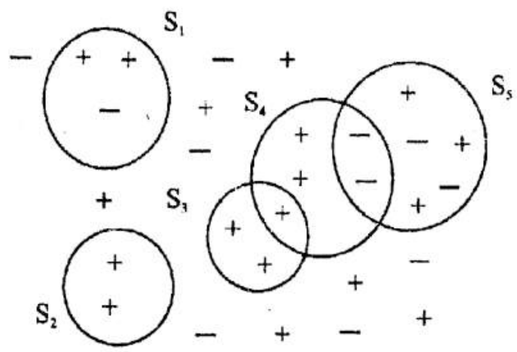
01. Two concentric spherical metal shells of radii R and 2R carry charges 4Q and 3Q respectively. The quantity of charge that passes from one to other when two shells are connected together by a conducting wire is,

(1) 4Q (2) 2Q (3) Q (4) $\frac{Q}{2}$ (5) zero

(1993)

02. In the diagram shown + and - symbols represent +q and –q

Charges respectively in a charge distribution, S_1 to S_5 are five closed spherical surfaces drawn by a student enclosing these charges. The total outward electric flux from the, surface is maximum in

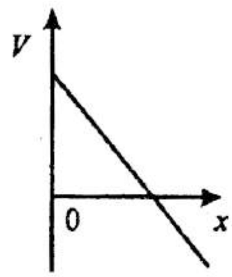


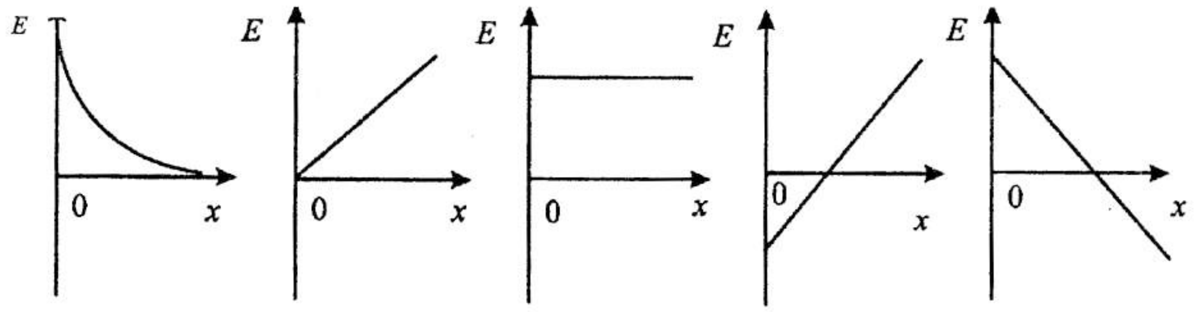
(1) S_1 (2) S_2 (3) S_3

(4) S_4 (5) S_5

(1993)

03. Figure shows the variation of the electrostatic potential, V, along the x-direction. Which one of the following curves best represents the variation of the electric field intensity, E, along the same direction?

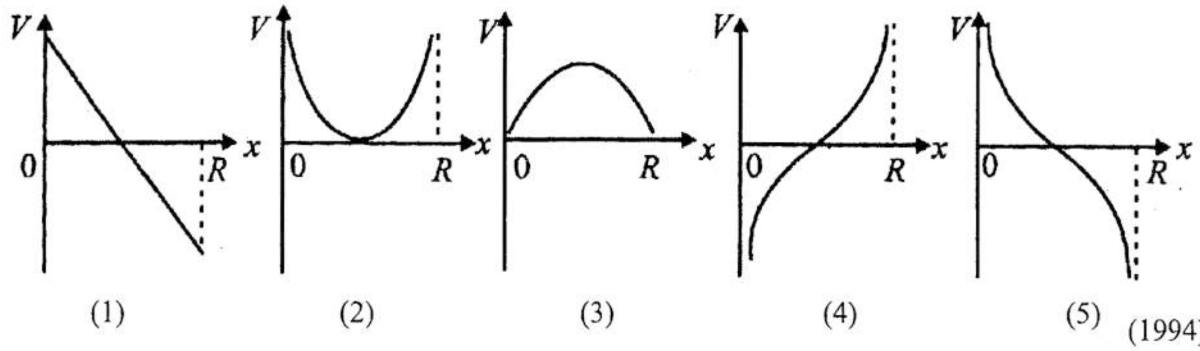




(1) (2) (3) (4) (5)

(1994)

04. Two small spheres carrying charges +Q and -Q are placed at x = 0 and x = R respectively as shown in the figure. Which of the following graphs best represents the variation of electric potential V, with distance



(1994)

05. Two small spheres of equal masses are suspended from two identical light inextensible strings. The free ends of the strings are connected to a common point at the ceiling. One sphere has a charge +Q and the other has a charge +2Q. If the string attached to Q makes an angle θ with the vertical, the angle that the other string makes with the vertical its

(1) 0 (2) $\frac{\theta}{4}$ (3) $\frac{\theta}{2}$ (4) θ (5) 2θ

(1994)

10. A positively charged small sphere is brought down into an uncharged tall metallic container placed on an insulating surface. The sphere is allowed to touch the bottom of the container and then removed without touching it again. Which of the following statement is true?

(1) The container is positively charged on the outside and negatively charged on the inside.

(2) The charge is equally divided between the sphere and the container.

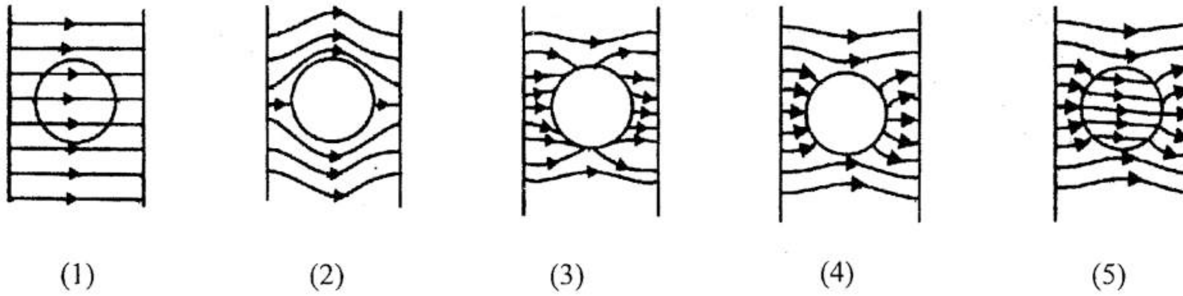
(3) The sphere will have a negative charge.

(4) The sphere retains all of its positive charge.

(5) The sphere retains no charge.

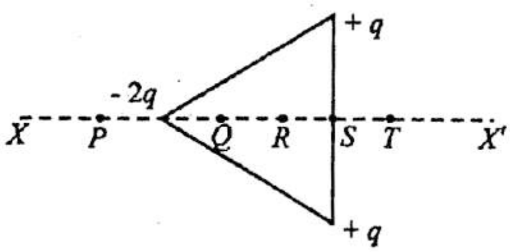
(1995)

12. A metal sphere is plated in the region between two oppositely charged parallel plates. Which one of the following diagrams best represents the electric field between the plates?



(1995)

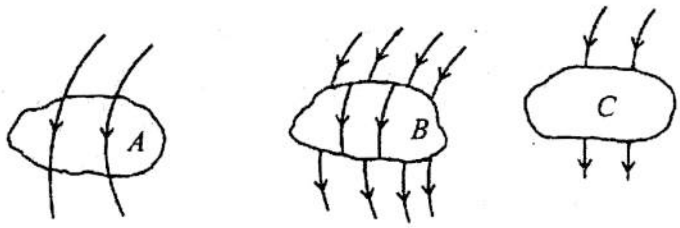
13. Charges + q, + q and - 2q are placed at the corners of an equilateral triangle shown in the figure. The point along the line XX', at which the electric field intensity is most likely to be zero is



(1) P (2) Q (3) R
(4) S (5) T

(1995)

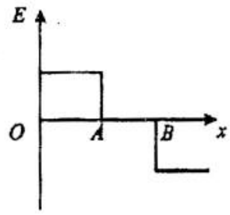
14. The paths of eclectic lines of forces in and around three regions A, B and C are shown in the figure. Which of the following combinations correctly describe the nature of the regions?

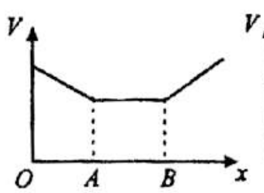


	A	B	C
(1)	uncharged conductor	charged conductor	dielectric
(2)	free space with zero net charge	dielectric	charged conductor
(3)	dielectric	free space with positive charges	free space with zero net charge
(4)	free space with zero net charge	dielectric	uncharged conductor
(5)	uncharged conductor	free space with negative charge	dielectric

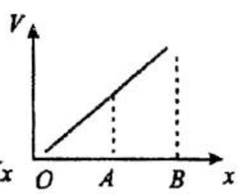
(1995)

15. Figure shows the variation of an electric field intensity E along the direction Ox. The variation of the electric potential V along the same direction is best represented by

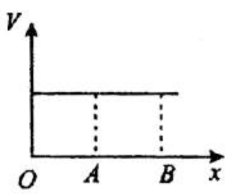




(1)



(2)



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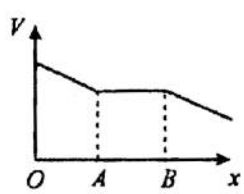

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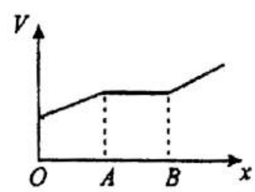
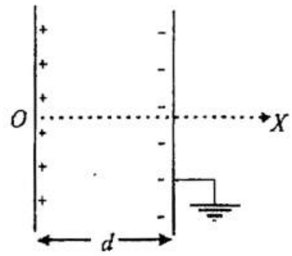
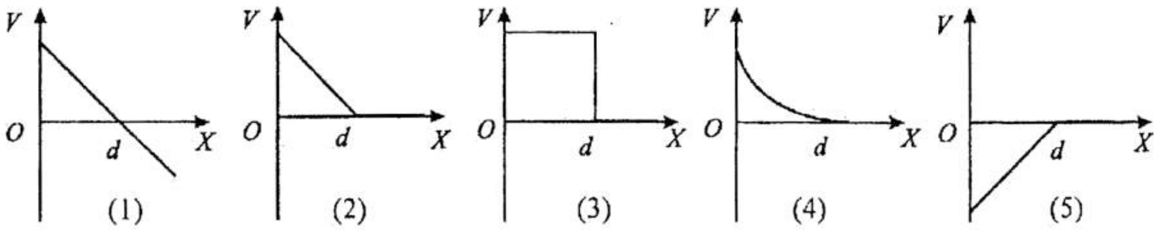


(5)

(1995)

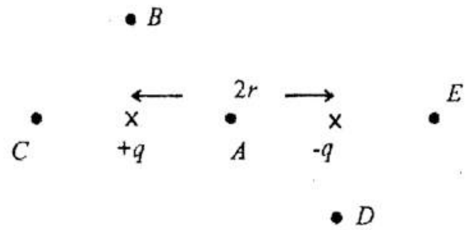
16. The variation of the potential V along the direction OX due to a charged, parallel late capacitor placed as shown in the figure is best represented by





(1996)

17. Two point charges +q and -q are at a distance 2r apart, as shown in the figure. The points A, B and C are situated at a distance r from +q , while the points D and E are situated at a distance r from -q . Of the points given the largest positive potential can be found at



(1) A (2) B (3) C (4) D (5) E

(1996)

18. Each of the metal spheres, A and B of radii 'a' and '2a' respectively curies a + Q charge. If A and B are connected by a metal wire,

(1) A charge of +Q/3 will flow from A to B.
(2) A charge of +Q/3 will flow from B to A.
(3) A charge of +Q/2 will flow from A to B.
(4) A charge of +Q/2 will flow from B to A.
(5) A charge wilt not flow from A to B or B to A.

(1996)

20. Which of the following statements regarding electric fields/potential is true?

(1) If the electric field intensity is zero at a point, then the electric potential must also be zero at that point.
(2) If the electric potential is zero at a point, then the electric field intensity must also be zero at that point.
(3) If the electric field intensity is zero throughout a region, then the electric potential must also be zero throughout that region.
(4) If the electric potential is zero throughout a region, then the electric field must also be zero throughout that region.
(5) The electric field intensity is large where the electric potential is large and small where the potential is small.

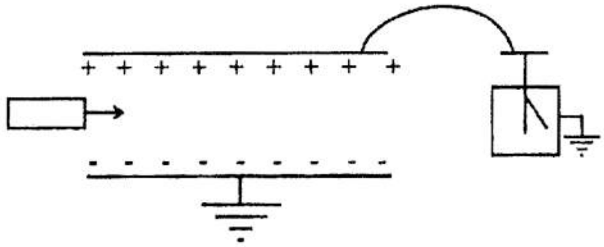
(1996)

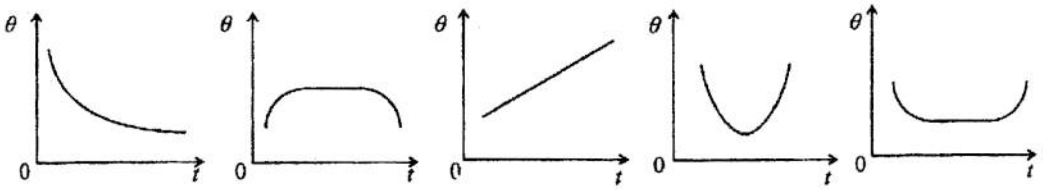
21. Two identical conducting spheres X and Y carry charges of +97e and -100e respectively. Here e is the charge of an electron. When X and Y are allowed to touch, the final charge charges on Y

(1) -1.5e or 0 (2) -1.5e (3) -3e or 0 (4) -3e (5) -e or – 2e

(1996)

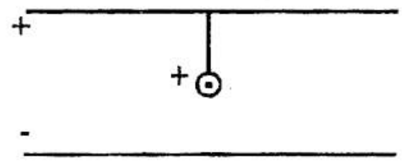
22. A charged capacitor is connected to the cap of a gold leaf electroscope as shown in the figure. When an uncharged dielectric slab is inserted with a certain velocity from one side and removed from the other side of the capacitor as shown, the variation of deflection (θ) of the leaf with time (t) is best represented by

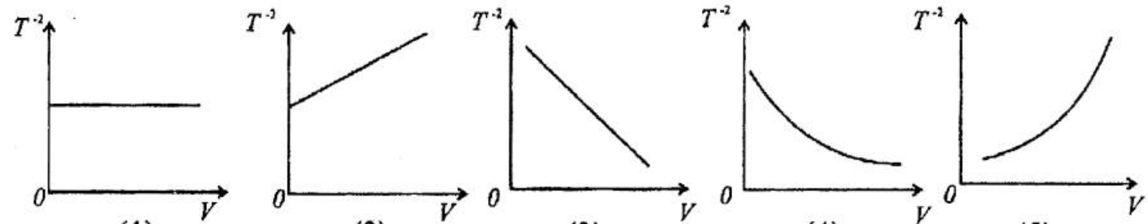




(1) (2) (3) (4) (5) (1996)

23. A simple pendulum which carries a positive charge is placed in between the horizontal plates of a parallel plate capacitor, as shown in the figure. If T is the period for small oscillations when a potential difference of V is applied to the capacitor, the variation of T^2 with V is best represented by

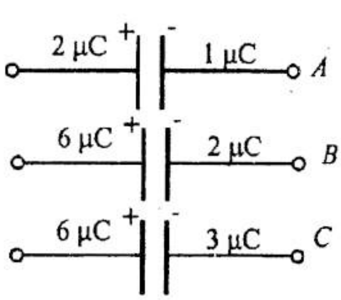




(1) (2) (3) (4) (5)

(1996)

24. Three isolated capacitors having capacitances of 1μF, 2 μF and 3μF carry charges 2 μC, 6μC and 6μC respectively as shown in the figure. If the positive plates of the capacitors are connected together, the potentials (in volts) at the other plate terminals, A, B and C with respect to the positive plates are

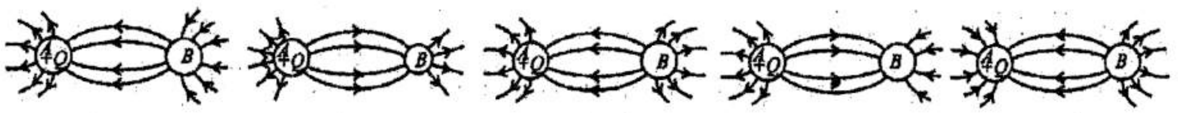


(1) -2, -3, -2 (2) 2, 3, 2 (3) $\frac{7}{3}, \frac{7}{3}, \frac{7}{3}$

(4) $-\frac{7}{3}, -\frac{7}{3}, -\frac{7}{3}$ (5) $\frac{77}{3}, \frac{77}{3}, \frac{77}{3}$

(1997)

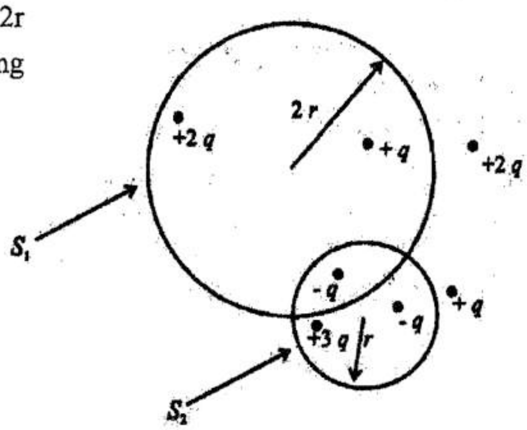
25. Positively charged metal sphere A and an uncharged metal sphere B are placed close to each other. Which of the following diagrams correctly represents the electric field at the vicinity of the spheres?



(1) (2) (3) (4) (5)

(1998)

27. S_1 and S_2 are two hypothetical spherical surfaces of radii 2r and r, drawn in a charge distribution of point charges having magnitudes -q, +q, +2q, and +3q.



The ratio

$$\frac{\text{net electric flux passing through } S_1}{\text{net electric flux passing through } S_2} \text{ is}$$

(1) 1 (2) 2 (3) 4

(4) 8 (5) 16

(1998)

28. Three identical metal spheres are supported on three insulating stands. A charge q is given on the first sphere. The first sphere is then momentarily touched with the second sphere and then the second sphere is momentarily touched with the third. Finally the third sphere is momentarily touched with the first again. The final amounts charge residing on first, second and the third spheres respectively are.

(1) $\frac{q}{4},\frac{q}{4},\frac{q}{8}$ (2) $\frac{3q}{8},\frac{q}{4},\frac{3q}{8}$ (3) $\frac{q}{4},\frac{q}{2},\frac{q}{4}$ (4) $\frac{q}{2},0,\frac{q}{2}$ (5) $\frac{q}{8},\frac{3q}{4},\frac{q}{8}$

(1998)

29. Two spherical conductors with radii R_1, and R_2 are separated by a very large distance and connected a thin conducting wire. If ε_0 is the permittivity of free space, the capacitance of the system is

(1) $4\pi\epsilon_0(R_1+R_2)$ (2) $4\pi\epsilon_0\frac{R_1R_2}{R_1+R_2}$ (3) $4\pi\epsilon_0\frac{R_1^2}{R_2}$ (4) $4\pi\epsilon_0(R_1-R_2)$ (5) $\frac{4\pi\epsilon_0 R_1R_2}{R_1-R_2}$

(1999)

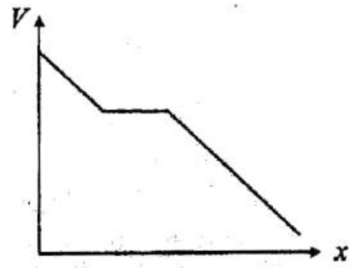
30. A charge is distributed uniformly with density σ over the surface of an isolated conducting sphere of radius a. The electric potential at the center of the sphere is

(1) $\frac{a\sigma}{\epsilon_0}$ (2) $\frac{a^2\sigma}{\epsilon_0}$ (3) $\frac{a^2\sigma^2}{\epsilon_0}$ (4) $\frac{\sigma}{2\epsilon_0}$ (5) 0

(1999)

31. The figure shows the variation of the electric potential (V) of a system along a particular direction x.

The system can be a charged



(1) Parallel plate capacitor with air between the plates.

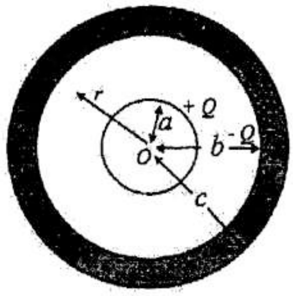
(2) Parallel plate capacitor with a metal slab in between the plates.

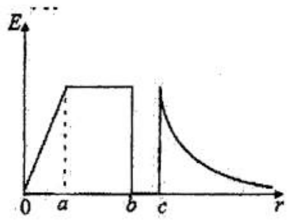
(3) Parallel plate capacitor with a dielectric slab in between the plates.

(4) Conducting sphere.

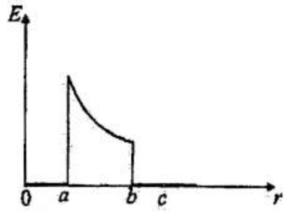
(5) Conducting sphere situated inside a charged concentric spherical conducting shell. (1999)

32. A conducting sphere and a concentric conducting spherical shell carry charges +Q and -Q respectively, as shown in the figure. The variation of the electric field intensity E, with radial distance r from the center O is best represented by

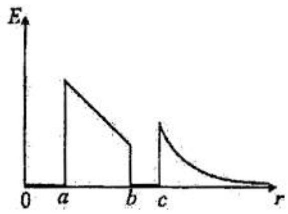




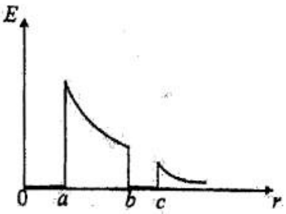
(1)



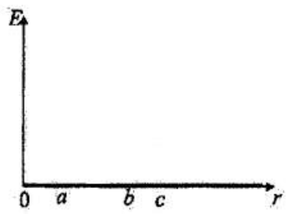
(2)



(3)



(4)

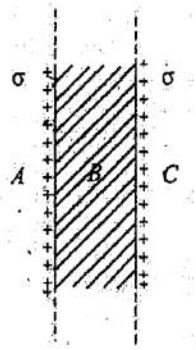


(5)

(1999)

33. An infinitely long thick conducting sheet shown in the figure carries a uniform surface charge density σ

The electric field intensities in the regions A, B and C respectively are

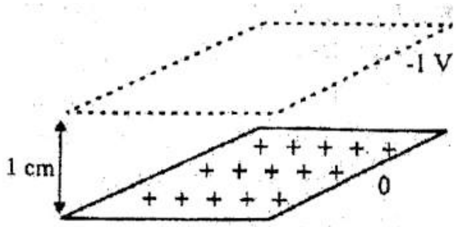


(1) $\frac{\sigma}{2\epsilon_0}, \frac{\sigma}{\epsilon_0}, \frac{-\sigma}{2\epsilon_0}$ (2) $\frac{\sigma}{\epsilon_0}, 0, \frac{\sigma}{\epsilon_0}$ (3) $\frac{2\sigma}{\epsilon_0}, 0, \frac{2\sigma}{\epsilon_0}$

(4) $0, \frac{\sigma}{2\epsilon_0}, 0$ (5) $\frac{\sigma}{2\epsilon_0}, 0, \frac{\sigma}{2\epsilon_0}$

(2000)

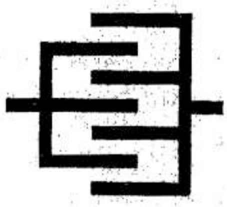
34. A uniformly charged large metal plate is kept at zero potential. An equipotential surface of -1V is observed at a distance of 1 cm, as shown in the figure. The potential of the equipotential surface at a distance of 2 cm above the metal plate is



(1) -2V (2) -1V (3) 0.5V (4) 1V (5) 2V

(2000)

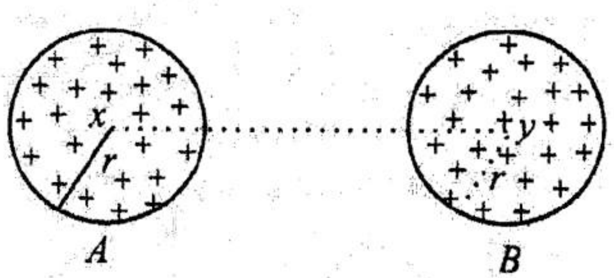
35. Cross-sectional view of a variable capacitor with parallel plates is shown in the figure. The separation between adjacent plaits is 0.5 cm, and the effective area of overlap of adjacent plates is 5 cm^2. If $\varepsilon_0 = 9 \times 10^{-12}$ F m^{-1}, the capacitance of the variable capacitor at this position is

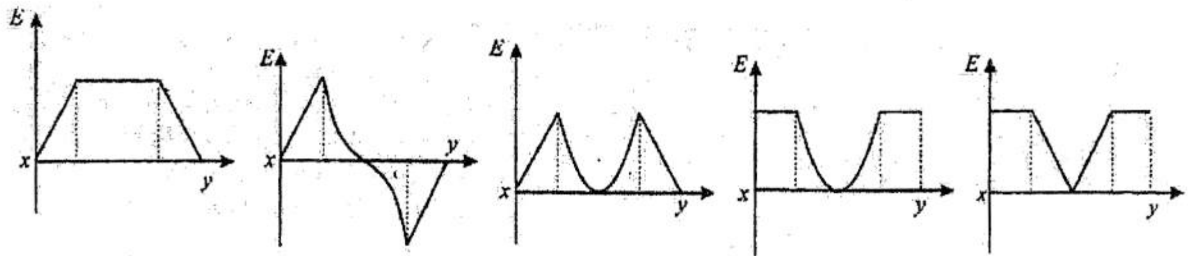


(1) 0.15pF (2) 0.3pF (3) 0.9pF (4) 2.7pF (5) 5.4pF

(2000)

36. A and B are two uniformly charged identical, non conducting solid spheres carrying equal charges. The distance between the spheres is very much greater than their radii r. The variation of the electric field intensity, E, along x y from x to is best represented by

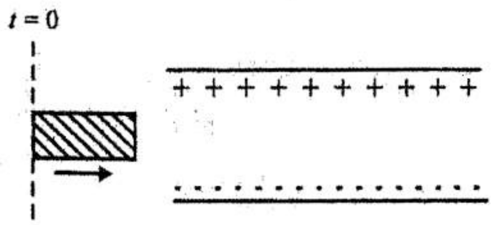


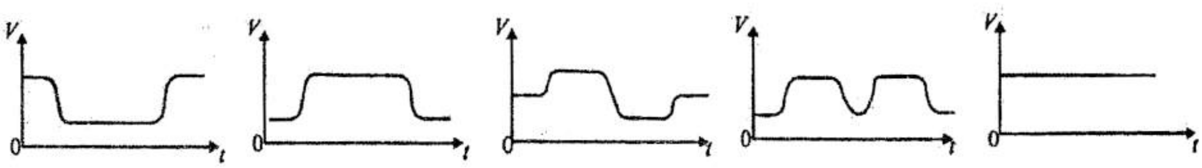


(1) (2) (3) (4) (5)

(2000)

37. A small dielectric slab is passed through an isolated charged parallel plate capacitor, as shown in the figure. As the slab moves the variation of the potential difference V across the capacitor with time t is best represented by

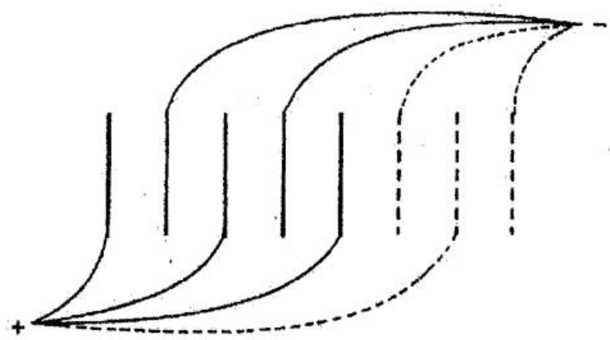




(1) (2) (3) (4) (5)

(2000)

38. A capacitor consists of n number of equally spaced, parallel conducting sheets. Alternate sheets connected together compose the positive plate, and the other alternate sheets compose the negative plate as shown in the figure. If A is the area of each sheet and d is the spacing between two adjacent sheets, the capacitance of the arrangement is

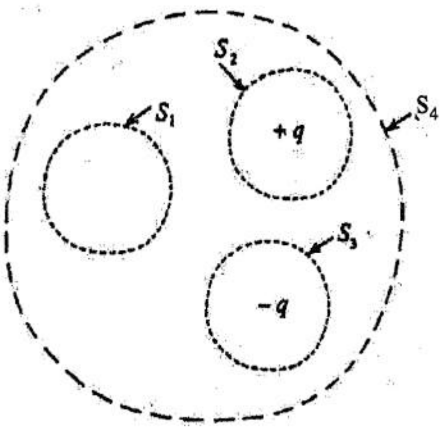


(1) $\frac{\varepsilon_0 A}{(n-1)d}$ (2) $\frac{2\varepsilon_0 A}{nd}$ (3) $\frac{(n-1)\varepsilon_0 A}{d}$ (4) $\frac{n\varepsilon_0 A}{d}$ (5) $\frac{\varepsilon_0 A}{nd}$

(2001)

39. S_1, S_2, S_3 and S_4 are four Gaussian surfaces drawn in the vicinity of two equal and opposite charges +q and -q as shown.

The net electric flux through the surfaces S_1, S_2, S_3 and S_4 are represented by ϕ_1, ϕ_2, ϕ_3 and ϕ_4 respectively. Which of the following is correct?



(1) $\phi_1=0,\ \phi_2=0,\ \phi_3=0,\ \phi_4=0$

(2) $\phi_1=0,\ \phi_2>0,\ \phi_3<0,\ \phi_4=0$

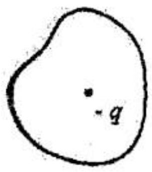
(3) $\phi_1>0,\ \phi_2>0,\ \phi_3<0,\ \phi_4>0$

(4) $\phi_1>0,\ \phi_2>0,\ \phi_3<0,\ \phi_4=0$

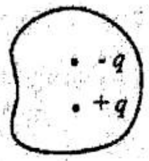
(5) $\phi_1<0,\ \phi_2>0,\ \phi_3<0,\ \phi_4>0$

(2001)

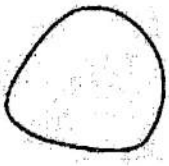
40. Across which of the following closed surfaces, is the net electric flux positive?



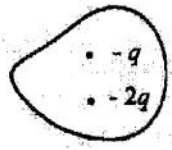
(1)



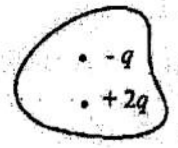
(2)



(3)



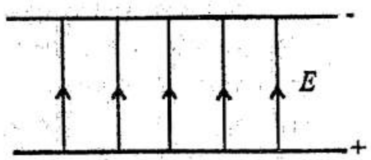
(4)

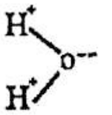


(5)

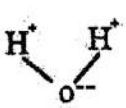
(2002)

41. If a water molecule is placed in the electric field shown in figure, which orientation would it take in order to minimize its energy?

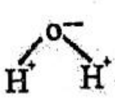




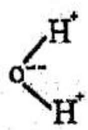
(1)



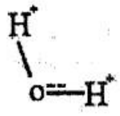
(2)



(3)



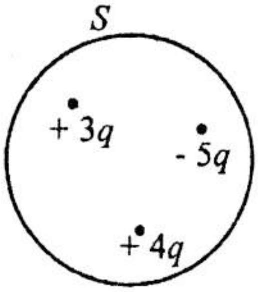
(4)



(5)

(2002)

42. Net flux through the closed surface S can be reversed by



(1) changing the +3q to +4q.

(2) changing the +4q to +3q

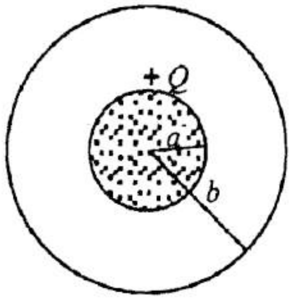
(3) changing the -5q to -7q

(4) changingthe+3qto+lq

(5) changing the +4q to +lq

(2003)

43. A solid metal sphere of radius a carrying a charge +Q, is placed concentrically inside an isolated spherical metal shell of radius b as shown in the figure. The electric potential of the solid sphere is



(1) $\frac{1}{4\pi \in_0}\frac{Q}{a}$ (2) $\frac{1}{4\pi \in_0}Q\left(\frac{1}{a}-\frac{1}{b}\right)$ (3) 0

(4) $\frac{1}{4\pi \in_0}\frac{Q}{b}$ (5) $-\frac{1}{4\pi \in_0}\frac{Q}{a}$

(2003)

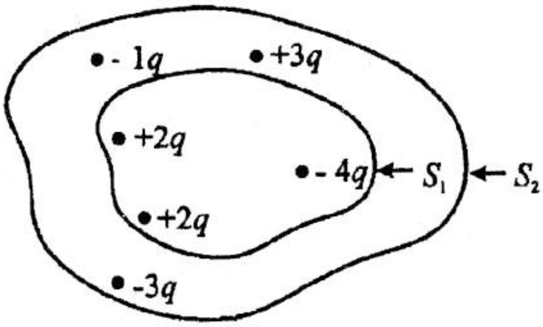
44. Consider the following statements made regarding the charge distribution shown.

(A) No electric field lines cross the closed surface S_1.

(B) Total electric flux due to the charge +3q does not depend on the rest of the charges present.

(C) Net electric flux through the closed surface S_2 is not zero.

Of the above statements



(1) only (A) is true.

(2) only (A) and (B) are true.

(3) only(B) and (C) are true.

(4) only (A) and (C) are true.

(5) all (A), (B) and (C) are true

(2004)

45. A metal sphere of radius r carrying a charge +q is connected by a conducting wire to another sphere of radius 2r carrying a charge +q. After the connection, the amount of charge in the sphere radius r is

(Assume that the amount of charge residing in the connecting wire is negligible.)

(1) 0 (2) $+\frac{q}{3}$ (3) $+\frac{q}{2}$ (4) $+\frac{2}{3}q$ (5) $+\frac{3}{2}q$

(2004)

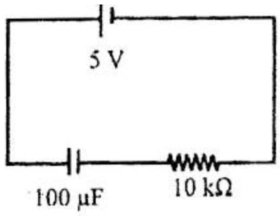
46. A given parallel plate capacitor is connected to a battery. When the e.m.f. of the battery is doubled, the electric field between the plates

(1) remains unchanged. (2) is halved. (3) is doubled.

(4) is quadrupled. (5) is trebled.

(2005)

47. A 100 μF capacitor connected in series with a 10kΩ resistor is connected to a 5 V battery as shown in the figure. The charge stored in the capacitor in this circuit at the steady state is

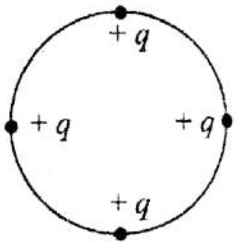


(1) 5×10^{-5}C (2) 50×10^{4}C (3) 5×10^{-3}C

(4) 5×10^{-2}C (5) 50×10^{-1} C

(2005)

48. Four point charges, each having charge q are fixed to the circumference of an insulating disk of radius r as shown in figure. When the disk is rotating about an axis passing through its center and perpendicular to its plane at n revolutions per second, the mean electric current along the circumference of the disk is

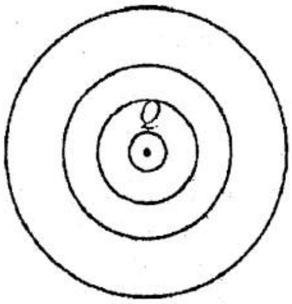


(1) $\frac{4q}{n}$ (2) $8\pi rqn$ (3) 4qn (4) $\frac{2qn}{\pi r}$ (5) qn

(2005)

49. The figure shows a set of circles centered on a stationary point charge Q.

The circles could be used to represent



(1) the electric field lines.

(2) the magnetic field lines.

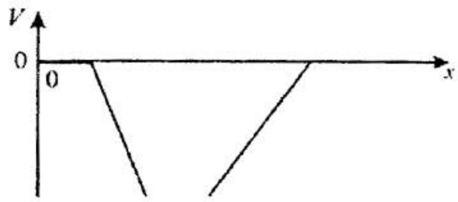
(3) the magnetic equipotential lines

(4) the gravitational field lines.

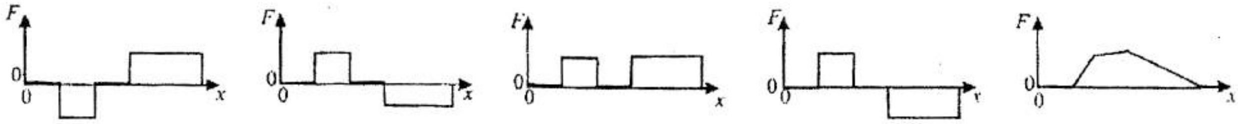
(5) the electric equipotential lines.

(2005)

50. The graph shows the variation of electric potential V with distance x in a certain region.



The variation of the force F experienced by a positively charged particle with x is best represented by



(1) (2) (3) (4) (5)

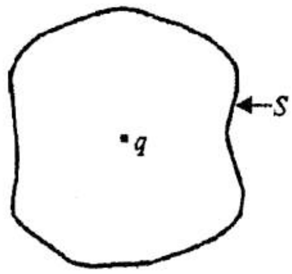
(2005)

51. S is a Gaussian surface and q is a charge inside it. Consider the following statements made about the net electric flux Φ through the surface S.

(A) If the volume enclosed by the surface S increases, then Φ increases.

(B) If the charge q is moved close to the surface S, then Φ increases.

(C) Even if the shape of the surface S is changed, Φ remains the same.



Of the above statements,

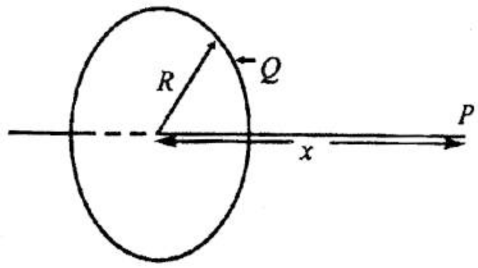
(1) only (B) is true. (2) only (A) and (B) are true.

(3) only B and C are true. (4) only (A) and (C) are true.

(5) all (A), (B) and (C) are true

(2006)

52. A thin conducting ring of radius R has a charge Q uniformly distributed over it. P is a point on the axis passing perpendicular to the plane of the ring and through its center. The electric potential at the point P is given by



(1) $\frac{Q}{4\pi\varepsilon_0 x}$ (2) $\frac{Q}{4\pi\varepsilon_0 (R^2+x^2)^{\frac{1}{2}}}$

(3) $\frac{Qx}{4\pi\varepsilon_0 (R^2+x^2)}$ (4) $\frac{Qx}{4\pi\varepsilon_0 (R^2+x^2)^{\frac{3}{2}}}$ (5) $\frac{QR}{4\pi\varepsilon_0 (R^2+x^2)}$

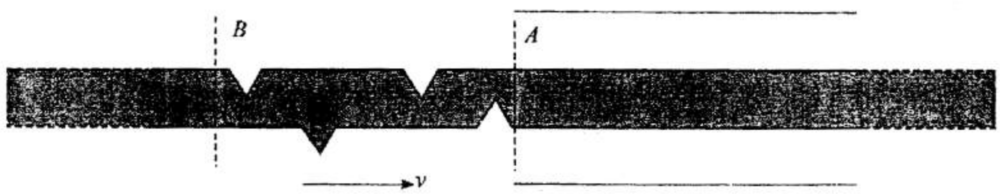
(2006)

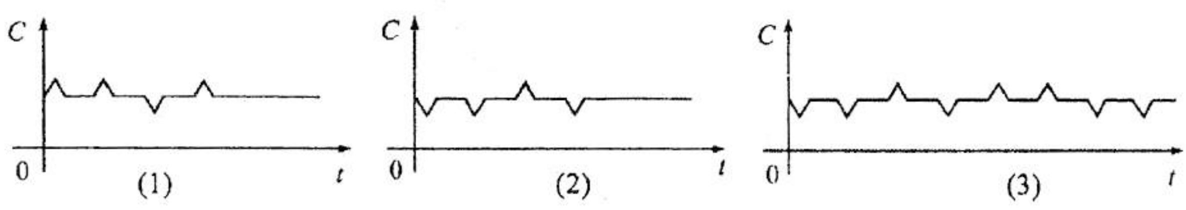
53. Two identical conducting spheres A and B carry equal charges. The spheres are separated by a distance which is much larger than their diameters. The electrostatic fo acting between them is F. Now a third identical uncharged conducting sphere is first made to touch and secondly B, and then removed. The new value of the force acting between A and B is

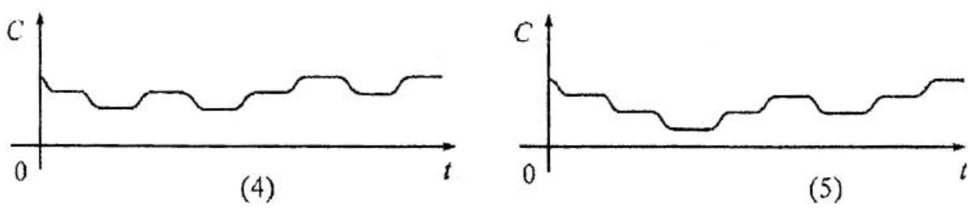
(1) 0 (2) $\frac{F}{16}$ (3) $\frac{F}{4}$ (4) $\frac{3F}{8}$ (5) $\frac{F}{2}$

(2006)

54. A uniform sheet of dielectric material is sent through two parallel metal plates as shown in figure at a constant velocity (v) to check for manufacturing defects. Some of such defects are shown in the figure. As the section AB of the sheet passes through the metal plates, variation of the capacitance (C) of the system with time (t) is best represented by

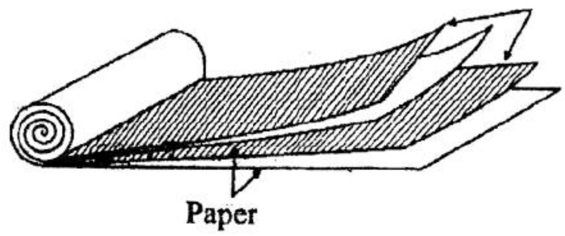






(2006)

55. A cylindrical capacitor is formed by inserting two sheets of paper of dielectric constant 4 and thickness 10^{-4}m, alternately between two rectangular sheets of metal foils, each of length 1m and breadth 10^{-2}m, and rolling them as shown in the figure.



(ε_0 = x 10^{-12} Fm^{-1})

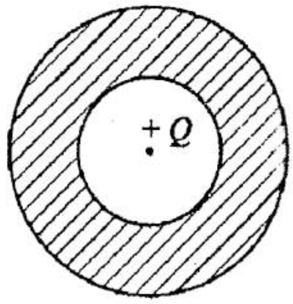
The capacitance of the capacitor is

(1) 3600pF (2) 360pF (3) 36pF (4) 18pF (5) 3.6 pF

(2007)

56. The figure shows a spherical conducting shell. A point charge +Q is placed at the centre of the shell and a charge -q is given to the shell.

Finally the shell will have



(1) zero charge on the inner surface, -q on the outer surface.

(2) -Q charge on the inner surface, -q on the outer surface.

(3) -Q charge on the inner surface, -q +Q on the outer surface.

(4) +Q charge on the inner surface, -q -Q on the outer surface.

(5) $-Q-\frac{q}{2}$ on the inner surface, $+Q-\frac{q}{2}$ on the outer surface.

(2007)

57. Two point charges $+q_1$ and $-q_2$ are placed as shown in the figure.

Resultant electric field intensity could be zero at a point,

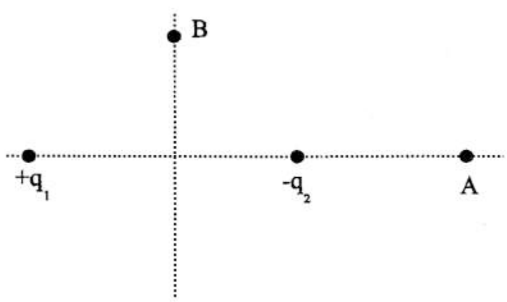
(1) A, if $q_1 = q_2$

(2) A, if $q_1 > q_2$

(3) A, if $q_1 < q_2$

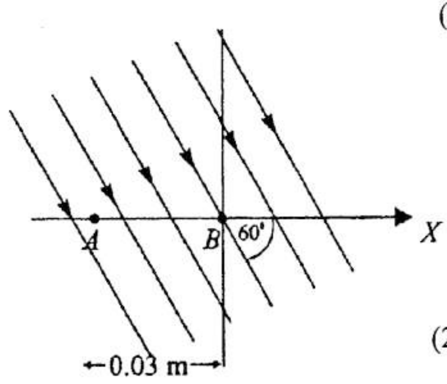
(4) B, if $q_1 = q_2$

(5) B, if $q_1 > q_2$



(2007)

58. A uniform electric field of magnitude 400 V m^{-1} is acting in the direction as shown in the figure. If V_A and V_A are the electric potentials at points A and B respectively, then $V_B - V_A$ is equal to



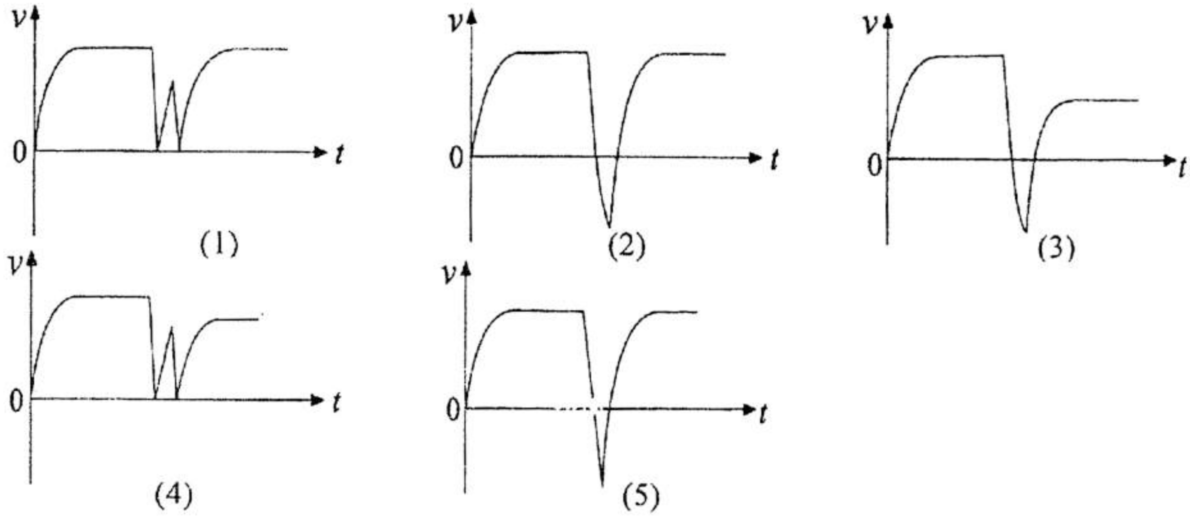
(1) -6V (2) -3V (3) 0

(4) 3V (5) 6V

(2007)

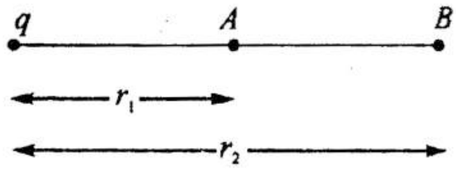
59. A tiny sphere with a static charge +q starts to fall through air under gravity at t = 0. After the sphere has reached terminal velocity, a vertically upward electric field E of constant magnitude is applied. A shown time after the sphere changes direction of its motion, the electric field is removed.

The variation of the velocity (v) of the sphere with time (t) is best epresented by,



(2007)

60. A point charge q_0 moves under the influence of the electric field created by another stationary point charge q. The change in the kinetic energy of q_0 when it moves from A to B is



(1) $\frac{qq_0}{4\pi\varepsilon_0}\left(\frac{1}{r_1}+\frac{1}{r_2}\right)$ (2) $\frac{qq_0}{4\pi\varepsilon_0}\left(\frac{1}{r_1}-\frac{1}{r_2}\right)$ (3) $\frac{qq_0}{4\pi\varepsilon_0}(r_1+r_2)$

(4) $\frac{qq_0}{4\pi\varepsilon_0}\left(\frac{1}{r_1^2}-\frac{1}{r_2^2}\right)$ (5) $\frac{q_0^2}{4\pi\varepsilon_0}\left(\frac{1}{r_1}+\frac{1}{r_2}\right)$

(2008)

61. A spherical liquid drop has an electrical capacitance C_1 and another spherical drop made of the same liquid has a capacitance C_2. If these two liquid drops coalesce to form one spherical drop, the capacitance C of that drop is given by

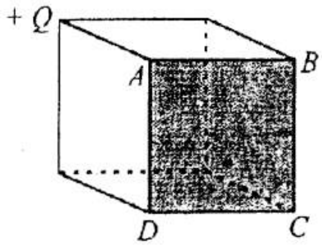
(1) $C = C_1+C_2$ (2) $C = \frac{C_1C_2}{C_1+C_2}$

(3) $C = (C_1^3+C_2^3)^{\frac{1}{3}}$ (4) $C = (C_1^2+C_2^2)^{\frac{1}{2}}$

(5) $C = (C_1C_2)^{\frac{1}{2}}$

(2008)

62. A point charge + Q is placed at one of the corners of a cube as shown in the figure. The electric flux through the surface ABCD of the cube due to the charge is

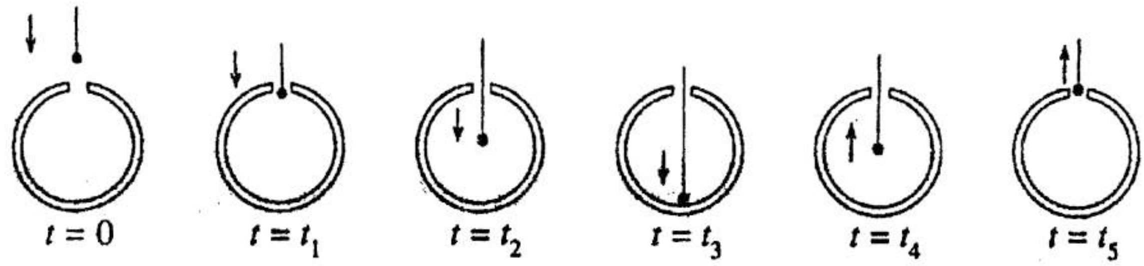


(1) $Q\left(\text{or}\ \frac{Q}{\varepsilon_0}\right)$ (2) $\frac{Q}{4}\left(\text{or}\ \frac{Q}{4\varepsilon_0}\right)$ (3) $\frac{Q}{6}\left(\text{or}\ \frac{Q}{6\varepsilon_0}\right)$

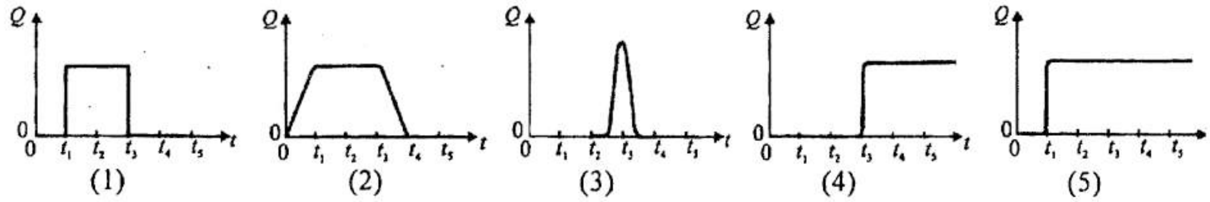
(4) $\frac{Q}{24}\left(\text{or}\ \frac{Q}{24\varepsilon_0}\right)$ (5) $\frac{Q}{36}\left(\text{or}\ \frac{Q}{36\varepsilon_0}\right)$

(2008)

63. A small metal ball, suspended by a insulating thread and carrying a charge q is inserted gradually into an uncharged, conducting hollow sphere through a small hole until it touches the bottom and then it is removed in the same manner. Positions of the metal ball at different times t = 0, t_1, t_2, t_3, t_4 and, t_5 are shown in the figure.

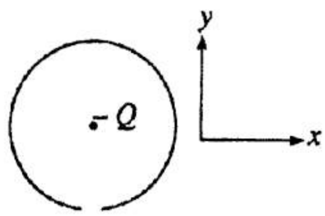


Variation of charge (Q) on the outer surface of the hollow sphere with time (t) is best represented by



(2008)

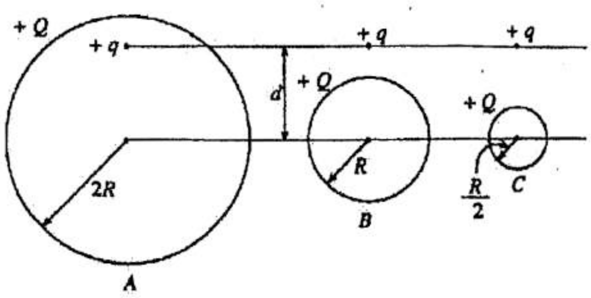
64. A charge +q is uniformly distributed along a very thin non-conducting circular ring of radius R and a charge - Q is placed at the centre of the ring. Now, a very small part containing a charge Δq is removed from the ring as shown in figure. The electrostatic force acting on the charge -Q at the centre of the ring is



(1) zero (2) $\frac{1}{4\pi\varepsilon_0}\frac{Q(q-\Delta q)}{R^2}$ along + y direction. (3) $\frac{1}{4\pi\varepsilon_0}\frac{Q(q-\Delta q)}{R^2}$ along - y direction.

(4) $\frac{1}{4\pi\varepsilon_0}\frac{Q(\Delta q)}{R^2}$ along + y direction. (5) $\frac{1}{4\pi\varepsilon_0}\frac{Q(\Delta q)}{R^2}$ along - y direction. (2009)

65. Figure shows three isolated systems (A, B and C) each having a point charge +q and uniformly charged conducting shell of charge +Q. If the respective electrostatic forces between the point charge and the shell are given by F_A, F_B, and F_C, then

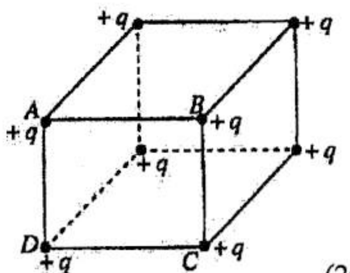


(1) FA=0, FB>FC (2) FA=0, FB=FC (3) FA=0, FC>FB

(4) FA<FB<FC (5) FA=FB=FC

(2009)

66. Eight +q point charges are placed at the vertices of a cube as shown in the figure. The number of electric field lines passing through the face $ABCD$ due to charges is

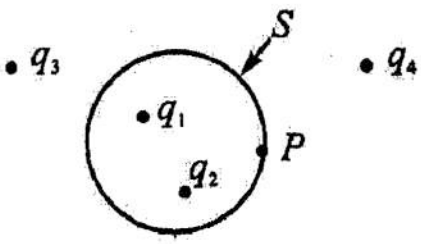


(1) $\frac{q}{3\varepsilon_0}$ (2) $\frac{q}{4\varepsilon_0}$ (3) $\frac{q}{6\varepsilon_0}$ (4) $\frac{q}{24\varepsilon_0}$ (5) $\frac{q}{48\varepsilon_0}$

(2009)

68. Figure shows four point charges and a Gaussian surface S.

Consider the following statements.



(A) Net electric flux through the surface depends only on the fields produced by q_1 and q_2

(B) The electric field intensity at point P depends only on the fields produced by q_1 and q_2

(C) The electric field intensity at point P depends on the locations of the charges q_1, q_2, q_3 and q_4.

Of the above statements

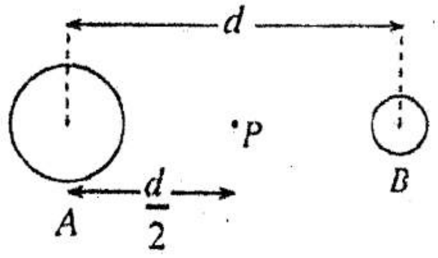
(1) only (A) is true. (2) only (A) and (B) are true.

(3) only (B) and (C) are true. (4) only (A) and (C) are true.

(5) all (A), (B) and (C) are true.

(2010)

69. A and B are two conducting spheres having radii R and $\frac{R}{2}$, respectively, and each carrying a charge $+Q$. When the two spheres are separated by a distance d (>> R), as shown in the figure, the electric potential at point P is V_0. When these two spheres are connected using a very thin B metal wire, the electric potential at P will become



(1) zero (2) $\frac{V_0}{2}$ (3) $\frac{3V_0}{4}$ (4) V_0 (5) $2V_0$

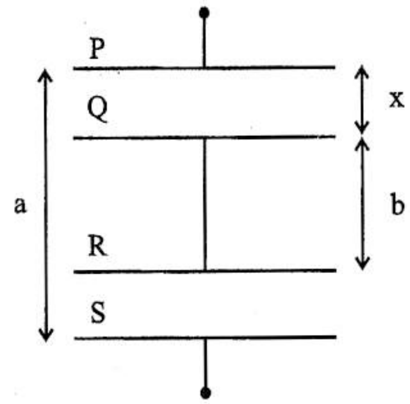
(2010)

70. P, Q, R and S are four parallel conducting plates each of area A, and P and S are fixed plates. Plates Q and R are connected by a rigid conductor as shown in the figure so that they could be moved up and down together. The equivalent capacitance of the system is given by

(1) $\frac{\varepsilon_0 A}{a}$ (2) $\frac{\varepsilon_0 A}{a-x}$

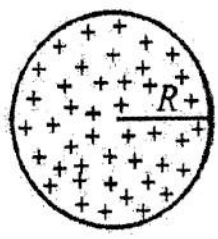
(3) $\frac{\varepsilon_0 A}{a+b-x}$ (4) $\frac{\varepsilon_0 A}{a+b+x}$

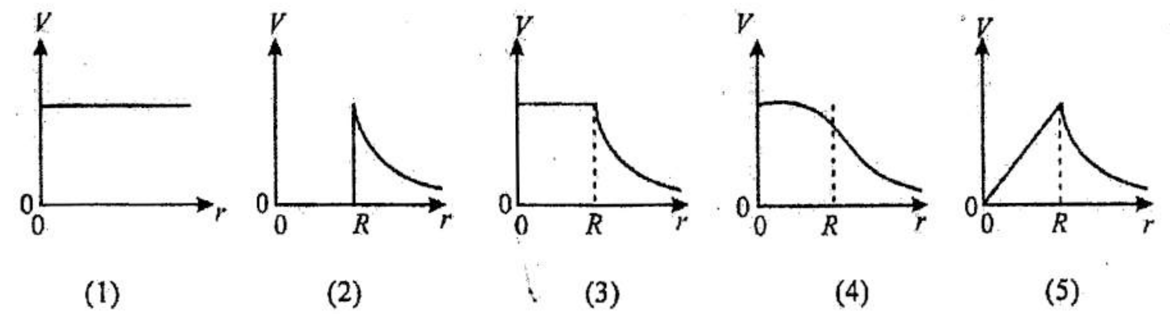
(5) $\frac{\varepsilon_0 A}{a-b}$



(2010)

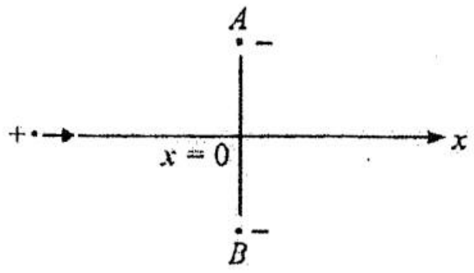
71. A nonconducting sphere of radius R has a uniform positive charge density distributed within the sphere. The variation of the electric potential (V) with radial distance (r) is best represented by

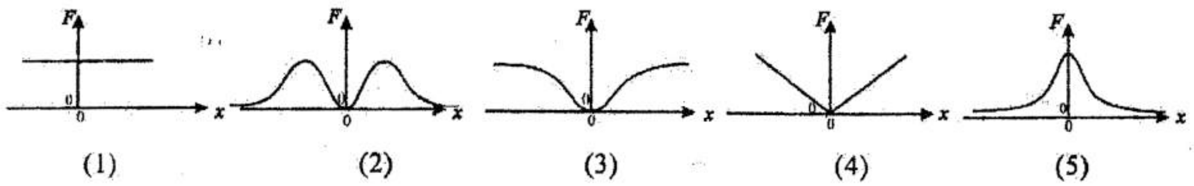




(2011)

72. The figure shows a positive, point-like charge moving along a straight path between two fixed 'equal negative point charges. The Variation of magnitude F of the net force on the positive charges due to the two negative charges, with the distance x is best represented by





(2011)

73. A spherical Gaussian surface surrounds a point charge q. The following changes were made to the system.

(A) The magnitude of the charge was tripled.

(B) The radius of the spherical Gaussian surface was doubled.

(C) The spherical Gaussian surface was changed to a surface of a cube.

(D) The charge was moved to another location inside the surface.

Of the changes mentioned above, the net electric flux through the surface is changed only in

(1) (A) (2) (A) and (B) (3) (C) and (D)

(4) (A), (B) and (D) (5) all (A), (B), (C) and (D)

(2012)

74. Which of the following statements made about electric field lines is **false**?

(1) Electric field lines can be either straight or curved.

(2) Electric field lines can be parallel to one another.

(3) Electric field lines can form closed loops.

(4) Electric field lines begin on positive charges and end on negative charges,

(5) Electric field lines can never intersect with one another.

(2012)

75. A fuel-gauge in a vehicle uses a parallel plate capacitor made of two rectangular metal plates to determine the height of the fuel level in the tank. Each of the metal plates (*ABCD* and *PQRS*) has a width *w* and a height *l*. The height of the fuel level between the plates is *h*. (see figure) Appropriate electronic circuitry *E* determines the effective capacitance of the combined air and fuel capacitors. The effective capacitance of this system is given by (*k* - dielectric constant of fuel)

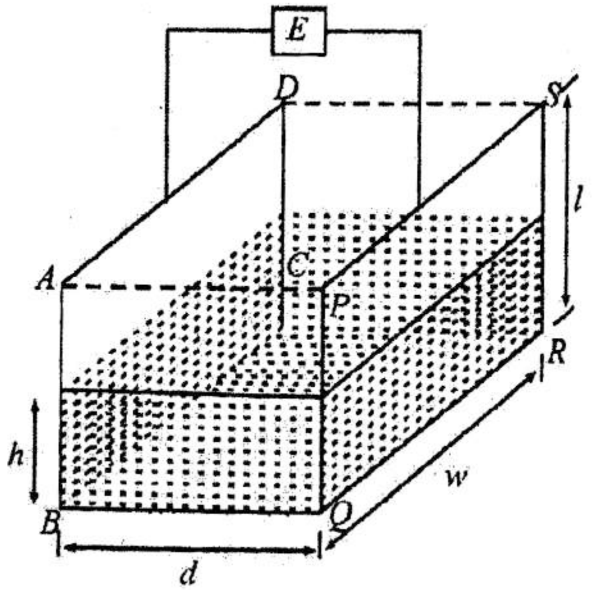
(1) $\frac{w\varepsilon_0}{d}[l + h(k-1)]$

(2) $\frac{(l-h)kh\varepsilon_0 w}{d[l + h(k-1)]}$

(3) $\frac{w\varepsilon_0}{2d}[l + h(k-1)]$

(4) $\frac{(l-h)kh\varepsilon_0 w}{2d[l + h(k-1)]}$

(5) $\frac{k\varepsilon_0 lw}{d}$



(2012)