Exercise-1

ONLY ONE OPTION CORRECT TYPE

SECTION (A) : PROPERTIES OF CHARGE AND COULOMB'S LAW

1. Relative permittivity of mica is :
(1) one (2) less than one (3) more then one (4) infinite

2. Two identical metallic sphere are charged with 10 and -20 units of charge. If both the spheres are first brought into contact with each other and then are placed to their previous positions, then the ratio of the force in the two situations will be :-
(1) -8 : 1 (2) 1 : 8 (3) -2 : 1 (4) 1 : 2

3. Two equal and like charges when placed 5 cm apart experience a repulsive force of 0.144 newton. The magnitude of the charge in microcoloumb will be :
(1) 0.2 (2) 2 (3) 20 (4) 12

4. Two charges of +1 μC & + 5 μC are placed 4 cm apart, the ratio of the force exerted by both charges on each other will be -
(1) 1 : 1 (2) 1 : 5 (3) 5 : 1 (4) 25 : 1

5. A negative charge is placed at some point on the line joining the two +Q charges at rest. The direction of motion of negative charge will depend upon the :
(1) position of negative charge alone
(2) magnitude of negative charge alone
(3) both on the magnitude and position of negative charge
(4) magnitude of positive charge.

6. A body has –80 microcoulomb of charge. Number of additional electrons on it will be :
(1) 8×10^{-5} (2) 80×10^{15} (3) 5×10^{14} (4) 1.28×10^{-17}

7. Coulomb's law for the force between electric charges most closely resembles with :
(1) Law of conservation of energy (2) Newton's law of gravitation
(3) Newton's 2nd law of motion (4) The law of conservation of charge

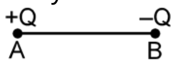
8. A charge Q_1 exerts force on a second charge Q_2. If a 3rd charge Q_3 is brought near, the force of Q_1 exerted on Q_2.
(1) Will increase
(2) Will decrease
(3) Will remain unchanged
(4) Will increase if Q_3 is of the same sign as Q_1 and will decrease if Q_3 is of opposite sign

9. A charge particle q_1 is at position (2, - 1, 3). The electrostatic force on another charged particle q_2 at (0, 0, 0) is :
(1) $\frac{q_1 q_2}{56\pi \in_0}(2\hat{i} - \hat{j} + 3\hat{k})$ (2) $\frac{q_1 q_2}{56\sqrt{14}\,\pi \in_0}(2\hat{i} - \hat{j} + 3\hat{k})$
(3) $\frac{q_1 q_2}{56\pi \in_0}(\hat{j} - 2\hat{i} - 3\hat{k})$ (4) $\frac{q_1 q_2}{56\sqrt{14}\,\pi \in_0}(\hat{j} - 2\hat{i} - 3\hat{k})$

10. Three charge +4q, Q and q are placed in a straight line of length ℓ at points distance x = 0, x = $\ell/2$ and x = ℓ respectively. What should be the value of Q in order to make the net force on q to be zero?
(1) –q (2) –2q (3) –q/2 (4) 4q

11. Two point charges placed at a distance r in air exert a force F on each other. The value of distance R at which they experience force 4F when placed in a medium of dielectric constant K = 16 is :
(1) r (2) r/4 (3) r/8 (4) 2r

12. Two point charges of same magnitude and opposite sign are fixed at points A and B. A third small point charge is to be balanced at point P by the electrostatic force due to these two charges. The point P:

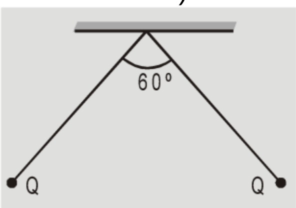


(1) lies on the perpendicular bisector of line AB (2) is at the mid point of line AB
(3) lies to the left of A (4) none of these.

13. A total charge of 20 μC is divided into two parts and placed at some distance apart. If the charges experience maximum coulombian repulsion, the charges should be :

(1) 5μC, 15 μC (2) 10 μC, 10 μC (3) 12 μC, 8 μC (4) $\frac{40}{3}\mu C, \frac{20}{3}\mu C$

14. Two small spherical balls each carrying a charge Q = 10 μC (10 micro-coulomb) are suspended by two insulating threads of equal lengths 1 each, from a point fixed in the ceiling. If is found that is equilibrium threads are separated by an angle 60º between them, as shown in the fig. What is the tension in the threads (Given $\frac{1}{(4\pi\varepsilon_0)}$ = 9 × 10₉ Nm/C₂) -



(1) 18 N (2) 1.8 N (3) 0.18 N (4) none of the above

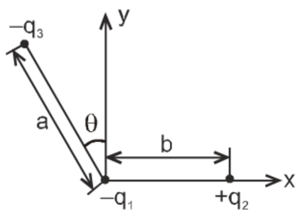
15. The separation between the two charges +q and – q becomes double. The value of force will be :
(1) two fold (2) half (3) four fold (4) one fourth

16. The dielectric constant K of an insulator can be :
(1) 5 (2) 0.5 (3) –1 (4) zero

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

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

18. Three charges $-q_1$, $+q_2$ and $-q_3$ are placed as shown in the figure. The x-component of the force on $-q_1$ is proportional to :



(1) $\frac{q_2}{b^2} - \frac{q_3}{a^2}\cos\theta$ (2) $\frac{q_2}{b^2} + \frac{q_3}{a^2}\sin\theta$ (3) $\frac{q_2}{b^2} + \frac{q_3}{a^2}\cos\theta$ (4) $\frac{q_2}{b^2} - \frac{q_3}{a^2}\sin\theta$

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

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

20. Under the influence of the Coulomb field of charge +Q, a charge –q is moving around it in an elliptical orbit. Find out the correct statement(s).
(1) The angular momentum of the charge –q is constant
(2) The linear momentum of the charge –q is constant
(3) The angular velocity of the charge – q is constant
(4) The linear speed of the charge –q is constant

21. When charge is given to a soap bubble, it shows :
(1) an increase in size `
(2) sometimes an increase and sometimes a decrease in size
(3) no change in size
(4) none of these

SECTION (B) : ELECTRIC FIELD

1. If an electron is placed in a uniform electric field, then the electron will :
(1) experience no force.
(2) moving with constant velocity in the direction of the field.
(3) move with constant velocity in the direction opposite to the field.
(4) accelerate in direction opposite to field.

2. If Q = 2 coloumb and force on it is F = 100 newton, then the value of field intensity will be :
(1) 100 N/C (2) 50 N/C (3) 200 N/C (4) 10 N/C

3. Two infinite linear charges are placed parallel at 0.1 m apart. If each has charge density of 5μ C/m, then the force per unit length of one of linear charges in N/m is :
(1) 2.5 (2) 3.25 (3) 4.5 (4) 7.5

4. The electric field intensity due to a uniformly charged sphere is zero :
(1) at the centre (2) at infinity
(3) at the centre and at infinite distance (4) on the surface

5. Two spheres of radii 2 cm and 4 cm are charged equally, then the ratio of charge density on the surfaces of the spheres will be -
(1) 1 : 2 (2) 4 : 1 (3) 8 : 1 (4) 1 : 4

6. Total charge on a sphere of radii 10 cm is 1 μC. The maximum electric field due to the sphere in N/C will be -
(1) 9×10^{-5} (2) 9×10^{3} (3) 9×10^{5} (4) 9×10^{15}

7. A charged water drop of radius 0.1 μm is under equilibrium in some electric field. The charge on the drop is equivalent to electronic charge. The intensity of electric field is (g = 10 m/s^2)-
(1) 1.61 NC^{-1} (2) 26.2 NC^{-1} (3) 262 NC^{-1} (4) 1610 NC^{-1}

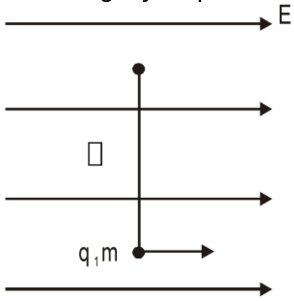
8. Two large sized charged plates have a charge density of +σ and -σ. The resultant force on the proton located midway between them will be -
(1) $\sigma e/\epsilon_0$ (2) $\sigma e/2\epsilon_0$ (3) $2\sigma e/\epsilon_0$ (4) zero

9. Two parallel charged plates have a charge density +σ and -σ. The resultant force on the proton located outside the plates at some distance will be -
(1) $2\sigma e/\epsilon_0$ (2) $\sigma e/\epsilon_0$ (3) $\sigma e/2\epsilon_0$ (4) zero

10. The charge density of an insulating infinite surface is (e/π) C/m^2 then the field intensity at a nearby point in volt/meter will be -
(1) 2.88×10^{-12} (2) 2.88×10^{-10} (3) 2.88×10^{-9} (4) 2.88×10^{-19}

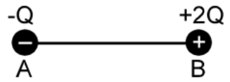
11. There is a uniform electric field in x-direction. If the work done by external agent in moving a charge of 0.2 C through a distance of 2 metre slowly along the line making an angle of 60º with x-direction is 4 joule, then the magnitude of E is :
(1) $\sqrt{3}$ N / C (2) 4 N/C (3) 5 N/C (4) 20 N/C

12. A simple pendulum has a length ℓ, mass of bob m. The bob is given a charge q coulomb. The pendulum is suspended in a uniform horizontal electric field of strength E as shown in figure, then calculate the time period of oscillation when the bob is slightly displace from its mean position is :



(1) $2\pi\sqrt{\frac{\ell}{g}}$ (2) $2\pi\sqrt{\left\{\frac{\ell}{g+\frac{qE}{m}}\right\}}$ (3) $2\pi\sqrt{\left\{\frac{\ell}{g-\frac{qE}{m}}\right\}}$ (4) $2\pi\sqrt{\frac{\ell}{\sqrt{g^2+\left(\frac{qE}{m}\right)^2}}}$

13. Charge 2Q and –Q are placed as shown in figure. The point at which electric field intensity is zero will be:



(1) Somewhere between –Q and 2Q
(2) Somewhere on the left of –Q
(3) Somewhere on the right of 2Q
(4) Somewhere on the right bisector of line joining –Q and 2Q

14. The maximum electric field intensity on the axis of a uniformly charged ring of charge q and radius R will be :

(1) $\frac{1}{4\pi\varepsilon_0}\frac{q}{3\sqrt{3}R^2}$ (2) $\frac{1}{4\pi\varepsilon_0}\frac{2q}{3R^2}$ (3) $\frac{1}{4\pi\varepsilon_0}\frac{2q}{3\sqrt{3}R^2}$ (4) $\frac{1}{4\pi\varepsilon_0}\frac{3q}{2\sqrt{3}R^2}$

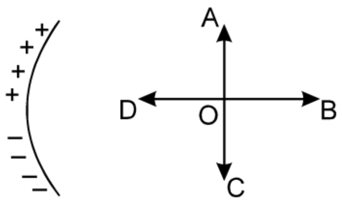
15. A charged particle of charge q and mass m is released from rest in an uniform electric field E. Neglecting the effect of gravity, the kinetic energy of the charged particle after time 't' seconds is

(1) $\frac{Eqm}{t}$ (2) $\frac{E^2q^2t^2}{2m}$ (3) $\frac{2E^2t^2}{mq}$ (4) $\frac{Eq^2m}{2t^2}$

16. The electric field above a uniformly charged nonconducting sheet is E. If the nonconducting sheet is now replaced by a conducting sheet, with the charge same as before, the new electric field at the same point is :

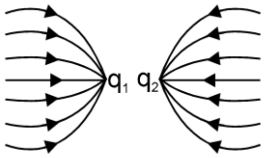
(1) 2E (2) E (3) $\frac{E}{2}$ (4) None of these

17. The linear charge density on upper half of a segment of ring is λ and at lower half, it is – λ. The direction of electric field at centre O of ring is :



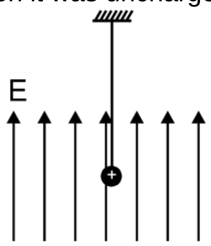
(1) along OA (2) along OB (3) along OC (4) along OD

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



(1) Both are negative
(2) Both are positive
(3) q_1 is positive but q_2 is negative
(4) q_1 is negative but q_2 is positive

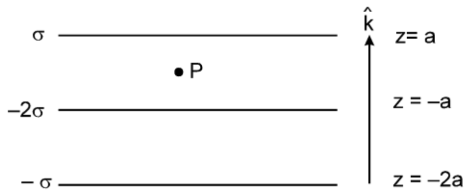
19. A positively charged pendulum is oscillating in a uniform electric field as shown in Figure. Its time period of SHM as compared to that when it was uncharged. (mg > qE)



(1) Will increase
(2) Will decrease
(3) Will not change
(4) Will first increase then decrease

20. A $+q_1$ charge is at centre of an imaginary spherical Gaussion surface 'S', and $-q_1$ charge is placed nearby this $+q_1$ charge inside 'S'. A charge $+q_2$ is located outside this Gaussian surface. Then electric field on Gaussian surface will be
(1) due to $-q_1$ & q_2 (2) uniform (3) due to all charges (4) zero

21. Three large parallel plates have uniform surface charge densities as shown in the figure. Find out electric field intensity at point P.



(1) $-\frac{4\sigma}{\epsilon_0}\hat{k}$ (2) $\frac{4\sigma}{\epsilon_0}\hat{k}$ (3) $-\frac{2\sigma}{\epsilon_0}\hat{k}$ (4) $\frac{2\sigma}{\epsilon_0}\hat{k}$

22. The wrong statement about electric lines of force is -
(1) These originate from positive charge and end on negative charge
(2) they do no intersect each other at a point
(3) they have the same form for a point charge and a sphere(outside the sphere)
(4) they have physical existences

23. The insulation property of air breaks down at intensity as 3×10^{6} V/m. The maximum charge that can be given to a sphere of diameter 5 m is :
(1) 2×10^{-2} C (2) 2×10^{-3} C (3) 2×10^{-4} C (4) 0

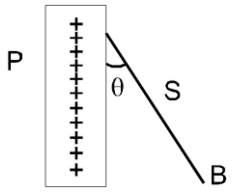
24. Choose correct statement regarding electric lines of force :
(1) emerges from (–υe) charge and meet from (+υe) charge
(2) where the electric lines of force are close electic field in that region is strong
(3) just as it is shown for a point system in the same way it represent for a solid sphere
(4) has a physical nature

25. The electric field required to keep a water drop of mass m and charge e just to remain suspended is :
(1) mg (2) emg (3) $\frac{mg}{e}$ (4) $\frac{em}{g}$

26. Two parallel large thin metal sheets have equal surface charge densities ($\sigma = 26.4 \times 10^{-12}\ C/m^2$) of opposite signs. The electric field between these sheets is

(1) 1.5 N/C (2) 1.5×10^{-10} N/C (3) 3 N/C (4) 3×10^{-10} N/C

27. A charged ball B hangs from a silk thread S, which makes an angle θ with a large charged conducting sheet P, as shown in the figure. The surface charge density σ of the sheet is proportional to

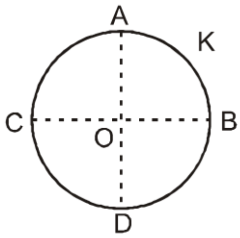


(1) cot θ (2) cos θ (3) tan θ (4) sin θ

28. The electric potential at a point in free space due to a charge Q coulomb is $Q \times 10^{11}$ V. The electric field at that point is

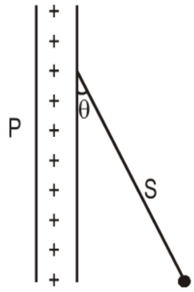
(1) $4\pi \varepsilon_0 Q \times 10^{22}$ V/m (2) $12\pi \varepsilon_0 Q \times 10^{20}$ V/m (3) $4\pi \varepsilon_0 Q \times 10^{20}$ V/m (4) $12\pi \varepsilon_0 Q \times 10^{22}$ V/m

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



(1) 3E along KO (2) E along OK (3) E along KO (4) 3 E along OK

30. A charged ball B hangs from a silk thread S, which makes an angle θ with a large charged conducting sheet P, as shown in the figure. The surface charge density σ of the sheet is proportional to:



(1) sin θ (2) tanθ (3) cosθ (4) cot θ

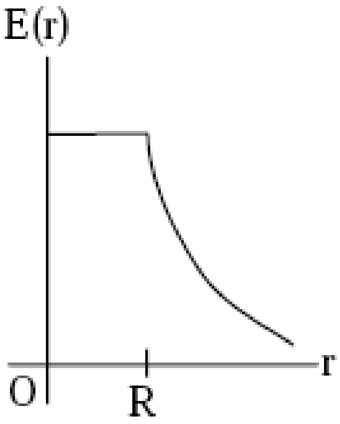
31. Two point charges + 8 q and – 2q are located at x = 0 and x = L respectively. The location of a point on the x axis at which the net electric field due to these two point charges is zero is:

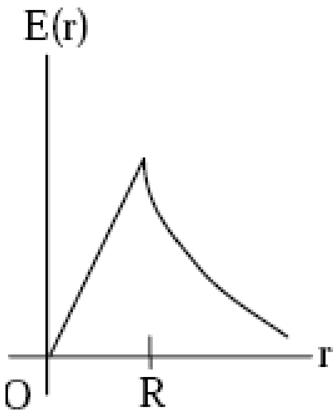
(1) 8L (2) 4L (3) 2L (4) L/4

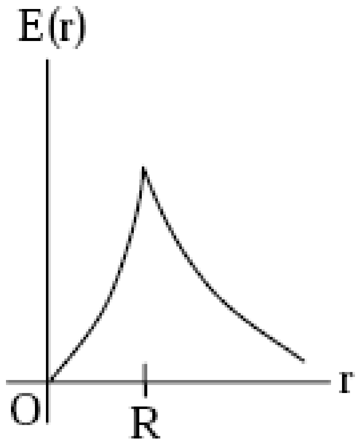
32. Two spherical conductors A and B of radii 1 mm and 2mm are separated by a distance of 5 cm and are uniformly charged. If the spheres are connected by a conducting wire then in equilibrium condition, the ratio of the magnitude of the electric fields at the surfaces of sphere A and B is :

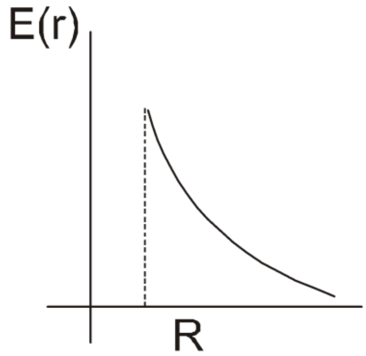
(1) 2 : 1 (2) 1 : 4 (3) 4 : 1 (4) 1 : 2

33. 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?

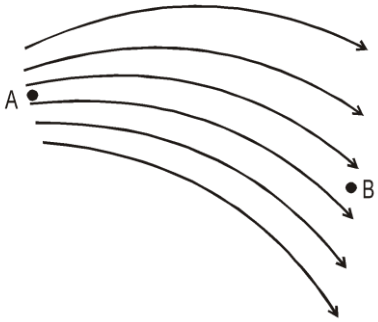
(1) 

(2) 

(3) 

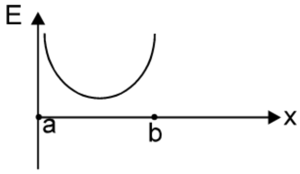
(4) 

34. The figure shows the electric lines of force emerging from a charged body. If the electric fields at A and B are E_A and E_B respectively and if the distance between A and B is r, then



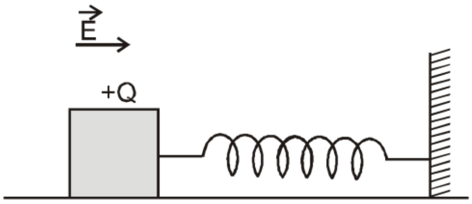
(1) $E_A < E_B$ (2) $E_A > E_B$ (3) $E_A = \frac{E_B}{r}$ (4) $E_A = \frac{E_B}{r^2}$

35. Two point charges a & b, whose magnitudes are same are positioned at a certain distance from each other with a at origin. Graph is drawn between electric field strength at points between a & b and distance x from a. E is taken positive if it is along the line joining from a to b. From the graph, it can be decided that



(1) a is positive, b is negative
(2) a and b both are positive
(3) a and b both are negative
(4) a is negative, b is positive

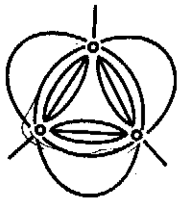
36. A wooden block performs SHM on a frictionless surface with frequency, ν_0. The block carries a charge +Q on its surface. If now a uniform electric field *E* is switched-on as shown, then the SHM of the block will be



(1) of the same frequency and with shifted mean position.
(2) of the same frequency and with the same mean position.
(3) of changed frequency and with shifted mean position.
(4) of changed frequency and with the same mean position.

37. A charged oil drop is suspended in uniform field of 3×10^4 V/m so that it neither falls nor rises. The charge on the drop will be (Take the mass of the drop = 9.9×10^{-15} kg and g = 10 m/s^2)
(1) 3.3×10^{-18} C (2) 3.2×10^{-18} C (3) 1.6×10^{-18} C (4) 4.8×10^{-18} C

38. Three positive charges of equal value q are placed at the vertices of an equilateral triangle. The resulting lines of force should be sketched as in :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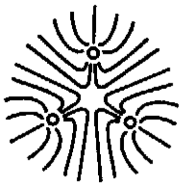
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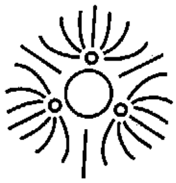
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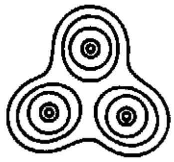
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SECTION (C) : ELECTRIC POTENTIAL AND POTENTIAL DIFFERENCE

1. If we move in a direction opposite to the electric lines of force :
(1) electrical potential decreases. (2) electrical potential increases.
(3) electrical potential remains uncharged (4) nothing can be said.

2. The distance between two plates is 2 cm, when an electric potential of 10 volt is applied to both the plates, then the value of electric field will be -
(1) 20 N/C (2) 500 N/C (3) 5 N/C (4) 250 N/C

3. Two objects A and B are charged with equal charge Q. The potential of A relative to B will be -
(1) more (2) equal (3) less (4) indefinite

4. In electrostatics the potential is equivalent to -
(1) temperature in heat (2) height of levels in liquids
(3) pressure in gases (4) all of the above

5. The potential due to a point charge at distance r is -
(1) proportional to r. (2) inversely proportional to r.
(3) proportional to r^2. (4) inversely proportional to r^2

6. The dimensions of potential difference are -
(1) $ML^2T^{-2}Q^{-1}$ (2) $MLT^{-2}Q^{-1}$ (3) $MT^{-2}Q^{-2}$ (4) $ML^2T^{-1}Q^{-1}$

7. An object is charged with positive charge. The potential at that object will be -
(1) positive only (2) negative only
(3) zero always (4) may be positive, negative or zero.

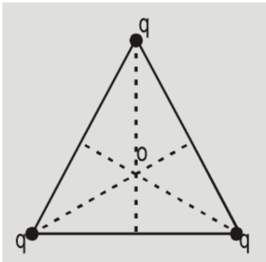
8. Two points (0, a) and (0, -a) have charges q and -q respectively then the electrical potential at origin will be-

(1) zero (2) kq/a (3) kq/2a (4) $kq/4a^2$

9. The charges of same magnitude q are placed at four corners of a square of side a. The value of potential at the centre of square will be -

(1) 4kq/a (2) $4\sqrt{2}kq/a$ (3) $4kq\sqrt{2a}$ (4) $kq/a\sqrt{2}$

10. Three equal charges are placid at the three corners of an isosceles triangle as shown in the figure. The statement which is true for electric potential V and the field intensity E at the centre of the triangle -



(1) V = 0, E = 0 (2) V = 0, E ≠ 0 (3) V ≠ 0, E = 0 (4) V ≠ 0, E ≠ 0

11. The potential at 0.5 Å from a proton is -

(1) 0.5 volt (2) 8μ volt (3) 28.8 volt (4) 2 volt

12. A wire of 5 m length carries a steady current. If it has an electric field of 0.2 V/m, the potential difference across the wire in volt will be -

(1) 25 (2) 0.04 (3) 1.0 (4) none of the above

13. An infinite number of charges of equal magnitude q, but alternate charge of opposite sign are placed along the x-axis at x = 1, x = 2, x = 4, x =8,... and so on. The electric potential at the point x = 0 due to all these charges will be -

(1) kq/2 (2) kq/3 (3) 2kq/3 (4) 3kq/2

14. The electric potential inside a uniformly positively charged non conducting solid sphere has the value which -

(1) increase with increases in distance from the centre.
(2) decreases with increases in distance from the centre.
(3) is equal at all the points.
(4) is zero at all the points.

15. Two metallic spheres which have equal charges, but their radii are different, are made to touch each other and then separated apart. The potential the spheres will be -

(1) same as before (2) more for bigger (3) more for smaller (4) equal

16. Two spheres of radii R and 2R are given source equally positive charged and then connected by a long conducting wire, then the positive charge will

(1)flow from smaller sphere to the bigger sphere (2) flow from bigger sphere to the smaller sphere
(3) not flow. (4) oscillate between the spheres.

17. The potential difference between two isolated spheres of radii r_1 and r_2 is zero. The ratio of their charges Q_1/Q_2 will be-

(1) r_1/r_2 (2) r_2/r_1 (3) r_1^2/r_2^2 (4) r_1^3/r_2^3

18. The potential on the conducting spheres of radii r_1 and r_2 is same, the ratio of their charge densities will be-

(1) r_1/r_2 (2) r_2/r_1 (3) r_1^2/r_2^2 (4) r_2^2/r_1^2

19. 64 charged drops coalesce to from a bigger charged drop. The potential of bigger drop will be times that of smaller drop -

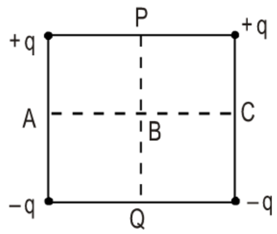
(1) 4 (2) 16 (3) 64 (4) 8

20. The electric potential outside a uniformly charged sphere at a distance 'r' is ('a' being the radius of the sphere)-
(1) directly proportional to a^3
(2) directily proportional to r.
(3) inversely proportional to r.
(4) inversely proportional to a^3.

21. A conducting shell of radius 10 cm is charged with 3.2×10^{-19} C. The electric potential at a distance 4cm from its centre in volt be -
(1) 9×10^{-9}
(2) 288
(3) 2.88×10^{-8}
(4) zero

22. At a certain distance from a point charge the electric field is 500 V/m and the potential is 3000 V. What is the distance ?
(1) 6 m
(2) 12 m
(3) 36 m
(4) 144 m

23. Figure represents a square carrying charges +q, +q, –q, –q at its four corners as shown. Then the potential will be zero at points



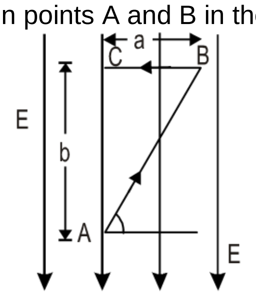
(1) A, B, C, P and Q
(2) A, B and C
(3) A, P, C and Q
(4) P, B and Q

24. Two equal positive charges are kept at points A and B. The electric potential at the points between A and B (excluding these points) is studied while moving from A to B. The potential
(1) continuously increases
(2) continuosly decreases
(3) increases then decreases
(4) decreases than increases

25. A semicircular ring of radius 0.5 m is uniformly charged with a total charge of 1.5×10^{-9} coul. The electric potential at the centre of this ring is :
(1) 27 V
(2) 13.5 V
(3) 54 V
(4) 45.5 V

26. The kinetic energy which an electron acquires when accelerated (from rest) through a potential difference of 1 volt is called :
(1) 1 joule
(2) 1 electron volt
(3) 1 erg
(4) 1 watt

27. The potential difference between points A and B in the given uniform electric field is :



(1) Ea
(2) $E\sqrt{(a^2+b^2)}$
(3) Eb
(4) $(Eb/\sqrt{2})$

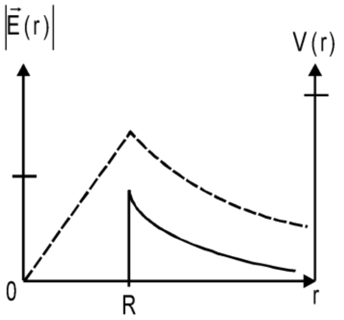
28. A particle of charge Q and mass m travels through a potential difference V from rest. The final momentum of the particle is :
(1) $\frac{mV}{Q}$
(2) $2Q\sqrt{mV}$
(3) $\sqrt{2m\ QV}$
(4) $\sqrt{\frac{2QV}{m}}$

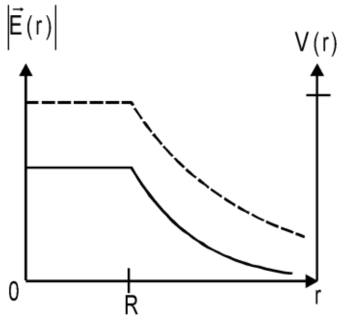
29. If a uniformly charged spherical shell of radius 10 cm has a potential V at a point distant 5 cm from its centre, then the potential at a point distant 15 cm from the centre will be :
(1) $\frac{V}{3}$
(2) $\frac{2V}{3}$
(3) $\frac{3}{2}V$
(4) 3V

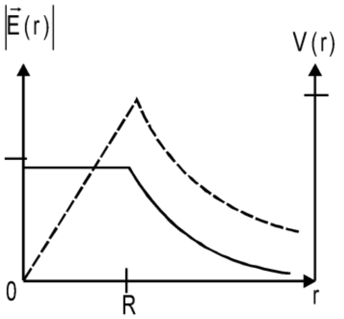
30. A hollow conducting sphere of radius R has a charge (+Q) on its surface. What it the electric potential within the sphere at a distance r = $\frac{R}{3}$ from its centre -

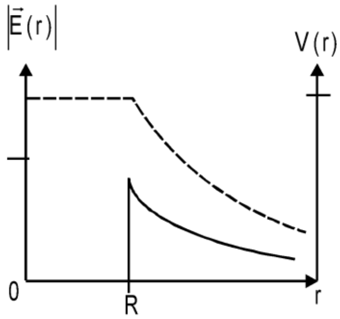
(1) zero (2) $\frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$ (3) $\frac{1}{4\pi\varepsilon_0}\frac{Q}{R}$ (4) $\frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}$

31. Consider a thin spherical shell of radius R with its centre at the origin, carrying uniform positive surface charge density. The variation of the magnitude of the electric field $|\vec{E}(r)|$ and the electric potential V(r) with the distance r from the centre, is best represented by which graph?

(1)


(2)


(3)


(4)


32. Electric field at point 20 cm away from the centre of dielectric sphere is 100 V/m, radius of sphere is 10 cm, then value of electric field at a distance 3 cm from the centre is :

(1) 100 V/m (2) 125 V/m (3) 120 V/m (4) 0

33. If n drops of potential V merge, find new potential on the big drop :

(1) $n_{2/3}$ V (2) $n_{1/3}$ V (3) nV (4) $V_{n/3}$

34. Two conducting spheres of radii R_1 and R_2 respectively are charged and joined by a wire. The ratio of electric fields of spheres is

(1) $\frac{R_2^2}{R_1^2}$ (2) $\frac{R_1^2}{R_2^2}$ (3) $\frac{R_2}{R_1}$ (4) $\frac{R_1}{R_2}$

35. Charge on a sphere of radius R is q and on the sphere of radius 2R is –2q. If these spheres are connected through a conducting wire then, amount of charge flown through wire will be :

(1) $-\frac{q}{3}$ (2) $\frac{2q}{3}$ (3) q (4) $\frac{4q}{3}$

36. Two identical conducting spheres R and S have negative charges Q_1 and Q_2 respectively, but Q_1 Q_2. The spheres are brought to touch each other and then kept in their original positions, now the force between them is

(1) greater than that before the spheres touched (2) less than that before the spheres touched
(3) same as that before the spheres (4) zero

37. 27 smaller drop combine to form a bigger drop if potential on smaller drop is v then potential on bigger drop will be-

(1) 9V (2) 3V (3) 27V (4) 1/3V

38. A thin spherical conducting shell of radius R has a charge q. Another charge Q is placed at the centre of the shell. The electrostatic potential at a point P at a distance R/2 from the centre of the shell is :

(1) $\frac{2Q}{4\pi\varepsilon_0 R}$ (2) $\frac{2Q}{4\pi\varepsilon_0 R} - \frac{2q}{4\pi\varepsilon_0 R}$ (3) $\frac{2Q}{4\pi\varepsilon_0 R} + \frac{q}{4\pi\varepsilon_0 R}$ (4) $\frac{(q+Q)}{4\pi\varepsilon_0 R}\ \frac{2}{R}$

39. A charged oil drop is suspended in uniform field of 3×10^4 V/m so that it neither falls nor rises. The charge on the drop will be : (take the mass of the charge = 9.9×10^{-15} kg, g = 10m/sec^2)

(1) 3.3×10^{-18} C (2) 3.2×10^{-18} C (3) 1.6×10^{-18} C (4) 4.8×10^{-18} C

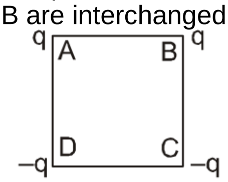
40. Two thin wire rings, each having a radius R are placed at a distance d apart with their axes coinciding. The charges on the two rings are + q and –q. The potential difference between the centers of the two rings is:

(1) zero (2) $\frac{q}{4\pi\varepsilon_0}\left[\frac{1}{R} - \frac{1}{\sqrt{R^2+d^2}}\right]$ (3) $\frac{qR}{4\pi\varepsilon_0 d^2}$ (4) $\frac{q}{2\pi\varepsilon_0}\left[\frac{1}{R} - \frac{1}{\sqrt{R^2+d^2}}\right]$

41. An electric charge 10^{-3}μC is placed at the origin (0, 0) of X–Y co-ordinate system. Two points A and B are situated at $\left(\sqrt{2}, \sqrt{2}\right)$ and (2, 0) respectively. The potential difference between the points A and B will be

(1) 9 volt (2) zero (3) 2 volt (4) 4.5 volt

42. Charges are placed on the vertices of a square as shown. Let $\vec{E}$ be the electric field and V the potential at the centre. If the charges on A and B are interchanged with those on D and C respectively, then



(1) $\vec{E}$ remains unchanged, V changes (2) Both $\vec{E}$ and V change

(3) $\vec{E}$ and V remain unchanged (4) $\vec{E}$ changes, V remains unchanged

43. A hollow uniformly charged sphere has radius r. If the potential difference between its surface and a point at distance 3r from the centre is V, then the electric field intensity at a distance 3r from the centre is:

(1) V/6r (2) V/4r (3) V/3r (4) V/2r

44. A hollow sphere of radius 5 cm is uniformly charged such that the potential on its surface is 10 volts then potential at centre of sphere will be :

(1) Zero (2) 10 volt

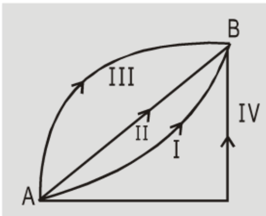
(3) Same as at a point 5 cm away from the surface (4) Same as at a point 25 cm away from the centre

SECTION (D) : ELECTRIC POTENTIAL ENERGY OF A PARTICLE

1. A nucleus has a charge of + 50e. A proton is located at a distance of 10^{-12} m. The potential at this point in volt will be -

(1) 14.4 x 10^4 (2) 7.2 x 10^4 (3) 7.2 x 10^{-12} (4) 14.4 x 10^8

2. Under the influence of charge, a point charge q is carried along different paths from a point A to point B, then work done will be -



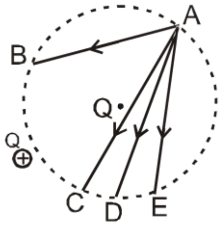
(1) maximum for path four. (2) maximum for path one.

(3) equal for all paths (4) minimum for path three.

3. An electron moving in a electric potential field V_1 enters a higher electric potential field V_2, then the change in kinetic energy of the electron is proportional to -

(1) $(V_2 — V_1)^{1/2}$ (2) $V_2 — V_1$ (3) $(V_2 — V_1)^2$ (4) $\frac{(V_2 - V_1)}{V_2}$

4. In the electric field of charge Q, another charge is carried from A to B. A to C, A to D and A to E, then work done will be -



(1) minimum along path AB. (2) minimum along path AD.
(3) minimum along path AE. (4) zero along all the paths.

5. The work done to take an electron from rest where potential is – 60 volt to another point where potential is – 20 volt is given by -
(1) 40 eV (2) –40 eV (3) 60 eV (4) –60 eV

6. If a charge is shifted from a low potential region to high potential region. the electrical potential energy:
(1) Increases (2) Decreases
(3) Remains constant (4) May increase or decrease.

7. A particle A has charge +q and particle B has charge + 4q with each of them having the same mass m. When allowed to fall from rest through same electrical potential difference, the ratio of their speed $v_A : v_B$ will be :
(1) 2 : 1 (2) 1 : 2 (3) 4 : 1 (4) 1 : 4

8. In an electron gun, electrons are accelerated through a potential difference of V volt. Taking electronic charge and mass to be respectively e and m, the maximum velocity attained by them is :
(1) $\frac{2eV}{m}$ (2) $\sqrt{\frac{2eV}{m}}$ (3) 2 m/eV (4) $(V^2 /2em)$

9. In a cathode ray tube, if V is the potential difference between the cathode and anode, the speed of the electrons, when they reach the anode is proportional to : (Assume initial velocity = 0)
(1) V (2) 1/V (3) $\sqrt{V}$ (4) V^2

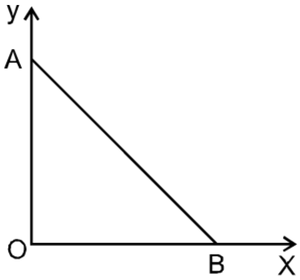
10. An electron of mass m and charge e is accelerated from rest through a potential difference V in vacuum . The final speed of the electron will be -
(1) $V\sqrt{e/m}$ (2) $\sqrt{eV/m}$ (3) $\sqrt{2eV/m}$ (4) 2eV/m

11. Positive and negative point charges of equal magnitude are kept at $\left(0, 0, \frac{a}{2}\right)$ and $\left(0, 0, \frac{-a}{2}\right)$, respectively. The work done by the electric field when another positive point charge is moved from (–a, 0, 0) to (0, a, 0) is
(1) positive (2) negative
(3) zero
(4) depends on the path connecting the initial and final positions.

12. If a positive charge is shifted from a low potential region to a high potential region, then electric potential energy
(1) decreases (2) increases (3) remains the same (4) may increase or decrease

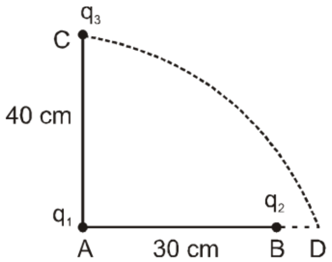
13. An electron is accelerated by 1000 volt, potential difference, its final velocity is :
(1) 3.8×10^7 m/s (2) 1.9×10^6 m/s (3) 1.9×10^7 m/s (4) 5.7×10^7 m/s

14. As per this diagram a point charge +q is placed at the origin O. Work done in taking another point charge –Q from the point A [co-ordiantes (o,a)] to another point B [co-ordinates(a,o)] along the straigth path AB is :



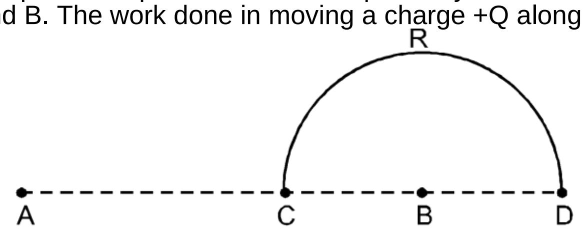
(1) zero (2) $\left(\frac{-qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\sqrt{2}a$ (3) $\left(\frac{qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right).\frac{a}{\sqrt{2}}$ (4) $\left(\frac{qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\sqrt{2}a$

15. Two charges q_1 and q_2 are placed 30 cm apart, as shown in the figure. A third charge q_3 is moved along the arc of a circle of radius 40 cm from C to D. The change in the potential energy of the system is $\frac{q_3}{4\pi\varepsilon_0}$ k, where k is :



(1) $8q_2$ (2) $8q_1$ (3) $6q_2$ (4) $6q_1$

16. Charges +q and –q are placed at points A and B respectively which are a distance 2 L apart, C is the midpoint between A and B. The work done in moving a charge +Q along the semicircle CRD is :

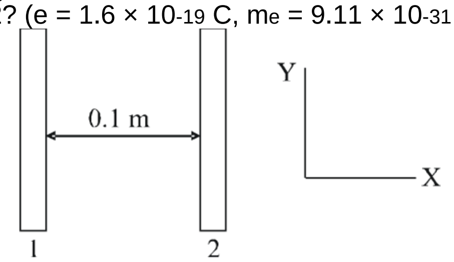


(1) $\frac{qQ}{4\pi\varepsilon_0 L}$ (2) $\frac{qQ}{2\pi\varepsilon_0 L}$ (3) $\frac{qQ}{6\pi\varepsilon_0 L}$ (4) $-\frac{qQ}{6\pi\varepsilon_0 L}$

17. A charged particle 'q' is shot towards another charged particle 'Q', which is fixed, with a speed 'v'. It approaches 'Q' upto a closest distance r and then returns. If q were given a speed of '2v', the closest distance of approach would be :

(1) r (2) 2r (3) $\frac{r}{2}$ (4) $\frac{r}{4}$

18. Two insulating plates are both uniformly charged in such a way that the potential difference between them is $V_2 - V_1 = 20$ V. (i.e. plate 2 is at a higher potential). The plates are separated by d = 0.1 m and can be treated as infinitely large. An electron is released from rest on the inner surface of plate 1. What is its speed when it hits plate 2? ($e = 1.6 \times 10^{-19}$ C, $m_e = 9.11 \times 10^{-31}$ kg)



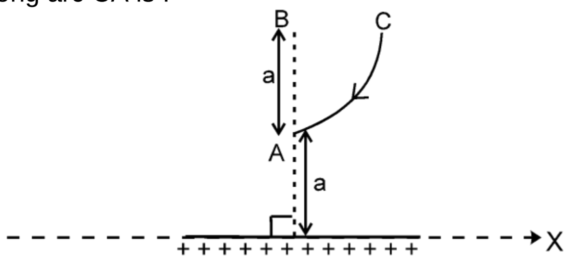
(1) 1.87×10^6 m/s (2) 32×10^{-19} m/s (3) 2.65×10^6 m/s (4) 7.02×10^{12} m/s

19. A particle of mass 2 g and charge 1μC is held at rest on a frictionless horizontal surface at a distance of 1 m from a fixed charge of 1 mC. If the particle is released it will be repelled. The speed of the particle when it is at distance of 10 m from the fixed charge is:

(1) 100 m/s (2) 90 m/s (3) 60 m/s (4) 45 m/s

20. On moving a charge of 20 coulombs by 2 cm, 2 J of work is done, then the potential difference between the points is :
(1) 0.1 V (2) 8 V (3) 2 V (4) 0.5 V

21. For an infinite line of charge having charge density λ lying along x-axis, the work required in moving charge q from C to A along arc CA is :



(1) $\frac{q\lambda}{\pi\varepsilon_0}\log_e\sqrt{2}$ (2) $\frac{q\lambda}{4\pi\varepsilon_0}\log_e\sqrt{2}$ (3) $\frac{q\lambda}{4\pi\varepsilon_0}\log_e 2$ (4) $\frac{q\lambda}{2\pi\varepsilon_0}\log_e\frac{1}{2}$

22. A flat circular fixed disc has a charge +Q uniformly distributed on the disc. A charge +q is thrown with kinetic energy K, towards the disc along its axis. The charge q :
(1) may hit the disc at the centre
(2) may return back along its path after touching the disc
(3) may return back along its path without touching the disc
(4) any of the above three situations is possible depending on the magnitude of K

SECTION (E) : POTENTIAL ENERGY OF A SYSTEM OF POINT CHARGE

1. In H atom, an electron is rotating around the proton in an orbit of radius r. Work done by an electron in moving once around the proton along the orbit will be -
(1) ke/r (2) ke^2/r^2 (3) 2πre (4) zero

2. You are given an arrangement of three point charges q, 2q and xq separated by equal finite distances so that electric potential energy of the system is zero. Then the value of x is :
(1) $-\frac{2}{3}$ (2) $-\frac{1}{3}$ (3) $\frac{2}{3}$ (4) $\frac{3}{2}$

3. You are given an arrangement of three point charges q, 2q and xq separated by equal finite distances so that electric potential energy of the system is zero. Then the value of x is :
(1) $-\frac{2}{3}$ (2) $-\frac{1}{3}$ (3) $\frac{2}{3}$ (4) $\frac{3}{2}$

4. If a charge q is placed at the centre of the line joining two equal charges Q each such that the system is in equilibrium, then the value of q is :
(1) Q / 2 (2) –Q/2 (3) Q / 4 (4) –Q/4

SECTION (F) : SELF ENERGY AND ENERGY DENSITY

1. A sphere of radius 1 cm has potential of 8000 V. The energy density near the surface of sphere will be:
(1) 64×10^5 J/m^3 (2) 8×10^3 J/m^3 (3) 32 J/m^3 (4) 2.83 J/m^3

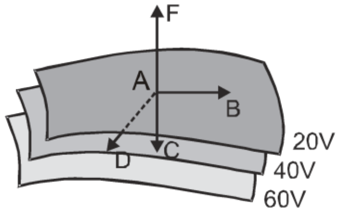
2. If 'n' identical water drops assumed spherical each charged to a potential energy U coalesce to a single drop, the potential energy of the single drop is(Assume that drops are uniformly charged):
(1) $n^{1/3}$ U (2) $n^{2/3}$ U (3) $n^{4/3}$ U (4) $n^{5/3}$ U

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

(1) $-\frac{Q}{4}(1+2\sqrt{2})$ (2) $\frac{Q}{4}(1+2\sqrt{2})$ (3) $-\frac{Q}{2}(1+2\sqrt{2})$ (4) $\frac{Q}{2}(1+2\sqrt{2})$

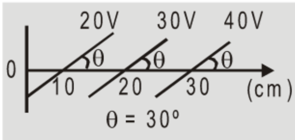
SECTION (G) : QUESTIONS BASED ON RELATION BETWEEN $\vec{E}$ AND V :

1. A family of equipotential surfaces are shown. The direction of the electric field at point A is along -



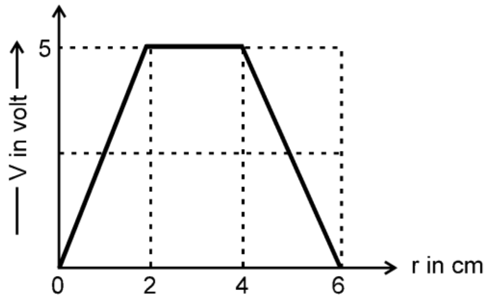
(1) AB (2) AC (3) AD (4) AF

2. Some equipotential surfaces are shown in the figure. The magnitude and direction of the electric field is-



(1) 100 V/m making angle 120_0 with the x-axis (2) 100 V/m making angle 60_0 with the x-axis
(3) 200 V/m making angle 120_0 with the x-axis (4) none of the above

3. The variation of potential with distance r from a fixed point is shown in Figure. The electric field at r = 5 cm, is :



(1) (2.5) V/cm (2) (–2.5) V/cm (3) (–2/5) cm (4) (2/5) V/cm

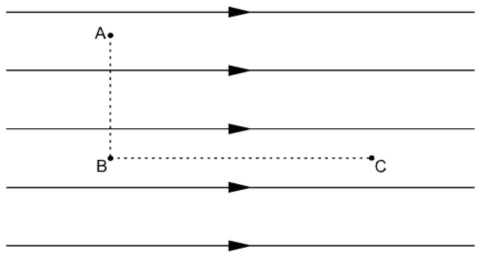
4. The electric field and the electric potential at a point are E and V respectively
(1) If E = 0, V must be zero (2) If V = 0, E must be zero
(3) If E ≠ 0, V cannot be zero (4) None of these

5. The electric field in a region is directed outward and is proportional to the distance r from the origin. Taking the electric potential at the origin to be zero, the electric potential at a distance r :
(1) is uniform in the region (2) is proportional to r
(3) is proportional to r_2 (4) increases as one goes away from the origin.

6. V = axy, then electric field at a point will be proportional to :
(1) r (2) r_{-1} (3) r_{-2} (4) r_2

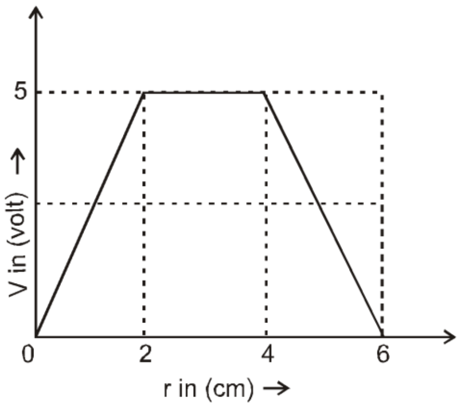
7. A point charge is located at O. There is a point P at a distance r from it. The electric field at point P is 500 V/m and a potential of 3000 V. Then the value of r is
(1) 6 m (2) 12 m (3) 24 m (4) 36 m

8. Figure shows three points A,B and C in a region of uniform electric field $\vec{E}$. The line AB is perpendicular and BC is parallel to the field lines. Then which of the following holds good ?



(1) $V_A = V_B = V_C$ (2) $V_A = V_B > V_C$ (3) $V_A = V_B < V_C$ (4) $V_A > V_B = V_C$
where $V_A > V_B$ and V_C represent the electric potential at points A,B and C respectively.

9. The variation of potential with distance r from a fixed point is shown in figure. The electric field at r = 3 cm is :



(1) zero (2) –2.5 V/cm (3) +2.5 V/cm (4) +5 V/cm

10. Electric potential at any point is V = –5x + 3y + $\sqrt{15}z$, then the magnitude of the electric field is -
(1) $3\sqrt{2}$ (2) $4\sqrt{2}$ (3) $5\sqrt{2}$ (4) 7

11. The potential at a point x (measured in μm) due to some charges situated on the x-axis is given by $V(x) = 20/(x^2 – 4)$ volts. The electric field E at x = 4 μm is given by :
(1) 5/3 volt/μm and in the –ve x direction (2) 5/3 volt/μm and in the +ve x direction
(3) 10/9 volt/μm and in the –ve x direction (4) 10/9 volt/μm and in the +ve x direction

12. The electric potential V as a function of distance x (in metre) is given by
$V = (5x^2 + 10x – 9)$ volt.
The value of electric field at x = 1 m would be :
(1) – 20 volt/m (2) 6 volt/m (3) 11 volt/m (4) –23 volt/m

13. A uniform electric field having a magnitude E_0 and direction along positive X-axis exists. If the electric potential V is zero at x = 0, then its value at x = +x will be :
(1) $V_x = xE_0$ (2) $V_x = –xE_0$ (3) $V_x = x^2E_0$ (4) $V_x = –x^2 E_0$

14. A uniform electric field pointing in positive x-direction exists in a region. Let A be the origin, B be the point on the x-axis at x = + 1 cm and C be the point on the y-axis at y = + 1 cm. Then the potentials at the points A, B & C satisfy :
(1) $V_A < V_B$ (2) $V_A > V_B$ (3) $V_A < V_C$ (4) $V_A > V_C$

15. A 5 coulomb charge experiences a constant force of 2000 N when moved between two points separated by a distance of 2 cm in a uniform electric field. The potential difference between these two points is:
(1) 8 V (2) 200 V (3) 800 V (4) 20,000 V

16. An equipotential surface and an electric line of force :
(1) never intersect each other (2) intersect at 45º
(3) intersect at 60º (4) intersect at 90º

SECTION (H) : DIPOLE

1. If an electric dipole is kept in a non-uniform electric field, then it will experience -
(1) only torque (2) no torque
(3) a resultant force and a torque (4) only a force

2. The force on a charge situated on the axis of a dipole is F. If the charge is shifted to double the distance, the acting force will be -
(1) 4F (2) F/2 (3) F/4 (4) F/8

3. A dipole of dipole moment p, is placed in an electric field $\vec{E}$ and is in stable equilibrium. The torque required to rotate the dipole from this position by angle θ will be -
(1) pE cos θ (2) pE sin θ (3) pE tan θ (4) –pE cosθ

4. The electric potential at a point due to an electric dipole will be -
(1) $\frac{k(\vec{p}.\vec{r})}{r^3}$ (2) $\frac{k(\vec{p}.\vec{r})}{r^2}$ (3) $\frac{k(\vec{p}\times\vec{r})}{r}$ (4) $\frac{k(\vec{p}\times\vec{r})}{r^2}$

5. The ratio of electric fields due to an electric dipole on the axis and on the equatorial line at equal distance will be -
(1) 4 : 1 (2) 1 : 2 (3) 2 : 1 (4) 1 : 1

6. An electric dipole is made up of two equal and opposite charges of 2×10^{-6} coulomb at a distance of 3 cm. This is kept in an electric field of 2×10^{5} N/C, then the maximum torque acting on the dipole -
(1) 12×10^{-1} Nm (2) 12×10^{-3} Nm (3) 24×10^{-3} Nm (4) 24×10^{-1} Nm

7. The distance between two singly ionised atoms is 1Å. If the charge on both ions is equal and opposite then the dipole moment in coulomb-metre is -
(1) 1.6×10^{-29} (2) 0.16×10^{-29} (3) 16×10^{-29} (4) $1.6 \times 10^{-29}/ 4\pi\varepsilon_0$

8. The electric potential in volt at a distance of 0.01 m on the equatorial line of an electric dipole of dipole moment p is -
(1) $p / 4\pi \epsilon_0 \times 10^{-4}$ (2) zero (3) $4\pi \epsilon_0\ p \times 10^{-4}$ (4) $4\pi \epsilon_0 /p \times 10^{-4}$

9. The electric potential in volt due to an electric dipole of dipole moment 2×10^{-8} C-m at a distance of 3m on a line making an angle of 60^{0} with the axis of the dipole is -
(1) 0 (2) 10 (3) 20 (4) 40

10. 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 :
(1) zero (2) π/2 (3) π (4) π/4

11. Potential due to an electric dipole at some point is maximum or minimum, when axis of dipole and line joining point & dipole are at angles respectively :
(1) 90° and 180° (2) 0° and 90° (3) 90° and 0° (4) 0° and 180°

12. Electric field on the axis of electric dipole, at a distance of r from its centre is E. If dipole is rotated through 90°; then electric field intensity at the same point will be :
(1) E (2) $\frac{E}{4}$ (3) $\frac{E}{2}$ (4) 2E

13. An electric dipole is placed along North-South direction in a sphere filled with water. Which statement is true.
(1) Electric flux is coming towards sphere.
(2) Electric flux is out going out of the sphere
(3) As much electric flux is going out of the sphere, as much is coming toward the sphere.

(4) Water do not allow electric flux to come inside the sphere

14. At the equator of electric dipole, angle between electric dipole moment and electric field is :
(1) 0° (2) 90° (3) 180° (4) None of these

15. The potential of dipole at its axial position is proportional to distance r as :
(1) r^{-2} (2) r^{-1} (3) r (4) r^0

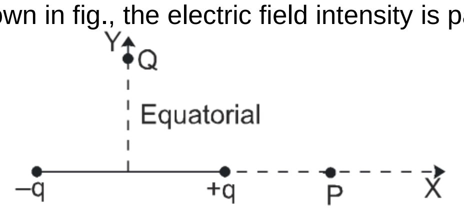
16. An electric dipole has the magnitude of its charge as q and its dipole moment is p. It is placed in a uniform electric field E. If its dipole moment is along the direction of the field, the force on it and its potential energy are respectively :
(1) 2qE and minimum (2) qe and pE (3) zero and minimum (4) qE and maximum

17. An electric dipole of moment $\vec{p}$ is lying along a unifrom electric field $\vec{E}$. The work done in rotating the dipole by 90° is :
(1) $\sqrt{2}$ pE (2) $\frac{pE}{2}$ (3) 2pE (4) pE

18. Three point charges +q, –2q and + q are placed at points (x = 0, y = a, z = 0), (x = 0, y = 0, z = 0) and (x = a, y = 0, z = 0), respectively. The magnitude and direction of the electric dipole moment vector of this charge assembly are :
(1) $\sqrt{2}$ qa along + y direction
(2) $\sqrt{2}$ qa along the line joining points (x = 0, y = 0, z = 0) and (x = a, y = a, z = 0)
(3) qa along the line joining points (x = 0, y = 0, z = 0) and (x = a, y = a, z = 0)
(4) $\sqrt{2}$ qa along + x direction

19. An electric dipole is placed at an angle of 30^o to a non-uniform electric field. The dipole will experience
(1) A torque as well as a translational force.
(2) A torque only.
(3) A translational force only in the direction of the field.
(4) A translational force only in a direction normal to the direction of the field.

20. Due to an electric dipole shown in fig., the electric field intensity is parallel to dipole axis :



(1) at P only (2) at Q only (3) both at P and at Q (4) neither at P nor at Q

21. An electric dipole consists of two opposite charges each of magnitude 1.0 μC, separated by a distance of 2.0 cm. The dipole is placed in an external electric field of 1.0×10^5 N/C. The maximum torque on the dipole is :
(1) 0.2×10^{-3} N-m (2) 1.0×10^{-3} N-m (3) 2.0×10^{-3} N-m (4) 4.0×10^{-3} N-m

22. Two opposite and equal charges of magnitude 4×10^{-8} coulomb each when placed 2×10^{-2} cm apart form a dipole. If this dipole is placed in an external electric field of 4×10^8 N/C, the value of maximum torque and the work required in rotating it through 180º from its initial orientation which is along electric field will be : (Assume rotation of dipole about an axis passing through centre of the dipole):
(1) 64×10^{-4} N-m and 44×10^{-4} J (2) 32×10^{-4} N-m and 32×10^{-4} J
(3) 64×10^{-4} N-m and 32×10^{-4} J (4) 32×10^{-4} N-m and 64×10^{-4} J

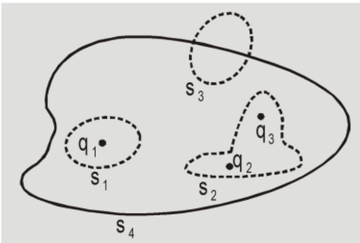
23. At a point on the axis (but not inside the dipole and not at infinity) of an electric dipole
(1) The electric field is zero
(2) The electric potential is zero
(3) Neither the electric field nor the electric potential is zero
(4) The electric field is directed perpendicular to the axis of the dipole

SECTION (I) : FLUX CALCULATION AND GAUSS'S LAW

1. For an electrostatic system which of the statement is always true :
(a) electric lines are parallel to metallic surface.
(b) electric field inside a metallic surface is zero.
(c) electric lines of force are perpendicular to equi-potential surface.
(1) (a) and (b) only (2) (b) and (c) only (3) (a) and (c) only (4) (a), (b) and (c)

2. Total flux coming out of some closed surface is :
(1) q/ε_0 (2) ε_0/q (3) $q\varepsilon_0$ (4) $\sqrt{q/\varepsilon_0}$

3. Three charges $q_1 = 1 \times 10^{-6}$, $q_2 = 2 \times 10^{-6}$, $q_3 = -3 \times 10^{-6}$ C have been placed, as shown in figure, in four surfaces S_1, S_2, S_3 and S_4 electrical flux emitted from the surface S_2 in N–m^2/C will be -



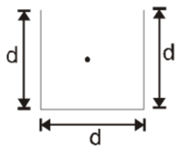
(1) $36\pi \times 10^3$ (2) $-36\pi \times 10^3$ (3) $36\pi \times 10^9$ (4) $-36\pi \times 10^9$

4. The intensity of an electric field at some point distant r from the axis of infinite long pipe having charges per unit length as q wil be :
(1) proportional to r^2 (2) proportional to r^3
(3) inversely proportional to r. (4) inversely proportional to r^2.

5. Eight charges, 1μC,. -7μC, -4μC, 10μC, 2μC, -5μC, -3μC and 6μC are situated at the eight corners of a cube of side 20 cm. A spherical surface of radius 80 cm encloses this cube. The centre of the sphere coincides with the centre of the cube. Then the total outgoing flux from the spherical surface (in unit of volt meter) is-
(1) $36\pi \times 10^3$ (2) $684\pi \times 10^3$ (3) zero (4) none of the above

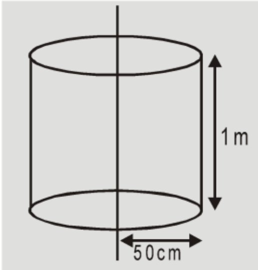
6. A closed cylinder of radius R and length L is placed in a uniform electric field E, parallel to the axis of the cylinder. Then the electric flux through the cylinder must be -
(1) $2\pi R^2E$ (2) $(2\pi R^2 + 2\pi RL)E$ (3) $2\pi RLE$ (4) zero

7. A charge q is placed at the centre of the cubical vessel (with one face open) as shown in figure. The flux of the electric field through the surface of the vessel is



(1) zero (2) q/ε_0 (3) $\frac{q}{4\varepsilon_0}$ (4) $5q/6\varepsilon_0$

8. Electric charge is uniformly distributed along a long straight wire of radius 1 mm. The charge per cm length of the wire is Q coulomb. Another cylindrical surface of radius 50 cm and length 1m symmetrically encloses the wire as shown in fig. The total electric flux passing through the cylindrical surface is -

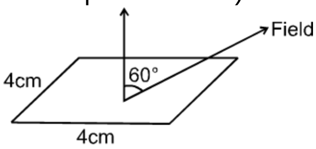


(1) $\frac{Q}{\varepsilon_0}$ (2) $\frac{100Q}{\varepsilon_0}$ (3) $\frac{10Q}{(\pi\varepsilon_0)}$ (4) $\frac{100Q}{(\pi\varepsilon_0)}$

9. If the geometric axis of cylinder is parallel to the electric field, the flux through the cylinder will be -
(1) $2\pi r \times B$ (2) $\pi r_2 \times B$ (3) $2\pi r_2 \times B$ (4) 0

10. A cubical box contains charge +Q at its centre. The total electric flux emerging from the box is :
(1) $\frac{Q}{\varepsilon_0}$ (2) $\frac{Q}{6\varepsilon_0}$ (3) $\frac{Q}{4\varepsilon_0}$ (4) $\varepsilon_0 Q$

11. If a square coil is making an angle 60° with electric field E according to figure, the electric flux passing through the square coil is (the side of square is 4 cm) :

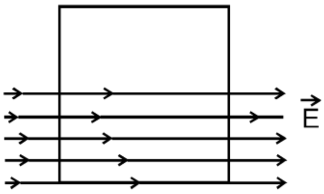


(1) 853 E (2) 8E (3) 16 E (4) none of these

12. Four equal charges q are placed at centre of a conducting hollow sphere. If they are displaced 1.5 cm from centre, the change in flux will be (Radius of sphere> 1.5 cm) :
(1) doubled (2) tripled (3) constant (4) none of these

13. If the electric flux entering and leaving an enclosed surface respectively is ϕ_1 and ϕ_2, the electric charge inside the surface will be
(1) $(\phi_2 - \phi_1)\ \varepsilon_0$ (2) $(\phi_1 + \phi_2)/\varepsilon_0$ (3) $(\phi_2 - \phi_1)/\ \varepsilon_0$ (4) $(\phi_1 + \phi_2)\ \varepsilon_0$

14. A square surface of side L m is in the plane of the paper. A uniform electric field $\vec{E}$ (V/m), also in the plane of the paper, is limited only to the lower half of the square suface, (see figure). The electric flux in SI units associated with the surface is :

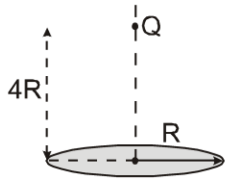


(1) $EL_2/\ (2\varepsilon_0)$ (2) $EL_2/\ 2$ (3) zero (4) EL_2

15. If the electric flux entering and leaving an enclosed surface respectively is ϕ_1 and ϕ_2, the electric charge inside the surface will be :
(1) $(\phi_2 - \phi_1)\varepsilon_0$ (2) $(\phi_1 + \phi_2)/\varepsilon_0$ (3) $(\phi_2 - \phi_1)/\varepsilon_0$ (4) $(\phi_1 + \phi_2)\ \varepsilon_0$

16. An electric dipole is placed at the centre of a sphere. Mark the correct options.
(1) The electric field is zero at every point of the sphere.
(2) The flux of the electric field through the sphere is non-zero.
(3) The electric field is zero on a circle on the sphere.
(4) The electic field is not zero anywhere on the sphere.

17. A charge Q is placed at a distance of 4R above the centre of a disc of radius R. The magnitude of flux through the disc is ϕ. Now a hemispherical shell of radius R is placed over the disc such that it forms a closed surface. The flux through the curved surface (taking direction of area vector along outward normal as positive), is -



(1) zero (2) ϕ (3) $-\phi$ (4) 2ϕ

18. A charge q is placed at the corner of a cube of side a. The electric flux through the cube is :

(1) $\frac{q}{\varepsilon_0}$ (2) $\frac{q}{3\varepsilon_0}$ (3) $\frac{q}{6\varepsilon_0}$ (4) $\frac{q}{8\varepsilon_0}$

19. A charge qμC is placed at the centre of a cube of a side 0.1 m, then the electric flux diverging from each face of the cube is :

(1) $\frac{q\times10^{-6}}{24\varepsilon_0}$ (2) $\frac{q\times10^{-4}}{\varepsilon_0}$ (3) $\frac{q\times10^{-6}}{6\varepsilon_0}$ (4) $\frac{q\times10^{-4}}{12\varepsilon_0}$

20. Gauss law is given by $\epsilon_0 \oint \vec{E}.\vec{ds} = q$, if net charge enclosed by Guassian surface is zero then -

(1) E on surface must be zero
(2) Incoming and outgoing electric lines are equal
(3) There is a net incoming electric flux
(4) none

SECTION (J) : CONDUCTOR, IT'S PROPERTIES & ELECTRIC PRESSURE

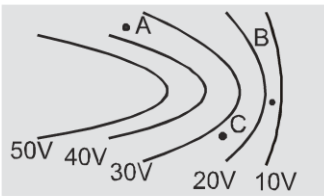
1. The electric field near the conducting surface of a uniform charge density σ will be -

(1) σ/ϵ_0 and parallel to surface.
(2) $2\sigma/\epsilon_0$ and parallel to surface.
(3) σ/ϵ_0 and perpendicular to surface.
(4) $2\sigma/\epsilon_0$ and perpendicular to surface.

2. An uncharged conductor A is brought close to another positive charged conductor B, then the charge on B -

(1) will increase but potential will be constant.
(2) will be constant but potential will increase
(3) will be constant but potential decreases.
(4) the potential and charge on both are constant.

3. The fig. shows lines of constant potential in a region in which an electric field is present. The value of the potential are written in brackets of the points A, B and C, the magnitude of the electric field is greatest at the point -

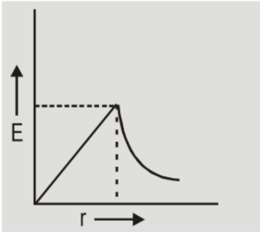
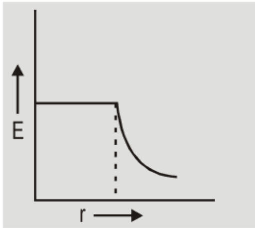


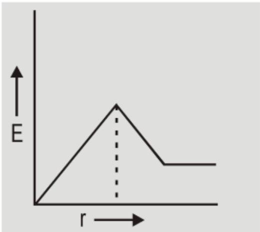
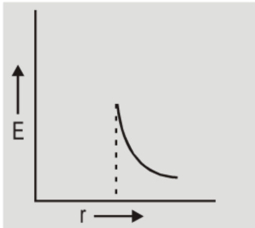
(1) A (2) B (3) C (4) A & C

4. The electric charge in uniform motion produces -

(1) an electric field only
(2) a magnetic field only
(3) both electric and magnetic fields
(4) neither electric nor magnetic fields

5. Which of the following represents the correct graph for electric field intensity and the distance r from the centre of a hollow charged metal sphere or solid metallic conductor of radius R :

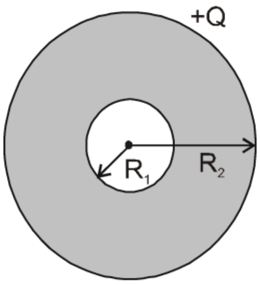
(1) 
(2) 

(3) 
(4) 

6. A neutral metallic object is placed near a finite metal plate carrying a positive charge. The electric force on the object will be :

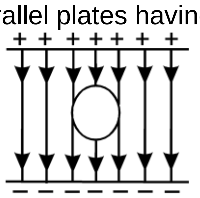
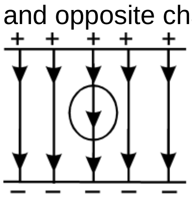
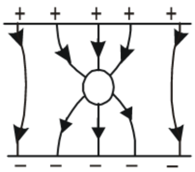
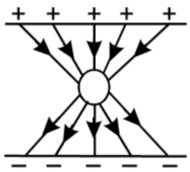
(1) towards the plate (2) away from the plate (3) parallel to the plate (4) zero

7. Figure shows a thick metallic sphere. If it is given a charge +Q, then electric field will be present in the region



(1) $r < R_1$ only (2) $r > R_1$ and $R_1 < r < R_2$ (3) $r \geq R_2$ only (4) $r \leq R_2$ only

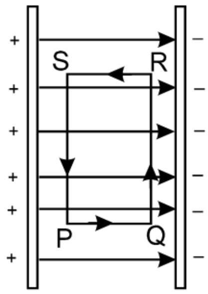
8. An uncharged sphere of metal is placed in a uniform electric field produced by two large conducting parallel plates having equal and opposite charges, then lines of force look like

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

9. You are travelling in a car during a thunder storm, in order to protect yourself from lightening would you prefer to :

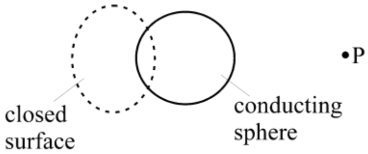
(1) Remain in the car
(2) Take shelter under a tree
(3) Get out and be flat on the ground
(4) Touch the nearest electrical pole

10. The amount of work done in Joules in carrying a charge +q along the closed path PQRSP between the oppositely charged metal plates is (where E is electric field between the plates)



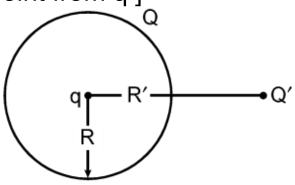
(1) zero (2) q (3) qE (PQ + QR + SR + SP) (4) $q \backslash \varepsilon_0$

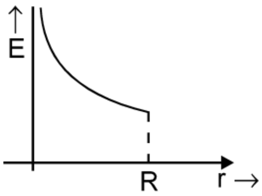
11. Figure shows a closed surface which intersects a conducting sphere. If a positive charge is placed at the point P, the flux of the electric field through the closed surface



(1) will remain zero
(2) will become positive
(3) will become neagative
(4) will become undefined

12. A charge ' q ' is placed at the centre of a conducting spherical shell of radius R, which is given a charge Q. An external charge Q′ is also present at distance R′ (R′ > R) from ' q '. Then the resultant field will be best represented for region r < R by:
[where r is the distance of the point from q]



(1)


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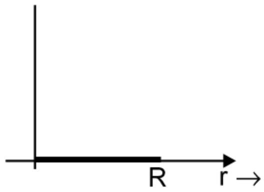
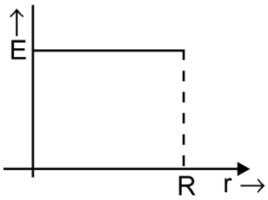


(3)


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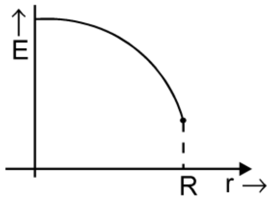
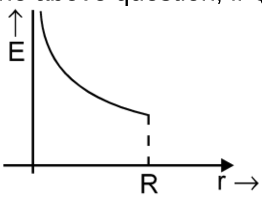
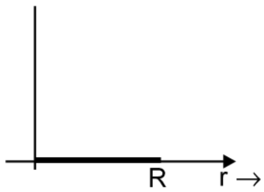
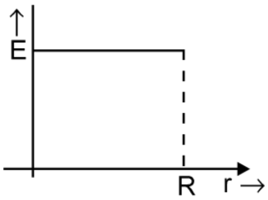


13. In the above question, if Q' is removed then which option is correct :

(1)


(2)


(3)


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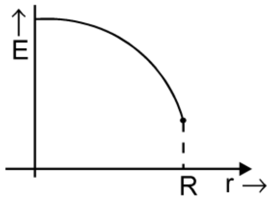


14. The net charge given to an isolated conducting solid sphere:
(1) must be distributed uniformly on the surface
(2) may be distributed uniformly on the surface
(3) must be distributed uniformly in the volume
(4) may be distributed uniformly in the volume.

15. The net charge given to a solid insulating sphere:
(1) must be distributed uniformly in its volume
(2) may be distributed uniformly in its volume
(3) must be distributed uniformly on its surface
(4) the distribution will depend upon whether other charges are present or not.

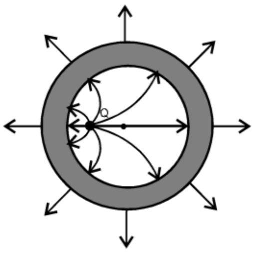
16. A charge Q is kept at the centre of a conducting sphere of inner radius R_1 and outer radius R_2. A point charge q is kept at a distance r (> R_2) from the centre. If q experiences an electrostatic force 10 N then assuming that no other charges are present, electrostatic force experienced by Q will be:

(1) – 10 N (2) 0 (3) 20 N (4) none of these

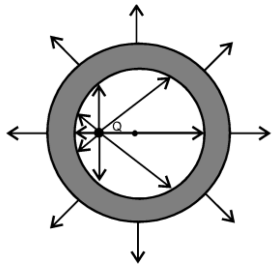
17. A solid conducting sphere having a charge Q is surrounded by an uncharged concentric conducting hollow spherical shell. Let the potential difference between the surface of the solid sphere and that of the outer surface of the hollow shell be V. If the shell is now given a charge –3Q, the new potential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

(1) V (2) 2V (3) 4V (4) –2V

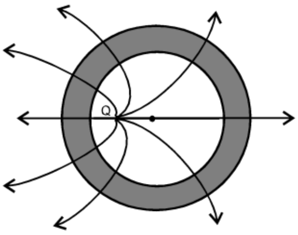
18. A point charge 'q' is placed at a point inside a hollow conducting sphere. Which of the following electric force pattern is correct?



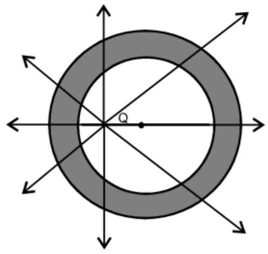
(1)



(2)



(3)



(4)

19. Consider a neutral conducting sphere. A positive point charge is placed outside the sphere. The net charge on the sphere is then,

(1) negative and distributed uniformly over the surface of the sphere
(2) negative and appears only at the point on the sphere closest to the point charge
(3) negative and distributed non-uniformly over the entire surface of the sphere
(4) zero

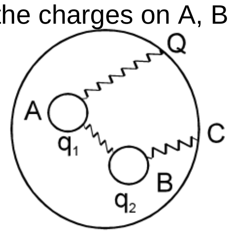
20. Three concentric metallic spherical shells of radii R, 2R, 3R, are given charges Q_1, Q_2, Q_3, respectively. It is found that the surface charge densities on the outer surfaces of the shells are equal. Then, the ratio of the charges given to the shells, $Q_1 : Q_2 : Q_3$, is

(1) 1 : 2 : 3 (2) 1 : 3 : 5 (3) 1 : 4 : 9 (4) 1 : 8 : 18

21. A positive point charge q is brought near a neutral metal sphere.

(1) The sphere becomes negatively charged.
(2) The sphere becomes positively charged.
(3) The interior remains neutral and the surface gets non-uniform charge distribution.
(4) The interior becomes positively charged and the surface becomes negatively charged.

22. Two small conductors A and B are given charges q_1 and q_2 respectively. Now they are placed inside a hollow metallic conductor (C) carrying a charge Q. If all the three conductors A, B and C are connected by conducting wires as shown, the charges on A, B and C will be respectively:



(1) $\frac{q_1+q_2}{2}, \frac{q_1+q_2}{2}, Q$ (2) $\frac{Q+q_1+q_3}{3}, \frac{Q+q_1+q_2}{3}, \frac{Q+q_1+q_2}{3}$

(3) $\frac{q_1+q_2+Q}{2}, \frac{q_1+q_2+Q}{2}, 0$ (4) 0, 0, $Q + q_1 + q_2$

23. A charge Q is kept at the centre of a conducting sphere of inner radius R_1 and outer radius R_2. A point charge q is kept at a distance r (> R_2) from the centre. If q experiences an electrostatic force 10 N then assuming that no other charges are present, electrostatic force experienced by Q will be:
(1) – 10 N (2) 0 (3) 20 N (4) none of these

24. Some charge is being given to a conductor then its potential is :
(1) Maximum at surface (2) Maximum at centre
(3) Same throughout the conductor (4) Maximum somewhere between surface and centre

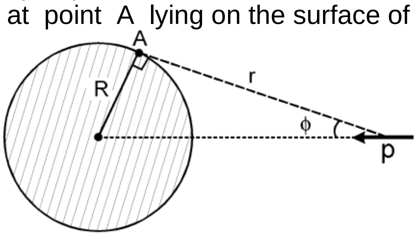
25. A solid metallic sphere has a charge +3Q. Concentric with this sphere is a conducting spherical shell having charge –Q. The radius of the sphere is a and that of the spherical shell is b(>a). What is the electric field at a distance r(a < r < b) from the centre?
(1) $\frac{1}{4\pi\varepsilon_0}\frac{Q}{r}$ (2) $\frac{1}{4\pi\varepsilon_0}\frac{3Q}{r}$ (3) $\frac{1}{4\pi\varepsilon_0}\frac{3Q}{r^2}$ (4) $\frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}$

26. Two charged spheres having radii a and b are joined with a wire then the ratio of electric field E_a/E_b on their surface is -
(1) a/b (2) b/a (3) a_2/b_2 (4) b_2/a_2

27. A long hollow conducting cylinder is kept coaxially inside another long, hollow conducting cylinder of larger radius. Both the cylinders are initially electrically neutral.
(1) A potential difference appears between the two cylinders when a charge density is given to the inner cylinder.
(2) A potential difference appears between the two cylinders when a charge density is given to the outer cylinder.
(3) No potential difference appears between the two cylinders when a uniform line charge is kept along the axis of the cylinders.
(4) No potential difference appears between the two cylinders when same charge density is given to both the cylinders.

Exercise-2

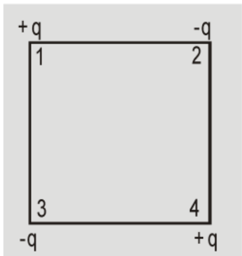
1. A dipole having dipole moment p is placed in front of a solid uncharged conducting sphere as shown in the diagram. The net potential at point A lying on the surface of the sphere is :



(1) $\frac{kp\cos\phi}{r^2}$ (2) $\frac{kp\cos^2\phi}{r^2}$ (3) zero (4) $\frac{2kp\cos^2\phi}{r^2}$

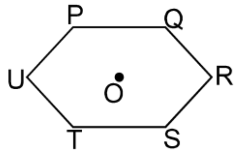
2. Two equal charges are separated by a distance d. A third charge placed on a perpendicular bisector at x distance will experience maximum coulomb force when -
(1) $x = d/\sqrt{2}$ (2) x = d/2 (3) x = d/2$\sqrt{2}$ (4) x = d/$2\sqrt{3}$

3. The work done in placing four charges at the corners of a square as shown in the figure, will be –



(1) $(4-\sqrt{2})\frac{Kq^2}{a}$ (2) $(4+\sqrt{2})\frac{Kq^2}{a}$ (3) $(4-\sqrt{2})\frac{Kq^2}{a^2}$ (4) $(4+\sqrt{2})\frac{Kq^2}{a^2}$

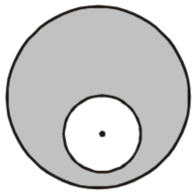
4. Six charges q,q,q, – q, –q and –q are to be arranged on the vertices of a regular hexagon PQRSTU such that the electric field at centre is double the field produced when only charge 'q' is placed at vertex R. The sequence of the charges from P to U is



(1) q, –q, q, q, –q, –q (2) q, q, q, –q, –q, –q (3) –q, q, q, –q, –q, q (4) –q, q, q, q, –q, –q

5. Which of the following groups do not have same dimensions
(1) Young's modulus, pressure, stress
(2) work, heat, energy
(3) electromotive force, potential difference, voltage
(4) electric dipole, electric flux, electric field

6. A spherical portion has been removed from a solid sphere having a charge distributed uniformly in its volume as shown in the figure. The electric field inside the emptied space is



(1) zero every where
(2) is not zero but uniform
(3) nonuniform
(4) is zero at centre only

7. **STATEMENT -1 :** For practical purposes, the earth is used as a reference at zero potential in electrical circuits.
and
STATEMENT -2 : The electrical potential of a sphere of radius R with charge Q uniformly distributed on the surface is given by $\frac{Q}{4\pi\varepsilon_0 R}$.
(1) STATEMENT -1 is True, STATEMENT -2 is True; STATEMENT -2 is a correct explanation for STATEMENT -1
(2) STATEMENT -1 is True, STATEMENT -2 is True; STATEMENT -2 is NOT a correct explanation for
STATEMENT -1
(3) STATEMENT -1 is True, STATEMENT -2 is False
(4) STATEMENT -1 is False, STATEMENT -2 is True.

8. Which of the following statement(s) is/are correct?
(1) If the electric field due to a point charge varies as $r^{-2.5}$ instead of r^{-2}, then the Gauss law will still be valid.
(2) The Gauss law can be used to calculate the field distribution around an electric dipole.
(3) If the electric field between two point charges is zero somewhere, then the sign of the two charges is the same.
(4) The work done by the external force in moving a unit positive charge from point A at potential V_A to point B at potential V_B is $(V_B — V_A)$.

9. Let $E_1 = x\hat{i} + y\hat{j}$,
and $E_2 = xy^2\hat{i} + x^2y\hat{j}$, then :
(1) E_1 represents constant electric field
(2) E_2 represents constant electric field
(3) both represents constant electric field
(4) none of these

10. When a glass rod is rubbed with silk, the amount of positive charge acquired by glass rod in magnitude is :
(1) less than the charge on silk
(2) greater than the charge on slik
(3) equal to the charge on silk
(4) none of these

11. A cube has point charges of magnitude - q at all its vertices. Electric field at the centre of the cube is :

(1) $\frac{1}{4\pi\varepsilon_0}\frac{6q}{3a^2}$ (2) $\frac{1}{4\pi\varepsilon_0}\frac{8q}{a^2}$ (3) zero (4) $\frac{1}{4\pi\varepsilon_0}\frac{-8q}{a^2}$

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

(1) $\sqrt{2}$ qa along +y direction

(2) $\sqrt{2}$ qa along the line joining points (x = 0, y = 0, z = 0) and (x = a, y = a, z = 0)

(3) qa along the line joining points (x = 0, y = 0, z = 0) and (x = a, y = a, z = 0)

(4) $\sqrt{2}$ qa along +x direction

13. An electric dipole is placed along the x-axis at the origin O.A point P is at a distance of 20 cm from this origin such that OP makes an angle π/3 with the x-axis. If the electric field at P makes an angle θ with the x-axis, the value of θ would be

(1) $\frac{\pi}{3}$ (2) $\frac{\pi}{3} + \tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (3) $\frac{2\pi}{3}$ (4) $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$

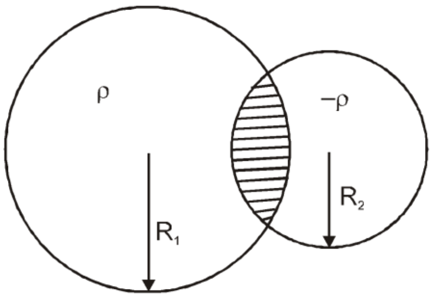
14. A Charged wire is bent in the from of a semi-circular arc of radius a. If charge per unit length is λ coulomb/metre, the electric field at the centre O is :

(1) $\frac{\lambda}{2\pi a^2\varepsilon_0}$ (2) $\frac{\lambda}{4\pi^2\varepsilon_0 a}$ (3) $\frac{\lambda}{2\pi\varepsilon_0 a}$ (4) zero

15. The dimensions of $\left(\frac{1}{2}\right)\varepsilon_0 E^2$ (ε_0: permittivity of free space; E: electric field) are**:**

(1) MLT^{-1} (2) ML^2T^{-2} (3) MLT^{-2} (4) $ML^{-1}T^{-2}$

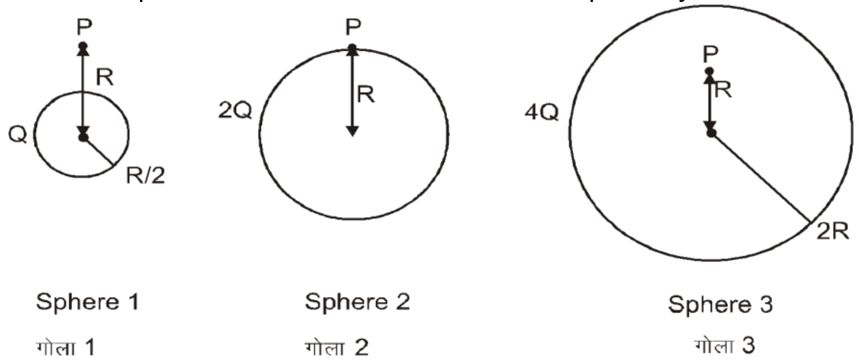
16. Two non–conducting spheres of radii R_1 and R_2 and carrying uniform volume charge densities +ρ and –ρ, respectively, are placed such that they partially overlap, as shown in the figure. At all points in the overlapping region :



(1) the electrostatic field is zero (2) the electrostatic potential is constant

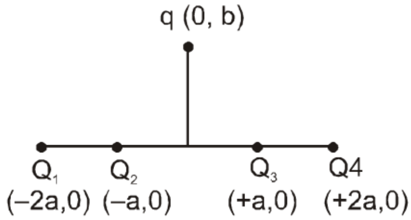
(3) the electrostatic field is constant (4) the electrostatic field has same magnitude only

17. Charges Q, 2Q and 4Q are uniformly distributed in three dielectric solid spheres 1, 2 and 3 of radii R/2, R and 2R respectively, as shown in figure. If magnitudes of the electric fields at point P at a distance R from the centre of spheres 1, 2 and 3 are E_1 E_2 and E_3 respectively, then



(1) $E_1 > E_2 > E_3$ (2) $E_3 > E_1 > E_2$ (3) $E_2 > E_1 > E_3$ (4) $E_3 > E_2 > E_1$

18. Four charge Q_1,Q_2,Q_3, and Q_4,of same magnitude are fixed along the x axis at x = –2a –a, +a and +2a, respectively. A positive charge q is placed on the positive y axis at a distance b > 0. Four options of the signs of these charges are given in List-I . The direction of the forces on the charge q is given in List- II Match List-1 with List-II and select the correct answer using the code given below the lists.



	List-I		**List-II**
P.	Q_1,Q_2,Q_3, Q_4, all positive	**1.**	+x
Q.	Q_1,Q_2 positive Q_3,Q_4 negative	**2.**	–x
R.	Q_1,Q_4 positive Q_2, Q_3 negative	**3.**	+y
S.	Q_1,Q_3 positive Q_2, Q_4 negative	**4.**	–y

Code :

(1) P-3, Q-1, R-4,S-2 (2) P-4, Q-2, R-3, S-1
(3) P-3, Q-1, R-2,S-4 (4) P-4, Q-2, R-1, S-3

Exercise-3

PART - I : NEET / AIPMT QUESTION (PREVIOUS YEARS)

1. The electric potential at a point (x, y, z) is given by **[2009 AIPMT]**
$V = -x_2 y - xz_3 + 4$
The electric field $\vec{E}$ at that point is

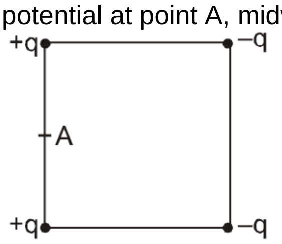
(1) $\vec{E} = \hat{i}\,(2xy + z_3) + \hat{j}\,x_2 + \hat{k}\,3xz_2$ (2) $\vec{E} = \hat{i}\,2xy + \hat{j}\,(x_2 + y_2) + \hat{k}\,(3xz - y_2)$
(3) $\vec{E} = \hat{i}\,z_3 + \hat{j}\,xyz + \hat{k}\,z_2$ (4) $\vec{E} = \hat{i}\,(2xy - z_3) + \hat{j}\,xy_2 + \hat{k}\,3z_2x$

2. The electric field at a distance $\frac{3R}{2}$ from the centre of a charged conducting spherical shell of radius R is E. The electric field at a distance $\frac{R}{2}$ from the centre of the sphere is **[AIPMT - 2010]**

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

3. A charge Q is enclosed by a Gaussian spherical surface of radius R. If the radius is doubled, then the outward electric flux will : **[AIPMT- 2011, 4/200]**
(1) increase four times (2) be reduced to half (3) remain the same (4) be doubled

4. Four electric charges +q, +q, –q and –q are placed at the corners of a square of side 2L (see figure). The electric potential at point A, midway between the two charges +q and +q, is : **[AIPMT- 2011, 4/200]**

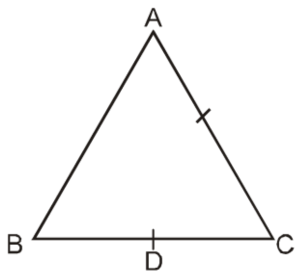


(1) $\frac{1}{4\pi \in_0}\frac{2q}{L}(1+\sqrt{5})$ (2) $\frac{1}{4\pi \in_0}\frac{2q}{L}\left(1+\frac{1}{\sqrt{5}}\right)$ (3) $\frac{1}{4\pi \in_0}\frac{2q}{L}\left(1-\frac{1}{\sqrt{5}}\right)$ (4) Zero

5. The electric potential V at any point (x, y, z), all in meters in space is given by $V = 4x^2$ volt. The electric field at the point (1, 0, 2) in volt/meter is : **[AIPMT Mains 2011]**

(1) 8 along positive X-axis
(2) 16 along negative X-axis
(3) 16 along positive X-axis
(4) 8 along negative X-axis

6. Three charges, each +q, are placed at the corners of an isosceles triangle ABC of sides BC and AC, 2a. D and E are the mid points of BC and CA. The work done in taking a charge Q from D to E is: **[AIPMT Mains 2011]**



(1) $\frac{eqQ}{8\pi \epsilon_0 a}$
(2) $\frac{qQ}{4\pi \epsilon_0 a}$
(3) zero
(4) $\frac{3qQ}{4\pi \epsilon_0 a}$

7. An electric dipole of moment ´p´ is placed in an electric field of intensity ´E´. The dipole acquires a position such that the axis of the dipole makes an angle θ with the direction of the field. Assuming that the potential energy of the dipole to be zero when θ = 90º, the torque and the potential energy of the dipole will respectively be : **[AIPMT_Pre_2012]**

(1) p E sin θ, – p E cos θ
(2) p E sin θ, – 2 p E cos θ
(3) p E sin θ, 2 p Ecos θ
(4) p E cos θ, – p Ecos θ

8. Four point charges –Q, –q, 2q and 2Q are placed, one at each corner of the square. The relation between Q and q for which the potential at the centre of the square is zero is : **[AIPMT_Pre_2012]**

(1) Q = –q
(2) $Q = -\frac{1}{q}$
(3) Q = q
(4) $Q = \frac{1}{q}$

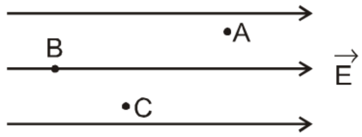
9. What is the flux through a cube of side 'a' if a point charge of q is at one of its corner : **[AIPMT_Pre_2012]**

(1) $\frac{2q}{\varepsilon_0}$
(2) $\frac{q}{8\varepsilon_0}$
(3) $\frac{q}{\varepsilon_0}$
(4) $\frac{q}{2\varepsilon_0}6a^2$

10. Two metallic spheres of radii 1 cm and 3 cm are given charges of -1×10^{-2} C and 5×10^{-2} C, respectively. If these are connected by a conducting wire, the final charge on the bigger sphere is : **[AIPMT 2012 (Mains)]**

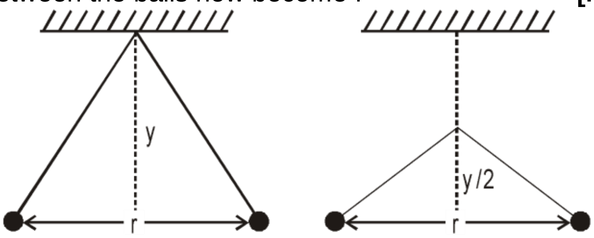
(1) 2×10^{-2} C
(2) 3×10^{-2} C
(3) 4×10^{-2} C
(4) 1×10^{-2} C

11. A, B and C are three points in a uniform electric field. The electric potential is : **[NEET_2013]**



(1) maximum at B
(2) maximum at C
(3) same at all the three points A, B and C
(4) maximum at A

12. Two pith balls carrying equal charges are suspended from a common point by strings of equal length, the equilibrium separation between them is r. Now the strings are rigidly clamped at half the height. The equilibrium separation between the balls now become : **[NEET_2013]**



(1) $\left(\frac{r}{\sqrt[3]{2}}\right)$ (2) $\left(\frac{2r}{\sqrt{3}}\right)$ (3) $\left(\frac{2r}{3}\right)$ (4) $\left(\frac{r}{\sqrt{2}}\right)^2$

13. A conducting sphere of radius R is given a charge Q. The electric potential and the electric field at the centre of the sphere respectively are: **[NEET_2014]**

(1) Zero & $\frac{Q}{4\pi\varepsilon_0 R^2}$ (2) $\frac{Q}{4\pi\varepsilon_0 R}$ & Zero (3) $\frac{Q}{4\pi\varepsilon_0 R}$ & $\frac{Q}{4\pi\varepsilon_0 R^2}$ (4) Both are zero.

14. In a region the potential is represented by V(x, y, z) = 6x – 8xy –8y + 6yz, where V is in volts and x, y, z, are in meters. The electric force experienced by a charge of 2 coulomb situated at point (1, 1,1) is : **[NEET_ 2014]**

(1) $6\sqrt{5}$ N (2) 30N (3) 24N (4) $4\sqrt{35}$ N

15. The electric field in a certain region is acting radially outward and is given by E = Ar. A charge contained in a sphere of radius 'a' centred at the origin of the field, will given by : **[NEET _2015]**

(1) $A \in_0 a^2$ (2) $4\pi \in_0 Aa^3$ (3) $\in_0 Aa^3$ (4) $4\pi \in_0 Aa^3$

16. If potential (in volts) in a region is expressed as V(x, y, z) = 6 xy – y + 2yz, the electric field (in N/C) at point (1, 1, 0) is : **[NEET_2015]**

(1) $-(6\hat{i}+5\hat{j}+2\hat{k})$ (2) $-(2\hat{i}+3\hat{j}+\hat{k})$ (3) $-(6\hat{i}+9\hat{j}+\hat{k})$ (4) $-(3\hat{i}+5\hat{j}+3\hat{k})$

17. Two identical charged spheres suspended from a common point by two mass less strings of lengths ℓ, are initially at a distance d(d << ℓ) a part because of their mutual repulsion. The charges begin to leak from both the spheres at a constant rate. As a result, the spheres approach each other with a velocity v. Then v varies as a function of the distance x between the spheres, as : **[NEET_2016]**

(1) $v \propto x^{-1}$ (2) $v \propto x^{1/2}$ (3) $v \propto x$ (4) $v \propto x^{-1/2}$

18. When an α-particle of mass 'm' moving with velocity ' v ' bombards on a heavy nucleus of charge 'Ze' its distance of closet approach from the nucleus depends on m as : **[NEET_2016]**

(1) m (2) $\frac{1}{m}$ (3) $\frac{1}{\sqrt{m}}$ (4) $\frac{1}{m^2}$

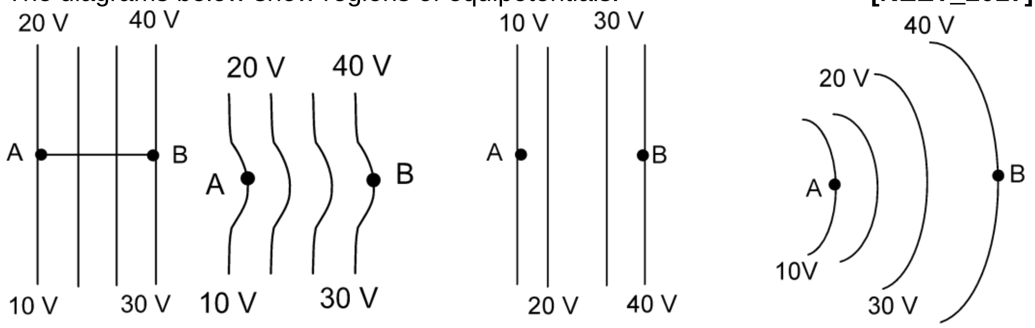
19. An electric dipole is placed at an angle of 30º with an electric field intensity 2×10^5 N/C. It experiences a torque equal to 4 N m. The charge on the dipole, if the dipole length is 2cm, is **[NEET_2016]**

(1) 7 μC (2) 8 mC (3) 2 mC (4) 5 mC

20. Suppose the charge of a proton and an electron differ slightly. One of them is – e, the other is (e + Δe). If the net of electrostatic force and gravitational force between two hydrogen atoms placed at a distance d (much greater than atomic size) apart is zero, then Δe is of the order of [Given mass of hydrogen $m_h = 1.67 \times 10^{-27}$ kg] **[NEET_2017]**

(1) 10^{-20} C (2) 10^{-23} C (3) 10^{-37} C (4) 10^{-47} C

21. The diagrams below show regions of equipotentials. **[NEET_2017]**



(a) (b) (c) (d)

A positive charge is moved from A to B in each diagram

(1) Maximum work is required to move q in figure (c).

(2) In all the four cases the work done is the same.

(3) Minimum work is required to move q in figure (a)

(4) Maximum work is required to move q in figure (b).

22. An electron falls from rest through a vertical distance h in a uniform and vertically upward directed electric field E. The direction of electric field is now reversed, keeping its magnitude the same. A proton is allowed to fall from rest in it through the same vertical distance h. The time of fall of the electron, in comparison to the time of falls of the proton is : **[NEET 2018]**

(1) smaller (2) equal (3) 10 times greater (4) 5 times greater

23. A toy car with charge q moves on a frictionless horizontal plane surface under the influence of a uniform electric field $\vec{E}$. Due to the force $q\vec{E}$, its velocity increases from 0 to 6 m/s in one second duration. At that instant the direction of the field is reversed. The car continues to move for two more seconds under the influence of this field. The average velocity and the average speed of the toy car between 0 to 3 seconds are respectively **[NEET 2018]**

24. Two point charges A and B, having charges +Q and –Q respectively, are placed at certain distance apart and force acting between them is F. If 25% charge of A is transferred to B, then force between the charges becomes: **[NEET_ 2019-I]**

(1) $\frac{4F}{3}$ (2) F (3) $\frac{9F}{16}$ (4) $\frac{16F}{9}$

25. Two parallel infinite line charges with linear charge densities +λ C/m and –λ C/m are placed at a distance of 2R in free space. What is the electric field mid-way between the two line charges ? **[NEET_2019-I]**

(1) $\frac{\lambda}{2\pi\varepsilon_0 R}$ N/C (2) zero (3) $\frac{2\lambda}{\pi\varepsilon_0 R}$ N/C (4) $\frac{\lambda}{\pi\varepsilon_0 R}$ N/C

26. Two metal spheres, one of radius R and the other of radius 2R respectively have the same surface charge density σ. They are brought in contact and separated. What will be the new surface charge densities on them? **[NEET_2019-II]**

(1) $\sigma_1 = \frac{5}{6}\sigma,\ \sigma_2 = \frac{5}{6}\sigma$ (2) $\sigma_1 = \frac{5}{2}\sigma,\ \sigma_2 = \frac{5}{6}\sigma$

(3) $\sigma_1 = \frac{5}{2}\sigma,\ \sigma_2 = \frac{5}{3}\sigma$ (4) $\sigma_1 = \frac{5}{3}\sigma,\ \sigma_2 = \frac{5}{6}\sigma$

27. A sphere encloses an electric dipole with charges $\pm 3 \times 10^{-6}$ C. What is the total electric flux across the sphere? **[NEET_2019-II]**

(1) -3×10^{-6} (2) Zero (3) 3×10^{-6} Nm^2/C (4) 6×10^{-6} Nm^2/C

PART - II : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. Two points P and Q are maintained at the potentials of 10 V and –4 V respectively. The work done in moving 100 electrons from P to Q is : **[AIEEE-2009, 4/144]**

(1) 9.60×10^{-17} J (2) -2.24×10^{-16} J (3) 2.24×10^{-16} J (4) -9.60×10^{-17} J

2. A charge Q is placed at each of the opposite corners of a square. A charge q is placed at each of the other two corners. If the net electrical force on Q is zero, then Q/q equals: **[AIEEE-2009, 4/144]**

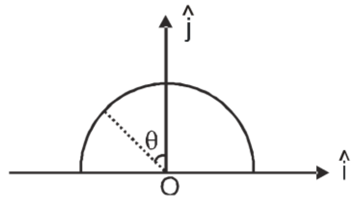
(1) –1 (2) 1 (3) $-\frac{1}{\sqrt{2}}$ (4) $-2\sqrt{2}$

3. Statement 1 : For a charged particle moving from point P to point Q, the net work done by an electrostatic field on the particle is independent of the path connecting point P to point Q. **[AIEEE-2009, 6/144]**

Statement 2 : The net work done by a conservative force on an object moving along a closed loop is zero.

(1) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation of Statement-1.
(2) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation of Statement-1.
(3) Statement-1 is false, Statement-2 is true.
(4) Statement-1 is true, Statement-2 is false.

4. A thin semi-circular ring of radius r has a positive charge q distributed uniformly over it. The net field $\vec{E}$ at the centre O is : **[AIEEE-2010, 4/144]**



(1) $\frac{q}{4\pi^2\varepsilon_0 r^2}\hat{j}$ (2) $-\frac{q}{4\pi^2\varepsilon_0 r^2}\hat{j}$ (3) $-\frac{q}{2\pi^2\varepsilon_0 r^2}\hat{j}$ (4) $\frac{q}{2\pi^2\varepsilon_0 r^2}\hat{j}$

5. Two identical charged spheres are suspended by strings of equal lengths. The strings make an angle of 30º with each other. When suspended in a liquid of density 0.8 g cm^{-3}, the angle remains the same. If density of the material of the sphere is 1.6 g cm^{-3}, the dielectric constant of the liquid is **[AIEEE-2010, 8/144]**

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

6. The electrostatic potential inside a charged spherical ball is given by $\phi = ar^2 + b$ where r is the distance from the centre; a,b are constants. Then the charge density inside the ball is : **[AIEEE - 2011, 4/120, –1]**

(1) $-24\pi a\varepsilon_0 r$ (2) $-6\pi a\varepsilon_0 r$ (3) $-24\pi a\varepsilon_0$ (4) $-6 a\varepsilon_0$

7. Two identical charged spheres suspended from a common point by two massless strings of length ℓ are initially a distance d(d < < ℓ) apart becuase of their mutual repulsion. The charge begins to leak from both the spheres at a constant rate. As a result the charges approach each other with a velocity υ. Then as a function of distance x between them : **[AIEEE - 2011, 4/120, –1]**

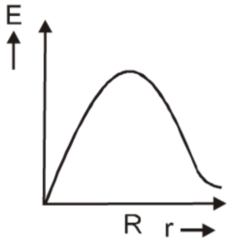
(1) $\upsilon \propto x^{-1/2}$ (2) $\upsilon \propto x^{-1}$ (3) $\upsilon \propto x^{1/2}$ (4) $\upsilon \propto x$

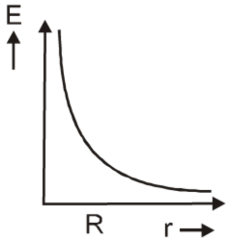
8. Two positive charges of magnitude 'q' are placed at the ends of a side (side 1) of a square of side '2a'. Two negative charges of the same magnitude are kept at the other corners. Starting from rest, if a charge Q moves from the middle of side 1 to the centre of square, its kinetic energy at the centre of square is : **[AIEEE 2011, 11 May; 4/120, –1]**

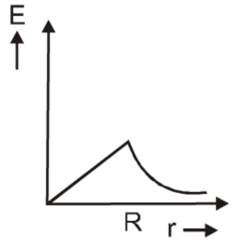
(1) zero (2) $\frac{1}{4\pi\varepsilon_0}\frac{2qQ}{a}\left(1+\frac{1}{\sqrt{5}}\right)$

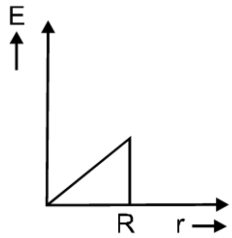
(3) $\frac{1}{4\pi\varepsilon_0}\frac{2qQ}{a}\left(1-\frac{2}{\sqrt{5}}\right)$ (4) $\frac{1}{4\pi\varepsilon_0}\frac{2qQ}{a}\left(1-\frac{1}{\sqrt{5}}\right)$

9. In a uniformly charged sphere of total charge Q and radius R, the electric field E is plotted as function of distance from the centre. The graph which would correspond to the above will be : **[AIEEE 2012, ; 4/120, –1]**

(1) 

(2) 

(3) 

(4) 

10. This questions has statement-1 and statement-2. Of the four choices given after the statements, choose the one that best describe the two statements. **[AIEEE 2012, ; 4/120, –1]**

An insulating solid sphere of radius R has a unioformly positive charge density ρ. As a result of this uniform charge distribution there is a finite value of electric potential at the centre of the sphere, at the surface of the sphere and also at a point out side the sphere. The electric potential at infinite is zero.

Statement-1 : When a charge 'q' is take from the centre of the surface of the sphere its potential energy changes by $\frac{q\rho}{3\varepsilon_0}$.

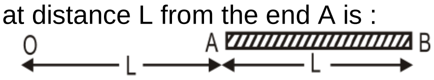
Statement-2 : The electric field at a distance r (r < R) from the centre of the sphere is $\frac{\rho r}{3\varepsilon_0}$

(1) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation of statement-1.
(2) Statement 1 is true Statement 2 is false.
(3) Statement 1 is false Statement 2 is true.
(4) Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation of Statement 1.

11. Two charges, each equal to q, are kept at x = – a and x = a on the x-axis. A particle of mass m and charge $q_0 = \frac{q}{2}$ is placed at the origin. If charge q_0 is given a small displacement (y <<a) along the y-axis, the net force acting on the particle is proportional to : **[JEE-Mains 2013, 4/120]**

(1) y (2) –y (3) $\frac{1}{y}$ (4) $-\frac{1}{y}$

12. A charge Q is uniformly distributed over a long rod AB of length L as shown in the figure. The electric potential at the point O lying at distance L from the end A is : **[JEE-Mains 2013, 4/120]**

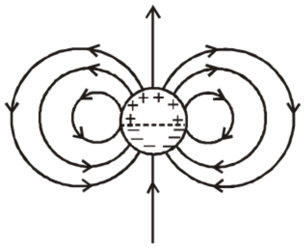


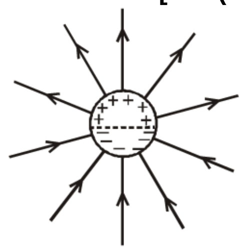
(1) $\frac{Q}{8\pi\epsilon_0 L}$ (2) $\frac{3Q}{4\pi\epsilon_0 L}$ (3) $\frac{Q}{4\pi\epsilon_0 L\ln 2}$ (4) $\frac{Q\ln 2}{4\pi\epsilon_0 L}$

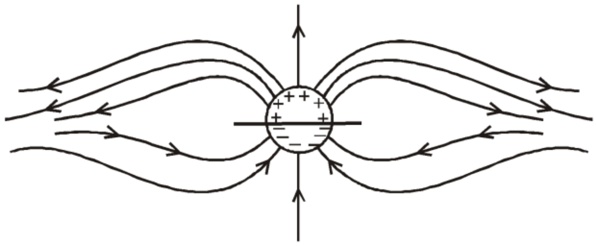
13. Assume that an electric field $\vec{E} = 30x^2\hat{i}$ exists in space. Then the potential difference $V_A - V_O$, where V_O is the potential at the origin and V_A the potential at x = 2 m is : **[JEE-Mains 2014, 4/120]**

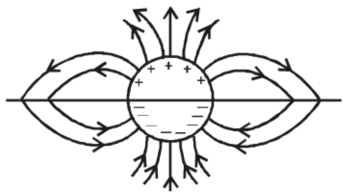
(1) 120 V (2) –120 V (3) – 80 V (4) 80 V

14. A long cylindrical shell carries positive surface charge σ in the upper half and negative surface charge –σ in the lower half. The electric field lines around the cylinder will look like figure given in :
(figures are schematic and not drawn to scale) **[JEE(Main)-2015; 4/120, –1]**


(1)


(2)

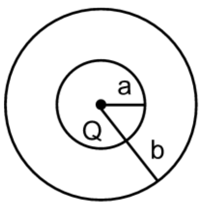

(3)


(4)

15. A uniformly charged solid sphere of radius R has potential V_0 (measured with respect to ∞) on its surface. For this sphere the equipotential surfaces with potentials $\frac{3V_0}{2}, \frac{5V_0}{4}, \frac{3V_0}{4}$ and $\frac{V_0}{4}$ have radius R_1, R_2, R_3 and R_4 respectively. Then **[JEE(Main)-2015; 4/120, –1]**

(1) $R_1 = 0$ and $R_2 > (R_4 - R_3)$ (2) $R_1 \neq 0$ and $(R_2 - R_1) > (R_4 - R_3)$
(3) $R_1 = 0$ and $R_2 < (R_4 - R_3)$ (4) $2R < R_4$

16. The region between two concentric spheres of radii 'a' and 'b', respectively (see figure), has volume charge density $\rho = \frac{A}{r}$, where A is a constant and r is the distance from the centre. At the centre of the spheres is a point charge Q. The value of A such that the electric field in the region between the spheres will be constant, is : **[JEE Main 2016]**



(1) $\frac{Q}{2\pi(b^2 - a^2)}$ (2) $\frac{2Q}{\pi(a^2 - b^2)}$ (3) $\frac{2Q}{\pi a^2}$ (4) $\frac{Q}{2\pi a^2}$

17. An electric dipole has a fixed dipole moment $\vec{p}$, which makes angle θ with respect to x-axis. When subjected to an electric field $\vec{E_1} = E\hat{i}$, it experiences a torque $\vec{T_1} = \tau\hat{k}$. When subjected to another electric field $\vec{E_2} = \sqrt{3}E_1\hat{j}$ it experiences a torque $\vec{T_2} = -\vec{T_1}$. The angle θ is : **[JEE Main 2017]**

(1) 90° (2) 30° (3) 45° (4) 60°

18. Three concentric metal shells A, B and C of respective radii a,b and c (a < b < c) have surface charge densities +σ, –σ and +σ respectively. The potential of shell B is : **[JEE-Main-2018]**

(1) $\frac{\sigma}{\varepsilon_0}\left[\frac{b^2-c^2}{b}+a\right]$ (2) $\frac{\sigma}{\varepsilon_0}\left[\frac{b^2-c^2}{c}+a\right]$ (3) $\frac{\sigma}{\varepsilon_0}\left[\frac{a^2-b^2}{a}+c\right]$ (4) $\frac{\sigma}{\varepsilon_0}\left[\frac{a^2-b^2}{b}+c\right]$

19. Three charges +Q, q, +Q are placed respectively, at distance, 0, d/2 and d from the origin, on the x-axis. If the net force experienced by +Q, placed at x = 0, is zero, then value of q is : **[JEE Main 2019]**

(1) +Q/2 (2) +Q/4 (3) –Q/2 (4) –Q/4

20. For a uniformly charged ring of radius R, the electric field on its axis has the largest magnitude at a distance h from its centre. Then value of h is : **[JEE Main 2019]**

(1) $\frac{R}{\sqrt{2}}$ (2) R (3) $\frac{R}{\sqrt{5}}$ (4) $R\sqrt{2}$

21. Two point charges $q_1(\sqrt{10}\mu C)$ and $q_2(-25\mu C)$ are placed on the x-axis at x = 1 m and x = 4 m respectively. The electric field (in V/m) at a point y = 3 m on y-axis is, **[JEE Main 2019]**

$\left[\text{take} = \frac{1}{4\pi g\varepsilon_0} = 9\times10^9 Nm^2C^{-2}\right]$

(1) $(-81\hat{i}+81\hat{j})\times10^2$ (2) $(81\hat{i}-81\hat{j})\times10^2$ (3) $(-63\hat{i}+27\hat{j})\times10^2$ (4) $(63\hat{i}-27\hat{j})\times10^2$

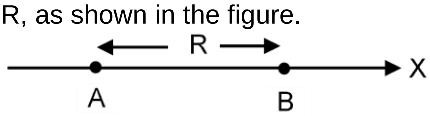
22. Charge is distributed within a sphere of radius R with a volume charge density $\rho(r)=\frac{A}{r^2}e^{-2r/a}$, where A and a are constant. If Q is the total charge of this charge distribution, the radius R is : **[JEE Main 2019]**

(1) $a\log\left(\frac{1}{1-\frac{Q}{2\pi aA}}\right)$ (2) $\frac{a}{2}\log\left(\frac{1}{1-\frac{Q}{2\pi aA}}\right)$ (3) $\frac{a}{2}\log\left(1-\frac{Q}{2\pi aA}\right)$ (4) $a\log\left(1-\frac{Q}{2\pi aA}\right)$

23. A charge Q is distributed over three concentric spherical shells of radii a, b, c (a < b < c) such that their surface charge densities are equal to one another. The total potential at a point at distance r from their common centre, where r < a, would be **[JEE Main- 2019]**

(1) $\frac{Q}{12\pi\epsilon_0}\frac{ab+bc+ca}{abc}$ (2) $\frac{Q}{4\pi\epsilon_0(a+b+c)}$ (3) $\frac{Q(a+b+c)}{4\pi\epsilon_0(a^2+b^2+c^2)}$ (4) $\frac{Q(a^2+b^2+c^2)}{4\pi\epsilon_0(a^3+b^3+c^3)}$

24. Two electric dipoles, A, B with respective dipole moments $\vec{d}_A=-4qa\hat{i}$ and $\vec{d}_B=-2qa\hat{i}$ are placed on the x–axis with a separation R, as shown in the figure. **[JEE Main 2019]**



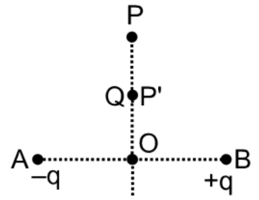
The distance from A at which both of them produce the same potential is :

(1) $\frac{R}{\sqrt{2}-1}$ (2) $\frac{\sqrt{2}R}{\sqrt{2}+1}$ (3) $\frac{\sqrt{2}R}{\sqrt{2}-1}$ (4) $\frac{R}{\sqrt{2}+1}$

25. Four equal point chargs Q each are placed in the xy-plane at (0, 2), (4, 2), (4, –2) and (0, –2). The work required to put a fifth charge Q at the origin of the coordinate system will be **[JEE Main 2019]**

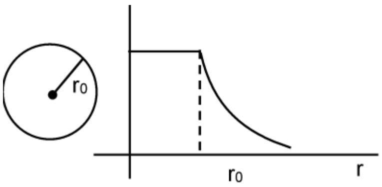
(1) $\frac{Q^2}{4\pi\epsilon_0}\left(1+\frac{1}{\sqrt{3}}\right)$ (2) $\frac{Q^2}{4\pi\epsilon_0}\left(1+\frac{1}{\sqrt{5}}\right)$ (3) $\frac{Q^2}{4\pi\epsilon_0}$ (4) $\frac{Q^2}{2\sqrt{2}\pi\epsilon_0}$

26. Charge –q and +q located at A and B, respectively, constitute an electric dipole. Distance AB = 2a, O is the mid-point of the dipole and OP is perpendicular to AB. A charge Q is placed at P where OP = y and y >> 2a. The charge Q experiences an electrostatic force F. If Q is now moved along the equatorial line to P' such that OP' = $\left(\frac{y}{3}\right)$, the force on Q will be close to : $\left(\frac{y}{3} >> 2a\right)$ **[JEE Main 2019]**



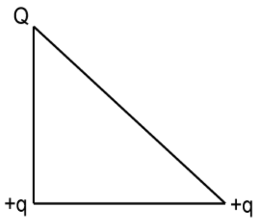
(1) 3F (2) 27F (3) 9F (4) F/3

27. The given graph shown variation (with distance r from centre) of : **[JEE Main 2019]**



(1) Electric field of a uniformly charged sphere
(2) Potential of a uniformly charged spherical shell
(3) Potential of a uniformly charged sphere
(4) Electric field of a uniformly charged spherical shell

28. Three charges Q, +q and +q and placed at the vertices of a right-angle isosceles triangle as shown below. The net electrostatic energy of the configuration is zero, if the value of Q is :**[JEE Main 2019]**



(1) + q (2) $\frac{-\sqrt{2}q}{\sqrt{2}+1}$ (3) –2q (4) $\frac{-q}{1+\sqrt{2}}$

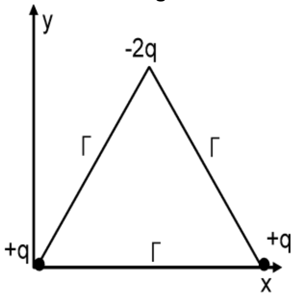
29. A particle of mass m and charge q is in an electric and magnetic field given by $\vec{E} = 2\hat{i} + 3\hat{j}$; $\vec{B} = 4\hat{j} + 6\hat{k}$. The charged particle is shifted from the origin to the point P(x = 1; y = 1) along a straight path. The magnitude of the total work done is : **[JEE Main 2019]**

(1) 5q (2) (2.5)q (3) (0.35) q (4) (0.15)q

30. An electric field of 1000 V/m is applied to an electric dipole at angle of 45°. The value of electric dipole moment is 10^{-29} C.m. What is the potential energy of the electric dipole ? **[JEE Main 2019]**

(1) -9×10^{-20} J (2) -7×10^{-27} J (3) -10×10^{-29} J (4) -20×10^{-18} J

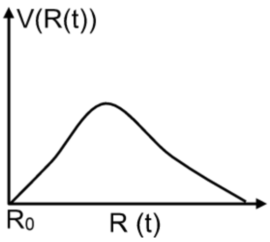
31. Determine the electric dipole moment of the system of three charges, placed on the vertices of an equilateral triangle, as shown in the figure : **[JEE Main 2019]**

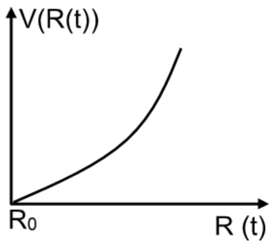


(1) $-\sqrt{3}\ q\ell\,\hat{j}$ (2) $(q\ell)\dfrac{\hat{i}+\hat{j}}{\sqrt{2}}$ (3) $2q\ell\,\hat{j}$ (4) $\sqrt{3}\ q\ell\,\dfrac{\hat{j}-\hat{i}}{\sqrt{2}}$

32. There is a uniform spherically symmetric surface charge density at a distance R_0 from the origin. The charge distribution is initially at rest and starts expanding because of mutual repulsion. The figure that represents best the speed V(R(t)) of the distribution as a function of its instantaneous radius R(t) is:

[JEE Main 2019]

(1)


(2)


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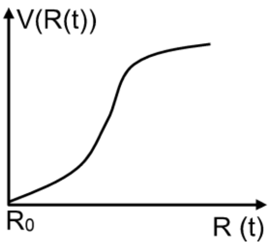

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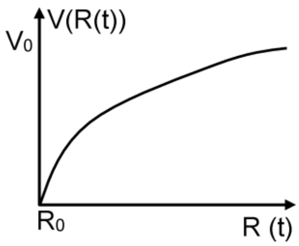

Answers

EXERCISE - 1

SECTION (A) :

1.	(3)	**2.**	(1)	**3.**	(1)	**4.**	(1)	**5.**	(1)	**6.**	(3)	**7.**	(2)
8.	(3)	**9.**	(4)	**10.**	(1)	**11.**	(3)	**12.**	(4)	**13.**	(2)	**14.**	(2)
15.	(4)	**16.**	(1)	**17.**	(4)	**18.**	(2)	**19.**	(4)	**20.**	(1)	**21.**	(1)

SECTION (B) :

1.	(4)	**2.**	(2)	**3.**	(3)	**4.**	(3)	**5.**	(2)	**6.**	(3)	**7.**	(3)
8.	(1)	**9.**	(4)	**10.**	(3)	**11.**	(4)	**12.**	(4)	**13.**	(2)	**14.**	(3)
15.	(2)	**16.**	(2)	**17.**	(3)	**18.**	(1)	**19.**	(1)	**20.**	(3)	**21.**	(3)
22.	(4)	**23.**	(2)	**24.**	(2)	**25.**	(3)	**26.**	(3)	**27.**	(3)	**28.**	(1)
29.	(2)	**30.**	(2)	**31.**	(3)	**32.**	(1)	**33.**	(4)	**34.**	(2)	**35.**	(1)
36.	(1)	**37.**	(1)	**38.**	(2)								

SECTION (C) :

1.	(2)	**2.**	(2)	**3.**	(4)	**4.**	(4)	**5.**	(2)	**6.**	(1)	**7.**	(4)
8.	(1)	**9.**	(2)	**10.**	(3)	**11.**	(3)	**12.**	(3)	**13.**	(3)	**14.**	(2)
15.	(4)	**16.**	(1)	**17.**	(1)	**18.**	(2)	**19.**	(2)	**20.**	(3)	**21.**	(3)
22.	(1)	**23.**	(2)	**24.**	(4)	**25.**	(1)	**26.**	(2)	**27.**	(3)	**28.**	(3)
29.	(2)	**30.**	(3)	**31.**	(4)	**32.**	(4)	**33.**	(1)	**34.**	(3)	**35.**	(4)
36.	(1)	**37.**	(1)	**38.**	(3)	**39.**	(1)	**40.**	(4)	**41.**	(2)	**42.**	(4)
43.	(1)	**44.**	(2)										

SECTION (D) :

1.	(2)	**2.**	(3)	**3.**	(2)	**4.**	(4)	**5.**	(2)	**6.**	(4)	**7.**	(2)
8.	(2)	**9.**	(3)	**10.**	(3)	**11.**	(3)	**12.**	(2)	**13.**	(3)	**14.**	(1)
15.	(1)	**16.**	(4)	**17.**	(4)	**18.**	(3)	**19.**	(2)	**20.**	(1)	**21.**	(1)
22.	(4)												

SECTION (E) :

1.	(4)	**2.**	(1)	**3.**	(1)	**4.**	(4)

SECTION (F) :

1.	(4)	**2.**	(4)	**3.**	(2)

SECTION (G) :

1.	(4)	**2.**	(3)	**3.**	(1)	**4.**	(4)	**5.**	(3)	**6.**	(1)	**7.**	(1)
8.	(2)	**9.**	(1)	**10.**	(4)	**11.**	(4)	**12.**	(1)	**13.**	(2)	**14.**	(2)
15.	(1)	**16.**	(4)										

SECTION (H) :

1.	(3)	**2.**	(4)	**3.**	(2)	**4.**	(1)	**5.**	(3)	**6.**	(2)	**7.**	(1)
8.	(2)	**9.**	(2)	**10.**	(3)	**11.**	(4)	**12.**	(3)	**13.**	(3)	**14.**	(3)
15.	(1)	**16.**	(3)	**17.**	(4)	**18.**	(2)	**19.**	(1)	**20.**	(3)	**21.**	(3)
22.	(4)	**23.**	(3)										

SECTION (I) :

1.	(2)	**2.**	(1)	**3.**	(2)	**4.**	(3)	**5.**	(3)	**6.**	(4)	**7.**	(4)
8.	(2)	**9.**	(4)	**10.**	(1)	**11.**	(2)	**12.**	(4)	**13.**	(1)	**14.**	(3)
15.	(1)	**16.**	(4)	**17.**	(3)	**18.**	(4)	**19.**	(3)	**20.**	(2)		

SECTION (J) :

1.	(3)	**2.**	(3)	**3.**	(2)	**4.**	(3)	**5.**	(4)	**6.**	(1)	**7.**	(3)
8.	(3)	**9.**	(1)	**10.**	(1)	**11.**	(2)	**12.**	(1)	**13.**	(1)	**14.**	(1)
15.	(2)	**16.**	(2)	**17.**	(1)	**18.**	(1)	**19.**	(4)	**20.**	(2)	**21.**	(3)
22.	(4)	**23.**	(2)	**24.**	(3)	**25.**	(3)	**26.**	(2)	**27.**	(1)		

EXERCISE - 2

1.	(2)	**2.**	(3)	**3.**	(1)	**4.**	(1)	**5.**	(4)	**6.**	(2)	**7.**	(2)
8.	(3)	**9.**	(4)	**10.**	(3)	**11.**	(3)	**12.**	(2)	**13.**	(2)	**14.**	(3)
15.	(4)	**16.**	(3)	**17.**	(3)	**18.**	(1)						

EXERCISE - 3

PART-I

1.	(1)	**2.**	(1)	**3.**	(3)	**4.**	(3)	**5.**	(4)	**6.**	(3)	**7.**	(1)
8.	(1)	**9.**	(2)	**10.**	(2)	**11.**	(1)	**12.**	(1)	**13.**	(2)	**14.**	(4)
15.	(2)	**16.**	(1)	**17.**	(4)	**18.**	(2)	**19.**	(3)	**20.**	(3)	**21.**	(2)
22.	(1)	**23.**	(4)	**24.**	(3)	**25.**	(4)	**26.**	(4)	**27.**	(2)		

PART – II

1.	(3)	**2.**	(4)	**3.**	(1)	**4.**	(3)	**5.**	(3)	**6.**	(4)	**7.**	(1)
8.	(4)	**9.**	(3)	**10.**	(3)	**11.**	(1)	**12.**	(4)	**13.**	(3)	**14.**	(1)
15.	(3,4)	**16.**	(4)	**17.**	(4)	**18.**	(4)	**19.**	(4)	**20.**	(1)	**21.**	(4)
22.	(2)	**23.**	(3)	**24.**	(3)	**25.**	(2)	**26.**	(2)	**27.**	(2)	**28.**	(2)
29.	(1)	**30.**	(2)	**31.**	(1)	**32.**	(4)						