EXERCISE-I

Charge and Coulomb's Law

1. The minimum charge on an object is

(A) 1 *coulomb* (B) 1 *stat coulomb*

(C) 1.6×10^{-19} *coulomb* (D) 3.2×10^{-19} *coulomb*

2. Out of gravitational, electromagnetic, Vander Waals, electrostatic and nuclear forces; which two are able to provide an attractive force between two neutrons

(A) Electrostatic and gravitational

(B) Electrostatic and nuclear

(C) Gravitational and nuclear

(D) Some other forces like Vander Waals

3. A total charge Q is broken in two parts Q_1 and Q_2 and they are placed at a distance R from each other. The maximum force of repulsion between them will occur, when

(A) $Q_2 = \frac{Q}{R},\ Q_1 = Q - \frac{Q}{R}$

(B) $Q_2 = \frac{Q}{4},\ Q_1 = Q - \frac{2Q}{3}$

(C) $Q_2 = \frac{Q}{4},\ Q_1 = \frac{3Q}{4}$

(D) $Q_1 = \frac{Q}{2},\ Q_2 = \frac{Q}{2}$

4. Three charges $4q, Q$ and q are in a straight line in the position of 0, $l/2$ and l respectively. The resultant force on q will be zero, if $Q =$

(A) $-q$ (B) $-2q$

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

5. An isolated solid metallic sphere is given $+Q$ charge. The charge will be distributed on the sphere

(A) Uniformly but only on surface

(B) Only on surface but non-uniformly

(C) Uniformly inside the volume

(D) Non-uniformly inside the volume

6. Two small spheres each having the charge $+Q$ are suspended by insulating threads of length L from a hook. This arrangement is taken in space where there is no gravitational effect, then the angle between the two suspensions and the tension in each will be

(A) $180^o, \frac{1}{4\pi\varepsilon_0}\frac{Q^2}{(2L)^2}$ (B) $90^o, \frac{1}{4\pi\varepsilon_0}\frac{Q^2}{L^2}$

(C) $180^o, \frac{1}{4\pi\varepsilon_0}\frac{Q^2}{2L^2}$ (D) $180^o, \frac{1}{4\pi\varepsilon_0}\frac{Q^2}{L^2}$

7. Two charges each of $1\,coulomb$ are at a distance $1\,km$ apart, the force between them is

(A) 9×10^3 *Newton* (B) 9×10^{-3} *Newton*

(C) 1.1×10^{-4} *Newton* (D) 10^4 *Newton*

8. $+2C$ and $+6C$ two charges are repelling each other with a force of $12\,N$. If each charge is given $-2C$ of charge, then the value of the force will be

(A) $4N$ (Attractive) (B) $4N$ (Repulsive)

(C) $8N$ (Repulsive) (D) Zero

9. Dielectric constant of pure water is 81. Its permittivity will be

(A) 7.12×10^{-10} MKS units

(B) 8.86×10^{-12} MKS units

(C) 1.02×10^{13} MKS units

(D) Cannot be calculated

10. There are two metallic spheres of same radii but one is solid and the other is hollow, then

(A) Solid sphere can be given more charge

(B) Hollow sphere can be given more charge

(C) They can be charged equally (maximum)

(D) None of the above

11. Two similar spheres having $+q$ and $-q$ charge are kept at a certain distance. F force acts between the two. If in the middle of two spheres, another similar sphere having $+q$ charge is kept, then it experience a force in magnitude and direction as

(A) Zero having no direction

(B) $8F$ towards $+q$ charge

(C) $8F$ towards $-q$ charge

(D) $4F$ towards $+q$ charge

12. A charge Q is divided into two parts of q and $Q-q$. If the coulomb repulsion between them when they are separated is to be maximum, the ratio of $\frac{Q}{q}$ should be

(A) 2 (B) $1/2$

(C) 4 (D) $1/4$

13. Number of electrons in one coulomb of charge will be

(A) 5.46×10^{29} (B) 6.25×10^{18}

(C) $1.6\times10^{+19}$ (D) 9×10^{11}

14. When air is replaced by a dielectric medium of constant k, the maximum force of attraction between two charges separated by a distance

(A) Decreases k times

(B) Remains unchanged

(C) Increases k times

(D) Increases k^{-1} times

15. A glass rod rubbed with silk is used to charge a gold leaf electroscope and the leaves are observed to diverge. The electroscope thus charged is exposed to X-rays for a short period. Then

(A) The divergence of leaves will not be affected

(B) The leaves will diverge further

(C) The leaves will collapse

(D) The leaves will melt

16. One metallic sphere A is given positive charge whereas another identical metallic sphere B of exactly same mass as of A is given equal amount of negative charge. Then

(A) Mass of A and mass of B still remain equal

(B) Mass of A increases

(C) Mass of B decreases

(D) Mass of B increases

17. The force between two charges $0.06\,m$ apart is $5\,N$. If each charge is moved towards the other by $0.01\,m$, then the force between them will become

(A) $7.20\,N$ (B) $11.25\,N$

(C) $22.50\,N$ (D) $45.00\,N$

18. Two charged spheres separated at a distance d exert a force F on each other. If they are immersed in a liquid of dielectric constant 2, then what is the force (if all conditions are same)

(A) $\frac{F}{2}$ (B) F

(C) $2F$ (D) $4F$

19. Two point charges $+3\mu C$ and $+8\mu C$ repel each other with a force of $40N$. If a charge of $-5\mu C$ is added to each of them, then the force between them will become

(A) $-10N$ (B) $+10N$

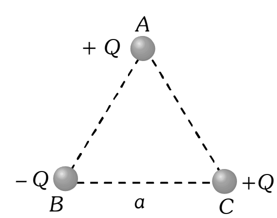
(C) $+20N$ (D) $-20N$

20. When 10^{19} electrons are removed from a neutral metal plate, the electric charge on it is

(A) – 1.6 C (B) + 1.6 C

(C) $10^{+19}\,C$ (D) $10^{-19}\,C$

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



(A) $Q^2/(4\pi\varepsilon_0 a^2)$

(B) $-Q^2/(4\pi\varepsilon_0 a^2)$

(C) Zero

(D) $Q^2/(2\pi\varepsilon_0 a^2)$

22. Two particle of equal mass m and charge q are placed at a distance of 16 *cm*. They do not experience any force. The value of $\frac{q}{m}$ is

(A) l (B) $\sqrt{\frac{\pi\varepsilon_0}{G}}$

(C) $\sqrt{\frac{G}{4\pi\varepsilon_0}}$ (D) $\sqrt{4\pi\varepsilon_0 G}$

23. When a glass rod is rubbed with silk, it

(A) Gains electrons from silk

(B) Gives electrons to silk

(C) Gains protons from silk

(D) Gives protons to silk

24. An electron is moving round the nucleus of a hydrogen atom in a circular orbit of radius r. The coulomb force $\vec{F}$ between the two is (Where $K = \frac{1}{4\pi\varepsilon_0}$)

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

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

25. A body has – 80 *micro coulomb* of charge. Number of additional electrons in it will be

(A) 8×10^{-5} (B) 80×10^{-17}

(C) 5×10^{14} (D) 1.28×10^{-17}

26. Two point charges placed at a certain distance r in air exert a force F on each other. Then the distance r' at which these charges will exert the same force in a medium of dielectric constant k is given by

(A) r (B) r/k

(C) $r/\sqrt{k}$ (D) $r\sqrt{k}$

27. Dielectric constant for metal is

(A) Zero (B) Infinite

(C) 1 (D) Greater than 1

28. A charge of Q *coulomb* is placed on a solid piece of metal of irregular shape. The charge will distribute itself

(A) Uniformly in the metal object

(B) Uniformly on the surface of the object

(C) Such that the potential energy of the system is minimised

(D) Such that the total heat loss is minimised

29. Five balls numbered 1 to 5 are suspended using separate threads. Pairs (1, 2), (2, 4) and (4, 1) show electrostatic attraction, while pair (2, 3) and (4, 5) show repulsion. Therefore ball 1 must be

(A) Positively charged

(B) Negatively charged

(C) Neutral

(D) Made of metal

30. Equal charges q are placed at the four corners A, B, C, D of a square of length a. The magnitude of the force on the charge at B will be

(A) $\frac{3q^2}{4\pi\varepsilon_0 a^2}$ (B) $\frac{4q^2}{4\pi\varepsilon_0 a^2}$

(C) $\left(\frac{1+2\sqrt{2}}{2}\right)\frac{q^2}{4\pi\varepsilon_0 a^2}$ (D) $\left(2+\frac{1}{\sqrt{2}}\right)\frac{q^2}{4\pi\varepsilon_0 a^2}$

31. Two identical conductors of copper and aluminium are placed in an identical electric fields. The magnitude of induced charge in the aluminium will be

(A) Zero

(B) Greater than in copper

(C) Equal to that in copper

(D) Less than in copper

32. 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 with C and finally removed away from both. The new force of repulsion between B and C is

(A) $F/4$ (B) $3F/4$

(C) $F/8$ (D) $3F/8$

33. When a body is earth connected, electrons from the earth flow into the body. This means the body is…..
(A) Unchanged
(B) Charged positively
(C) Charged negatively
(D) An insulator

34. The charges on two sphere are $+7\mu C$ and $-5\mu C$ respectively. They experience a force F. If each of them is given and additional charge of $-2\mu C$, the new force of attraction will be
(A) F (B) $F/2$
(C) $F/\sqrt{3}$ (D) $2F$

35. The ratio of electrostatic and gravitational forces acting between electron and proton separated by a distance $5\times10^{-11} m$, will be (Charge on electron = 1.6×10^{-19} C, mass of electron = 9.1×10^{-31} kg, mass of proton = $1.6\times10^{-27} kg$, $G = 6.7\times10^{-11}\ Nm^2/kg^2$)
(A) 2.36×10^{39} (B) 2.36×10^{40}
(C) 2.34×10^{41} (D) 2.34×10^{42}

36. Two point charges 3×10^{-6} C and 8×10^{-6} C repel each other by a force of 6×10^{-3} N. If each of them is given an additional charge -6×10^{6} C, the force between them will be
(A) 2.4×10^{-3} N (attractive)
(B) 2.4×10^{-9} N (attractive)
(C) 1.5×10^{-3} N (repulsive)
(D) 1.5×10^{-3} N (attractive)

37. Two equally charged, identical metal spheres A and B repel each other with a force 'F'. The spheres are kept fixed with a distance 'r' between them. A third identical, but uncharged sphere C is brought in contact with A and then placed at the mid-point of the line joining A and B. The magnitude of the net electric force on C is
(A) F (B) $3F/4$
(C) $F/2$ (D) $F/4$

38. Two charges of equal magnitudes and at a distance r exert a force F on each other. If the charges are halved and distance between them is doubled, then the new force acting on each charge is
(A) $F/8$ (B) $F/4$
(C) $4F$ (D) $F/16$

39. An infinite number of charges, each of charge 1 μC, are placed on the x-axis with co-ordinates $x = 1, 2, 4, 8, ...\infty$. If a charge of 1 C is kept at the origin, then what is the net force acting on 1 C charge
(A) 9000 N (B) 12000 N
(C) 24000 N (D) 36000 N

40. The number of electrons in 1.6 C charge will be
(A) 10^{19} (B) 10^{20}
(C) 1.1×10^{19} (D) 1.1×10^{2}

Electric Field

41. The electric charge in uniform motion produces
(A) An electric field only
(B) A magnetic field only
(C) Both electric and magnetic field
(D) Neither electric nor magnetic field

42. Two charged spheres of radii 10 cm and 15 cm are connected by a thin wire. No current will flow, if they have
(A) The same charge on each
(B) The same potential
(C) The same energy
(D) The same field on their surfaces

43. The electric field inside a spherical shell of uniform surface charge density is
(A) Zero
(B) Constant, less than zero
(C) Directly proportional to the distance from the centre
(D) None of the above

44. Electric lines of force about negative point charge are
(A) Circular, anticlockwise
(B) Circular, clockwise
(C) Radial, inward
(D) Radial, outward

45. Three charges $2q, -q, -q$ are located at the vertices of an equilateral triangle. At the centre of the triangle

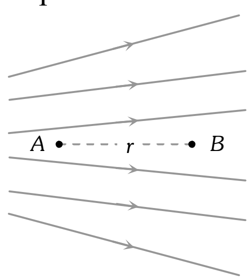
(A) The field is zero but potential is non-zero

(B) The field is non-zero but potential is zero

(C) Both field and potential are zero

(D) Both field and potential are non-zero

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



(A) $E_A > E_B$ (B) $E_A < E_B$

(C) $E_A = \frac{E_B}{r}$ (D) $E_A = \frac{E_B}{r^2}$

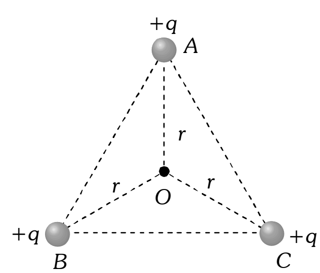
47. ABC is an equilateral triangle. Charges $+q$ are placed at each corner. The electric intensity at O will be

(A) $\frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$

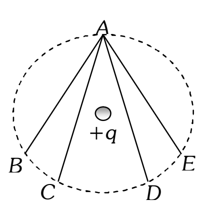
(B) $\frac{1}{4\pi\varepsilon_0}\frac{q}{r}$

(C) Zero

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



48. In the electric field of a point charge q, a certain charge is carried from point A to B, C, D and E. Then the work done



(A) Is least along the path AB

(B) Is least along the path AD

(C) Is zero along all the paths AB, AC, AD and AE

(D) Is least along AE

49. An electron and a proton are in a uniform electric field, the ratio of their accelerations will be

(A) Zero

(B) Unity

(C)The ratio of the masses of proton and electron

(D) The ratio of the masses of electron and proton

50. Two parallel plates have equal and opposite charge. When the space between them is evacuated, the electric field between the plates is $2\times10^5 V/m$. When the space is filled with dielectric, the electric field becomes $1\times10^5 V/m$. The dielectric constant of the dielectric material

(A) 1/2 (B) 1

(C) 2 (D) 3

51. The insulation property of air breaks down at $E = 3\times10^6$ *volt/metre*. The maximum charge that can be given to a sphere of diameter $5m$ is approximately (in coulombs)

(A) 2×10^{-2} (B) 2×10^{-3}

(C) 2×10^{-4} (D) 2×10^{-5}

52. The distance between the two charges $25\mu C$ and $36\mu C$ is $11cm$ At what point on the line joining the two, the intensity will be zero

(A) At a distance of $5cm$ from $25\mu C$

(B) At a distance of $5cm$ from $36\mu C$

(C) At a distance of $10cm$ from $25\mu C$

(D) At a distance of $11cm$ from $36\mu C$

53. Two spheres A and B of radius $4cm$ and $6cm$ are given charges of $80\mu c$ and $40\mu c$ respectively. If they are connected by a fine wire, the amount of charge flowing from one to the other is

(A) $20\mu C$ from A to B

(B) $16\mu C$ from A to B

(C) $32\mu C$ from B to A

(D) $32\mu C$ from A to B

54. A charge particle is free to move in an electric field. It will travel

(A) Always along a line of force

(B) Along a line of force, if its initial velocity is zero

(C) Along a line of force, if it has some initial velocity in the direction of an acute angle with the line of force

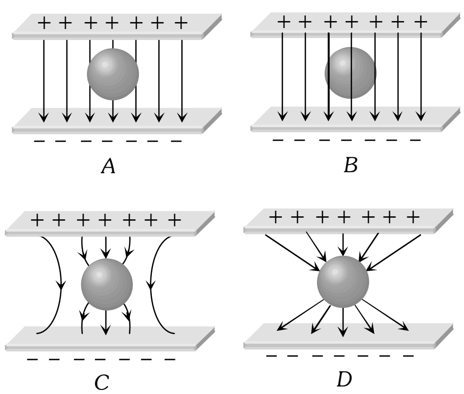
(D) None of the above

55. If E is the electric field intensity of an electrostatic field, then the electrostatic energy density is proportional to

(A) E (B) E^2

(C) $1/E^2$ (D) E^3

56. An uncharged sphere of metal is placed in between two charged plates as shown. The lines of force look like



(A) A (B) B

(C) C (D) D

57. The intensity of electric field required to balance a proton of mass $1.7\times10^{-27}\,kg$ and charge $1.6\times10^{-19}\,C$ is nearly

(A) $1\times10^{-7}\ V/m$ (B) $1\times10^{-5}\ V/m$

(C) $1\times10^{7}\ V/m$ (D) $1\times10^{5}\ V/m$

58. Two point charges Q and $-3Q$ are placed at some distance apart. If the electric field at the location of Q is E then at the locality of $-3Q$, it is

(A) $-E$ (B) $E/3$

(C) $-3E$ (D) $-E/3$

59. The number of electrons to be put on a spherical conductor of radius $0.1\,m$ to produce an electric field of $0.036\,N/C$ just above its surface is

(A) 2.7×10^5 (B) 2.6×10^5

(C) 2.5×10^5 (D) 2.4×10^5

60. The intensity of the electric field required to keep a water drop of radius $10^{-5}\,cm$ just suspended in air when charged with one electron is approximately

(A) $260\,volt/cm$

(B) $260\,newton/coulomb$

(C) $130\,volt/cm$

(D) $130\,newton/coulomb$

$(g=10\,newton/kg, e=1.6\times10^{-19}\,coulomb)$

61. Deutron and $\alpha-$particle are put $1\,\mathring{A}$ apart in air. Magnitude of intensity of electric field due to deutron at $\alpha-$particle is

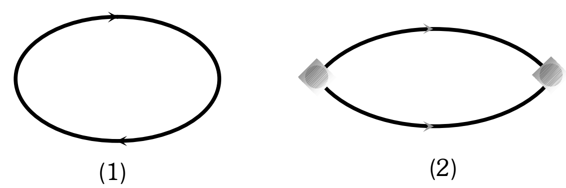
(A) Zero

(B) $2.88\times10^{11}\ newton/coulomb$

(C) $1.44\times10^{11}\ newton/coulomb$

(D) $5.76\times10^{11}\ newton/coulomb$

62. Below figures (1) and (2) represent lines of force. Which is correct statement



(A) Figure (1) represents magnetic lines of force

(B) Figure (2) represents magnetic lines of force

(C) Figure (1) represents electric lines of force

(D) Both figure (1) and figure (2) represent magnetic lines of force

63. The unit of electric field is not equivalent to

(A) N/C (B) J/C

(C) V/m (D) $J/C-m$

64. A flat circular disc has a charge $+Q$ uniformly distributed on the disc. A charge $+q$ is thrown with kinetic energy E towards the disc along its normal axis. The charge q will

(A) Hit the disc at the centre

(B) Return back along its path after touching the disc

(C) Return back along its path without touching the disc

(D)Any of the above three situations is possible depending on the magnitude of E

65. The magnitude of electric field $\mathbf{E}$ in the annular region of a charged cylindrical capacitor

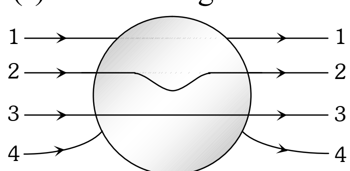
(A) Is same throughout

(B) Is higher near the outer cylinder than near the inner cylinder

(C)Varies as $1/r$, where r is the distance from the axis

(D) Varies as $1/r^2$, where r is the distance from the axis

66. A metallic solid sphere is placed in a uniform electric field. The lines of force follow the path(s) shown in figure as



(A) 1 (B) 2

(C) 3 (D) 4

67. The distance between a proton and electron both having a charge 1.6×10^{-19} *coulomb*, of a hydrogen atom is 10^{-10} *metre*. The value of intensity of electric field produced on electron due to proton will be

(A) $2.304\times10^{-10}\ N/C$ (B) $14.4\ V/m$

(C) $16\ V/m$ (D) $1.44\times10^{11}\ N/C$

68. What is the magnitude of a point charge due to which the electric field $30\,cm$ away has the magnitude 2 *newton / coulomb*

$[1/4\pi\varepsilon_0 = 9\times10^9\ Nm^2/C^2]$

(A) 2×10^{-11} *coulomb* (B) 3×10^{-11} *coulomb*

(C) 5×10^{-11} *coulomb* (D) 9×10^{-11} *coulomb*

69. Two positive charges of 20 *coulomb* and Q *coulomb* are situated at a distance of $60\,cm$. The neutral point between them is at a distance of $20\,cm$ from the 20 *coulomb* charge. Charge Q is

(A) $30\,C$ (B) $40\,C$

(C) $60\,C$ (D) $80\,C$

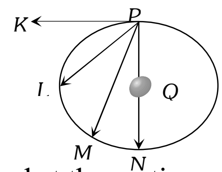
70. In the figure the charge Q is at the centre of the circle. Work done is maximum when another charge is taken from point P to

(A) K

(B) L

(C) M

(D) N



71. Equal charges q are placed at the vertices A and B of an equilateral triangle ABC of side a. The magnitude of electric field at the point C is

(A) $\dfrac{q}{4\pi\varepsilon_0 a^2}$ (B) $\dfrac{\sqrt{2}\,q}{4\pi\varepsilon_0 a^2}$

(C) $\dfrac{\sqrt{3}\,q}{4\pi\varepsilon_0 a^2}$ (D) $\dfrac{q}{2\pi\varepsilon_0 a^2}$

72. Two equal charges q are placed at a distance of $2a$ and a third charge $-2q$ is placed at the midpoint. The potential energy of the system is

(A) $\dfrac{q^2}{8\pi\varepsilon_0 a}$ (B) $\dfrac{6q^2}{8\pi\varepsilon_0 a}$

(C) $-\dfrac{7q^2}{8\pi\varepsilon_0 a}$ (D) $\dfrac{9q^2}{8\pi\varepsilon_0 a}$

73. Two point charges $100\,\mu C$ and $5\,\mu C$ are placed at points A and B respectively with $AB = 40\,cm$. The work done by external force in displacing the charge $5\,\mu C$ from B to C, where $BC = 30\,cm$, angle $ABC = \dfrac{\pi}{2}$ and $\dfrac{1}{4\pi\varepsilon_0} = 9\times10^9\ Nm^2/C^2$

(A) $9\,J$ (B) $\dfrac{81}{20}\,J$

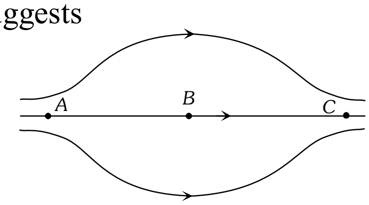
(C) $\dfrac{9}{25}\,J$ (D) $-\dfrac{9}{4}\,J$

74. The unit of intensity of electric field is

(A) *Newton / Coulomb* (B) *Joule / Coulomb*

(C) *Volt – metre* (D) *Newton / metre*

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



(A) $E_A > E_B > E_C$ (B) $E_A = E_B = E_C$

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

76. A cube of side b has a charge q at each of its vertices. The electric field due to this charge distribution at the centre of this cube will be

(A) q/b^2 (B) $q/2b^2$

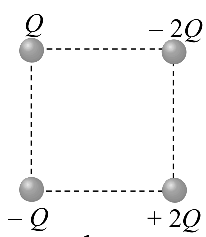
(C) $32q/b^2$ (D) Zero

77. A charged water drop whose radius is $0.1\,\mu m$ is in equilibrium in an electric field. If charge on it is equal to charge of an electron, then intensity of electric field will be $(g = 10\,ms^{-1})$

(A) $1.61\,N/C$ (B) $26.2\,N/C$

(C) $262\,N/C$ (D) $1610\,N/C$

78. Four charges are placed on corners of a square as shown in figure having side of $5\,cm$. If Q is one microcoulomb, then electric field intensity at centre will be



(A) $1.02\times10^7\,N/C$ upwards

(B) $2.04\times10^7\,N/C$ downwards

(C) $2.04\times10^7\,N/C$ upwards

(D) $1.02\times10^7\,N/C$ downwards

79. Point charges $+4q, -q$ and $+4q$ are kept on the $x-$axis at points $x = 0, x = a$ and $x = 2a$ respectively, then

(A) Only q is in stable equilibrium

(B) None of the charges are in equilibrium

(C) All the charges are in unstable equilibrium

(D) All the charges are in stable equilibrium

80. Two point charges of $20\,\mu C$ and $80\,\mu C$ are $10\,cm$ apart. Where will the electric field strength be zero on the line joining the charges from $20\,\mu C$ charge

(A) $0.1\,m$ (B) $0.04\,m$

(C) $0.033\,m$ (D) $0.33\,m$

81. What is the magnitude of a point charge which produces an electric field of 2 *N*/coulomb at a distance of 60 *cm* $(1/4\pi\varepsilon_0 = 9\times10^9\,N-m^2/C^2)$

(A) $8\times10^{-11}\,C$ (B) $2\times10^{-12}\,C$

(C) $3\times10^{-11}\,C$ (D) $6\times10^{-10}\,C$

82. The electric field due to a charge at a distance of 3 *m* from it is 500 *N*/coulomb. The magnitude of the charge is $\left[\frac{1}{4\pi\varepsilon_0} = 9\times10^9\,\frac{N-m^2}{coulomb^2}\right]$

(A) 2.5 *micro-coulomb*

(B) 2.0 *micro-coulomb*

(C) 1.0 *micro-coulomb*

(D) 0.5 *micro-coulomb*

83. Electric field strength due to a point charge of $5\mu C$ at a distance of 80 *cm* from the charge is

(A) 8×10^4 *N/C* (B) 7×10^4 *N/C*

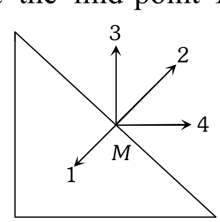
(C) 5×10^4 *N/C* (D) 4×10^4 *N/C*

84. Two positive point charges of $12\mu C$ and $8\mu C$ are $10cm$ apart. The work done in bringing them 4 *cm* closer is

(A) 5.8 *J* (B) 5.8 *eV*

(C) 13 *J* (D) 13 *eV*

85. Three identical point charges, as shown are placed at the vertices of an isosceles right angled triangle. Which of the numbered vectors coincides in direction with the electric field at the mid-point M of the hypotenuse



(A) 1 (B) 2

(C) 3 (D) 4

86. Which of the following is deflected by electric field

(A) X-rays (B) γ -rays

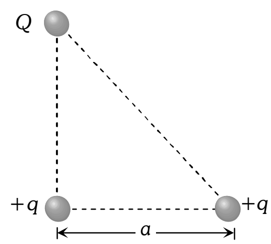
(C) Neutrons (D) α -particles

87. A charged particle of mass $5\times10^{-5}\,kg$ is held stationary in space by placing it in an electric field of strength $10^7\,NC^{-1}$ directed vertically downwards. The charge on the particle is

(A) $-20\times10^{-5}\,\mu C$ (B) $-5\times10^{-5}\,\mu C$

(C) $5\times10^{-5}\,\mu C$ (D) $20\times10^{-5}\,\mu C$

88. Three charges $Q, +q$ and $+q$ are placed at the vertices of a right-angled isosceles triangle as shown. The net electrostatic energy of the configuration is zero if Q is equal to



(A) $\dfrac{-q}{1+\sqrt{2}}$

(B) $\dfrac{-2q}{2+\sqrt{2}}$

(C) $-2q$

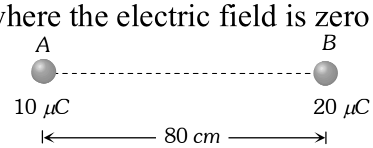
(D) $+q$

89. Two electric charges $12\mu C$ and $-6\mu C$ are placed 20 cm apart in air. There will be a point P on the line joining these charges and outside the region between them, at which the electric potential is zero. The distance of P from $-6\mu C$ charge is

(A) 0.10 m (B) 0.15 m

(C) 0.20 m (D) 0.25 m

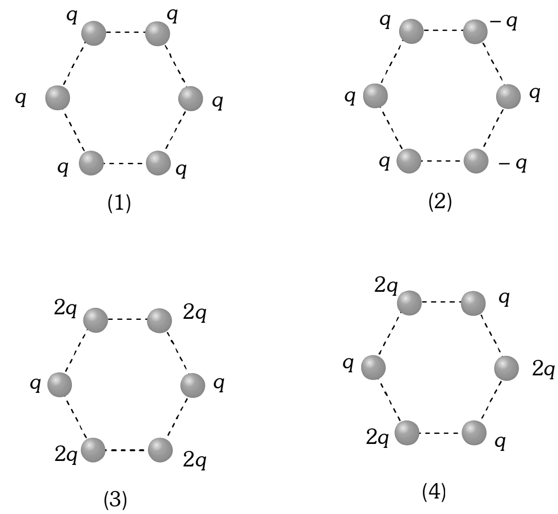
90. In the given figure distance of the point from A where the electric field is zero is



(A) 20 cm (B) 10 cm

(C) 33 cm (D) None of these

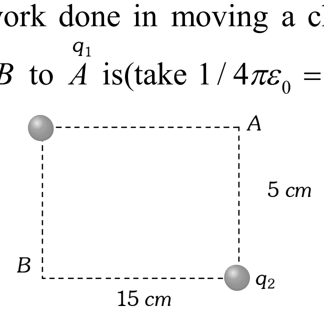
91. Figures below show regular hexagons, with charges at the vertices. In which of the following cases the electric field at the centre is not zero



(A) 1 (B) 2

(C) 3 (D) 4

92. In the rectangle, shown below, the two corners have charges $q_1 = -5\mu C$ and $q_2 = +2.0\mu C$. The work done in moving a charge $+3.0\mu C$ from B to A is(take $1/4\pi\varepsilon_0 = 10^{10}\,N\text{-}m^2/C^2$)



(A) 2.8 J (B) 3.5 J

(C) 4.5 J (D) 5.5 J

93. A cube of a metal is given a positive charge Q. For the above system, which of the following statements is true

(A) Electric potential at the surface of the cube is zero

(B) Electric potential within the cube is zero

(C) Electric field is normal to the surface of the cube

(D) Electric field varies within the cube

94. If q is the charge per unit area on the surface of a conductor, then the electric field intensity at a point on the surface is

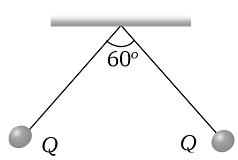
(A) $\left(\frac{q}{\varepsilon_0}\right)$ normal to surface

(B) $\left(\frac{q}{2\varepsilon_0}\right)$ normal to surface

(C) $\left(\frac{q}{\varepsilon_0}\right)$ tangential to surface

(D) $\left(\frac{q}{2\varepsilon_0}\right)$ tangential to surface

95. Two small spherical balls each carrying a charge $Q = 10\mu C$ (10 *micro-coulomb*) are suspended by two insulating threads of equal lengths 1m each, from a point fixed in the ceiling. It is found that in equilibrium threads are separated by an angle 60^o between them, as shown in the figure. What is the tension in the threads (Given: $\frac{1}{(4\pi\varepsilon_0)} = 9\times10^9 Nm/C^2$)



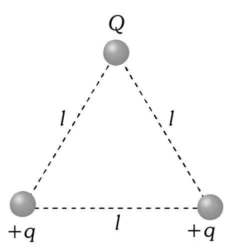
(A) 18 N

(B) 1.8 N

(C) 0.18 N

(D) None of the above

96. Three charges $Q, (+q)$ and $(+q)$ are placed at the vertices of an equilateral triangle of side l as shown in the figure. If the net electrostatic energy of the system is zero, then Q is equal to



(A) $\left(-\frac{q}{2}\right)$

(B) $(-q)$

(C) $(+q)$

(D) Zero

97. A positively charged particle moving along x-axis with a certain velocity enters a uniform electric field directed along positive y-axis. Its

(A) Vertical velocity changes but horizontal velocity remains constant

(B) Horizontal velocity changes but vertical velocity remains constant

(C) Both vertical and horizontal velocities change

(D) Neither vertical nor horizontal velocity changes

98. A hollow sphere of charge does not produce an electric field at any

(A) Point beyond 2 metres

(B) Point beyond 10 metres

(C) Interior point

(D) Outer point

99. A drop of $10^{-6}\,kg$ water carries $10^{-6}\,C$ charge. What electric field should be applied to balance its weight (assume $g = 10m/s^2$)

(A) 10 V/m upward

(B) 10 V/m downward

(C) 0.1 V/m downward

(D) 0.1 V/m upward

100. A charged particle of mass 0.003 gm is held stationary in space by placing it in a downward direction of electric field of $6\times10^4\,N/C$. Then the magnitude of the charge is

(A) $5\times10^{-4}C$ (B) $5\times10^{-10}C$

(C) $-18\times10^{-6}C$ (D) $-5\times10^{-9}C$

101. Two point charges $+9e$ and $+e$ are at 16 cm away from each other. Where should another charge q be placed between them so that the system remains in equilibrium

(A) 24 cm from $+9e$ (B) 12 cm from $+9e$

(C) 24 cm from $+e$ (D) 12 cm from $+e$

102. The distance between charges $5 \times 10^{-11} C$ and $-2.7 \times 10^{-11} C$ is 0.2 *m*. The distance at which a third charge should be placed in order that it will not experience any force along the line joining the two charges is

(A) 0.44 *m* (B) 0.65 *m*
(C) 0.556 *m* (D) 0.350 *m*

103. If identical charges $(-q)$ are placed at each corner of a cube of side *b*, then electric potential energy of charge $(+q)$ which is placed at centre of the cube will be

(A) $\frac{8\sqrt{2}q^2}{4\pi\varepsilon_0 b}$ (B) $\frac{-8\sqrt{2}q^2}{\pi\varepsilon_0 b}$
(C) $\frac{-4\sqrt{2}q^2}{\pi\varepsilon_0 b}$ (D) $\frac{-4q^2}{\sqrt{3}\pi\varepsilon_0 b}$

104. An electron having charge '*e*' and mass '*m*' is moving in a uniform electric field *E*. Its acceleration will be

(A) $\frac{e^2}{m}$ (B) $\frac{E^2 e}{m}$
(C) $\frac{eE}{m}$ (D) $\frac{mE}{e}$

105. If an insulated non-conducting sphere of radius *R* has charge density ρ. The electric field at a distance r from the centre of sphere $(r < R)$ will be

(A) $\frac{\rho R}{3\varepsilon_0}$ (B) $\frac{\rho r}{\varepsilon_0}$
(C) $\frac{\rho r}{3\varepsilon_0}$ (D) $\frac{3\rho R}{\varepsilon_0}$

106. The wrong statement about electric lines of force is

(A) These originate from positive charge and end on negative charge
(B) They do not intersect each other at a point
(C) They have the same form for a point charge and a sphere
(D) They have physical existence

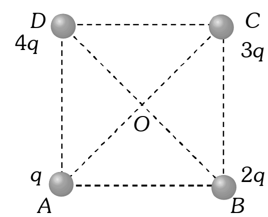
107. A charge produces an electric field of 1 *N*/*C* at a point distant 0.1 *m* from it. The magnitude of charge is

(A) $1.11 \times 10^{-12} C$ (B) $9.11 \times 10^{-12} C$
(C) $7.11 \times 10^{-6} C$ (D) None of these

108. A charged particle is suspended in equilibrium in a uniform vertical electric field of intensity 20000 *V*/*m*. If mass of the particle is $9.6 \times 10^{-16} kg$, the charge on it and excess number of electrons on the particle are respectively $(g = 10\, m/s^2)$

(A) $4.8 \times 10^{-19} C, 3$ (B) $5.8 \times 10^{-19} C, 4$
(C) $3.8 \times 10^{-19} C, 2$ (D) $2.8 \times 10^{-19} C, 1$

109. Charges *q*, 2*q*, 3*q* and 4*q* are placed at the corners *A*, *B*, *C* and *D* of a square as shown in the following figure. The direction of electric field at the centre of the square is along



(A) *AB* (B) *CB*
(C) *BD* (D) *AC*

110. Infinite charges of magnitude *q* each are lying at *x* =1, 2, 4, 8... *meter* on *X*-axis. The value of intensity of electric field at point *x* = 0 due to these charges will be

(A) $12 \times 10^9 q$ *N/C* (B) Zero
(C) $6 \times 10^9 q$ *N/C* (D) $4 \times 10^9 q$ *N/C*

111. A square of side '*a*' has charge *Q* at its centre and charge '*q*' at one of the corners. The work required to be done in moving the charge '*q*' from the corner to the diagonally opposite corner is

(A) Zero (B) $\frac{Qq}{4\pi \epsilon_0 a}$
(C) $\frac{Qq\sqrt{2}}{4\pi \epsilon_0 a}$ (D) $\frac{Qq}{2\pi \epsilon_0 a}$

112. A pendulum bob of mass $30.7\times10^{-6}\,kg$ and carrying a charge $2\times10^{-8}\,C$ is at rest in a horizontal uniform electric field of 20000 V/m. The tension in the thread of the pendulum is $(g = 9.8\,m/s^2)$

(A) $3\times10^{-4}\,N$ (B) $4\times10^{-4}\,N$

(C) $5\times10^{-4}\,N$ (D) $6\times10^{-4}\,N$

113. An electron experiences a force equal to its weight when placed in an electric field. The intensity of the field will be

(A) $1.7\times10^{-11}\,N/C$ (B) $5.0\times10^{-11}\,N/C$

(C) $5.5\times10^{-11}\,N/C$ (D) 56 N/C

114. The dielectric strength of air at NTP is $3\times10^{6}\,V/m$ then the maximum charge that can be given to a spherical conductor of radius 3 m is

(A) $3\times10^{-4}\,C$ (B) $3\times10^{-3}\,C$

(C) $3\times10^{-2}\,C$ (D) $3\times10^{-1}\,C$

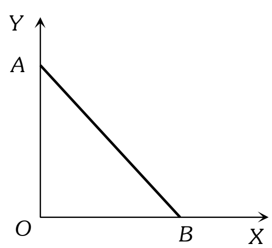
115. As per this diagram a point charge $+q$ is placed at the origin O. Work done in taking another point charge $-Q$ from the point A [co-ordinates $(0, a)$] to another point B [co-ordinates $(a, 0)$] along the straight path AB is

(A) Zero

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

(C) $\left(\frac{qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\frac{a}{\sqrt{2}}$

(D) $\left(\frac{qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\sqrt{2}a$



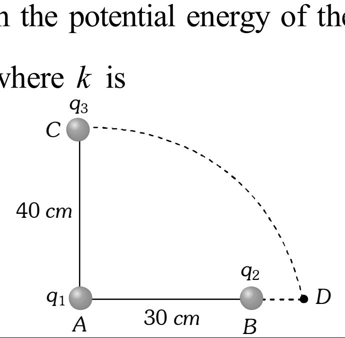
116. To charges q_1 and q_2 are placed 30 cm apart, shown in the figure. A third charge q_3 is moved along the arc of a circle of radius 40 cm from C to D. The change in the potential energy of the system is $\frac{q_3}{4\pi\varepsilon_0}k$, where k is

(A) $8q_2$

(B) $8q_1$

(C) $6q_2$

(D) $6q_1$



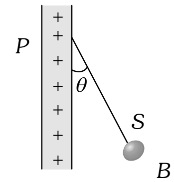
117. A charged ball B hangs from a silk thread S, which makes an angle θ with a large charged conducting sheet P, as shown in the figure. The surface charge density σ of the sheet is proportional to

(A) $\sin\theta$

(B) $\tan\theta$

(C) $\cos\theta$

(D) $\cot\theta$



118. Two point charges $+8q$ 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

(A) 8 L (B) 4 L

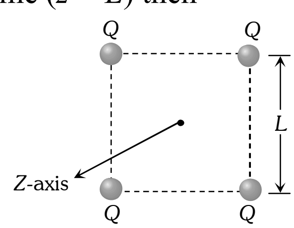
(C) 2 L (D) $\frac{L}{4}$

119. Two infinitely long parallel conducting plates having surface charge densities $+\sigma$ and $-\sigma$ respectively, are separated by a small distance. The medium between the plates is vacuum. If ε_0 is the dielectric permittivity of vacuum, then the electric field in the region between the plates is

(A) $0\,volts/meter$ (B) $\frac{\sigma}{2\varepsilon_o}volts/meter$

(C) $\frac{\sigma}{\varepsilon_o}volts/meter$ (D) $\frac{2\sigma}{\varepsilon_o}volts/meter$

120. Four point + ve charges of same magnitude (Q) are placed at four corners of a rigid square frame as shown in figure. The plane of the frame is perpendicular to Z axis. If a $-ve$ point charge is placed at a distance z away from the above frame ($z<<L$) then



(A) – ve charge oscillates along the z axis.

(B) It moves away from the frame

(C) It moves slowly towards the frame and stays in the plane of the frame

(D) It passes through the frame only once.

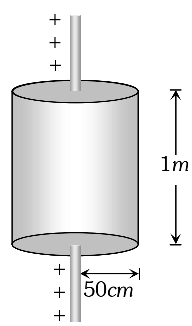
Electric Flux and Gauss's Law

121. According to Gauss' Theorem, electric field of an infinitely long straight wire is proportional to

(A) r (B) $\frac{1}{r^2}$

(C) $\frac{1}{r^3}$ (D) $\frac{1}{r}$

122. Electric charge is uniformly distributed along a long straight wire of radius $1mm$. 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 the figure. The total electric flux passing through the cylindrical surface is



(A) $\frac{Q}{\varepsilon_0}$

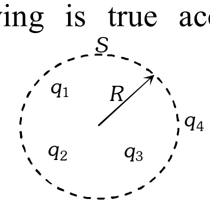
(B) $\frac{100Q}{\varepsilon_0}$

(C) $\frac{10Q}{(\pi\varepsilon_0)}$

(D) $\frac{100Q}{(\pi\varepsilon_0)}$

123. The S.I. unit of electric flux is
(A) *Weber*
(B) *Newton per coulomb*
(C) *Volt* × *metre*
(D) *Joule* per *coulomb*

124. q_1, q_2, q_3 and q_4 are point charges located at points as shown in the figure and S is a spherical Gaussian surface of radius R. Which of the following is true according to the Gauss's law



(A) $\oint_s (\vec{E}_1 + \vec{E}_2 + \vec{E}_3).d\vec{A} = \frac{q_1 + q_2 + q_3}{2\varepsilon_0}$

(B) $\oint_s (\vec{E}_1 + \vec{E}_2 + \vec{E}_3).d\vec{A} = \frac{(q_1 + q_2 + q_3)}{\varepsilon_0}$

(C) $\oint_s (\vec{E}_1 + \vec{E}_2 + \vec{E}_3).d\vec{A} = \frac{(q_1 + q_2 + q_3 + q_4)}{\varepsilon_0}$

(D) None of the above

125. Gauss's law should be invalid if
(A) There were magnetic monopoles
(B) The inverse square law were not exactly true
(C) The velocity of light were not a universal constant
(D) None of these

126. The inward and outward electric flux for a closed surface in units of $N\text{-}m^2/C$ are respectively 8×10^3 and 4×10^3. Then the total charge inside the surface is [where ε_0 = permittivity constant]

(A) 4×10^3 C (B) -4×10^3 C

(C) $\frac{(-4\times10^3)}{\varepsilon}$ C (D) $-4\times10^3\varepsilon_0 C$

127. A charge q is placed at the centre of a cube. Then the flux passing through one face of cube will be

(A) $\frac{q}{\varepsilon_0}$ (B) $\frac{q}{2\varepsilon_0}$

(C) $\frac{q}{4\varepsilon_0}$ (D) $\frac{q}{6\varepsilon_0}$

128. If a spherical conductor comes out from the closed surface of the sphere then total flux emitted from the surface will be

(A) $\frac{1}{\varepsilon_0}\times$ (the charge enclosed by surface)

(B) $\varepsilon_0\times$ (charge enclosed by surface)

(C) $\frac{1}{4\pi\varepsilon_0}\times$ (charge enclosed by surface)

(D) 0

129. 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

(A) $(\varphi_1 + \varphi_2)\varepsilon_0$ (B) $(\varphi_2 - \varphi_1)\varepsilon_0$

(C) $(\varphi_1 + \varphi_2)/\varepsilon_0$ (D) $(\varphi_2 - \varphi_1)/\varepsilon_0$

130. A charge q is located at the centre of a cube. The electric flux through any face is

(A) $\frac{4\pi q}{6(4\pi\varepsilon_0)}$ (B) $\frac{\pi q}{6(4\pi\varepsilon_0)}$

(C) $\frac{q}{6(4\pi\varepsilon_0)}$ (D) $\frac{2\pi q}{6(4\pi\varepsilon_0)}$