**SECTION 1**

**QUESTIONS**

1. When a body is negatively charged by electrostatic conduction, its mass will
   a) slightly increase  
   b) slightly decrease  
   c) remain same  
   d) increase or decrease depending on material

2. Two charges \( q_1, q_2 \) are separated by a distance \( r \). If a metal plate of thickness \( x \) is introduced between the charges the force between the charges \( F \) will now be
   a) \( F = 0 \)  
   b) \( F = A\frac{q_1 q_2}{(r-x)^2} \)  
   c) \( F = A\frac{q_1 q_2}{r^2} \)  
   d) \( F = A\frac{q_1 q_2}{(r+x)^2} \)

3. Two point charges +4 mC and –1 mC are separated by a distance of \( d \). The ratio force acting on them will be
   a) 1:4  
   b) 1:16  
   c) 1:1  
   d) 1:1

4. Two insulated copper spheres of radius 0.1 m and 0.15 m are given equal charges. They are connected by a wire. Then
   a) both spheres attain the same charge  
   b) both spheres attain the same potential  
   c) smaller sphere attains greater charge  
   d) bigger sphere attains greater charge

5. Three point charges \(+q\) each are placed on the vertices of an equilateral triangle, which lie on the circumference of a circle of radius \( r \). The electric field at the centre of the circle is
   a) \( Aq/r^2 \)  
   b) zero  
   c) \( 3Aq/r^2 \)  
   d) \( 3q/r^2 \)

6. Inside a uniformly charged solid sphere, the electric field intensity at any point distant \( r \) from the centre of the sphere varies as
   a) \( 1/r^2 \)  
   b) \( r^2 \)  
   c) \( r^2 \)  
   d) \( r \)

7. A charge \( q \) is located at the centre of a cube. The electric flux through any one face of the cube is
   a) \( q/\varepsilon_0 \)  
   b) zero  
   c) \( q/4\varepsilon_0 \)  
   d) \( q/6\varepsilon_0 \)

8. When a soap bubble is negatively charged
   a) it collapses  
   b) it increases in size  
   c) it decreases in size  
   d) it remains as such

9. Two metallic spheres of radius 1 cm and 2 cm are given charges 10^{-2} C and 5 x 10^{-2} C, respectively. If they are connected by a conducting wire, the final charge on the smaller sphere is
   a) 2 x 10^{-2} C  
   b) 4 x 10^{-2} C  
   c) 1 x 10^{-2} C  
   d) 3 x 10^{-2} C

10. There is an electric field \( E \) along \( x \)-direction. If the work done in moving a charge 0.2 C through a distance 2 metres along a line making an angle 60° with the \( x \)-axis is 4 J, the value of \( E \) is
    a) 4 N/C  
    b) 8 N/c  
    c) \( \sqrt{3} \) N/C  
    d) 20 N/C

11. A particle of mass 1 kg and charge 1 C falls through a potential of 1 V. Its velocity is
    a) \( 1.4 \) m/s  
    b) \( 2 \) m/s  
    c) \( 0.5 \) m/s  
    d) \( 1 \) m/s

12. The dimensions of \( e_s \) is the same as that of
    a) capacitance  
    b) capacitance/unit length  
    c) capacitance/area  
    d) potential/length

13. The radius of the hydrogen atom is 5 x 10^{-11} m and the charge on electron or proton is of magnitude 1.6 x 10^{-19} C. At the ground state, the dipole moment of the atom (in C m) is
    a) \( 8 \) x 10^{-30}  
    b) \( 16 \) x 10^{-30}  
    c) 0  
    d) \( 4 \) x 10^{-30}

14. Two conductors of capacitances 1 \( \mu \)F and 2 \( \mu \)F are charged to 200 V and 100 V respectively, and then connected by a wire. The final potential of the connected system is
    a) 150 V  
    b) 106 V  
    c) 133 V  
    d) 187 V

15. The dielectric strength of a certain material is 10^6 V/m. The breakdown voltage to be applied across a 1 mm thick specimen is
    a) \( 10^5 \) V  
    b) \( 10^5 \) V  
    c) \( 10^3 \) V  
    d) \( 2 \) x \( 10^6 \) V
16. A charge q is placed at the centre of the line joining two equal charges Q. The system of the three charges will be in equilibrium if q is equal to
   a) \(-Q/2\)  \hspace{1cm} b) \(-Q/4\)  \hspace{1cm} c) \(+Q/4\)  \hspace{1cm} d) \(+Q/2\)

17. *A parallel plate capacitor is charged and the charging battery is then disconnected. If the plates of the capacitor are moved farther apart by means of insulating handles, a) the charge on the capacitor increases  
   b) the voltage across the plates increases  
   c) the capacitance increases  
   d) the electrostatic energy stored in the capacitor increases

18. A certain charge is divided in the ratio m: n so that when kept at a given distance, the force between them is maximum. The ratio m:n is
   a) 2:1  \hspace{1cm} b) 4:1  \hspace{1cm} c) 1:1  \hspace{1cm} d) 3:1

19. A condenser is connected to a battery. If a dielectric slab is introduced fully in the intervening space between the condenser plates, the electric field between the plates will
   a) decrease  \hspace{1cm} b) increase  
   c) remain the same  \hspace{1cm} d) cannot be answered from the data

20. An electron falls between two parallel plates of separation 2m, in which a uniform electric field 2.5 V/m exists. The energy gained by electron is equal to
   a) 2.5 eV  \hspace{1cm} b) 1 eV  \hspace{1cm} c) 4 x 10^{-19} J  \hspace{1cm} d) 8 x 10^{-19} J

21. A condenser of capacity C is connected to a battery of potential difference V. If q is the charge given by the battery, the energy given by the battery and energy stored by the condenser are respectively
   a) \(1/2)qV, (1/2) qV\)  \hspace{1cm} b) \(qV, (1/2) qV\)  \hspace{1cm} c) \(1/2)qV, qV\)  \hspace{1cm} d) \(qV, qV\)

22. The potential due to an electric dipole on the axial line at a point r from the dipole is V. The potential at a distance 2r from the dipole will be
   a) V/2  \hspace{1cm} b) V/4  \hspace{1cm} c) V/8  \hspace{1cm} d) V/16

23. Which of the following statement(s) is/are true?
   a) If electric field at a point is zero, electric potential will always be zero  
   b) If electric potential at a point is zero, electric field will always be zero  
   c) Electric field can exist at point even when the potential is zero at the point  
   d) Electric potential can exist even when the field is zero at the point

24. The number of lines of force coming out from +1C is
   a) \(1.11 \times 10^{11}\)  \hspace{1cm} b) \(1.11 \times 10^{10}\)  \hspace{1cm} c) \(1.1 \times 10^{19}\)  \hspace{1cm} d) 1

25. Two identical capacitors are joined in parallel and charged to a potential V. Then these are separated and connected in series with the positive plate of one connected to the negative of the other. Then
   a) the charges on the plates connected together are destroyed  
   b) the charges on the free plates are enhanced  
   c) the energy stored in the system increases  
   d) the potential difference between the plates becomes 2V

26. If the distance between the plates of a parallel plates condenser is increased, its potential will
   a) remain the same  \hspace{1cm} b) decrease  
   c) increase  \hspace{1cm} d) decrease exponentially

27. The insulating property of air breaks down at the intensity of electric field 3 \(\times 10^6\) Vm\(^{-1}\). The maximum charge that can be given to a sphere of diameter 5m is about
   a) \(2 \times 10^9\) C  \hspace{1cm} b) \(2 \times 10^3\) C  \hspace{1cm} c) \(2 \times 10^5\) C  \hspace{1cm} d) \(2 \times 10^6\) C

28. A hollow metallic sphere of radius 5 cm is charged such that the potential on its surface is 10V. The potential at the centre of the sphere is
   a) 10 V  
   b) zero  
   c) same as at a point 10 cm away from the surface  
   d) same as at a point 25 cm away from the surface

29. Two identical small metal balls are given charges equal to 10 units and -20 units. They are allowed to touch each other and are again separated to the same distance as before. The ratio of the force between the two balls in the two cases respectively is
   a) -8:1  \hspace{1cm} b) 8:1  \hspace{1cm} c) 1:8  \hspace{1cm} d) 1:8
Electrostatics

30. Two concentric thin metallic spheres of radii \( R_1 \) and \( R_2 \) (\( R_1 > R_2 \)) bear charges \( Q_1 \) and \( Q_2 \) respectively. The potential at radius \( r \) between \( R_1 \) and \( R_2 \) is
   a) \( \frac{1}{4\pi\varepsilon_0} \left( \frac{Q_1}{R_1} + \frac{Q_2}{R_2} \right) \)
   b) \( \frac{1}{4\pi\varepsilon_0} \left( \frac{Q_1}{r} + \frac{Q_2}{r} \right) \)
   c) \( \frac{1}{4\pi\varepsilon_0} \left( \frac{Q_1}{R_1} + \frac{Q_2}{r} \right) \)
   d) \( \frac{1}{4\pi\varepsilon_0} \left( \frac{Q_1}{Q_2} \frac{1}{R_1} \frac{1}{R_2} \right) \)

31. A parallel plate capacitor is charged. With charging battery connected, the plates of the capacitor are moved further apart by means of insulating handles
   a) the electric field between the plates increases
   b) the electric field between the plates decreases
   c) the electric field between the plates remains the same
   d) cannot be said from the data.

32. (Fig) A parallel plate capacitor with plate area \( A \) and separation is filled with dielectric as shown. The dielectric constants are \( k_1 \) and \( k_2 \). The capacitance will be
   a) \( \varepsilon_0 A \frac{1}{k_1 + k_2} \)
   b) \( \varepsilon_0 A \frac{1}{k_1 + k_2} \frac{1}{k_1 k_2} \)
   c) \( \varepsilon_0 A \frac{k_1 k_2}{k_1 + k_2} \)
   d) \( \varepsilon_0 A \frac{k_1 + k_2}{k_1 k_2} \)

33. Three protons A,B and C are located between the plates of a parallel plate condenser such that B is midway between the plates, A at a distance from one plate and C is at an equal distance from the other plate. (Fig.) Check the correct statement(s)
   a) The force on all the protons will be same
   b) The force on proton B will be zero
   c) The force on A and C will be same in magnitude and direction
   d) The force on the proton A and C will be equal and opposite

34. There is a non-uniform electric field along x-axis as shown in fig. The field increases at a uniform rate along +ve x-axis. A dipole is kept inside the field as shown. Which one of the following statements is correct for dipole?
   a) dipole moves along positive x-axis and rotates clockwise
   b) dipole moves along negative x-axis and rotates clockwise
   c) dipole moves along positive x-axis and rotates anticlockwise
   d) dipole moves along negative x-axis and rotates anti-clockwise

35. Two spheres A and B of radius \( a \) and \( b \) respectively are at the same potential. The ratio of the surface density of charge of A to that of B is
   a) \( b/a \)
   b) \( a/b \)
   c) \( a^2/b^2 \)
   d) \( b^2/a^2 \)

36. In a certain region of space there exists a uniform electric field of 2000 kV m\(^{-1}\). A rectangular coil of sides 10 cm x 20 cm is kept in XY plane. The electric flux through the coil in SI will be
   a) zero
   b) 40
   c) 4 \times 10^4
   d) 4

37. An isolated metal sphere of radius \( R \) is given a charge \( q \). Its potential energy will be
   a) \( q^2/4\pi\varepsilon_0 R \)
   b) \( q/4\pi\varepsilon_0 R \)
   c) \( q^2/8\pi\varepsilon_0 R \)
   d) \( q^2/8\pi\varepsilon_0 R \)

38. The electric field at a certain point is 10 \( \text{NC}^{-1} \). The electric lines of force crossing unit area around the point at right angles to it is
   a) \( \varepsilon_0 \)
   b) \( 1/\varepsilon_0 \)
   c) 5
   d) 10

39. The number of lines crossing at an angle 30\(^0\) with the surface in previous question is
   a) \( \varepsilon_0 \)
   b) \( 1/\varepsilon_0 \)
   c) 5
   d) 10

40. A rectangular coil of area 200 cm\(^2\) is placed in an electrostatic field 200 k \( \hat{i} \), in Y-Z plane. The electric flux through the coil will be
   a) zero
   b) 4 \times 10^4
   c) 40
   d) 4

41. Two small balls are given equal positive charge \( Q \) coulomb each and are suspended by two insulating strings of length \( L \) each (metre) from a hook fixed to a stand. If the arrangement is taken to a satellite orbiting round earth, the angle \( \theta \) between the two strings will be
   a) \( 0^0 \)
   b) \( 90^0 \)
   c) \( 180^0 \)
   d) \( 0^0 < \theta < 180^0 \)

42. The tension of each string in this position as given in previous question will be
   a) 0
   b) \( Q^2 / 16\pi\varepsilon_0 L^2 \)
   c) \( Q^2 / 8\pi\varepsilon_0 L^2 \)
   d) \( Q^2 / 4\pi\varepsilon_0 L^2 \)
43. An electron kept in an electric field of strength $E$ experiences a force equal to its weight. If $m$ is the mass of electron, the value of $E$ is equal to
   a) $mg$
   b) $mg/e$
   c) $mg/e^2$
   d) $e/mg$

44. A hollow charged metal sphere has a 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
   a) $V/6r$
   b) $V/4r$
   c) $V/3r$
   d) $V/2r$

45. If one penetrates into a uniformly charged sphere, the electric field strength $E$ will
   a) decrease
   b) increase
   c) remain the same as that at the surface
   d) be zero at all points

46. If all the electrons are removed from 1 g of hydrogen atom, the charge it will have would be nearly
   a) $10^6 C$
   b) $10^4 C$
   c) $1.6 \times 10^{-19} C$
   d) $10^5 C$

47. The electric potential $V$ at a certain point distant $x$ (in metre) is given by $V(x) = 5x^2 + 10x - 9$ volt. The electric field at $x = 1 m$ will be
   a) $20 V/m$
   b) $-10 V/m$
   c) $-23 V/m$
   d) $-20 V/m$

48. At any point on the right bisector of an electric dipole
   a) the electric field is zero
   b) the electric potential is zero
   c) the electric field is perpendicular to the dipole
   d) the electric field is parallel to the dipole

49. A parallel plate capacitor of plate area $A$ and plate separation $d$ is charged to potential difference $V$ and then the battery is disconnected. A slab of dielectric constant $K$ is then inserted between the plates of the capacitor so as to fill the space between the plates. The work done on the system in inserting the slab is
   a) $\varepsilon_0 AV^2/d$
   b) $\varepsilon_0 KAV^2/2d$
   c) $\varepsilon_0 (K-1)AV^2/2Kd$
   d) $\varepsilon_0 AKV^2/2d(K-1)$

50. A proton moving with a constant velocity passes through a region of space without any change in its velocity. If $E$ and $B$ represent the electric and magnetic fields respectively, this region of space may have
   a) $E = 0, B = 0$
   b) $E = 0, B$ not equal to 0
   c) $E$ not equal to 0, $B = 0$
   d) $E$ not equal 0, $B$ not equal to 0

51. Two equal negative charge $-q$ are placed at points $(0,a)$ and $(0,-a)$. A positive charge $Q$ is released from rest from a point $2a, 0$ on the $x$-axis. The charge $Q$ will
   a) execute S.H.M about the origin
   b) move to origin and remain at rest
   c) move to infinity
   d) execute oscillations but not simple harmonic

52. 1000 small water drops each of radius and charge $q$ coalesce to form a single bigger drop. The ratio of potential of the bigger drop to that of the smaller one is
   a) 1
   b) 10
   c) 100
   d) 1000

53. An infinite number of electric charge each of magnitude $+e$ are arranged along along the X-axis at distance $x=1m$, $x=2m$, $x=4m$, $x=8m$ ....etc. The electrostatic potential at the origin is
   a) $\infty$
   b) $e/2\pi\varepsilon_0$
   c) $e/3\pi\varepsilon_0$
   d) $e/5\pi\varepsilon_0$

54. If the charges in the above question are alternately + and − beginning with a positive charge, the potential at the origin will be
   a) zero
   b) $e/2\pi\varepsilon_0$
   c) $e/3\pi\varepsilon_0$
   d) $e/6\pi\varepsilon_0$

55. In the arrangement as given in question (53), the electric field at the origin will be
   a) zero
   b) $e/2\pi\varepsilon_0$
   c) $e/3\pi\varepsilon_0$
   d) $e/5\pi\varepsilon_0$

56. In the arrangement as given in question (54), the electric field at the origin will be
   a) zero
   b) $e/2\pi\varepsilon_0$
   c) $e/3\pi\varepsilon_0$
   d) $e/5\pi\varepsilon_0$

57. Two condensers of capacity 0.3 $\mu F$ and 0.6 $\mu F$ respectively are connected in series. The combination is connected across a potential of 6 volts. The ratio of energies stored by the first condenser to that of second will be
   a) 1/2
   b) 4
   c) 1/4
   d) 2
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58. 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 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 surface is
a) \(V\)  
b) \(2V\)  
c) \(4V\)  
d) \(-2V\)

59. A ball carrying a positive charge hangs from a silk thread. If we keep a positive test charge \(q_0\) at a point and measure the force \(F\) on the test charge, then it can be said that the electric field strength \(E\) at the point will be
a) \(\frac{F}{q_0}\)  
b) \(F/q_0\)  
c) \(<\frac{F}{q_0}\)  
d) \(\frac{F}{2q_0}\)

60. A condenser of capacitance 2 \(\mu\)F is charged to 200 V. It is now discharged through a resistor the heat produced in the resistor is
a) 400 J  
b) 0.02 J  
c) 0.04 J  
d) 0.08 J

61. The capacity of a parallel plate f condenser is 5 \(\mu\)F. When a glass plate is placed between the plates of the condenser, its potential difference reduces to 1/8 of the original value. the value of the dielectric constant of glass is
a) 1.6  
b) 8  
c) 5  
d) 40

62. The force acting on a charged particle kept between the plates of a charged parallel plate condenser is \(F\). If one of the plates of the condenser is removed, then the force acting on the same particle will be
a) 0  
b) \(F/2\)  
c) \(F\)  
d) \(2F\)

63. Two identical capacitors are connected first in series and then in parallel to the same source. The ratio of energy of the system will be
a) 1:4  
b) 4:1  
c) 1:2  
d) 2:1

64. *Two identical charged spheres are suspended by strings of equal length making an angle of 40° with each other. If they are immersed in a liquid of density less than the density of the material of the spheres, then
a) the electrostatic force between them will increase
b) the electrostatic force between them will decrease
c) the net downward force on the spheres will decrease
d) the net downward force will remain the same

65. Vandergraff generator can be used for
a) charging of batteries
b) checking voltmeter markings
c) producing very high magnetic fields
d) accelerating charged particles

66. Three point charges +q, -q, -q are placed on the corners of an equilateral triangle of side \(r\). The potential energy of the system will be \((A = \frac{1}{4\pi\varepsilon_0})\)
a) 0  
b) \(3Aq^2/r\)  
c) \(-2Aq^2/r\)  
d) \(Aq^2/r\)

67. An uncharged metallic sphere A suspended between positively and negatively charged metal plates is given a small push towards the +ve plate. Which one of the following statements is correct?
a) A touches +ve plate and remains there
b) A touches +ve plate and then moves towards –ve plate and remains there
c) A oscillates between the two plates with a constant time period
d) A oscillates between the two plates with an increasing time-period

68. A particle A has charge +q and another particle B has charge +4q. Each of them has a mass of \(m\). They are allowed to fall from rest through the same electrical potential difference. The ratio of their speeds \(v_A/v_B\) will be
a) 2:1  
b) 1:2  
c) 1:4  
d) 4:1

69. The radius hydrogen atom is 0.53 x 10^{-10} metre. The electrostatic potential produced by the proton at the side of the electron will be
a) 27.2 V  
b) 13.6 V  
c) -27.2V  
d) -13.6 V

70. The effective capacitance between the points A and D in adjacent figure is
a) 3 \(\mu\)F  
b) 21 \(\mu\)F  
c) 1/3 \(\mu\)F  
d) 1 \(\mu\)F

71. A charged particle of mass 8 g remains stationary on a vertical electrical field 1000 kN/C. The number of fundamental quantum of charges carried by it is
a) \(5 \times 10^{11}\)  
b) \(5 \times 10^{13}\)  
c) \(5 \times 10^{14}\)  
d) \(5 \times 10^{15}\)
72. Two identical copper spheres of mass 1 g each kept at a distance of 1 m carry equal unbalanced negative charge. They repel with a force of 2.56 nN. The number of extra electrons carried by either of them is
   a) $3.3 \times 10^9$
   b) $3.3 \times 10^{10}$
   c) $3.3 \times 10^{11}$
   d) $3.3 \times 10^{12}$

73. Volt coulomb has a dimensions of
   a) force
   b) acceleration
   c) velocity
   d) torque

74. An electron moves along x-direction with a uniform speed. An electric field is applied along the z-direction. The path of electron will be
   a) a parabola in x-y plane
   b) a circle in x-y plane
   c) a parabola in x-z plane
   d) a straight line along z axis

75. If the applied field is uniform magnetic in the z-direction, path of electron will be
   a) a helix in x-z plane
   b) a helix in x-y plane
   c) a circle in x-z plane
   d) a circle in x-y plane

76. A conducting plate carries a charge $+q$. Another identical plate carrying zero charge is brought from infinity and kept at a distance $r$ from the first plate. The second plate is earthed. The electrostatic energy between the plates is ($A = \frac{1}{4\pi\varepsilon_0}$)
   a) $0$
   b) $-Aq^2/r^2$
   c) $Aq^2/r$
   d) $-Aq^2/r$

77. The electric field at a distance 2 m from a charged plane sheet is $E$. When electric field at infinity will be
   a) $E$
   b) $E/2$
   c) infinity
   d) 0

78. A simple pendulum having a bob of mass $m$ carries a charge $q$. When the bob is kept in a uniform electric field $E$ in the horizontal direction, the inclination of the string with vertical is
   a) $\cos^{-1}(qE/mg)$
   b) $\tan^{-1}(qE/mg)$
   c) $\sin^{-1}(qE/mg)$
   d) $\cot^{-1}(qE/mg)$

79. If electric field at a point from a charged needle is plotted with distance which of the following will be the correct graph?
   a) a straight line of negative slope
   b) a straight line with positive slope
   c) a rectangular hyperbola
   d) an exponential graph

80. A charged particle of mass $m$ charge $q$ is released from rest in an electric field of strength $E$. After a time $t$ seconds the kinetic energy of the particle will be
   a) $2Et^2/mq$
   b) $Emq^2/2t^2$
   c) $E^2q^2t^2/2m$
   d) $qE$

81. Two charges exert a force $F$ when kept at a distance $r$ between them in air. The distance at which they exert same force in a medium of relative permittivity 4 is
   a) $r/4$
   b) $r/2$
   c) $4r$
   d) $2r$

82. Two conducting spheres of radii 5 cm and 3 cm are equally charged. The ratio of their potentials is
   a) 3:5
   b) 5:3
   c) 9:25
   d) 25:9

83. Two conducting spheres of radii 5 cm and 3 cm charged to the same potential. The ratio of their charges will be
   a) 3:5
   b) 5:3
   c) 9:25
   d) 25:9

84. Two conducting spheres of radii 5 cm and 3 cm are equally charged. The ratio of electric fields on their surfaces will be
   a) 3:5
   b) 5:3
   c) 9:25
   d) 25:9

85. Two conducting spheres of radii 5 cm and 3 cm are charged so that the electric field on their surfaces is same. The ratio of the charges will be
   a) 3:5
   b) 5:3
   c) 9:25
   d) 25:9

86. A charge $q_1$ exerts some force on another charge $q_2$. If a third charge $q_3$ is brought near $q_1$, the force exerted by $q_1$ on $q_2$
   a) decreases
   b) remains unchanged
   c) increases
   d) decrease for like and increase for unlike

87. Twelve identical condenser plates are given. Two such plates will give a capacitance of 1 µF. The maximum capacitance which we can have from these plates is (in µF)
   a) 1
   b) 6
   c) 10
   d) 11
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88. A point charge q is placed at the corner of a square of side a. The potential difference between one adjacent corner and opposite corner is \[ A = \frac{1}{4\pi}\epsilon_0 \] a) \(\frac{aq}{a}\) b) \(10.7\frac{aq}{a}\) c) \(0.35\frac{aq}{a}\) d) \(0.29\frac{aq}{a}\)

89. Two conducting spheres A and B are charged to +10 \(\mu\)C and +20 \(\mu\)C. They have radii 3 cm and 6 cm respectively. If they are connected by a wire
a) charge flows from A to B and heat is produced in the wire
b) charge flows from B to A and heat is produced in the wire
c) no charge flows between A and B and no heat is produced in the wire
d) charge flows from B to A and no heat is produced in the wire

90. The Coulomb’s law will not operate at a distance less than
a) \(10^{-8}\)m b) \(10^{-10}\)m c) \(10^{-12}\)m d) \(10^{-15}\)m

91. A charged particle will move along an electric line of force if
a) it is free
b) it is accelerated
c) it is moving with a uniform velocity
d) it is moving with a non uniform velocity

92. Two given point charges are placed at a fixed distance in the following media. In which of the medium the Coulomb force between them will be minimum?
a) water b) oil c) mica d) paper

93. Three charges \(q_1\), \(q_2\), \(q_3\) are kept at the corners of an equilateral triangle. The force between \(q_1\) and \(q_2\) is F. If \(q_3\) is removed from the third corner force between \(q_1\) and \(q_2\)
a) increases b) decreases
c) remains the same d) cannot be said from the data

94. Three charges +2q, -q, -q are placed at the corners of an equilateral triangle. If V is electric potential and E the electric field at the centre of the triangle, then
a) \(E = 0\), \(V \neq 0\) b) \(E \neq 0\), \(V = 0\)
c) \(E \neq 0\), \(V \neq 0\) d) cannot be said from the data

95. An electric line of force in x-y plane is given by the equation \(x^2 + y^2 = 1\). A particle with a unit positive charge initially at rest at a point \(x = 1, y = 0\) in the x-y plane
a) will move opposite the line of force
b) will move at an angle to the line of force
c) will continue to be at rest
d) will move along the line of force

96. A charge of one coulomb is placed at the centre of a cube of side a. The number of lines of force coming out from one face of the cube is
a) \(1.11x 10^{11}/a^2\) b) \(1.11x 10^{11}/a^2\)
c) \(6x1.11x 10^{11}/a^2\) d) \(1/6) 1.11x 10^{11}\)

97. Two charges +1C and -1C are placed at points (0,0) and (1,0) respectively. A non-uniform electric field exists along the X axis which increases at a uniform rate of 1V/m\(^2\). If the force on +1C is 5 N, the force on -1C is
a) 6 N b) -6 N c) 5 N d) -5 N

98. The electric lines of force coming out a charged body ‘A’ is parallel and equidistant up to infinity. This body is
a) a solid sphere b) a hollow sphere c) a needle d) a plane sheet

99. The electric field due to a dipole at a distance 2 m from it is E. The electric field at a distance 4 m from it will be
a) \(E/2\) b) \(E/4\) c) \(E/8\) d) \(E/16\)

100. A hollow metallic sphere P is charged to a potential V volt. Another sphere Q is charged to a potential V/2. If Q is placed inside P and they are connected by a wire, then
a) charge will flow from P to Q until the potential becomes 3V/4
b) whole charge will flow from P to Q
c) the whole charge will flow from Q to P
d) no charge flows

101. The potential due a point charge at a distance 2 m from it is 6 V. The field at the same point due to the same charge will be
a) 3 N/C b) 6 N/C c) 12 N/C d) 0
102. An electric dipole kept in a uniform electric field is disturbed slightly. Which of the following will happen?
   a) It returns immediately to the equilibrium state
   b) It moves away from the equilibrium state
   c) It oscillates and returns to the equilibrium state
   d) It oscillates for ever.

103. An electric dipole is subjected to two mutually perpendicular uniform fields $F$ along the $X$ axis and $2F$ along the $Y$ axis. The dipole will
   a) oscillate in $XY$ plane
   b) settle at an angle $45^\circ$ with $X$ axis
   c) settle at an angle $\tan^{-1}(2)$ with $X$ axis
   d) settle at an angle $\tan^{-1}(1/2)$ with $X$ axis

104. An charged particle is moving with a velocity $10 \hat{i}$ m/s. It is subjected to an electric field $50 \hat{i}$ N/C. The path of the particle will be
   a) a straight line
   b) a parabola in $XZ$ plane
   c) a parabola in $YZ$ plane
   d) a parabola in $XY$ plane

105. If the applied field in the above question is magnetic, the path of the particle will be
   a) a straight line
   b) a circle in $Y-Z$ plane
   c) a circle in $X-Y$ plane
   d) a circle in $X-Z$ plane

106. Three point charges each $\frac{1}{3} \mu C$ are brought from infinity and are placed at the corners of an equilateral triangle of side 1 m. The work done for this will be
   a) $9 \text{ mJ}$
   b) $3 \text{ mJ}$
   c) $0$
   d) $4.5 \text{ mJ}$

107. Two spheres of radii 1 cm and 2 cm have equal charge density. The ratio of the electric field on their surfaces in the given order will be
   a) 1
   b) $2/1$
   c) $4/1$
   d) $1/2$

108. A cube of side $a$ is placed in an electric field $E_0 \hat{i}$. The net number of flux lines passing through the cube is
   a) $6a^2 E_0$
   b) $2a^2 E_0$
   c) $4a^2 E_0$
   d) $0$

109. The relative permittivity of a medium is $x$ and the dielectric strength of the medium is $y$. For the medium to be a good insulator, it should have
   a) high $x$ and low $y$
   b) high $y$ and low $x$
   c) low $y$ and low $x$
   d) high $x$ and high $y$

110. A point charge $q$ is kept at the centre $O$ of a circle of radius $r$. $A$ and $B$ are two points in the circumference of the circle. $\angle AOB = 60^\circ$. The work done in taking a unit positive charge from $A$ to $B$ along the smaller arc will be
   a) $\frac{r^4 q \pi \varepsilon_0}{4}$
   b) $\frac{r^4 q \pi \varepsilon_0}{6}$
   c) $\frac{5r^4 q \pi \varepsilon_0}{6}$
   d) zero.

111. A solid sphere of radius $R$ has a uniform charge density $\rho$ per unit volume. The electric field at a point inside at a distance $r$ ($r < R$) from the centre of the sphere is given by
   a) zero
   b) $\frac{r \rho}{3 \varepsilon_0}$
   c) $\frac{R \rho}{3 \varepsilon_0}$
   d) $\frac{2r \rho}{3 \varepsilon_0}$

112. Two soap bubbles P and Q are charged with same surface density of charge $\sigma$, but P positively and Q negatively. Then
   a) both the bubbles expand
   b) P contracts while Q expands
   c) Q contracts while P expands
   d) both the bubbles contract

113. Two capacitors 1 pF and 2 pF are charged to 200V and 100 V respectively. They are then connected so that the positive plate of the one is connected to the negative plate of the other. The final potential of the connected system will be
   a) 150 V
   b) 106 V
   c) 133 V
   d) 0 V

114. The mass of an $\alpha$ particle is nearly 8000 times the mass of an electron. An $\alpha$ particle is accelerated through 1 volt. The energy of this particle will be
   a) 1 eV
   b) 2 eV
   c) 8000 eV
   d) 16000 eV

115. An electric dipole is formed with charges $+q$ and $-q$ points (-1,0) and (+1,0) respectively on the $x$ axis. Check the correct statements.
   a) The $y$-axis will be an equipotential line.
   b) The electric field at all points on the $y$-axis will have same magnitude and direction.
   c) The electric field at all points on the $y$-axis will be along the positive $x$-axis.
   d) The electric field at all points in the $y$-axis will have same magnitude but different directions.
116. The magnitude of torque on a dipole is doubled, when the angle made by the dipole with the field is increased to three times. The initial angle of the dipole with the field is
a) 15°  

b) 45°  

c) 60°  

d) 30°

117. Three identical capacitors are connected in parallel. Then they connected in series. The difference between the effective capacitance is 16 \( \mu F \). Then capacity of each in \( \mu F \) is
a) 3  

b) 6  

c) 8/3  

d) 16/3

118. A condenser of capacitance 2 \( \mu F \) is connected to a battery through a resistor 3 ohm. The battery spends energy of 4 mJ to charge the condenser fully. The heat produced across the resistor during charging is equal to (in mJ)
 a) 1  

b) 3/2  

c) 2  

d) 2/3

119. \( n \) identical capacitors are connected in parallel to a potential difference \( V \). These capacitors are reconnected in series, their charges being left undisturbed. The potential difference obtained is
 a) \( V/n \)  

b) (\( n-1 \))\( V \)  

c) \( n^2 \)\( V \)  

d) \( n \)\( V \)

120. An isolated metallic object is charged in vacuum to a potential \( V \), its electrostatic energy being \( E \). It is then disconnected from the source of potential, its charge being left unchanged. It is immersed in a large volume of dielectric with dielectric constant \( K \). Its electrostatic energy becomes
 a) \( E/K \)  

b) \( KE \)  

c) \( E/K \)\( V \)  

d) \( E^2/K/V \)

122. Two metal spheres of radii \( R_1 \) and \( R_2 \) are charged with \( Q_1 \) and \( Q_2 \) respectively. Then they are connected by a wire. The charge flows
 a) until \( Q_1 = Q_2 \)  

b) until \( Q_1R_1 = Q_2R_2 \)  

c) until \( Q_1R_2 = Q_2R_1 \)  

d) never

123. A capacitor of capacitance 5 \( \mu F \) is charged to a potential difference of 100 V. The battery is disconnected, and then it is connected in parallel to an uncharged capacitor of capacitance \( C \). The potential difference measured across this combination is 25V. The capacitance \( C \) is
 a) 20 \( \mu F \)  

b) 10 \( \mu F \)  

c) 5 \( \mu F \)  

d) 15 \( \mu F \)

124. In the previous question, the ratio of electrostatic energy of the system before to that after the connection of \( C \) is
 a) 4/1  

b) 1/2  

c) 2/1  

d) 1/4

125. A parallel plate condenser has an energy \( U \). The plates of the condenser are pulled using an insulating handle until their separation is 3 times the original value. The work done in the process is
 a) 3\( U \)  

b) 2\( U \)  

c) \( U \)  

d) 3/2 \( U \)

126. The minimum radius of a body which will hold a charge of 1 C so that the surrounding air will not become ionised is nearest to
 a) 1 cm  

b) 1 m  

c) 50 m  

d) the radius of earth

127. One thousand identical drops each of capacity 2\( \mu F \) are charged to a potential 100 V each. If they coalesce into a single drop, the capacity of single drop will be
 a) 20\( \mu F \)  

b) 200\( \mu F \)  

c) 2000\( \mu F \)  

d) 4000\( \mu F \)

128. The potential of the resulting drop given in the previous is equal to
 a) 100 V  

b) 1000 V  

c) 10000 V  

d) \( 10^4 \) V

129. Check which one of the following statements is not correct.
 a) The SI unit of charge is greater than CGS (esu).  

b) The SI unit of capacity is greater than CGS (esu).  

c) The SI unit of energy is greater than CGS unit  

d) The SI unit of potential is greater than CGS (esu)

130. The capacity of a parallel plate condenser with air as dielectric is \( C \). If the condenser is filled with 3 dielectrics of equal thickness and dielectric constants 2, 3, 4 the capacity will be
 a) (36/13)\( C \)  

b) (13/12)\( C \)  

c) (18/13)\( C \)  

d) 9\( C \)

131. Two condensers of capacitance \( C \) each are connected in series to a battery of potential difference \( V \). The same condensers are later connected in parallel to the same battery. The ratio of energy of the system in the two cases in the given order is
 a) 1/2  

b) 1/4  

c) 2  

d) 4
132. A parallel plate condenser contains a dielectric of relative permittivity 2. The condenser is charged by a battery. The battery is disconnected and the dielectric slab is removed. In the process the energy of the condenser
a) decreases by 50%  b) increases by 50%
c) decreases by 100%  d) increases by 100%

133. An external electric field $E_0$ is applied across a dielectric. At any point inside the dielectric the electric field
a) will be greater than $E_0$  b) will be less than $E_0$
c) will be equal to $E_0$  d) will be greater or less depending on direction.

134.* If the negatively charged plate of a parallel plate condenser is removed to infinity
a) the potential of the positive plate increases
b) the potential of the positive plate decreases
c) the capacity of the positive plate increases
d) the capacity of the positive plate decreases

135. Ten identical charged drops each having an energy $E$, coalesce to form a single drop. The energy of the resulting drop is
a) 10 $E$  b) $10^{3/2}E$
c) $10^{5/3}E$  d) $10^{2/3}E$

136. What is a capacitance between $A$ and $B$ in the adjacent diagram?( all capacitances are in $\mu$F)

a) 2  b) 4  c) 6  d) 8

137. The effective capacitance between the points $A$ and $B$ in the adjacent diagram (all in $\mu$F) is
a) 2  b) 4  c) 6  d) 0.5

138. In the adjacent figure, each edge of the cube contains a capacitor of value $C$. The total capacitance of the circuit when a battery is connected between $A$ and $B$ will be,

a) $(5/6)C$  b) $(6/5)C$
c) zero  d) infinite

139. An infinite network of capacitors, each 2 $\mu$F, is made as shown in the figure below. The capacitance between $A$ and $B$ (in $\mu$F) is
a) 2  b) 2.6  c) 3.2  d) 0

140. A parallel plate capacitor has a separation $d$ and a capacitance of 100 pF. If a metal foil of thickness $d/3$ is introduced between the plates, the new capacitance will be (in pF )
a) 300  b) 150  c) 100  d) 67

141. Two conductors have equal volume and carry equal charge. Then
a) they have same potential  b) they have same capacity
c) they have same energy  d) all the above three will be different.
Solve the following two problems within a maximum time of 2 minutes using only one equation.

142. A capacitor of capacitance 2\(\mu\)F is charged to 200 V. Another capacitor of capacitance of 2\(\mu\)F is charged to 100 V. They are connected in parallel. What is the heat energy produced in the connection wires?

143. Three capacitors of capacitance 1\(\mu\)F, 2\(\mu\)F and 3\(\mu\)F are connected to a source of potential difference 110 V. What is the potential difference across each of them?

144. If \(E\) is the electric field, \(E^2\epsilon_0\epsilon_r\) has the dimensions of
a) energy                 b) energy per unit area
b) energy per unit length       d) energy per unit volume

145. Two point charges \(q\) and -3\(q\) are placed at a given distance. The electric field at the site of \(q\) is \(E\). Then the electric field at the site of -3\(q\) is
a) -\(E\)       b) -\(E/3\)       c) -3\(E\)        d) +\(E/3\)

146. A ring of radius \(R\) carries a uniformly distributed charge +\(Q\). A point charge -\(q\) is placed on the axis of the ring at a distance 2\(R\) from the centre of the ring and released from rest. The charge
a) executes oscillatory motion but not simple harmonic.
b) moves to the centre of the ring and remains at rest there
c) remains in equilibrium at the point
d) executes simple harmonic motion along the axis

147. Three identical spheres of masses \(m_1\), \(m_2\), \(m_3\) are charged positively and negatively and no charge respectively. Which of the following is correct?
 a) \(m_1 > m_2 > m_3\)              b) \(m_2 > m_3 > m_1\)
 c) \(m_2 > m_3 < m_1\)              d) \(m_2 > m_3 = m_1\)

148. A parallel plate air capacitor has a capacitance of 100 pF. The plates are at a distance apart. If a metallic wire of very small thickness is introduced parallel to plates between them, the new capacitance will be
a) 100 pF     b) < 100 pF      c) >100 pF      d) 0

149. * A capacitor \(C_1\) of capacitance 1 microfarad and another capacitor \(C_2\) of capacitance 2 microfarad are separately charged fully by a common battery. The two capacitors are then separately allowed to discharge through equal resistors at time \(t = 0\). Then
a) the current in each of the two discharging circuits is zero at \(t = 0\)
b) the currents in the two discharging circuits at \(t = 0\) are equal but not zero
c) the currents in the two discharging circuits at \(t = 0\) are unequal
d) capacitor \(C_1\) loses 50% of its initial charge sooner than \(C_2\) loses 50% of its initial charge

150. The plates of a parallel plate capacitor of capacitance \(C\) are connected to a battery of emf 12V. A dielectric of relative permittivity \(K\) is introduced in between the plates of the capacitor. The capacitance \(C\) and potential \(V\)
a) both increase to \(K\) times
b) both remain the same
c) \(C\) increases \(K\) times and \(V\) decreases to \(K\) times
d) \(C\) increases to \(K\) times and \(V\) remains the same

151. Two point charges are kept at a distance in a medium. Each charge feels the presence of the other
a) instantaneously       b) in about a second
c) after a small but finite time       d) after a time of the order of a few minutes

152. The maximum amount of electrostatic energy density which air can have so that it will not break its insulating property is
a) 900 J/m\(^3\)       b) 90 J/m\(^3\)       c) 40 J/m\(^3\)       d) 1 J/m\(^3\)
153. Two point charges \(-2 \mu C\) and \(+4 \mu C\) are placed at points A and B as shown in the figure below. Which of the points marked in the figure is a possible null point (point of zero electric field) for the arrangement?

- a) P
- b) R
- c) Q
- d) all the three points

154. In the figure given along with previous question, which point will possibly a point of zero potential?

- a) P
- b) R
- c) Q
- d) P and R

155. An infinite number of capacitors each of \(2 \mu F\) are connected as shown in the figure below. What is the capacitance between the points A and B?

- a) 1.6 \(\mu F\)
- b) 0.66 \(\mu F\)
- c) 0.8 \(\mu F\)
- d) 1.2 \(\mu F\)

156. Two rings each of radius \(R\) are kept perpendicular to the plane of the paper so that their centres \(P\) and \(Q\) are at a distance \(R\). They carry uniform charge \(q\) each. The potential due to one ring at its centre is \(V\). Then the potential due to both rings at the centre \(P\) will be

- a) \(2V\)
- b) \(\sqrt{2}V\)
- c) 0
- d) \((\sqrt{2}+1)V/\sqrt{2}\)

157. Four identical condensers connected in series have an effective capacitance \(1 \mu F\). One of them is removed from the combination and connected in parallel with the rest. The effective capacitance will now be (in \(\mu F\))

- a) \(7/4\)
- b) \(7/3\)
- c) \(16/3\)
- d) \(3/4\)

Solve the following problems within a maximum time of 2 minutes.

158. 12 identical capacitors each of \(1 \mu F\) are given to you. How will you get a capacitance of \(3/4 \mu F\) using all of them? Draw the circuit diagram.

159. How will you obtain a capacitance of \(1/3 \mu F\) using all of them?
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