PHYSICS

BOOKS - BINA LIBRARY PHYSICS (ASSAMESE ENGLISH)

ELECTROSTATICS

Example

1. Calculate the electrostatic force in hydrogen atom in which the electron and proton are

about $5.3 \cdot 10^{-11}$ metre apart.

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2. The electric field produced due to an electron is just sufficient to balance the gravitational force on another electron located above the first. Find the distance between the two electrons.

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3. A train 100 m long is moving with the velocity of 72 km/hr. Find the time it takes to cross the bridge which is 2 km long?

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4. Two charged particles are separated by a distance 1 cm. What is the minimum possible electric force acting on each charge ?

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5. What will be the electric field strength at the surface of a gold atom? Assume that charge on an atom is distributed uniformly in a sphere of radius 10^{-10} metre (z for gold = 79).

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6. Two spherical balls are charged with 1.2 and 4.8 coulomb of charges. The distance between their centre is 120 cm. Find out the point where the forces neutralise each other.

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7. Two charges of $5 \cdot 10^{-6} C$ and $-5 \cdot 10^{-6} C$ are placed 5 cm apart, at points A and B respectively. Find the electric field at C, 5 cm away from both A and B.

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8. Three charges $2.0 \cdot 10^{-6} C$, $3.0 \cdot 10^{-6} C$ and $4.0 \cdot 10^{-6} C$ are placed at the three corners A,

B. C of an equilateral triangle of side 20 cm. Find the force on the charge at C due to the rest two.

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9. Three charges, each equal to $16 \cdot 10^{-9} C$ are placed at the three corners of a square of side 4 cm. Find the electric field at fourth corner.

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10. Four point charges q, -q, 2q and - 2q are placed at the comers of a square of side 5 cm. If $q = 5 \cdot 10^{-6} C$, find the magnitude of the electric field at the intersection of the diagonals.

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11. A charge +q is placed at the mid point between two unit negative charges. What should be the magnitude of the charge q so

that the three charges remain in equilibrium state?

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12. Two point charge $+16\mu C$ and $-9\mu C$ are placed at 8 cm apart in air. Determine the position of the point at which the resultant electric field is zero.

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13. An electric dipole is formed by $+4\mu C$ and $-4\mu C$ charges at 5 mm distance. Calculate the dipole moment.

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14. Calculate the electric field at a point on the axial line of a dipole at 20 cm from the centre. The dipole is made of $\pm 10\mu C$ charges separated by 1 cm.

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15. An electric dipole consists of charges +2e and -2e separated by 0.78 nm. It is placed perpendicular to a field $3.4 \cdot 10^6 NC^{-1}$. Calculate the torque on it.

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16. An electric dipole of length 10cm having charges $\pm 6 \cdot 10^{-3} C$, placed at 30° with respect to a uniform electric field experiences

a torque of magnitude $10\sqrt{3}Nm$. Calculate the magnitude of the electric field.

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17. An electric dipole consists of two charges of $1\mu C$ separated by a distance of 2cm. The dipole is placed in an external field of $10^5 NC^{-1}$. Calculate the maximum torque experienced by the dipole.

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18. A spherical Gaussion surface encloses a charge of $8.85 \cdot 10^{-8} C$. Calculate the clectric flux passing through the surface.

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19. A spherical Gaussion surface encloses a charge of $8.85 \cdot 10^{-8} C$. If the radius of the Gaussian surface is doubled, how much flux would pass through the surface?

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20. A hollow spherical conductor has charge 10^{-7} coulomb of electric charge. Find the potential at the surface of the sphere. The radius of the sphere is 10 cm.

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21. A spherical conductor of radius 10 cm has a charge of 3.2×10 ^−7 C distributed uniformly. What is the magnitude of electric field at a point 15cm from the centre of the sphere?

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22. Twenty seven identical drops of mercury are charged to the same potential 10 volts. What will be the potential, if all the drops are combined to form one large drop ?

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23. A spherical liquid drop of 4mm diameter is given a charge of $2 \cdot 10^{-10}$ coulomb. If nine

such drops coalesce to form a single drop, calculate the potential of the new drop.

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24. ABCD is a square of side 20 cm positive charges of $+2 \cdot 10^{-9}C.$ $+4 \cdot 10^{-9}C$ and $+8 \cdot 10^{-9}C$ are placed at the corners A, B and C respectively. Calculate the work required to be done to transfer a unit positive charge from D to the point of intersection of the diagonals.

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25. A charge Q is distributed over two concentric hollow spheres of radii r and R where R>r. such that the surface densities are equal. Find the potential at the common centre.

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26. An electric dipole of length 4cm, when placed with axis making an angle of 60^{o} with

uniform electric field experiences a torque of $4\sqrt{3}$ Nm. Calculate the potential energy of the dipole, if it has charge of $\pm 8nC$.

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27. What must be the initial velocity of the electrons which can just strike a conductor at -1200 V potential?

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28. Three capacitors whose capacitances are 5, 10 and 50 microfarads are connected in series across a 12 volt battery. Find the potential difference across each of them.

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29. Calculate the equivalent capacitance between the points A and B in the

combination shown in Fig. 1.32

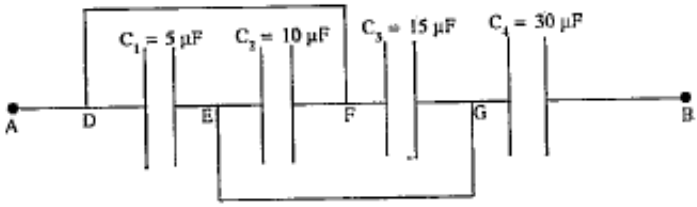

Fig. 1.32

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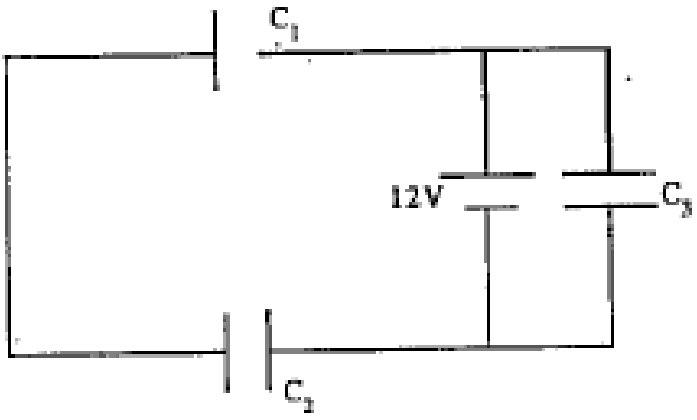
30. Three identical capacitors $C_1 C_2$ and C_3 of capacitance $6\mu F$ each are connected to a 12V battery as shown. Find Charge on each

capacitor.



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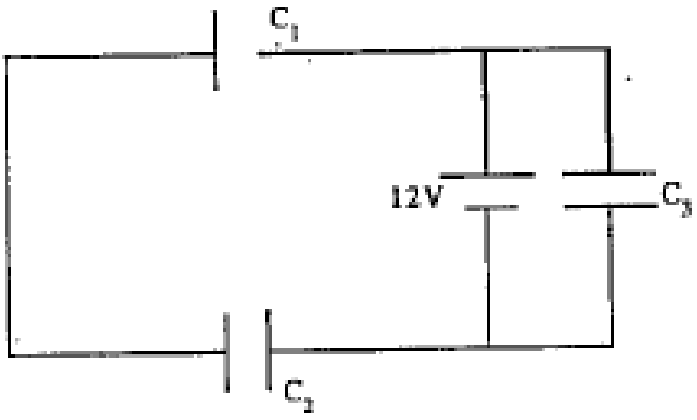
31. Three identical capacitors $C_1 C_2$ and C_3 of capacitance $6\mu F$ each are connected to a 12V battery as shown. Find Equivalent capacitance

of the network.



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32. A spherical capacitor is connected to another spherical capacitor of radius twice that of the former. What is the common

potential ? How the charges are distributed in the two capacitors ?

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33. If a charged capacitor is connected in parallel to a chargeless capacitor of double capacitance, what will be the total loss of energy ?

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Exercise

1. What is an electric charge ?

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2. Name the scientist who first showed that two kinds of charges exist.

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3. Name the scientist who first assigned signs to the two charges.

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4. What is the value of charge on an electron?

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5. What is qunatisation of chage?

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6. What do you mean by conservation of charge?

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7. Is there any variation of mass of a charged body? Give reason.

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8. Which is bigger 1C or charge on the proton?

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9. Define the surface density of charge.

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10. What are electric lines of force ?

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11. Define electric field.

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12. Is electric field intensity a scalar or a vector quantity?

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13. What is the electric field inside a hollow sphere ?

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14. What is an electric dipole?

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15. Define electric dipole moment. Is it a scalar or vector quantity ?

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16. Define electrostatic potential at a point.

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17. What is an equipotential surface?

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18. What is the SI unit of electrostatic potential?

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19. Is potential difference a vector or a scalar quantity?

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20. How is electric field related to potential?

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21. State Gauss's theorem of electrostatics.

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22. Define capacitance of a capacitor.

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23. What form of energy is stored in the capacitor?

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24. Give the SI unit of electric flux.

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25. What are dimensions of electric flux?

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26. What are dimensions of volt?

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27. What are dimensions of capacitance?

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28. How is capacitance of a capacitor depend on separation between the plates?

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29. Can we have a capacitor of one farad capacitance?

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30. Define dielectric constant of a medium.

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31. Define SI unit of capacitance.

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32. Define one electron volt.

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33. A simple pendulum with a negatively charged bob is made to oscillate just above a positively charged plate. What happens to its time period?

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34. How much work is done when a charge q moves over an equipotential surface?

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35. Two copper spheres of same radii, one hollow and the other solid, are charged to the same potential. Which, if any, of the two would hold more charge ?

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36. Is work to be done to move a charge on a surface of an isolated charged conductor ?

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37. How is an isulated conductor charged by the process of electrostatic induction?

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38. What are basic properties of a charge?

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39. What is an electric field line? Two point charges +q and -q are separated by a certain distance. Draw the field lines.

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40. Establish Coulomb's law from Gauss's theorem.

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41. Apply Gauss's theorem to calculate electric field due to an infinite plane sheet of charge.

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42. Apply Gauss's theorem to show that for a charged spherical shell, the electric field outside it is as if all the charge is concentrated at the centre.

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43. Find an expression for electric filed at any position on an axial line of an electric dipole.

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44. Find an expression for electric field at a point on equatorial line of an electric dipole.

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45. An object starting from rest travels 20 m in first 2 s and 160 m in next 4 s.What will be the velocity after 7 s from the start.

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46. Find the capacitance of a sphere of radius 1 m.

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47. An object moves along a straight line with an acceleration of 2 m/s2. If its initial speed is 10 m/s, what will be its speed 2 s later?

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48. Two cars A and B race each other. The Car A ran for 2 minute at a speed of 7.5 km/h, slept for 56 minute and again ran for 2 minute at a speed of 7.5 km/h. find the average speed of the car A in the race.

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49. What is electrostatic shielding? How can it be achieved?

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50. What is electric polarisation vector? Define the electric susceptibility.

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51. Find an expression for the energy of a charged capacitor.

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52. n identical capacitors are connected in parallel. Find their equivalent capacitance.

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53. n identical capacitors are connected in series. What is their equivalent capacitance?

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54. State Coulomb's law of force in electrostatics. Express it in vector form.

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55. An object dropped from a cliff falls with a constant acceleration of 10 m/s2. Find its speed 5 s after it was dropped.

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56. The maximum speed of a train is 90 km/h. It takes 10 hours to cover a distance of 500 km. Find the ratio of its average speed to maximum speed?

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57. Derive an expression for the electric field it a point on the equatorial line of an electric dipole.

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58. Show that in a uniform electric field, the dipole experiences only a torque, but no net force. Derive an expression for the torque experienced by an clectric dipole kept in a uniform clcctric field.

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59. What is meant by potential at a point? Find an expression for potential at a point due to a

point charge.

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60. Find the relationship between the intensity and potential at a point in an electric field. What is meant by potential gradient of a field?

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61. Define the term 'electrostatic potential'. Derive an expression for electric potential at a

point along the axial line of an electric dipole.

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62. An object moves along a straight line with an acceleration of 2 m/s2. If its initial speed is 10 m/s, what will be its speed 2 s later?

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63. Apply Gauss's theorem to calculate electric field due to an infinite plane sheet of charge.

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64. A bullet hits a Sand box with a velocity of 20 m/s and penetrates it up to a distance of 6 cm. Find the deceleration of the bullet in the sand box.

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65. What is capacitance? Mention the factors upon which the capacitance of a capacitor

depends.

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66. A car start from rest and acquire a velocity of 54 km/h in 2 sec. Find (i) the acceleration (ii) distance travelled by car assume motion of car is uniform?

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67. What happens to speed, velocity acceleration when an object moves in a circle with uniform speed?

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68. Explain why electric lines of force donot cross each other.

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69. An insulated balloon is charged by rubbing it with fur. Will it stick more readily to a conducting or insulating wall ?

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70. A charged particle is free to move in an electric field. Will it always move along an electric line of force?

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71. Can the electric potential be zero when the electric field is not zero ?

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72. Can the electric potential be zero when the electric field is not zero ?

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73. A positive charge Q is located at a point. What is the work done if a unit positive charge is carried once, completely round the charge along a circle of radius r about this point ?

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74. A person standing on an insulated tool, touches a charged insulated conductor. Is the conductor discharged completely ?

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75. Two adjacent conductors are carrying the same positive charge. Can there be a potential difference between them ?

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76. A positively charged glass rod attracts a suspended object. Can we conclude that the object is negatively charged ?

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77. A positively charged glass rod repels a suspended object. Can we conclude that the object is positively charged ?

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78. A car is travelling at a speed of 90 km/h. Brakes are applied so as to produce a uniform acceleration of – 0.5 m/s2. Find how far the car will go before it is brought to rest?

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79. Why do electrostatics not work well in humid days ?

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80. A man inside an insulated metallic cage does not receive a shock, when the cage is connected to a high voltage source. He may get a severe shock, if he tries to step out of it. Discuss.

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81. The observation deck of tall skyscraper 370 m above the street. Determine the time required for a penny to free fall from the deck to the street below.

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82. Two point charges of $+3 \cdot 10^{-19} C$ and $+2 \cdot 10^{-19} C$ are separated by a distance of

2.5m. Find the point on the line joining them at which electric intensity is zero.

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83. Calculate the magnitute of electrostatic force between a proton and an electron separated by a distance 0.5.A Give that magnitude of charge of proton and electron to be 1.6×10^{-19}C each

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84. Two charges each of magnitude $4\mu C$ are placed at two corners of an equilateral triangle of side 4m. Find the magnitude of electric field at the third corner.

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85. An electrle dipole when held at 30^{o} with respect to a uniform electric field of $10^{4}NC^{-1}$, experiences a torque of $9 \cdot 10^{-26}Nm$. Calculate the dipole moment of the dipole.

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86. An electric dipole of length 2cm is placed with its axis at an angle of 60° to a uniform electric field of $10^5 NC^{-1}$. If it experiences a torque of $8\sqrt{3}Nm$. Calculate Magnitude of the charge on the dipole.

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87. An electric dipole of length 2cm is placed with its axis at an angle of 60° to a uniform

electric field of $10^5 NC^{-1}$. If it experiences a torque of $8\sqrt{3}Nm$. Calculate Potential energy of the dipole.

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88. A conducting sphere of radius 10cm has unknown charge. If the electric field at 20cm from the centre of the sphere is $1.5 \cdot 10^3 NC^{-1}$ and points radially inward, what is the net charge of the sphere?

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89. Two plates of a parallel plate capacitor have an area of $100cm^2$ each and are separated by 2.5 mm. The capacitor is charged to 200V. Calculate the energy stored in the capacitor.

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90. A capacitor of 20 μF and charged to 500 V is connected in parallel with another capacitor

of $10\mu F$ charged to 200V. Find the common potential.

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91. A parallel plate capacitor of capacity $100\mu F$ is charged to 500 V. If the distance between the plates is halved, what will be the new potential difference and the change of stored energy?

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92. The distance between the plates of a parallel plate capacitor is 5 mm and the area of either plate is $2m^2$. If n potential of 3000 volt is applied to the capacitor, estimate its capacity, charge on either of the plates and the electric field.

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93. The potential difference between two parallel plates 1 cm apart is 100V. The electric field strength between them is ?

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94. A 400 pF capacitor is charged by a 100V battery. How much electrostatic energy is stored in the capacitor?

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95. Work done in moving a unit positive charge through a disance x metre on an equipotential surface is

A. xJ

B. 1/xJ

C. zero

D. $x^2 J$

Answer:

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96. The charges q each are placed at a distance 2a and a third charge -2q is placed at the mid point. The P.E. of the system is

A. $\frac{q^2}{8\pi\varepsilon_0 a^2}$

B. $\frac{6q^2}{8\pi\varepsilon_0 a}$

C. $\frac{-7q^2}{8\pi\varepsilon_0 a}$

D. $\frac{9q^2}{8\pi\varepsilon_0 a}$

Answer:

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97. An electron is moving round the nucleus of a H_2 atom in a circular orbit of radius r. The coulomb force F between the two is

A. $K\frac{e^2}{r^2}\hat{r}$

B. $-K\frac{e^2}{r^3}r$

C. $-K\frac{e^2}{r^3}\hat{r}$

D. $K\frac{e^2}{r^2}r$

Answer:

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98. A charge $Q\mu C$ is placed at the centre of a cube. The flux coming out from any surface is

A. $\frac{Q}{6\varepsilon_0} \cdot 10^{-6}$

B. $\frac{Q}{6\varepsilon_0} \cdot 10^{-3}$

C. $\frac{Q}{24\varepsilon_0}$

D. $\frac{Q}{8\varepsilon_0}$

Answer:

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99. If there are n capacitors in parallel connected to V volt source. The energy stored is

A. CV

B. CV^2

C. $\frac{1}{2n}CV^2$

D. $\frac{1}{2}nCV^2$

Answer:

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100. Two spherical conductors cach of capacity C are charged to potential V and -V. These are

connected by means of a wire. The loss of energy is

A. zero

B. $\frac{1}{2}CV^2$

C. CV^2

D. $2CV^2$

Answer:

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101. A parallel plate capacitor is first charged and then a dielectric slab is introduced between the plates. The quantity that remains unchanged is

A. charge

B. potential

C. capacity

D. energy

Answer:

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102. A parallel plate capacitor is filled by copper plate of thickness b. The new capacity will be

A. $\frac{\varepsilon_0 A}{2d - b}$

B. $\frac{\varepsilon_0 A}{d - b}$

C. $\frac{\varepsilon_0 A}{d - \left(\frac{b}{2}\right)}$

D. $\frac{\varepsilon_0 A}{d}$

Answer:

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103. A capacitor works in

A. A.C. circuit

B. D.C. circuit

C. both (a) & (b)

D. neither (a) nor (b)

Answer:

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104. A particle of mass m and charge q is placed at rest in a uniform electric field E and then released. The K.E. attained by the particle after moving a distance y is

A. qEy^2

B. qE^2y

C. qEy

D. q^2Ey

Answer:

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105. The K.E. of an electron which is accelerated in a potential difference of 100V is

A. $1.6 \cdot 10^{-17} J$

B. $1.6 \cdot 10^{4} J$

C. $416.6 cal$

D. $6.636 cal$

Answer:

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106. When two charged conductors are connected by a conducting wire, then charge will not flow if the conductors are of

A. same capacity

B. same potential

C. same charge

D. same electrical energy

Answer: B

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107. Electron volt is the unit of

A. electrical potential difference

B. power

C. energy

D. electric intensity

Answer: C

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108. Unit of capacitance of a capacitor is

A. henry

B. farad

C. tesla

D. hertz

Answer: B

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109. Which of the following is a vector quantity ?

A. electric charge

B. electric potential

C. charge density

D. electric field intensity

Answer: D

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110. A hollow insulated brass sphere is positively charged. The electric potential inside the sphere is

A. zero

B. greater than the potential on the surface

C. less than the potential on the surface

D. the same as on the surface

Answer: D

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111. A charge q is placed at the Centre of the line joining two equal charges Q. The system of three charges will be in equilibrium if q is equal to

A. $\frac{Q}{2}$

B. $\frac{+Q}{2}$

C. $\frac{-Q}{4}$

D. $\frac{+Q}{4}$

Answer: C

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112. If one penetrates a uniformly charged sphere the electric field

A. dicereases

B. increases

C. zero at all points

D. remains same as at the surface

Answer: A

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113. Work done in moving a positive charge on an equipotential surface is

A. zero

B. positive

C. negative

D. infinite

Answer: A

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114. Work done in moving a unit positive charge through a disance x metre on an equipotential surface is

A. work is done on the charge

B. work is done by the charge

C. no work is done

D. work done is constant

Answer: C

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115. When air is replaced by dielectric medium of constant K, the maximum capacitance of the capacitor

A. Increases K times

B. increases K^2 times

C. decreases K times

D. remains unchanged

Answer: A

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116. Two $1\mu F$ capacitors in series is equal to

A. $2\mu F$

B. $1\mu F$

C. $0.5\mu F$

D. $3.25\mu F$

Answer: C

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117. A capacitor (0.2F) is charged to 600V. After removing the charge battery it is connected across another capacitor (1.0 farad). The voltage across the capacitor changes from 600V

A. 100 V

B. 120 V

C. 300 V

D. 600 V

Answer: A

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118. Which of the following pairs correctly express potential and field of a point charge Q ?

A. $\frac{4\pi Q}{\varepsilon_0 r}, \frac{4\pi Q}{\varepsilon_0 r^2}$

B. $\frac{Q}{4\pi\varepsilon_0 r}, \frac{Q}{4\pi\varepsilon_0 r^2}$

C. $\frac{4\pi\varepsilon_0 Q}{r}, \frac{4\pi\varepsilon_0 Q}{r^2}$

D. `(4piQr),(4piQr^2)

Answer: B

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