PHYSICS

BOOKS - FULL MARKS PHYSICS (TAMIL ENGLISH)

ELECTROSTATICS

In Text Solved Examples

1. Calculate the number of electrons in one coulomb of negative charge.

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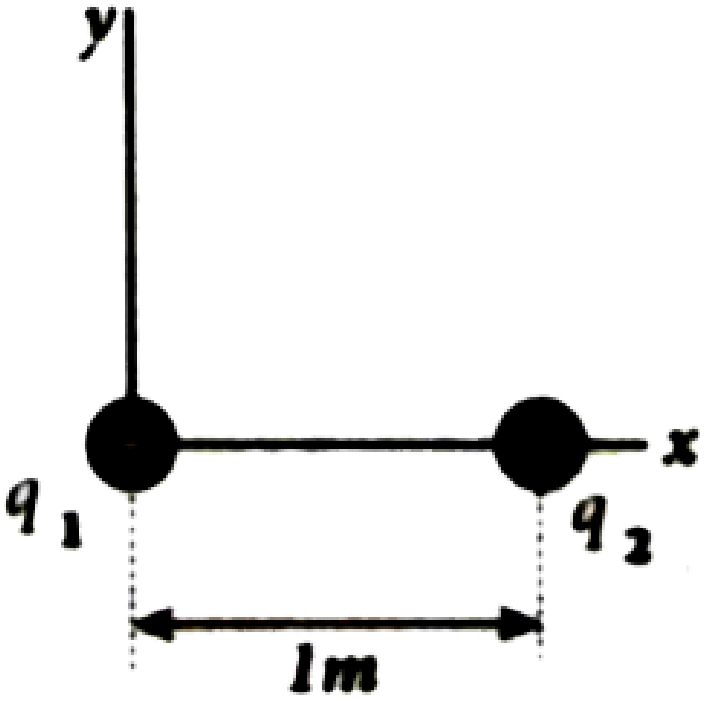
2. Consider two point charges q_1 and q_2 at rest as shown in the figure. They are separated by a distance of 1 m. Calculate the force experienced by the two charges for the following cases:

(a) $q_1 = +2\mu$ C and $q_2 = +3\mu C$

(b) $q_1 = +2\mu$C and $q_2 = -3\mu$ C

(c) $q_1 = +2\mu C$ and $q_2 - 3\mu$ C kept in water $(\varepsilon_r = 80)$



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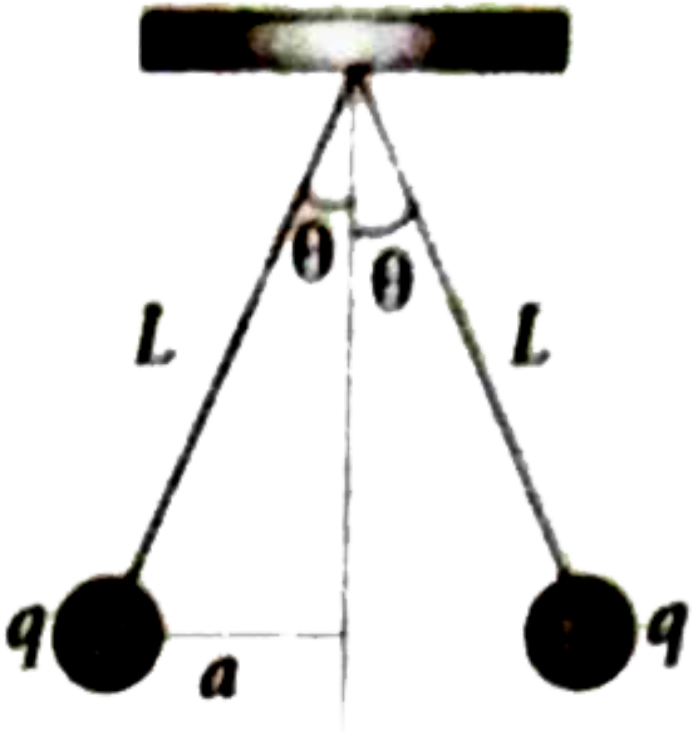
3. Two small -sized identical equally charged spheres each having mass 1 mg are hanging in equilibrium as shown in the figure . The length of each string is 10 cm and the angle θ is 7° with the vertical . Calculate the magnitude of the charge in each sphere . (Take g =$10ms^{-2}$)



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4. Calculate the electrostatic force and gravitational force between the protos and the electron in a hydrogen atom. They are separated by a distance of 5.3×10^{11} m. The magnitude of charges on the electron and proton are 1.6×10^{-19} C.M Mass of the electrons is $m_e = 9.1 \times 10^{-31}$ kg and mass of proton is $m_p = 1.6 \times 10^{-27}$ kg .

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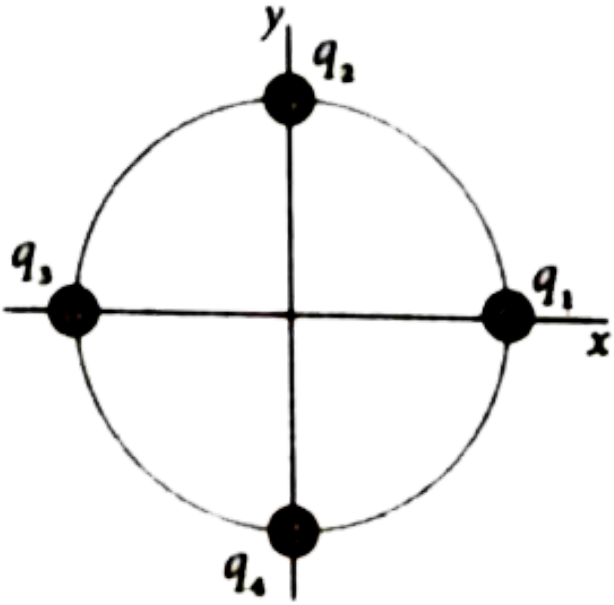
5. Consider four equal charges q_1, q_2, q_3 and $q_4 = q = +1\mu C$ located at four different points on a circle of radius 1m , as shown in the figure. Calculate the total force acting on the

charge q_1 due to all the other charges .



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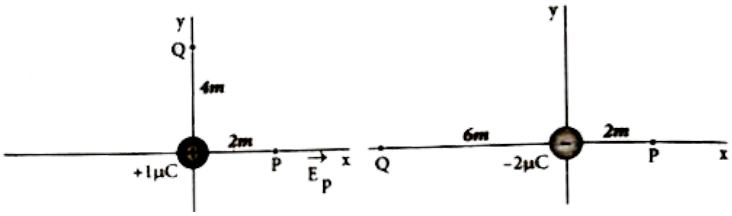
6. Calculate the electric field at point P,Q for the following two cases as shown in the figure

(a) A positive point charge +1 μC is placed at the origin

(b) A negative point charge $-2\mu C$ is placed at the origin



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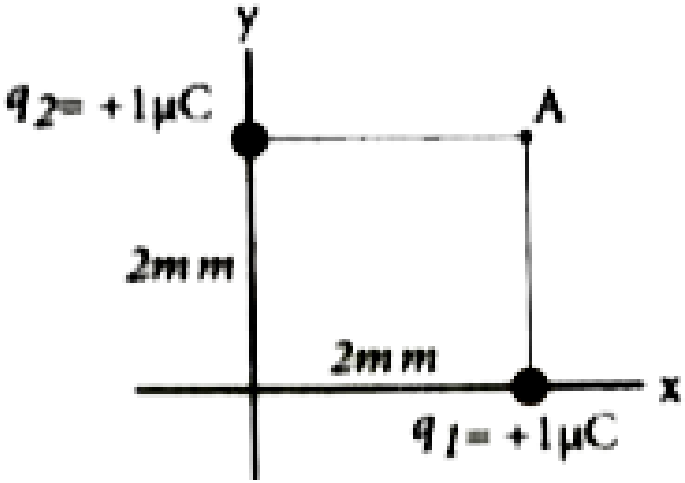
7. Consider the charge configuration as shown in the figure . Calculate the electric field at point A. If an electron is placed at points A, what is the acceleration exerienced by this electron? (mass of the electron $= 9.1 \times 10^{-31}$ kg and charge of

electron $= -1.6 \times 10^{-19} C)$.



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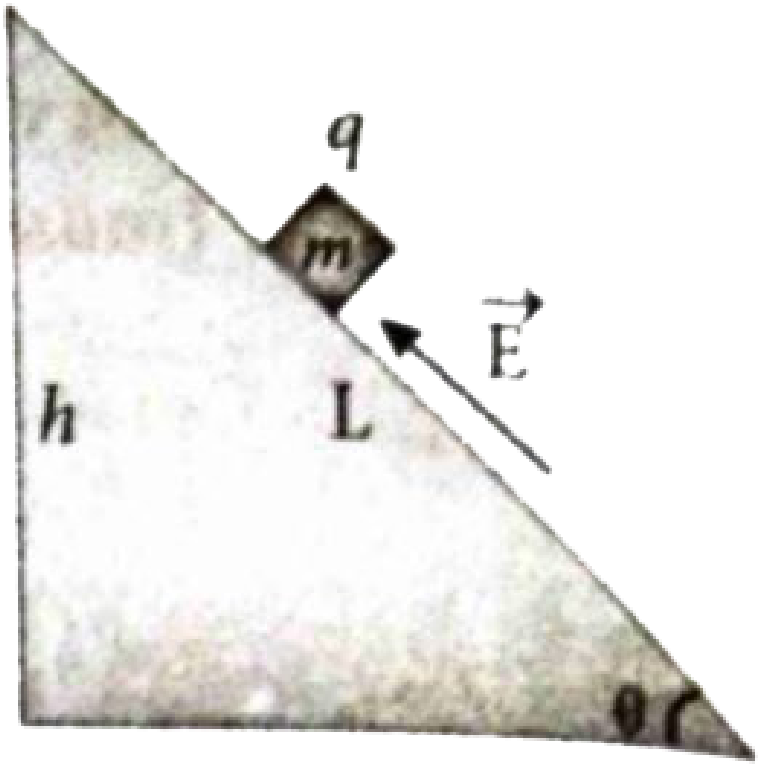
8. A block of mass m and positive charge q is placed on an insulated frictionless inclined plane as shown in the figure. A uniform electric field E is applied parallel to the inclined surface such that the block is at rest. Calculate the magnitude

of the electric field E.



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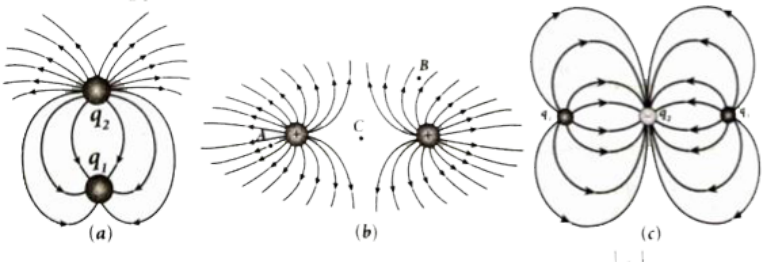
9. The following pictures depict electric field lines for various charge configurations.



(i) In figure (a) identify the signs of two charges and find the ratio $\left|\frac{q_1}{q_2}\right|$

(ii) In figure (b) calculate the ratio of two positive charges and identify teh strength of the electric field at three points A, B and C

(iii) Figure (c) represents the electric field lines for three charges . If q_2 =-20nC then calculate the values of q_1 and q_3

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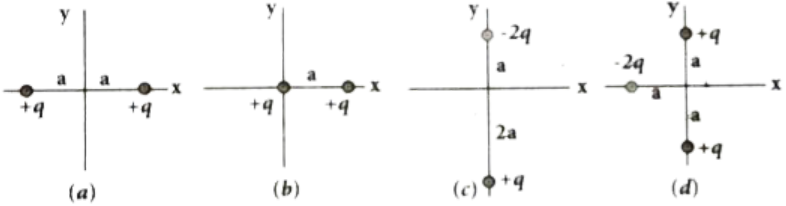
10. Calculate the electric dipole moment for the following charge configurations .



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11. A sample of HCI gas is placed in a uniform electric field of magnitude $3 \times 10^4 N.C^{-1}$. The dipole moment of each HCI molecule is 3.4×10^{-39} Cm. Calculate the maximum torque experienced each HCI molecule.

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12. (a) Calculate the electric potential at points P and Q as shown in the figure below.

(b) Suppose the charge $+9\mu C$ is replaced by $-9\mu C$ find the

electrostatic potentials at points P and Q

(c) Calculate the work done to bring a test charge $+2\mu C$ from infinity to the point P. Assume the charge $+9\mu C$ is held fixed at origin and $+2\mu C$ is brought from infinity to P.

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13. Consider a point charge +q placed at the origin and another point charge -2p placed at a distance of 9 m from the charge $+q$. Determine the point between the two charges at which electric potential is zero.

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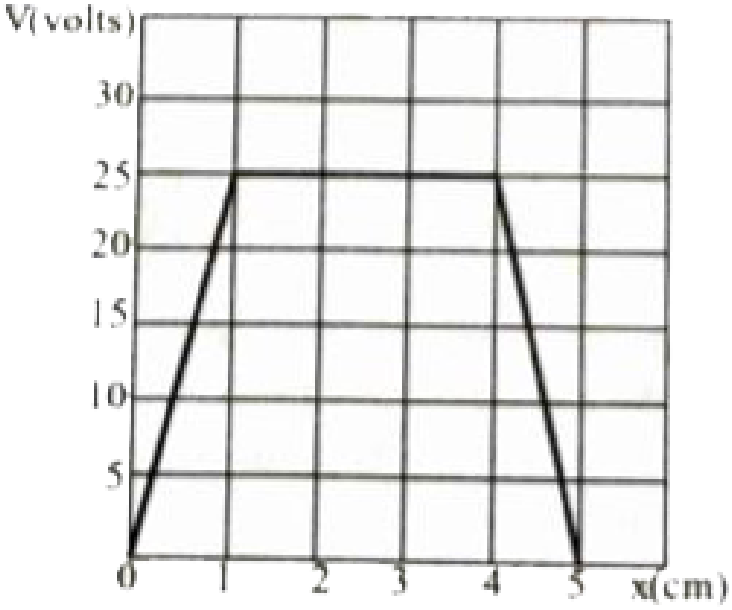
14. The following figure represents the electric potential as a function of x -coordinate Plot the corresponding electric field as a function of x.



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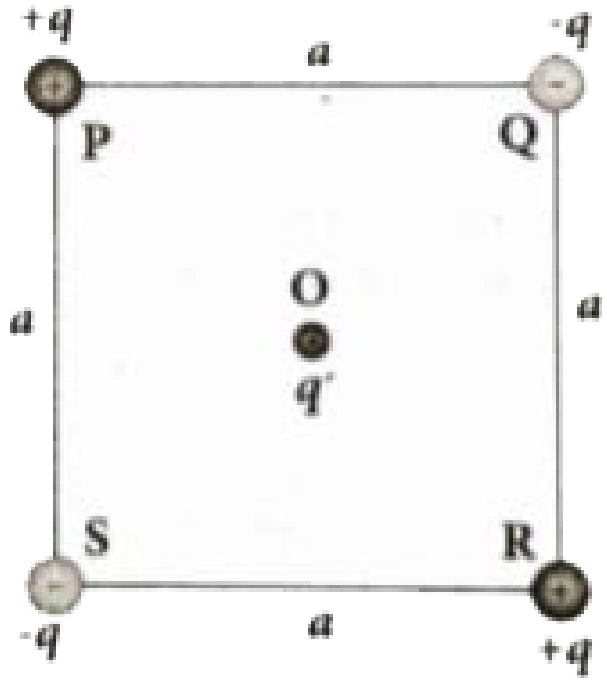
15. Four charges are arranged at the corners of the square PQRS of side a as shown in the figure . (a) Find the work

required to assemble these charges in the given configuration . (b) Suppose a charge q is brought to the center of the square by keeping the four charges fixed at the corners how much extra work is required for this ?



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16. A water molecule has an electric dipole moment of 6.3×10^{-30} cm . A sample contains 10^{22} water molecules with all the dipole moments aligned parallel to the external electric field of magnitude $3 \times 10^{5} NC^{-1}$. How much work is required to rotate all the water molecules from $\theta = 0^{\circ} \text{to} 90^{\circ}$?

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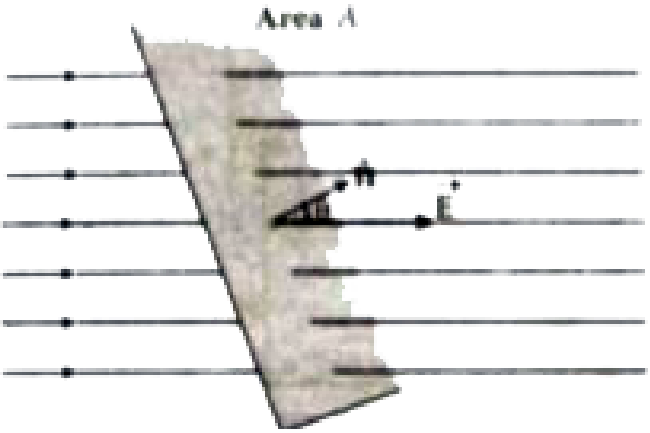
17. Calculate the electric flux through the ractangle of sides 5 cm and 10 cm kept in the rigion of a uniform field 100 NC^{-1} . The angle θ is 60° . Suppose θ becomes zero what is the

electric flux?



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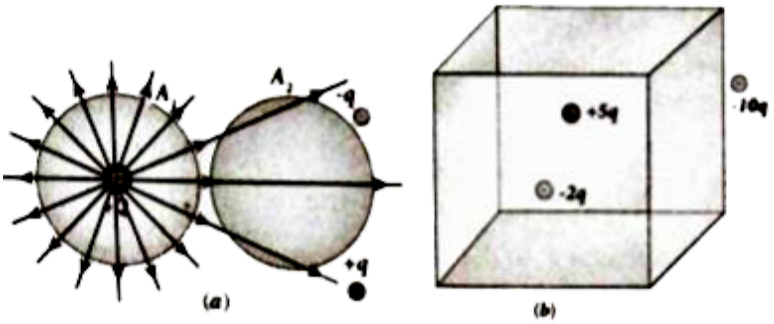
18.



(i) In figure (a) calulate the electric flux through the closed

areas A_1 and A_2

(ii) In figure (b) calculate the electric flux through the cube

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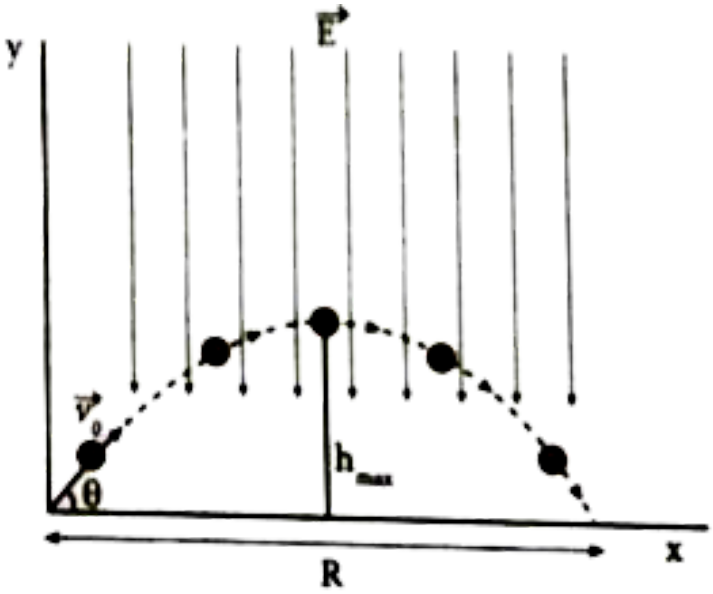
19. A small ball of conducting material having a charge +q and mass m is thrown upward at and angle θ to horizontal surface with an initial speed ν_0 as shown in the figure. There exists an uniform electric field E downward along with the gravitational field g . Calculate the range maximum height and time of flight in the motion of this charged ball. Neglect the effect of air and

treat the ball as a point mass .



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20. A parallel plate capacitor has square plate of side 5 cm and separated by a distance of 1 mm . (a) Calculate the capacitance of this capacitor . (b) If a 10 V battery is connected to the capacitor what is the charge stored in any one of the plates? (The value of $\varepsilon_0 = 8.85 \times 10^{-12} Nm^2 C^{-2}$).

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21. A parallel plate capacitor filled with mica having ε_r = 5 is connected to a $10V$ battery . The area of the parallel plate is $6m^2$ and separation distance is 6 mm.

(a) Find the capacitance and stored charge . (b) After the capacitor is fully charged the battery is disconnected and the dielectric is removed carefully .

`Calculated the new values of capacitance stored energy and charge.

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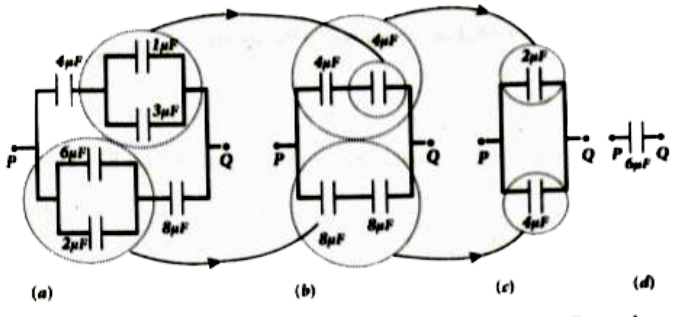
22. Find the equivalent capacitance between P and Q for the configuration shown below in the figure (a).



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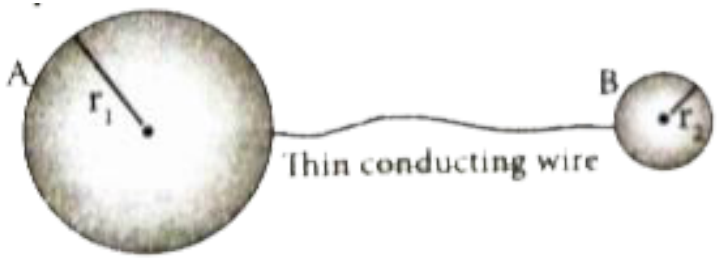
23. Two conducting spheres of radius r_1 =8 cm and r_2 =2 cm are separated by a distance much larger than 8 cm and are connected by a thin conducting wire as shown in the figure . A total charge of Q=+100 nC is placed on one of the spheres . After a fraction of a second the charge Q is redistributed and both the spheres attain electrostatic equilibrium .



(a) Calculate the charge and surface charge density on each sphere.

(b) Calculate the potential at the surface of each sphere .

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24. Dielectric strength of air is $3 \times 10^6 V.m^{-1}$. Suppose the radius of a hollow sphere in the Van de Graff generation is R =0.5 m , calculate the maximum potential difference created by this Van de Graaff generator .

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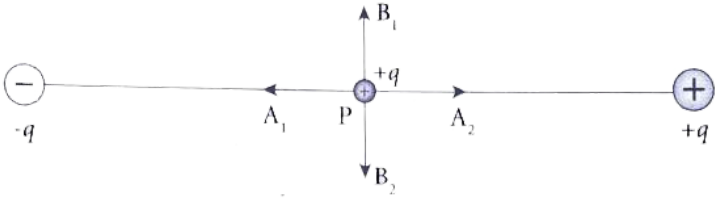
Textual Evaluation Solved Multiple Choice Questions

1. Two identical point charges'of magnitude -q are fixed as shown in the figure below. A third charge $+q$ is placed midway between the two charges at the point P. Suppose this charge is displaced a small distance from the point P in the directions indicated by the arrows, in which direction(s) will +q be stable with respect to the displacement?



A. A_1 and A_2

B. B_1 and B_2

C. both directions

D. No stable

Answer: A::B::D

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2. Which charge configuration produces a uniform electric field ?

A. point charge

B. infinite uniform line charge

C. uniformly charged infinite plane

D. uniformly charged spherical shell

Answer: A::C::D

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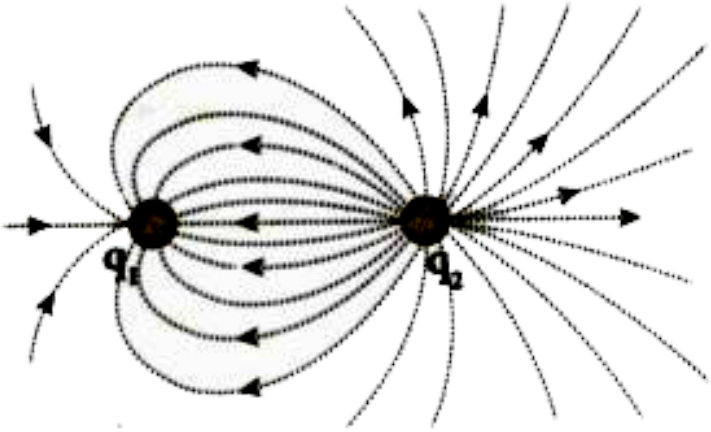
3. What is the ratio of the charges $\left|\frac{q_1}{q_2}\right|$ for the following electric field line pattern ?



A. a) $\frac{1}{5}$

B. b) $\frac{25}{11}$

C. c) 5

D. d) $\frac{14}{25}$

Answer: A::B

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4. An electric dipole is placed at an alignment angle of 30° with an electric field of 2×10^{5} N C^{-1} . It experiences a torque equal to 8 N m. The charge on the dipole if the dipole length is 1 cm is .....

A. 4 mC

B. 8 mC

C. 5 mC

D. 7 mC

Answer: C

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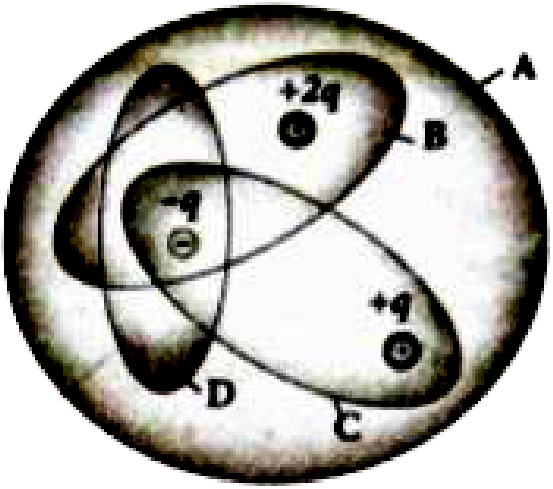
5. Four Gaussian surface are given below with charges inside each Gaussian surface . Rank the electric flux through each Gaussian surface in increasing order ..... .



A. $D < C < B < A$

B. $A < B = C < D$

C. $C < A = B < D$

D. $D > C > B > A$

Answer: A::B::C::D

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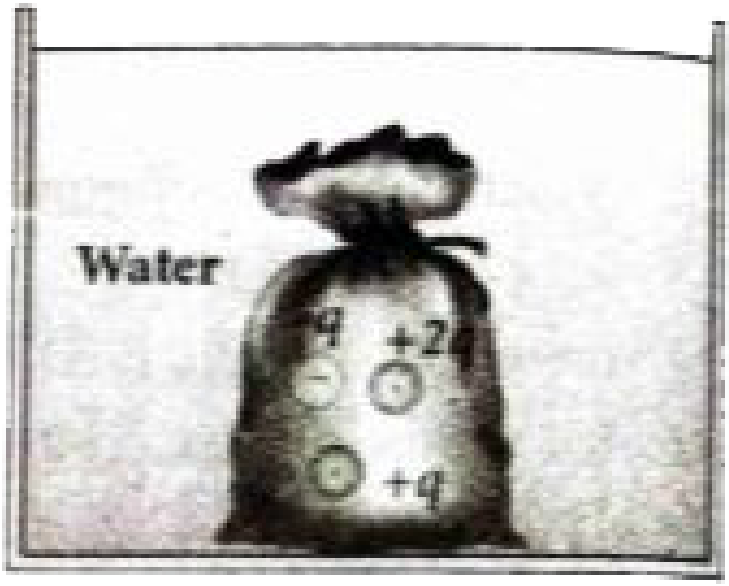
6. The total electric flux for the following closed surface which is kept inside water ..... .



A. $\frac{80q}{\varepsilon_0}$

B. $\frac{q}{40\varepsilon_0}$

C. $\frac{q}{80\varepsilon_0}$

D. $\frac{q}{160\varepsilon_0}$

Answer: D

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7. Two identical conducting balls having positive charges q_1 and q_2 are separated by a center to center distance r. If they are made to touch each other and then separated to the same distance, the force between them will be.

A. less than before

B. same as before

C. more than before

D. zero

Answer: A::B

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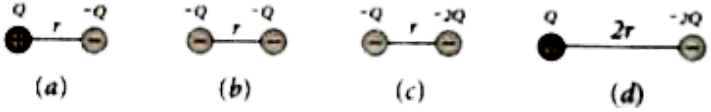
8. Rank the electrostatic potential energies for the given system of charges in increasing order ..... .



A. $1 = 4 < 2 < 3$

B. $2 = 4 < 3 < 1$

C. $2 = 3 < 1 < 4$

D. $3 < 1 < 2 < 4$

Answer: A::B::C::D

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9. An electric field $\vec{E} = 10xhaii$ exists in a certain region of space. Then the potential difference $V = V_0 - V_A$, where V_0 is the potential at the origin and V_A is the potential at x =2 m is ..... .

A. 10 j

B. -20 J

C. $+20$J

D. -10 J

Answer: B

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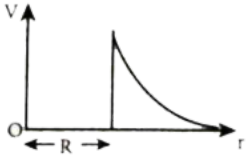
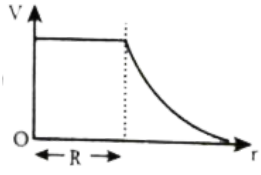
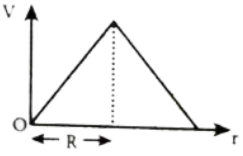
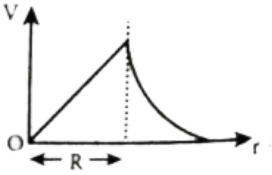
10. A thin conducting spherical shell of radius R has a charge Q which is uniformly distributed on its surface . The correct plot for electroistatic potential due to this spherical shell is ..... .

A. 

B. 

C. 

D. 

Answer: B

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11. Two points A and B are maintained at a potential of 7 V and -4 V respectively . The work down in moving 50 electrons from A to B is ..... .

A. $8.80 \times 10^{-17} J$

B. -8.80×10^{-17} J

C. $4.40 \times 10^{-17} J$

D. $5.80 \times 10^{-17} J$

Answer: A

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12. If voltage applied on a capacitor is increased from V to 2V:

A. Q remains the same C is doubled

B. Q is doubled C doubled

C. C remains same Q doubled

D. Both Q and C remain same

Answer: A::B::C::D

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13. A parallel plate capacitor stores a charge Q at a voltage V . Suppose the area of the parallel plate capacitor and the distance between the plates are each doubled then which is the quantity that will change ?

A. a) Capacitance

B. b) Charge

C. c) Voltage

D. d) Energy density

Answer: D

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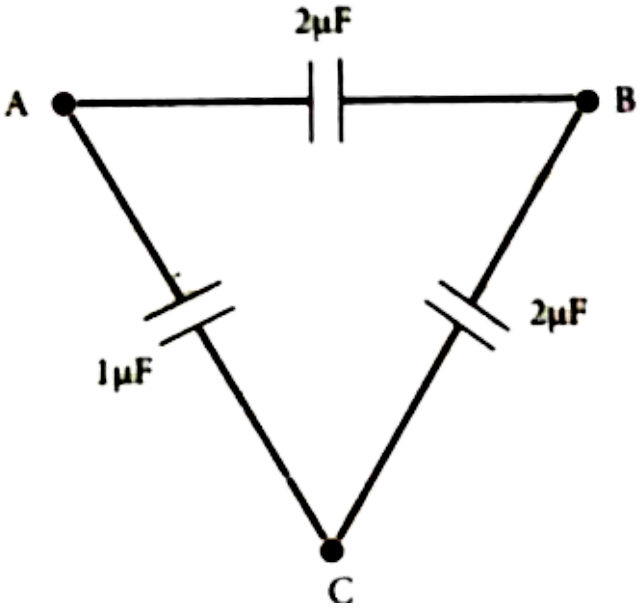
14. Three capacitors are connected in triangle as shown in the figure . The equivalent capacitance between the points A and C

is ..... .



A. a) $1\mu F$

B. b) $2\mu F$

C. c) $3\mu F$

D. d) $\frac{1}{4}\mu F$

Answer: B

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15. Two metallic spheres of radii 1 cm and 3 cm are given charges of $-1 \times 10^{-2} C$ and 5×10^{-2} C respectively . IF these are connected by a conducting wire the final charge on the bigger sphere is ..... .

A. a) 3×10^{-2}C

B. b) 4×10^{-2} C

C. c) $1 \times 10^{-2} C$

D. d) 2×10^{-2} C

Answer: A::B::C

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Textual Evaluation Solved Ii Short Answer Questions

1. What is meant by quantisation of charges ?

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2. Write down Coulomb 's law in vector form and mention what each term represents .

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3. What are the differences between Coulomb force and gravitational force ?

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4. Write a short note on superposition principle.

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5. Define Electric field .

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6. What is mean by Electric field lines ?

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7. The electric field lines never intersect . Justify.

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8. Define Electric dipole.

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9. What is dipole moment ?

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10. Define electric potential and potential difference.

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11. What is an equipotential surface?

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12. What are the properties of an equipotential surface?

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13. Give the relation between electric field and electric potential .

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14. Define electrostatic potential energy.

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15. Define 'electric flux

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Watch Video Solution

16. What is meant by electrostatic energy density ?

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17. Write a short note on electrostatic shielding .

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18. What is polarisation?

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19. What is dielectric strength ?

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20. Define capacitance . Give its unit.

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21. What is corona discharge?

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Textual Evaluation Solved Iii Long Answer Questions

1. Discuss the basic properties of electric charges.

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2. Explain in detail Coulomb 's law and its various aspects.

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3. Define Electric field .

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4. How do we determine the electric field due to a continuous charge distribution ? Explain. Electric field due to continous charge distribution

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5. Calculate the electric field due to a dipole on its axial line and equatorial plane.

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6. Derive an expression for the torque experienced by a dipole due to a uniform electric field .

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7. Derive an expression for electrostatic potential due to a point charge .

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8. Derive an expression for electrostatic potential due to an electric dipole.

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9. Obtain an expression for potential energy due to a collectrion of three point charges which are separated by finite distances.

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10. Derive an expression for electrostatic potential energy of the dipole in a uniform electric field .

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11. Obtain Gauss law from Coulomb 's law .

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12. Obtain the expression for electric field due to an infinitely long charged wire .

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13. Obtain the expression for electric field due to an charged infinite plane sheet .

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14. Obtain the expression for electric field due to an uniformly charge spherical shell.

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15. Discuss the various properties of conductors in electrostatic equilibrium . Properties of conductors in electrostatic equilibrium:

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16. Explain the process of electrostatic induction .

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17. Explain dielectrics in detail and how an electric field is induced inside a dielectric .

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18. Obtain the expression for capacitance for capacitance for a parallel plate capacitor .

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19. Obtain the expression for the energy stored in a parallel plate capacitor.

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20. Explain in detail the effect of a dielectric placed in a parallel plate capacitor.

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21. Derive the expression for resultant capacitance when capacitors are connected in series and in parallel .

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22. Explain in detail how charges are distributed in a conductor and the principle behind the lightning conductor.

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23. Explain in detail the construction and working of a Van de Graaff generator.

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Exercises

1. When two objects are rubbed with each other approximately a charge of 50 nC can be produced in each object . Calculate the number of electrons that must be transferred to produce this charge.

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2. The total number of electrons in the human body is typically in the order of 10^{28} . Suppose due to some reason you and your friend lost $1\ \%$ of this number of electrons. Calculate the electrostatic force between you and your friend separated at a distance of 1m. Compare this with your weight . Assume mass of each person is 60 kg and use point charge approximation.

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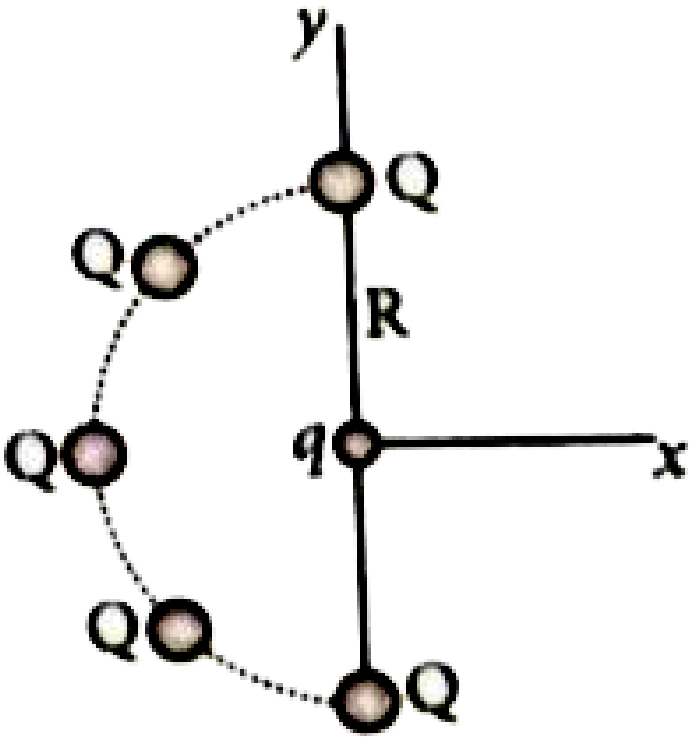
3. Five identical charges Q are placed equidistant on a semicircle as shown in the figure . Another point charge q is kept at the center of the circle of radius R. Calculate the

electrostatic force experienced by the charge q.



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4. Suppose a charge + q on Earth's surface and another +q charge is placed on the surface of the Moon . (a) Calculate the

value of q required to balance the gravitational attraction between Earth and Moon (b) Suppose the distance between the Moon and Earth is halved would the charge q change ? (Take $m_E = 5.9 \times 10^{24} kg m_M = 7.348 \times 10^{22} kg$)

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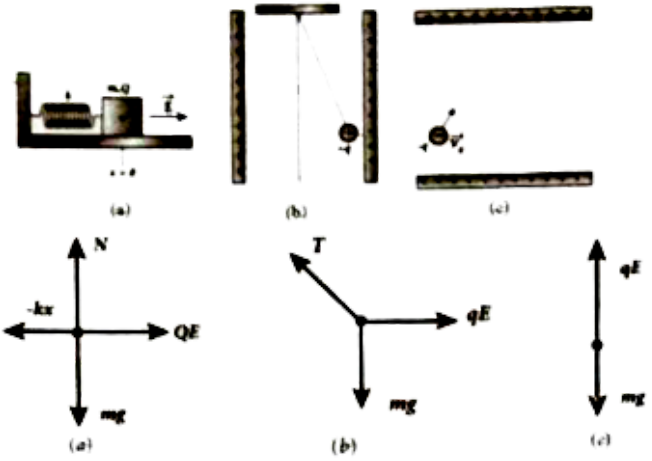
5. Draw the free body diagram for the following charges as shown in the figure (a), (b) and (c).



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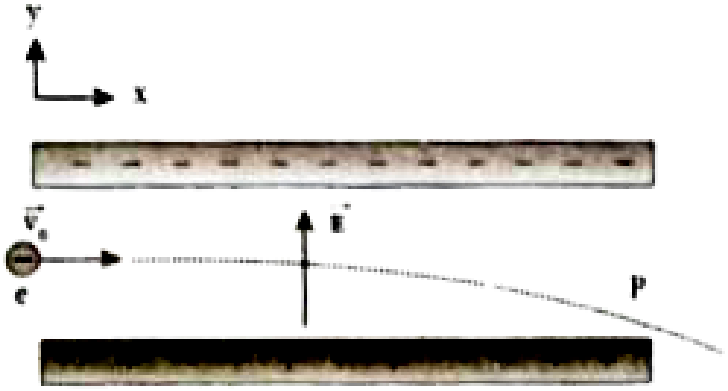
6. Consider an electron travelling with a speed V_0 and entering into a uniform electric field $\vec{E}$ which is perpendicular to $\vec{V}_0$ as shown in the Figure.



Ignoring gravity, obtain the electron 's acceleration velocity and position as functions of time.

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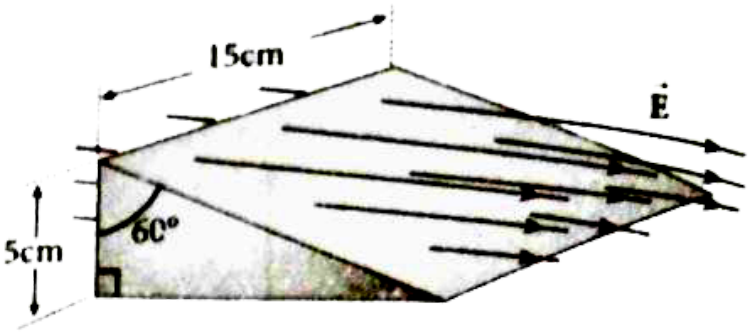
7. A closed triangular box is kept in an electric field of magnitude $E = 2 \times 10^3 NC^{-1}$ as shown in the figure . Calculate the electric flux through the (a) vetical rectangular

surface (b) slanted surface and (c) entire surface.



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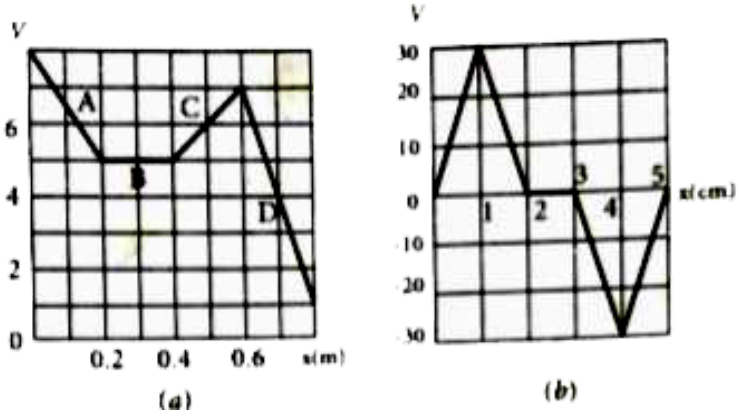
8. The electrostatic potential is given as a function of x in figure (a) and (b) . Calculate the corresponding electric fields in regions A, B, C and D . Plot the electric field as a function of x

for the figure (b).



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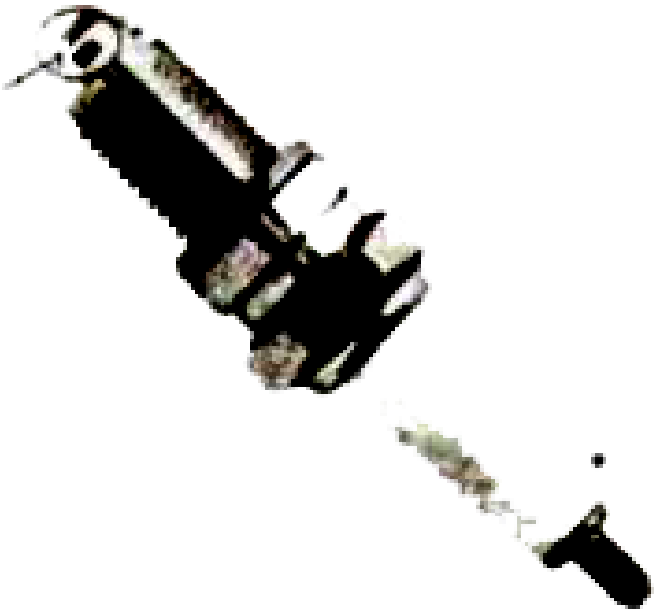
9. A spark plug in a bike or a car is used to ignite the air - fuel mixture in the engine. It consists of two electrodes separated by a gap of around 0.6 mm gap as shown in the figure.



To create the spark an electric field of magnitude $3 \times 10^6 Vm^{-1}$ is required. (a) What potential difference must be applied to produce the spark ? (b) If the gap is increased , does the potential defference increase decrease or remains the same the same ? (c) find the potential difference if the gap is 1 mm .

Watch Video Solution

10. A point charge of +10 μ C is placed at a distance of 20 cm from another identical point charge of +10 μC. A point charge of -2μ C is moved from point a to b as shown in the figure . Calculate the change in potential energy of the system ? Interpret your result .

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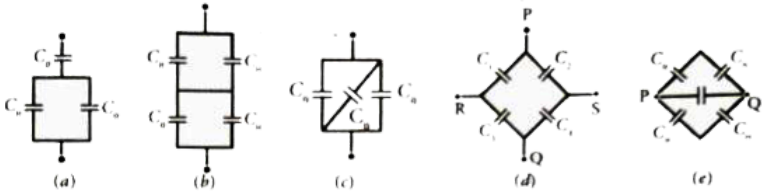
11. Calculate the resultant capacitances for each of the following combinations of capacitors .



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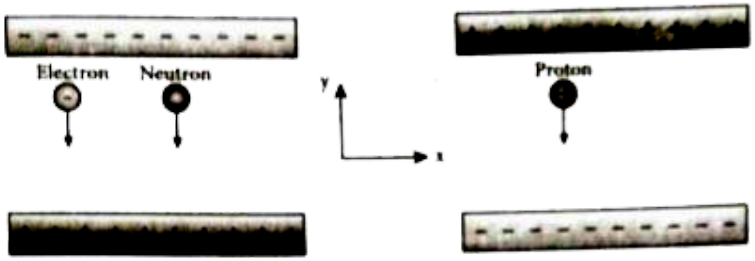
12. An electron and a proton are allowed to fall through the separation the plates of a parallel plate capacitor of voltage 5 V and separation distance h = 1 mm as shown in the figure .



(a) Calculate the time of flight for both electron and proton

(b) Suppose if a neutron is allowed to fall what is the time of flight ?

(c) Among the three which one will reach the bottom first?

(Take $m_p = 1.6 \times 10^{-27} kg, m_c = 9.1 \times 10^{-31}$ kg and g $= 10 ms^{-2}$)

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13. During a thunder storm the movement of water molecules within the clouds creates friction partially causing the bottom part of the clouds to become negatively charged. This implies that the bottom of the cloud and the ground act as a parallel plate cpacitor . If the electric field between the cloud and ground exeeds the dielectric breakdown of the air $\left(3 \times 10^{6} V m^{-1}\right)$ lightning will occur.

(a) If the bottom part of the cloud is 1000 m above the ground determine the electric potential difference that exists between the cloud and ground.

(b) In a typical lightning phenomenon around 25 C of electrons are transferred from cloud to ground . How much electrostatic

potential energy is transferred to the ground?

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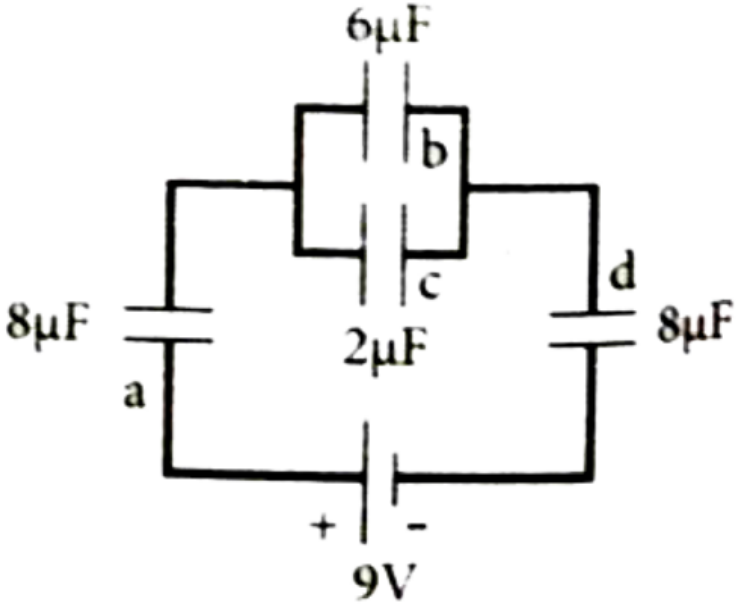
14. For the given capacitor configuration

(a) Find the charges on each capacitor

(b) potential difference across them

(c) energy stored in each capacitor .



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15. What is the area of the plates of a 2 F parallel plate capacitor, given that the separation between the plates is 0.5 cm? [You will realise from your answer why ordinary capacitors are in the range of μF or less. However, electrolytic capacitors

do have a much larger capacitance (0.1 F) because of very minute separation between the conductors.]

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Additional Questions Solved Multiple Choice Questions

1. When a slide body is negatively charged by friction, it means that the body has

A. acquired excess of electrons

B. lost some problem

C. acquired some electrons and lost a lesser number of protons

D. lost some positive ions

Answer: A::C::D

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2. A force of 0.01 N is exerted on a charge of 1.2×10^{-5} C at a certain point. The electric field at that point is

A. $5.3 \times 10^4 NC^{-1}$

B. $8.3 \times 10^4 NC^{-1}$

C. $5.3 \times 10^4 NC^1$

D. $8.3 \times 10^2 NC^{-1}$

Answer: A::B::C

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3. The electric field intensity at a point 20 cm away from a charge of 2×10^{-5} C is

A. $4.5 \times 10^{6} NC^{-1}$

B. $3.5 \times 10^{5} NC^{-1}$

C. $3.5 \times 10^{6} NC^{-1}$

D. $4.5 \times 10^{5} NC^{-1}$

Answer: A::C::D

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4. How many electrons will have a charge of one coulomb ?

A. 6.25×10^{18}

B. 6.25×10^{19}

C. 1.6×10^{18}

D. 1.6×10^{19}

Answer: A::B

Watch Video Solution

5. The ratio of the force between two charges in air and that in a medium of dielectric constant K is

A. K : 1

B. 1 : K

C. k^2: 1

D. $1 : K^2$

Answer: A

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6. The workdone in moving a positve charge on an equipotenial surface is

A. finite and positive

B. infinite

C. finite and negative

D. zero

Answer:

Watch Video Solution

7. If a charge is moved against the coulomb force of an electric field.

A. a) work is done by the electric field

B. b) energy is used from some outside source

C. c) the strength of the field is decreased

D. d) The energy of the system is decreased

Answer: A::C::D

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8. No current flows between two charged particles when connected if they have same _____ .

A. If they have the same capacitance

B. if they have same quantity of charge

C. If they have the same potential

D. If they have the same charge density

Answer: A

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9. Electric field lines about a negative point charge are

A. circular, anticlockwise

B. circular, chockwise

C. radial, inwards

D. radial, outwards

Answer: A::D

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10. Two plates are 1 cm aprt and the potential difference between them is 10 V. the electric field between the plates is

A. $10NC^1$

B. $250NC^{-1}$

C. $500NC^{-1}$

D. $1000NC^{-1}$

Answer: A::C

Watch Video Solution

11. At a large distance (r), the electric field due to a dipole varies as

A. a) $\frac{l}{r}$

B. b) $\frac{l}{r^2}$

C. c) $\frac{l}{r^3}$

D. d) $\frac{l}{r^4}$

Answer: C

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12. Two thin infinite parallel plates have uniform charge densities $+\sigma \text{ and } -\sigma$. The electric field in the space between then is

A. $\frac{\sigma}{2\varepsilon_0}$

B. $\frac{\sigma}{\varepsilon_0}$

C. $\frac{2\sigma}{\varepsilon_0}$

D. zero

Answer: A

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13. Two isolated, charged coducting spheres of radii R_1 and R_2 produce the same electric field near their surfaces. The ratio of electric potentials on their surfaces is

A. $\frac{R_1}{R_2}$

B. $\frac{R_2}{R_1}$

C. $\frac{R_1^2}{R_2^2}$

D. $\frac{R_2^2}{R_2^1}$

Answer: A::B

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14. A 100 μF capacitor is to have an energy content of 50 J in order to opreator a flash lamp . The voltage required to charge the capacitor is

A. 500 V

B. 1000 V

C. 1500 V

D. 2000 V

Answer: A

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15. A 1 μF capacitor is placed n parallel with a 2 μF capacitor across a 100 V supply. The total charge on the system is

A. $\frac{100}{3}\mu$C

B. 100 μC

C. 150μC

D. 300μC

Answer: C

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16. A parallel plate capacitor of capacitance 100 μ F Is charged to 500 V. The plate separation is then reduce to half its original value. Then the potential on the capacitor becomes

A. 250 V

B. 500 V

C. 1000 V

D. 2000 V

Answer: B

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17. A point charge q is placed at the midpoint of a cube of side L. The electric flux emerging from the cube is

A. $\frac{q}{\varepsilon_0}$

B. $\frac{q}{61\varepsilon_0}$

C. $\frac{6Lq}{\varepsilon_0}$

D. zero

Answer:

Watch Video Solution

18. The capacitor C of a spherical conductor of radius R is proportional to

A. R^2

B. R

C. R^1

D. R^0

Answer:

Watch Video Solution

19. Energy of a capacitor of capacitance C, when subjected to a pontential V, is given by

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

B. $\frac{1}{2}C^2\text{V}$

C. $\frac{1}{2}\text{CV}$

D. $\frac{1}{2}\frac{C}{V}$

Answer: A::B::C

Watch Video Solution

20. The electric field due to a dipole at a distnce r from its centre is proportional to

A. $\frac{1}{r^{3.2}}$

B. $\frac{1}{r^3}$

C. $\frac{1}{r}$

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

Answer: A::C

Watch Video Solution

21. The work done in carrying a charge 'a' once round a circle of radius 'a' with a charge Q at its centre is

A. $2\pi rq$

B. $2\pi Qq$

C. $\frac{Q}{2\varepsilon_0}r$

D. zero

Answer:

Watch Video Solution

22. The workdone in rotating an electric dipole of moment P in an electric field E through an angle θ from the direction of the field is

A. $pE\,(1-\cos\theta)$

B. 2pE

C. zero

D. pE cos θ

Answer: A::C

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23. Capacitance of a parallel plate capacitor can be increased by

A. a) increasing the distance between the plates

B. b) increasing the thickness of the plates

C. c) increasing the thickness of the plates

D. d) decreasing the distance between the plates

Answer: A::B::C::D

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24. Two charges are placed in vacuum at a distance d apart. The force between them is F. if a medium of dielectric constant 2 is introduced between them, the force will now be

A. 4F

B. 2F

C. F/2

D. F/4

Answer: D

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25. An electric charge is placed at the centre of a cube of side a. The electric flux through one of its foces will be

A. $\frac{q}{6\varepsilon_0}$

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

C. $\frac{q}{4\pi\varepsilon_0 a^2}$

D. $\frac{q}{\varepsilon_0}$

Answer:

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26. The electric field in the region between two concentric charged spherical shells

A. is zero

B. increases with distance from centre

C. is constant

D. decreases with distance from centre

Answer: A::C::D

Watch Video Solution

27. A hollow metal sphere of radius 10 cm is charged such that the potential on its surface is 80 V. the potential at the centre of the sphere is

A. 800 V

B. zero

C. 8 V

D. 80 V

Answer:

Watch Video Solution

28. A 4 μF capacitor is charged to 400 V and then its plates are joined through a resistance of 1 K Ω. The heat produced in the resistance is

A. 0.16 J

B. 0.32 J

C. 0.64 J

D. 1.28 J

Answer: B::C

Watch Video Solution

29. The work done in carrying a charge 'a' once round a circle of radius 'a' with a charge Q at its centre is

A. $\frac{Q_1 Q_2}{4\pi\varepsilon_0 R^2}$

B. zero

C. $\frac{Q_1 Q_2}{4\pi\varepsilon_0 R}$

D. infinite

Answer:

Watch Video Solution

30. Two plates are 2 cm apart. If a potential difference of 10 V is applied between them. The electric field between the plates will be

A. $20NC^{-1}$

B. $500NC^{-1}$

C. $5NC^{-1}$

D. 250 NC^{-1}

Answer: A::C

Watch Video Solution

31. The capacitance of a parallel plate capacitor does not depend on

A. area of the plates

B. metal of the plates

C. medium between the plates

D. distance between the plates

Answer: A

Watch Video Solution

32. A capacitor of 50 μF is charged to 10 volts. Its energy in joules is

A. 2.5×10^{-3}

B. 5×10^{-3}

C. 10×10^{-4}

D. 2.5×10^4

Answer: A::B::C

Watch Video Solution

33. 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 the cube is

A. $\frac{q}{b^2}$

B. $\frac{q}{2b^2}$

C. $\frac{32q}{b^2}$

D. zero

Answer:

Watch Video Solution

34. Total electric fulx coming out of a unit positive charge put in air is

A. ε_0

B. ε_0^{-1}

C. $(4\pi\varepsilon_0)^{-1}$

D. $4\pi\varepsilon_0$

Answer: A

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35. Electron volt (eV) is a unit of

A. energy

B. potential

C. current

D. charge

Answer:

Watch Video Solution

36. A point Q lies on the perpendicular bisector of an electric dipole of dipole moment P. If the distance of Q from the dipole is r, then electric field at Q is proportional to

A. p^{-1} and r^{-2}

B. p and r^{-2}

C. p and r^{-3}

D. p^2 and r^{-3}

Answer: A::C::D

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37. A hollow insulated conducting sphere is given a positive charge of 10 μC . What will be the electric field at the centre of the sphere is its radius is 2 meters ?

A. zero

B. 8 μCm^{-2}

C. $20\mu Cm^{-2}$

D. $5\mu Cm^{-2}$

Answer:

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38. A particle of charge q is placed at rest in a uniform electric field E and then released . The kinetic energy attained by the particle after moving a distance y is

A. qE^2y

B. q^2Ey

C. qEy^2

D. qEy

Answer:

Watch Video Solution

39. Dielectric constant of metals is

A. 1

B. greater than 1

C. zero

D. infinite

Answer:

Watch Video Solution

40. When a positively charged conductor is earth connected

A. a) protons flow from the conductor to the earth

B. b) electrons flow from the earth to the conductor

C. c) electrons flow from the conductor to the earth

D. d) no charge flow occurs

Answer: A::C::D

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41. The SI unit of electric flux is

A. volt $metre^2$

B. newton per coulomb

C. volt meter

D. joule per coulomb

Answer:

Watch Video Solution

42. Twenty seven water drops of the same size are charged to the same potential .if they are combined to from a big drop, the ratio of the potential of the big drop to that of a small drop is

A. 3

B. 6

C. 9

D. 27

Answer:

Watch Video Solution

43. A point charge +q is placed at the midpoint of a cube of side l. the electric flux emerging from the cube is

A. $\frac{q}{\varepsilon_0}$

B. $\frac{6ql^2}{\varepsilon_0}$

C. $\frac{q}{6l^2\varepsilon_0}$

D. $\frac{C^2V^2}{2}$

Answer:

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44. Energy of a capacitor of capacitance C, when subjected to a pontential V, is given by

A. $\frac{C^2V}{2}$

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

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

D. $\frac{C^2V^2}{2}$

Answer: B::C

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45. The electric potential at the centre of a charged conductor is

A. zero

B. twice that on the surface

C. half that on the surface

D. same as that on the surface

Answer: A::C

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46. The energy stored in a capacitor is given by

A. qV

B. $\frac{1}{2}$qV

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

D. $\frac{q}{2C}$

Answer: A::B

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47. The unit of permitivity of free space ε_0 is

A. coulomb/newton-meter

B. newton-meter^2 / coulomb^2

C. coulomb^2/newton-meter^2

D. conlomb /$(\text{newton - meter})^2$

Answer: B::C

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48. An electric dipole has the magnitude of its charge as q and its dipole moment is p. It is placed in a uniform electric field E. It its dipole moment is along the direction of the field, the force on it and its potential energy are, respectively.

A. 2qE and minimum

B. qE and pE

C. zero and minimum

D. qE and maximum

Answer: A::D

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49. An electric dipole of moment p is lying along a uniform electric field $\vec{E}$. The workdone in rotating the dipole by 90° is

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

B. 2pE

C. pE

D. $\sqrt{2}pE$

Answer:

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50. A parallel plate capacitor is charged to a potential difference of V volts. After disconnecting the charging battery the distance between the plates of the capacitor is increased using an insulating handle. As a result the potential difference between the plates

A. does not charge

B. becomes zero

C. increases

D. decreases

Answer: A::C

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

A. increases K times

B. increases K^{-1} times

C. decreases K times

D. remains constant

Answer: A::C::D

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52. When a comb rubbed with dry hair attracts pieces of paper. This is because the

A. comb is a good conductor

B. paper is a good conductor

C. the atoms in the paper gets polarised by the charged combe

D. the comb possese magnetic properties

Answer: A::B::C::D

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53. Which of the following is not a property of equipotential surfaces ?

A. a) They do not cross each other

B. b) they are concentric spheres for uniform electric field

C. c) the rate of change of potential with distance on them is zero

D. d) they can be imaginary spheres

Answer: A::C::D

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54. A charge Q is enclosed by a Gaussian spherical surface of radius R. if the radius is doubled. Then the outward electric flux will be

A. reduced to half

B. doubled

C. becomes 4 times

D. remains the same

Answer: A

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55. If the electric field in a region is given by $\vec{E} = 5\hat{i} + 4\hat{j} + 9\widehat{K}$, then the electric flux through a surface of area 20 units lying in the y-z plane will be

A. 20 units

B. 80 units

C. 100 units

D. 180 units

Answer: A

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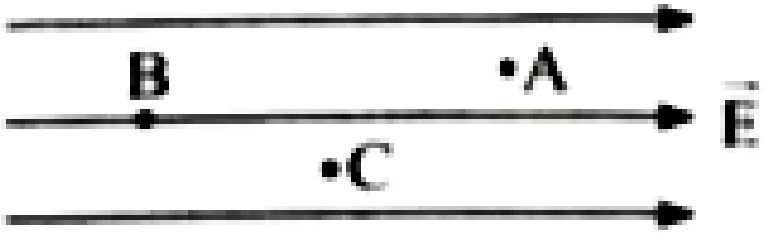
56. A , B and C are three points in a uniform electric field. The electric potential is



A. a) maximum at A

B. b) maximum at B

C. c) maximum at C

D. d) same at all the three points A, B and C

Answer: A::B

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57. A conducting sphere of radius R is give a charge Q. The electric potential and the electric field at the centre of the sphere are, respectively

A. a) zero, $\frac{Q}{4\pi\varepsilon_0 R^2}$

B. b) $\frac{Q}{4\pi\varepsilon_0 R^2}, \frac{Q}{4\pi\varepsilon_0 R^2}$

C. c) $\frac{Q}{4\pi\varepsilon_0 R}$, zero

D. d) zero, zero

Answer: D

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Additional Questions Solved Ii Fill In The Blanks

1. A dipole is placed in a uniform electric field with its axis parallel to the field. It experiences

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2. The unit of permittivity is ..... .

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3. The branch of physics which deals with static electric charges or charges at rest is ..... .

Watch Video Solution

4. The charges in a electrostatics field are analogous to ..... In a gravitational field.

Watch Video Solution

5. The substances which acequire charges on rubbing are said to be ..... .

Watch Video Solution

6. Electron means ..... .

Watch Video Solution

7. when a glass rod is rubbed with silk cloth, both get charged.

Watch Video Solution

8. When an ebonite rod is rubbed with fur, the charge acquired by the fur is.

Watch Video Solution

9. ..... Termed the classification of positive and negative charges.

Watch Video Solution

10. Applications such as electrostatic point spraying and powder coating. Are based on the property of ..... Between charged bodies.

Watch Video Solution

11. Bodies which allow the charge to pass through them are called ..... .

Watch Video Solution

12. Bodies which do not allow the charge to pass through them are called ..... .

Watch Video Solution

13. The unit of electric charge is ..... .

Watch Video Solution

14. Total charge in an isolated sysem ..... .

Watch Video Solution

15. The force between two charged bodies was studied by ..... .

Watch Video Solution

16. The unit of permittivity in free space (ε_0) is ..... .

Watch Video Solution

17. The value of ε_r for air or vacuum is .....

Watch Video Solution

Watch Video Solution

18. Charges can neither be created nor be destroyed is the statement of law of conservation of

Watch Video Solution

19. The space around the test charge, in which it experiences a force is known as

Watch Video Solution

20. Electric field at a point is measured in terms of

Watch Video Solution

21. The unit of electric field in tensity is ..... .

Watch Video Solution

22. The lines of force are far apart, when electric field E is ..... .

Watch Video Solution

23. The lines of force are close together, when electric field E is ..... .

Watch Video Solution

24. Electric dipole moment ..... .

Watch Video Solution

25. Torque experienced by electric dipole is ..... .

Watch Video Solution

26. An electric dipole placed in a non-uniform electric field at an angle θ experiences

Watch Video Solution

27. When the dipole is aligned parallel to the field, its electric potential energy is

Watch Video Solution

28. Change of potential with distance is known as

Watch Video Solution

29. The number of electric lines of force crossing through a given area is

Watch Video Solution

30. The process of isolating a certain region of space from external field is called ..... .

Watch Video Solution

31. Capacitor is a device to store ....

Watch Video Solution

32. The charge density is maximum at .....

Watch Video Solution

33. The principle made use of an lightning arrester is ..... .

Watch Video Solution

34. Van de Graaff generator producers large electrostatic potential difference of the order of ..... .

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Additional Questions Solved Iii Match The Following

1.

(i)Quantisation of charges	$(a)\int_{\infty}^{P} -\vec{E}.d\vec{r}$
(ii)Electric field	(b)ne
(iii)Electric dipole moment	$(c)\frac{F}{q}$
(iv) Electric potential	$(d)2qa$

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2.

(i)Positive and negative	(a) Michael Faraday
(ii)Electrostatic force	(b)Gauss
(iii)Concept of field	(c) Benjamin Franklin
(iv) q in arbitrary closed surface	(d) coulomb

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3.

(i) Electric dipole	(a)Ebonite
(ii) Dielectric	(b)H_2
(iii)Polar molecules	(c) Ammonia
(iv)Non-polar molecules	(d)H_2O

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4.

(i)Electric charge	(a) Cm
(ii) Dipole moment	(b)Nm^2C^{-1}
(iii) Electric field	(c) coulomb
(iv)electric flux	(d)NC^{-1}

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Additional Questions Solved Iv Assertion And Reason Type

1. Assertion : Electric lines of force cross each other.

Reason: Electric field at a point supermpose to give one resultant electric field.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both assertion and reason are true but the reason is not correct explanation of the assertion.

C. If assertion is true but reason is false.

D. If the assertion and reason both are false.

Answer:

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2. Assertion : Charge is quantized .

Reason: Charge , which is less than 1 C is not possible .

A. If both assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both assertion and reason are true but the reason is not correct explanation of the assertion.

C. If assertion is true but reason is false.

D. If the assertion and reason both are false.

Answer:

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3. Assertion: A point charge is brought in an electric field. The field at a nearby point will increases whatever be the nature of the charge.

Reason : the electric field is independent of the nature of charge.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both assertion and reason are true but the reason is not correct explanation of the assertion.

C. If assertion is true but reason is false.

D. If the assertion and reason both are false.

Answer:

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4. Assertion : they tyre's of aircraft's are slightly conducting.

Reason: If a conductor is connected to ground, the extra charge induced on conductor will flow to ground.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both assertion and reason are true but the reason is not correct explanation of the assertion.

C. If assertion is true but reason is false.

D. If the assertion and reason both are false.

Answer:

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5. Assertion: The lightening conductor at the top of a high building has sharp ends.

Reason : The surface density of charge at sharp points is very high. Resulting in setting up of electric wind.

A. If both assertion and reason are true and the reason is the correct explanation of the assertion.

B. If both assertion and reason are true but the reason is not correct explanation of the assertion.

C. If assertion is true but reason is false.

D. If the assertion and reason both are false.

Answer:

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Additional Questions Solved V Short Answer Questions

1. What is meant by triboelectric charging ?

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2. What is meant by conservation of total charges ?

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3. State Bragg's law.

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4. Write a short note on electrostatic shielding .

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5. What is meant by dielectric ?

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6. What are polar molecules ? Give examples.

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7. What are polar molecules ? Give examples.

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8. What is a capacitors ?

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Additional Questions Solved Vi Long Answer Questions

1. Assertion: A point charge is brought in an electric field. The field at a nearby point will increases whatever be the nature of the charge.

Reason : the electric field is independent of the nature of charge.

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2. Derive an expression for electric flux of rectangular area placed in uniform electric field.

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Additional Questions Solved Vii Numerical Problems

1. Electrons are caused to fall through a potential difference of 1500 volts. If they were initially at rest. Then calculate their final speed.

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2. Small mercury drops of the same size are charged to the same potential V. If n such drops coalesce to form a single large drop, then calculate its potential.

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3. Two particles having charges Q_1 and Q_2 , when kept at a certain distance, exert a force F on each other. If the distance

between the two particles is reduced to half and the charge on each particle is doubled. Find the force between the particles.

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4. Two charges are placed in vacuum at a distance d apart. The force between them is F. if a medium of dielectric constant 2 is introduced between them, the force will now be

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5. Find the force of attraction between the plates of a parallel plate capacitor.

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