PHYSICS

FOR IIT JEE ASPIRANTS OF CLASS 12 FOR PHYSICS

ELECTROSTATIC POTENTIAL AND CAPACITANCE

Illustration

1. Determine the potential at a point 0.50 m (i) from a$+20\mu C$ potential charge (ii) from a $-20\mu C$ point charge.

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2. A charge $+q$ is fixed at each of the points $x=x_0$, $x=3x_0$, $x=5x_0$,............$x=\infty$ on the x axis, and a charge $-q$ is fixed at each of the points $x=2x_0$, $x=4x_0$, $x=6x_0$, ... $x=\infty$. Here x_0 is a positive constant. Take the electric potential at a point due to a charge Q at a distance r from it to be $Q/(4\pi\varepsilon_0 r)$.Then, the potential at the origin due to the above system of

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

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4. In the given figure, there are four point charges placed at the vertices of a square of side a= 1.4m. If $q_1 = +18nC, q_2 = 24nC, q_{30} = +35nC$ and $q_4 = +16nC$, then find the electrid potential at the centre P of the square. Assume the potential to be zero at infintiy.

5. If 100 J of work must be done to move electric charge equal tp 4C from a place where potential is $-10V$ to another place where potential si V volt, find the value of V.

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6. A charge of 10C is moved in an electric field of a fixed charge distribution from point A to another point B slowly. The work done by external agent in doing so is 100J. What is the potential difference

$(V_A - V_B)$?

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7. Suppose an electron in the picture tube of a television set is accelerated from rst through a potential differencre $V_b - V_a = V_{ba} = +$ 5000V

(a) What is the change in electric potential energy of the electron?

(b) What is the speed of the electron

$(m = 9.1 \times 10^{31} kg)$ as a result of this acceleration?

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8. A particle of mass m and positive charge q is released from point A. Its speed is found to be v when it passes through a point B. which of the two points is at higher potential ? What is the potential difference between the points?

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9. Charge q_1 is fixed and another point charge q_2 is placed at a distance r_0 from q_1 on a frictionless horizontal surface.Find the velocity of q_2 as a function of separation r between them (treat the changes as point charges and mass of q_2 is m)

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10. A charge $+q_0$ is fixed at a position in space. From a large distance another charged particle of charge -q and mass m is thrown towards $+q_0$

with an impact parameter L as shown. The initial speed of the projected particle is v. Find the distance of closer approach of the two particles?

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11. A particle of mass 40 mg and carrying a charge $5 \times 10^{-9} C$ is moving directly towards a fixed positive point charge on magnitude $10^{-8} C$. When it is at a distance of 10 cm from the fixed positive point charge it has a velocity

of $50 cm s^{-1}$ at what distance from the fixed point charge will the particle come momentarily to rest ? Is the acceleration constant during motion?

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12. A proton moves with a speed of $7.45 \times 10^5 m / s$ directly towards a free proton originally at rest.Find the distance of closest approach for the two protons. Given $(1 / 4\pi\varepsilon_0 \_ = 9 \times 10^9 m / s, m_p = 1.67 \times 10^{-27} kg$ and $e = 1.6 \times 10^{-19}$coulomb.

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13. An electron travelling from infinity with velocity v into an electric field due to two stationary electrons separated by a distance of $2m$.if it comes to rest when it reaches the mid point of the line joining the stationary electrons.The initial velocity v of the electron is

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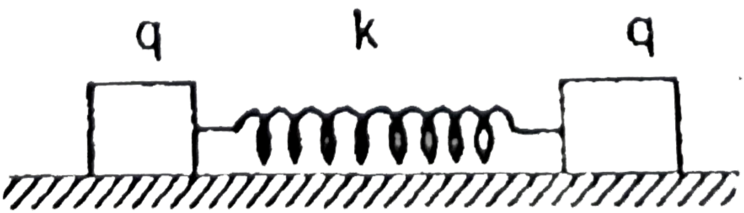
14. Two identical particles of charge q each are connected by a massless spring of force constant k. They are placed over a smooth horizontal surface. They are released when the separation between them is r and spring is unstretched. If maximum extension of the spring is r, the value of k is (neglect gravitational effect)



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15. IF an electron enters into a space between the plates of a parallel plate capacitor at an an angle α with the plates an leaves at an angle β to the plates find the ratio of its kinetic energy while entering the capacitor of that while leaving.

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16. Three particles of equal mass 'm' are situated at the vertices of an equilateral triangle of side

L. The work done in increasing the side of the triangle to $2L$ is

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17. Determine the interaction enery of the point charge located at the corners of a square with the side a in the circuits shown in figure.

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18. Two protons are separated by a distance R. What will be the speed of each proton when they reach infinity under their mutual repulsion?

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19. A bullet of mass $2gm$ is having a charge of $2\mu c$. Through what potential difference must it be accelerated, starting from rest, to acquire a speed of $10m/s$

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20. Three equal charges Q are at the vertices of an equilateral triangle of side A. How much work is done (by an external agent) in bringing them closer to an equilateral triangle of side A/2?

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21. Two particles have equal masses of 5.0 g each and opposite charges of $+4.0 \times 10^{-5} C$. They are released from rest with a separation of 1.0 m between them. Find the speeds of the particles when the separation is reducced to 50 cm.

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22. The electric potential existing in space is $V(x, y, z) = A(xy + yz + zx)$.(a) Write the dimensional A. (b) find the expression for the electric field.(c) If A is 10 SI units, find the magnitude of the electric field at (1m, 1m, 1m).

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23. An electric field $E = \left(20\hat{i} + 30\hat{j}\right)$ N/C exists in the space. If thepotential at the origin is taken be zero, find the potential at $(2m, 2m)$.

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24. An electric field $\overrightarrow{E} = \overrightarrow{I} Ax$ exists in the space, where $A = 10Vm^{-2}$. Take the potential at (10m, 20m) to be zero. Find the potential at the origin.

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25. A positively charged oil droplet remins stationary in the electric field between two horizontal plates separated by a distance of $1cm$. The charge on the drop is $10^{-15}C$ and mass of the droplet is $10^{-11}g$, the potential difference between the plates and if the polarity is reversed , the instantaneous of the droplet are

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26. An oil drop 'B' has charge $1.6 \times 10^{-19} C$ and mass $1.6 \times 10^{-14} kg.$ If the drop is in equilibrium position, then what will be potential difference between the plates. [The distance between the plates is 100mm]

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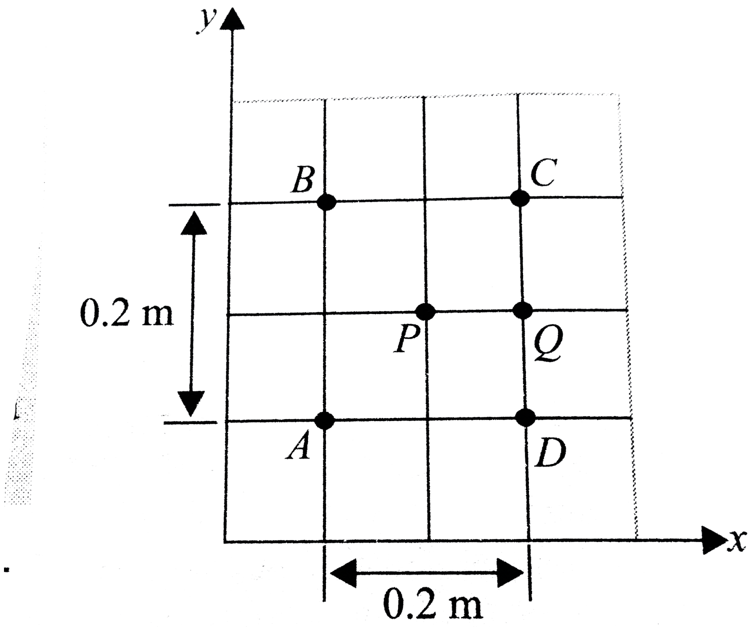
27. A, B, C, D, P, and Q are points in a uniform electric field. The potentials at these points are $V(A) = 2V. V(P) = V(B) = V(D) = 5V,$

and $V(C) = 8V$. Find the electric field at P.



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28. The electric potential V at any point x,y,z (all in metre) in space is given by $V = 4x^2$ volt. The electric field at the point $(1m, 0, 2m)$ is ....

$\frac{V}{m}$.

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29. Find the potential difference V_{AB} between $A(2m, 1m, 0)$ and $B(0, 2m, 4m)$ in an electric field,

$$E = \left(x\hat{i} - 2y\hat{j} + z\hat{k}\right)\frac{V}{m}$$

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30. Find the potential difference between points A and B in an electric field

$\overrightarrow{E} = \left(2\hat{i} + 3\hat{j} + 4\hat{k}\right) NC^{-1}$

where

$\overrightarrow{r_A} = \left(\hat{i} - 2\hat{j} + \hat{k}\right) m$ and $\overrightarrow{r_B} = \left(2\hat{i} + \hat{j} - 2\hat{k}\right) m$

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31. An infinite plane sheet of charge density $10^{-8} Cm^{-2}$ is held in air. In this situation how far apart are two equipotenitial surfaces, whose p.d is 5 V ?

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32. A unifrom field of magnitude 2000 N/C is directed 37° below the horizontal as shown in the figure . Find (a) the potenital differenc between P and R. (b) If we define the reference level of potential so that potential at R is 500 V, what is the potential at P ?

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33. Electric field intensity at a point B due to a point charge Q kept at point A is $24NC^{-1}$, and electric potential at B due to the same charge is $12JC^{-1}$. Calculate the distance AB and magnitude of charge.

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34. The electric field in a region is given by $\vec{E} = \left(\frac{A}{x^3}\right)\vec{I}$. Write a suitable SI unit for A. Write an experssion for. the potential in the region assuming the potential at. infinity to be zero.

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35. Two point charges $-5\mu C$ and $+3\mu C$ are placed 64 cm apart . At what points on the line joining the two charges is the electric potential zero ? (Assume the potential at infinity to be zero) .

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36. An electirc dipole consists of two charges of equal magnitude and opposite sign separated by a distance 2a , as shown in figure . The diople is along the x-axis and is centered at the orgin.

(A) Calculate the electric potential at point P .

(B) Calculate V at point far from the dipole.

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37. When an electric dipole is placed in a uniform electric field making angle θ with electric field, it experiences a torque τ. Calculate the minimum work donein changing the orientation to 2θ.

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38. A molecule of a substance has a permanent electric dipole moment of magnitude 10^{-29}C m. A mole of this substance is polarized at low temperature by appling a strong elecrostatic field of magnitude $10^6 Vm^{-1}$. The direction of the field is suddenly changed by an angle of 60°. Estimate the heat released by the substance in aligning its dipole along the new direction of the field. For simplicity, assume 100% polarisation of sample.

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39. An electric dipole in a uniform electric field E is turned form $\theta = 0$ position to $\theta = 60^{\circ}$ position . Find work done by the field .

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40. An electric dipole of dipole moment p is kept at a distance r form infinite long charged wire of linear charge denisty λ as shown . Find the force acting on the dipole ?

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

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42. Figure shows two conectric conducting shell of radii , r_1 and r_2 carrying uniformly distributed charages q_1 and q_2 . Respectively . Find out an expression for the potential of each shell.

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43. In the previous example, if the charge $q_1 = +q_0$ and no charge an outer shell. The outer shell is earthed , then

(a) determine the charge on the outer shell, and

(b) find the potential of the inner shell .

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44. Consider two concentric spherical metal shells fo radii 'a' and $b > a$. The outer shell has charge Q, but the inner shell has no charge , Now the inner shell is grounded. This means that the inner shell will come at zero potential and that electric field lines leave the outer shell an end on the inner shell .

(a) Find the charge on the inner shell .

(b) Find the potential on outer sphere.

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45. Two circular loops of radii 0.05 and 0.09m, respectively , are put such that their axes coincide and their centre are 0.12 m apart.

Charge of 10^{-6} coulomb is spread uniformly on each loop. Find the potential difference between the centres of loops.

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46. A circular ring of radius R with uniform positive charge density λ per unit length is loacted in the y - z plane with its centre at the origin O . A particle of mass 'm' and positive charge 'q' is projected form the point $p\left[-\sqrt{3}R, 00\right]$ on the negative x - axis directly towards O , with initial speed V. Find the smallest (non - zero) value of the speed such that the particle does not return to P ?

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47. A charge of $+2.0 \times 10^{-8} C$ is placed on the positive place and a charge of -$1.0 \times 10^{-8} C$ on the negative plate of a parallel- plate capacitor of capacitance $1.2 \times \left(10^{-3}\right) \mu$ F. Calculate the potential difference developed between the plates.

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48. A capacitor of capacitance C is charged by connecting it to a battery of emf epsilon. The capacitor is now disconnected and reconnected to the battery with the polarity reversed. Calculate the heat developed in the connecting wires.

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49. A parallel plate air capacitor is made using two plates 0.2 m square , spaced 1 cm apart . It is connected to a 50V battery.

(a) what is the capacitance ?

(b) what is the charge one each plane ?

(c) what is energy stored in the capacitor ?

(d) what is the electric field between the plates ?

(e) If the battery is disconnected and then the plates are pulled apart to a separation of 2 cm , what are the answer to the above parts ?

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50. Figure shows two capacitors connected in series and joined to a battery . Draw the graph showing the variation in potential as one moves form left to ring on the branch containing the capacitors. Take $C_1 > C_2$

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51. A capacitor is made of a flat plate of area A and a second plate having a stair - like structure as shown in figure. The width fo each stair is a and the height is b. Find the capacitance of the assembly.

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52. Two capacitors of capacitance 20.0 pF and 50.0 pF are connected is series with a battery of 20 V. Find the energy supplied by the battery.

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53. Each capacitor shown in figure has a capacitance of $6.0 \mu F$. The emf fo the battery is 50 v. How much charge will flow through AB if the switch S is closed ?

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54. A capaitor of capacitance $C_1 = 1.0 \mu F$ withstands teh maximum voltage $V_1 = 6.0 kV$ while a capacitor of capacitance $C_s = 2.0 \mu F$, the maximum voltage $V_s = 4.0 kV$. What voltage will the system of these two capacitors withsatand if they are connected in sereis ?

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55. Find the p.d between the point A and B in the fig. The value of capacitance are in μF.

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56. Find the equivalent capacitance between points A and B for the following figs . Assume that each plate has surface area A and the separation between the two consective plates is s.

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57. A capacitor is composed of two plates separated by a sheet of insulating material 13 mm thick and or relative permittivity 4. The distance between the plates is increased to allow the insertion of second sheet 5 mm thick and of relative permittivity $\in_r$. If the capacitance of the capacitor so formed is 1/3 of the original capacitance, find $\in_r$.

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58. The parallel plate of a capacitor have an area $0.2m^2$ and are 10^{-2} m apart. The original potential difference between them is 3000V, and it decreases to 1000 when a sheet of dielectric is inserted between the plates.

Compute

(a) Original capacitance C_0

(b) The original charge Q on each plate .

(C) Capacitance C after insertion of the dielectric .

(d) Dielectric constant K .

(e) The original field E_0 between the plates and .

(f) The electric field E_0 between the plates and .

(f) The electric field E after insertion of the dielectric . $\left(\varepsilon_0 = 8.85 \times 10^{-12} S. I\right.$ unit).

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Evaluate yourself-1

1. In a region of uniform electric field, as an electron travels from A to B, it slows from $v_A = 6.1 \times 10^6 m/s$ to $v_B = 4.5 \times 10^6 m/s$. The potential change $\Delta V = V_B - V_A$ in volts nearly.

A. 18

B. -18

C. $+48$

D. -48

Answer: D

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2. A proton is accelerated from rest through a potential of 500 volts . Its final kinetic energy is

A. 50eV

B. 500eV

C. 1000eV

D. 2000eV

Answer: B

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3. An alpha particle (charge= +2e) is accelerated from rest through a potential difference of 500 volts. Its final kinetic energy is

A. 50eV

B. 500eV

C. 1000eV

D. 2000eV

Answer: C

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4. The electric potential at point A is $20V$ and at B is $-40V$. Find the work done by an external and electrostatic force in moving an electron slowly from B to A.

A. $9.6 \times 10^{-18} J$

B. $-9.6 \times 10^{-18} J$

C. $3.2 \times 10^{-18} J$

D. $-3.2 \times 10^{-18} J$

Answer: B

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5. The electric potential at point A is $20V$ and at B is $-40V$. Find the work done by an external and electrostatic force in moving an electron slowly from B to A.

A. $9.6 \times 10^{-18} J$

B. $-9.6 \times 10^{-18} J$

C. $3.2 \times 10^{-18} J$

D. $-3.2 \times 10^{-18} J$

Answer: A

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Evaluate yourself-2

1. What happens to electrostatic potential energy of a two electron system, if one electrons brought towards another electron?

A. It become zero

B. It decreases

C. It increases

D. It remains same

Answer: C

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2. Two small spheres, each carrying a charge q are placed r m apart and they interact with force F. If one of the sphere is taken around the other once in a circular path, the work done will be equal to

A. Force between them $\times r$

B. $\frac{\text{Force between them}}{2\pi r}$

C. Force between them $\times 2\pi r$

D. zero

Answer: D

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3. If an alpha particle and a proton are accelerated from rest by a potential difference of 1MeV, then the ratio of their kinetic energies will be

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

B. 1

C. 2

D. 4

Answer: C

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4. Two electrons each moving with a velocity of $10^6 ms^{-1}$ are released towards eachother. What will be the closest distance of approach between them ?

A. $1.53 \times 10^{-8} m$

B. $2.53 \times 10^{-10} m$

C. $2.53 \times 10^{-6} m$

D. zero

Answer: B

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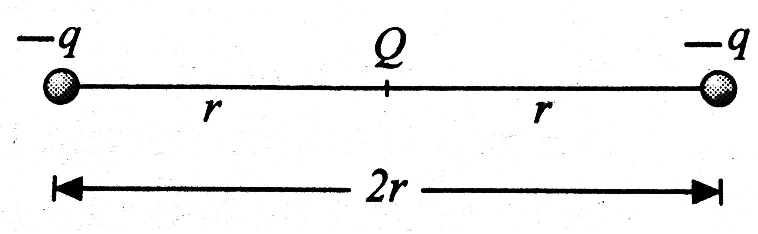
5. Charges $-q, Q,$ and $-q$ are placed at an equal distance on a straight liner. If the total potential energy of the system of three charges is zero, then find the ratio Q/q.



A. $1:1$

B. $1:2$

C. $1:3$

D. $1:4$

Answer: D

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6. The electrostatic potential energy between proton and electron separated by a distance 1 Å is

A. 13.6eV

B. $-13.6eV$

C. 14.4eV

D. $-14.4eV$

Answer: D

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7. Two positive point charges of 12 and 5 microcoulombs, are placed 10 cm apart in air. The work needed to bring them 4 cm closer is

A. 2.4J

B. 3.6J

C. 4.8J

D. 6J

Answer: B

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8. An uniform electric field E exists along positive x-axis. The work done in moving a charge 0.5 C through a distance 2 m along a direction making an angle 60° with x-axis is 10 J. Then the magnitude of electric field is

A. $5Vm^{-1}$

B. $2Vm^{-1}$

C. $20Vm^{-1}$

D. $50Vm^{-1}$

Answer: C

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Evaluate yourself-3

1. The electric potential in volts due to a short electric dipole of dipole moment 2×10^{-8}

coulomb-meter at a distance of 3m on a line making an angle of 60° with the axis of dipole is

A. zero

B. 10

C. 20

D. 40

Answer: B

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2. The electric potential at a distance of 3m on the axis of a short dipole of dipole moment 4×10^{-12} coloumb -metre is

A. 1.33mV

B. 4mV

C. 12mV

D. 27mV

Answer: B

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3. When a test charge is brough in from infinity along the perpendicular bisector of an electric dipole the work done is

A. positive

B. zero

C. negative

D. none of these

Answer: B

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4. If the electric potential on the axis of an electric dipole at a distance 'r' from it is V, then the potential at a point on its equatorial line at the same distance away from it will be

A. $2V$

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

C. $-V$

D. zero

Answer: D

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5. Potential at a point 0.1m from an isolated point charge is +100 volt. The nature of the point charge is

A. positive

B. Negative

C. zero

D. either positive or negative

Answer: A

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6. A regular hexagon of side 10 cm has a charge $5\mu C$ at each of its vertices. Calculate the potential at the center of the hexagon.

A. $2.7 \times 10^2 V$

B. $27 \times 10^2 V$

C. $2.7 \times 10^5 V$

D. $2.7 \times 10^6 V$

Answer: D

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7. Three charges $4\mu C, 4\mu C$ and $-4\mu C$ are placed at vertices of an equilateral triangle of side length 20cm. The potential centre is nearly.

A. $3.1 \times 10^3 V$

B. $3.1 \times 10^4 V$

C. $3.1 \times 10^5 V$

D. $3.1 \times 10^6 V$

Answer: C

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8. The potential of a large liquid drop when eight liquid drops are combined is 20 V. Then, the potential of each single drop was

A. 10V

B. 7.5V

C. 5V

D. 2.5V

Answer: C

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9. Four point charges each +q is placed on the circumference of a circle of diameter $2d$ in such a way that they form a square. The potential at the centre is

A. 0

B. $\dfrac{4kq}{d}$

C. $\dfrac{2kq}{d}$

D. $\dfrac{kq}{d}$

Answer: B

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10. The work done in bringing a unit positive charge from infinite distance to a point at distance x from a positive charge Q is W. Then the potential ϕ at that point is

A. $\frac{WQ}{x}$

B. W

C. $\frac{W}{x}$

D. WQ

Answer: B

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Evaluate yourself-4

1. Electric charges $q, q, -2q$ are placed at the corners of an equilateral triangle ABC of side l. The magnitude of electric dipole moment of the system is

A. q1

B. $\sqrt{3}q1$

C. 2q1

D. 4q1

Answer: B

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2. An electric dipole of length $2cm$ is placed with its axis making an angle 30° to a uniform electric field $10^{5}\frac{N}{C}$ .If it experiences a torque of $10\sqrt{3}$Nm ,then potential energy of the dipole ..

A. $-10J$

B. $-20J$

C. $-30J$

D. $-40J$

Answer: C

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3. An electric dipole when placed in a uniform electric field E will have minimum potential energy, if the positive direction of dipole moment makes the following angle with E

A. 0^0

B. 90^0

C. 45^0

D. 60^0

Answer: A

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Evaluate yourself-5

1. From the following statements for an equipotential surface, the incorrect statement is

A. The potential difference between two points on the surface is zero

B. The direction of electric intensity is perpendicular to the surface at every point

C. No work is done in moving an electric charge on the surface.

D. The shape of the surface is always sperical

Answer: D

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2. There is an electric field E in x-direction. If the work done on moving a charge of $0.2C$ through a distance of 2w m along a line making a angle 60° with x-axis is 4 J, then what is the value of E?

A. 4N/C

B. 8N/C

C. $\sqrt{3}N/C$

D. 20N/C

Answer: D

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3. In a uniform electric field ,

A. All points are at the same potential

B. No two points can have the same potential

C. Pairs of points separated by the same distance must have the same difference in potential

D. None of the above

Answer: D

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4. If at distance r from a positively charged particle, electric field strength and potential are

E and V respectively, which of the following graph (s) is/are correct?

A.

B.

C.

D.

Answer: B

5. The electric potential V is givne as a function of distance x (metre) by $V = (5x^2 + 10x - 9)$ volt. Value of electric field at $x = 1$is

A. -20 V/m

B. 6 V/m

C. 11 V/m

D. -23V/m

Answer: A

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6. The potential at a point distant x (mesured in μm) due to some charges situated on the x-axis is given by $V(x) = \frac{20}{x^2 - 4}$ V. The electric field at $x = 4\mu m$ is given by

A. $\frac{10}{9}V / \mu$ and in the negative X-direction

B. $\frac{5}{3}V / \mu m$ and in the positive X-direction

C. $\frac{5}{3}V / \mu m$ and in the positive X-direction

D. $\frac{10}{9}V / \mu m$ and in the negative X-direction

Answer: D

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Evaluate yourself-6

1. A hollow metal sphere of radius $5cm$ is charged such that the potential on its surface is $10V$. The potential at a distance of $2cm$ from the centre of the sphere

A. zero

B. 10V

C. 4V

D. 5V

Answer: B

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2. The electric potential at the surface of an atomic nucleus (Z = 50) of radius $9 \times 10^{-15} m$ is

A. 80V

B. $8 \times 10^{6} V$

C. 9V

D. $9 \times 10^{5} V$

Answer: B

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3. Two concentric, thin metallic spheres of radii R_1 and R_2 $(R_1 > R_2)$ bear charges Q_1 and Q_2 respectively. Then the potential at distance r between R_1 and `R_(2) will be

A. $K\left(\frac{Q_1 + Q_2}{r}\right)$

B. $K\left(\frac{Q_1}{r} + \frac{Q_2}{R^2}\right)$

C. $K\left(\frac{Q_1}{R_1} + \frac{Q_2}{r}\right)$

D. $K\left(\frac{Q_1}{R_1} + \frac{Q_2}{R_2}\right)$

Answer: C

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4. Two conducting spheres of radii r_1 and r_2 are charged to the same surface charge density . The ratio of electric field near their surface is

A. $1:1$

B. $R_1 : R_2$

C. $R_2 : R_1$

D. $R_1^2 : R_2^2$

Answer: C

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5. Consider two concentric conducting spheres.The " outer sphere is hollow and initially has a charge $-7Q$ on it.The inner sphere is solid and has a change $+2Q$ on it.How much charge is on the outer surface and inner surface of the outer sphere??

A. $-2Q, \ -7Q$

B. $+2Q, \ -9Q$

C. $-2Q, \ -5Q$

D. $+2Q, \ +5Q$

Answer: C

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6. A point charge q is placed at a distance of r from cebtre of an uncharged conducting sphere of rad $R(<r)$. The potential at any point on the sphere is

A. $\frac{1}{4\pi \in_0} \frac{Q}{R}$

B. zero

C. $\frac{1}{4\pi \in_0} \frac{Q}{2R}$

D. $\frac{1}{4\pi \in_0} \frac{2Q}{R}$

Answer: A

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7. In the above problem, find the electric field and electric potential at the centre of the sphere due to induced charges on the sphere?

A. $\frac{1}{4\pi \in_0} \frac{Q}{R^2}$ and 0

B. 0 and $\frac{1}{4\pi \in_0} \frac{Q}{R}$

C. $\frac{1}{4\pi \in_0} \frac{Q}{R^2}$ and $\frac{1}{4\pi \in_0} \frac{Q}{R}$

D. 0 and 0

Answer: D

Watch Video Solution

8. Surface charge density of a conducting sphere of a radius 10 cm is $8.85 \times 10^{-8} c/m^2$. Potential at the centre of the sphere is

A. 1000V

B. 885V

C. $10^{-3}V$

D. 442.5V

Answer: A

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9. Two isolated metallic solid spheres of radii R and 2R are charged such that both of these have same charge density σ. The spheres are located far away from each other and connected by a thin conducting wire. Find the new charge density on the bigger sphere.

A. 5σ

B. 6σ

C. $\frac{5}{6}\sigma$

D. 2σ

Answer: C

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10. Two concentric spherical conducting shells of radii R and $2R$ carry charges Q and $2Q$ respectively.Change in electric potential on the outer shell when both are connected by a conducting wire is $\left(k = \frac{1}{4\pi\varepsilon_0}\right)$

A. zero

B. $\frac{3KQ}{2R}$

C. $\frac{KQ}{R}$

D. $\frac{2KQ}{R}$

Answer: A

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11. A point charge Q is placed inside a conducting spherical shell of inner radius 3R and outer radius 5R at a distance R from the centre of the shell. The electric potential at the centre of the shell will be

A. $\frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{R}$

B. $\frac{1}{4\pi\varepsilon_0} \cdot \frac{5Q}{6R}$

C. $\frac{1}{4\pi\varepsilon_0} \cdot \frac{13Q}{15R}$

D. $\frac{1}{4\pi\varepsilon_0} \cdot \frac{7Q}{9R}$

Answer: C

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12. A point charge q si located at a distance r from the centre O of an uncharged conducting conducting spherical layer whose inside and outside radii are equal to R_1 and R_2 respectively. Find the potentail at the point O if $r < R_1$.

A. $\left(\frac{1}{r} - \frac{1}{a} + \frac{1}{b}\right)$

B. $\left(\frac{1}{a} - \frac{1}{r} + \frac{1}{b}\right)$

C. $\left(\frac{1}{b} - \frac{1}{c} - \frac{1}{r}\right)$

D. $\left(\frac{1}{a} - \frac{1}{b} - \frac{1}{r}\right)$

Answer: A

Watch Video Solution

Evaluate yourself-7

1. The capacitance of a parallel plate condenser does not depend upon

A. Area of the plates

B. Medium between the plates

C. Distance between the plates

D. Metal of the plates

Answer: D

Watch Video Solution

2. The' distance between the plates of a parallel plate capacitor is d. A metal plate of thickness $d/2$ is placed between the plates. What will e its effect on the capacitance.

A. Capacitance will be halved

B. Capacitance will be doubled

C. Capacitance will be unchanged

D. Capacitance will become 1.5 times the original value

Answer: B

Watch Video Solution

3. A capcitor of capacitance $\frac{1}{300}\mu F$ is connected to a battery of 300V and charged. Then the energy stored in the condenser is

A. $3 \times 10^{-4} J$

B. $6 \times 10^{-14} J$

C. $1.5 \times 10^{-4} J$

D. $12 \times 10^{-5} J$

Answer: C

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4. In the above question, the energy sypplied by the battery is

A. $3 \times 10^{-4} J$

B. $6 \times 10^{-5} J$

C. $1.5 \times 10^{-4} J$

D. $12 \times 10^{-5} J$

Answer: A

View Text Solution

5. 64 identical drops of mercury are charged simultaneously to the same potential of 10 volt. Assuming the drops to be spherical, if all the charged drops are made to combine to form one large drop, then its potential will be

A. 100 units

B. 320 units

C. 640 units

D. 160 units

Answer: D

Watch Video Solution

Evaluate yourself-8

1. Two capacitors $2\mu F$ and $4\mu F$ are connected in parallel. A third capacitor of $6\mu F$is connected in series. The combination is then connected across a $12V$ battery. The voltage across $2\mu F$ capacitor is:

A. 2V

B. 8V

C. 6V

D. 1V

Answer: C

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2. Suppose n identical capacitors are joined in parallel and charged to potential V. Now, they are separated and joined in series. If the energy possessed by each capacitor is U, then on joining them in series, the energy and potential difference for the combination are

A. nU, V

B. U, nV

C. nU, nV

D. Less than nU, nV

Answer: D

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3. A capacitor of capacitance C is charged to a potential V. The flux of the electric field through a closed surface enclosing the capacitor is

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

B. $\frac{2CV}{\varepsilon_0}$

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

D. zero

Answer: D

Watch Video Solution

Evaluate yourself-9

1. A parallel plate capacitor having capacitance C farad is connected with a battery of emf V volts. Keeping the capacitor cannected with the battery, a dielectric slab of dielectric constant K is inserted between the plates. The dimensions of the slab are such that it fills the space between the capacitor plates. Then,

A. Charge on the capacitor plates remains the same

B. Charge on the plates increases K times

C. Potential difference between the plates decreases to V/K

D. All of the above

Answer: B

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2. Two identical parallel plate capacitors are placed in series and connected to a constant voltage source of V_0 volt. If one of the capacitors is completely immersed in a liquid with dielectric constant K, the potential difference between the plates of the other capacitor will change to -

A. $\frac{K+1}{K}V_0$

B. $\frac{K}{K+1}V_0$

C. $\frac{K+1}{2K}V_0$

D. $\frac{2K}{K+1}V_0$

Answer: B

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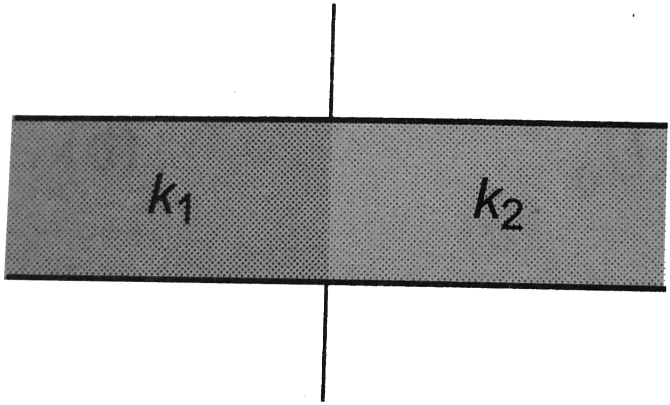
3. A parallel plate capacitor with air as medium between the plates has a capacitance of $10\mu F$. The area of capacitor is divided into two equal halves and filled with two media as shown in the figure having dielectric constnt $k_1 = 2$ and $k_2 = 4$. the capacitance of the system will now be



A. $10\mu F$

B. $20\mu F$

C. $30\mu F$

D. $40\mu F$

Answer: C

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4. A capacitor is charged by using a battery which is then disconnected. A dielectric slab is then slipped between the plates, which results in

A. Reduction of charge on the plates and increase of potential across the plates

B. Increase in the potential difference across the plates, reduction in soted energy, but no change in the charge on the plates

C. Decrease in the potential difference across the plates, reduction in stored energy, but no change in the charge on the above

D. None of the above

Answer: C

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Evaluate yourself-10

1. A parallel plate air capacitor of capacitance C is connected to a cell of $emF V$ and then disconnected from it. A dielectric slab of dielectric constant K, which can just fill the air gap of the capacitor, is now inserted in it. Which of the following is incorrect ?

A. The potential difference between the plates decreases K times

B. The energy stored in the capacitor decreases K times

C. The change in energy $\frac{1}{2} C_0 V^2 (K-1)$

D. The change in energy $\frac{1}{2}C_0V^2\left(\frac{1}{K}-1\right)$

Answer: C

Watch Video Solution

C.U.Q (Potential and Potential Difference)

1. The p.d $(V_B - V_C)$ between two point from C to B

A. does not depend on the path

B. depends on the path

C. depends on test charge

D. independent of electric field.

Answer: A

Watch Video Solution

2. When a positively charged conductor is placed near an earth connected conductor its potential

A. always increase

B. always decreases

C. may increase or decrease

D. remains the same

Answer: B

Watch Video Solution

3. Two conductors when connected by a wire, charge flows if they have

A. different charges

B. different potenials

C. different capacities

D. different charge densities

Answer: B

Watch Video Solution

4. when n small drops are made to combine to from a big drop then the big drop's

A. Potenital increases to $n^{1/2}$ times original potential and the charge density decreases to $n^{1/3}$ times original charge density

B. Potential increases to $n^{2/3}$ times original potential and charge density increases to $n^{1/3}$ times original charge density

C. Potential and charge density decreases to $n^{1/3}$ times original values

D. Potential and density increases to 'n' times original values

Answer: B

Watch Video Solution

5. The work done (in Joule) in carrying a charge of x coulomb between two points having a potential difference of y volt is

A. $\frac{x}{y}$

B. $\frac{x^2}{y}$

C. $\frac{y}{x}$

D. xy

Answer: D

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6. An electron enters in high potential region V_2 from lower potential region V_1 then its velocity

A. will increase

B. will change in direction of field

C. no change in direction of field

D. no change in direction perpendicular to field

Answer: A

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7. At each corner of an equilateral triangle identical charges are placed. Then at the centre of the triangle

A. the resultant electric intensity is zero

B. the net potential is zero

C. both electric intensity and potential are zero

D. neither electric intensity nor potential are zero

Answer: A

Watch Video Solution

8. When an alpha-particle is acceleration by a PD of 3 volt, its energy is

A. 1eV

B. 5eV

C. 3eV

D. 6eV

Answer: D

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9. In an electron gun, electron are accelerated through a potential difference of V volt. Taking electronic charge and mass to be respectively 'e' and 'm', the maximum velocity attained by them is

A. $\frac{2eV}{m}$

B. $\sqrt{\frac{2eV}{m}}$

C. $\frac{2m}{eV}$

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

Answer: B

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10. A cathode ray tube has a potential difference of V between the cathode and anode . The speed of the cathode rays is given by

A. V

B. 1/V

C. $\sqrt{V}$

D. $\frac{1}{\sqrt{V}}$

Answer: C

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11. Charges Q and -2Q are placed at some distance. The locus of points in the plane of the charges where the potential is zero will be :

A. straight lien

B. circle

C. parabola

D. ellipse

Answer: B

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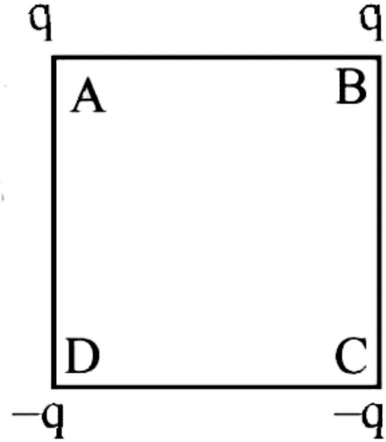
12. Charges are placed on the vertices of a square as shown



Let $\vec{E}$ be the electric field and V the potential at the centre. If the charges on A and B are interchanged with those on D and C respectively, then

A. $\vec{E}$ remains unchanged, V changes

B. both $\vec{E}$ and V change

C. $\vec{E}$ and V remains unchanged

D. $\overrightarrow{E}$ changes V remains unchanged

Answer: C

Watch Video Solution

13. The electric field and the potential of an electric dipole vary with distance 'r' as

A. $\frac{1}{r}$ and $\frac{1}{r^2}$

B. $\frac{1}{r^2}$ and $\frac{1}{r}$

C. $\frac{1}{r^2}$ and $\frac{1}{r^3}$

D. $\frac{1}{r^3}$ and $\frac{1}{r^2}$

Answer: D

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14. Which of the following is not true?

A. for a point charge, electrostatic potential varies as $\frac{1}{r}$

B. for a dipole the potential depends on the magnitude of position vector and dipole moment vector

C. the electric dipole potential varies as $\frac{1}{r}$ at large distance

D. for a point charge, the electro static field varies as $\frac{1}{r^2}$

Answer: C

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15. The value of electric potential at any point due to any electric dipole is

A. $\dfrac{K\left(\overrightarrow{p}\times\overrightarrow{r}\right)}{r^2}$

B. $\dfrac{K\left(\overrightarrow{p}\times\overrightarrow{r}\right)}{r^3}$

C. $\dfrac{K\left(\overrightarrow{p}.\overrightarrow{r}\right)}{r^2}$

D. $\dfrac{K\left(\overrightarrow{p}.\overrightarrow{r}\right)}{r^3}$

Answer: D

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16. In case of a dipole field

A. intensity can be zero

B. potential can be zero

C. both can be zero

D. none of these

Answer: B

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17. At a point on the axis of an electric dipole

A. the electric field E is zero

B. the electric potential V is zero

C. both E and V are zero

D. neither E nor V is zero

Answer: D

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18. On the perpendicular bisector of an electric dipole, electric intensity E and potential V are

A. $E = 0, V = 0$

B. $E \neq 0, V \neq 0$

C. $E \neq 0, V = 0$

D. $E = 0, V \neq 0$

Answer: C

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19. The electric potential at a point on the axis of an electric dipole depends on the distance r of the point from the dipole as

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

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

C. r

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

Answer: B

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20. Consider the following statements about electric dipole and select the correct ones.

S_1: Electric dipole moment vector $\overrightarrow{p}$ is directed from the negative charge to the positive charge

S_2: The electric field of a dipole potential falls off as $\frac{1}{r^2}$ and not as $\frac{1}{r}$

S_3: The electric field of a dipole at a point with position vector $\overrightarrow{r}$ depends on $\left|\overrightarrow{r}\right|$ as well as s angle between $\overrightarrow{r}$ and $\overrightarrow{p}$

S_4: In a uniform electric field, the electric dipole experience no net force but a torque

A. S_2, S_3 and S_4

B. S_2 and S_4

C. S_2 and S_3

D. all four

Answer: D

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21. A and B are two points on the axis and the perpendicular bisector of an electric dipole. A and B are far away from the dipole and at equal distances from it. The potentials at A and B are V_A and V_B respectively. Then

A. $V_A = V_B = 0$

B. $V_A = 2V_B$

C. $V_A \neq 0, V_B = 0$

D. $V_A \neq 0, V_B \neq 0$

Answer: C

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22. Consider a uniform electric field in the $\hat{z}$ direction. The potential is a constant.

A. for any x for a given z

B. for any y for a given z

C. on the x-y plane for a given z

D. all of these

Answer: D

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23. The work done to move a charge along an equipotential from A to B

A. must be defined as $-\int_P^Q \overrightarrow{E}.\overrightarrow{dl}$

B. is zero

C. can be a non-zero value

D. both1 and 2 are correct

Answer: D

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24. What is angle between electric field and equipotential surface?

A. 90^0 always

B. 0^0 always

C. 0^0 to 90^0

D. 0^0 to 180^0

Answer: A

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25. Equipotential surfaces

A. are closer in regions of large electric field compared to regions of lower electric fields

B. will be more crowded near sharp edges of a conductor

C. will always be equally spaced

D. both1 and 2 are correct

Answer: D

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26. The top of the atomosphere is about 400 kV with respect to the surface of earth, corresponding to an electric field that decreases with altitude. Near the surface of earth the field is about 100 V m^{-1}, but still don't get an electric shock, as we set out of out houses in to open because (assume the house is free from electric field)

A. our body is a perfect insulator

B. our body and ground form an equipotential surface

C. the original equipotential surface of open air remain same

D. none of these

Answer: B

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27. An infinite cylinder of radius r_o, carrying linear charge density λ. The equation of the equipotential surface for the cylinder is

A. $r = r_0 e^{\pi \in_0 [v(r) + v(r_0)]\lambda}$

B. $r = r_0 e^{2\pi \in_0 [v(r) - v(r_0)]\lambda^2}$

C. $r = r_0 e^{-2\pi \in_0 [v(r) - v(r_0)] / \lambda}$

D. $r = r_0 e^{-2\pi \in_0 [v(r) - v(r_0)]\lambda}$

Answer: C

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28. An equipotential line and a line of force are

A. perpendicular to each other

B. parallel to each other

C. in any direction

D. at an angle of 45°

Answer: A

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29. The equipotential surface corresponding to single positive charge are concentric spherical shells with the charge at its origin the spacing between the surface for the same change in potential

A. is uniform throughout the field

B. is getting closer as $r \to \infty$

C. is getting closer as $r \to 0$

D. can be varied as one wishes to

Answer: C

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30. Equipotential surfaces associated with an electric field which is increasing in magnitude along the x-direction are

A. planes parallel to yz-plane

B. planes parallel to xy-plane

C. planes parallel to xz-plane

D. coaxial cylinders of increasing radii around the x-axis

Answer: A

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C.U.Q (Potential energy of system of charges)

1. A positive charged particle when moves from potential to lower potential

A. remains same

B. increase

C. decrease

D. becomes zero

Answer: B

Watch Video Solution

2. Three charged particles are initially in position 1, "They are free to move and they come in position" 2 "after some time. Let" U_1

and U_2 be the electrostatic potential energies in position 1 and 2. Then

A. $U_1 > U_2$

B. $U_2 > U_1$

C. $U_1 = U_2$

D. $U_2 \geq U_1$

Answer: A

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3. when an electron approaches a proton their electron static potential energy

A. decrease

B. increases

C. remains same

D. all of above

Answer: A

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4. An electron and a proton move through a potential difference of 200V. Then

A. electron gains more energy

B. proton gains more energy

C. both gain same energy

D. none of them gain energy

Answer: C

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5. In bringing an electron towards another electron, the electrostatic potential energy of the system

A. decrease

B. increases

C. becomes zero

D. remains same

Answer: B

Watch Video Solution

6. A positively charged particle is released from rest in a uniform electric field. The electric potential energy of the charge.

A. remains a constant because the electric field is uniform

B. increases because the charge moves along the field

C. decreases because the charge moves along the field

D. decreases because the charge moves opposite to the field

Answer: C

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C.U.Q (Potential energy of dipole)

1. When dipole moment $\overrightarrow{p}$ of a dipole is parallel to electric field intensity $\overrightarrow{E}$ (stable equilibrium) the potential energy of dipole is

A. positive, maximum

B. positve, minimum

C. negative, maximum

D. negative, minimum

Answer: D

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2. When dipole moment $\overrightarrow{P}$ of a dipole is anti parallel to electric field intensity $\overrightarrow{E}$ (unstable equilibrium), the potential energy of dipole is

A. positive, maximum

B. positive, minimum

C. negative, maximum

D. negative, minimum

Answer: A

Watch Video Solution

3. In a uniform electric field,when dipole experiences maximum torque,its potential energy .???

A. maximum

B. minimum

C. zero

D. none of these

Answer: C

Watch Video Solution

C.U.Q (Potential due to continuous charge distribution)

1. Consider two conductinbg spheres of radill R_1 and R_2 with $R_1 > R_2$. If the two are at the same potential, and the larger sphere has more charge than the smaller sphere, then

A. the charge density of smaller shpere is less than that of larger sphere

B. the charge density of smaller sphere is more than that of larger sphere

C. both spheres may have same charge density

D. none of these

Answer: B

Watch Video Solution

2. Metallic sphere of radius R is charged to potential V. Then charge q is proportional to

A. V

B. R

C. Both V and R

D. none

Answer: C

Watch Video Solution

3. The insulated spheres of radii R_1 and R_2 having charges Q_1 and Q_2 respectively are connected to each other. There is

A. an increase in energy of system

B. no change in energy of system

C. always decrease in energy

D. a decrease in energy of the system unless

$$q_1 R_2 = q_2 R_1$$

Answer: D

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4. A small sphere of radius r_1 and charge q_1 is enclosed by a spherical shell of radius r_2 and charge q_2. Show that if q_1 is positive, charge will necessarily flow from the sphere to the shell (when the two are connected by a wire) no matter what the charge q_2 on the shell is [Fig]

A. charge will flow from sphere to shell

B. charge will flow from shell to sphere

C. change flow will depend on magnitude of q_2

D. charge flow will depend on magnitude of q_1

Answer: A

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5. If two conducting spheres are separately charged and then brought in contact.

A. the total energy of the spheres is conserved

B. the total charge on the spheres is conserved

C. both the total energy and charge are conserved

D. the final potential is always is mean of the original potential of the two spheres

Answer: C

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

A. Electric potential at the surface of the cube is zero

B. Electric potential with in the cube is zero

C. Electric field is normal to the surface of the cube

D. Electric field varises with in cube

Answer: C

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7. Inside a charged hollow spherical conductor. the potential :-

A. is constant

B. varies directly as the distance from the centre

C. varies inversely as the distance from the centre

D. varies inversely as the square of the distance from the centre.

Answer: A

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8. A hollow metallic sphere is charged. Insider the sphere

A. the potential is zero but the electric field is finite

B. the electric field is zero but the potential is finite

C. bothe electric field and potential are finite

D. both the electric field and potential are zero

Answer: B

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9. Electric potential at the center of a charged hollow spherical conductor is

A. zero

B. twice as that on the surface

C. half of that on the surface

D. same as that on the surface

Answer: D

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10. Two copper spheres A and B of same radii, one hollow and the other solid are charged to the same potential. Which of the two will hold more charge

A. hollow sphere holds more charge

B. solid sphere holds more charge

C. both hold equal charge

D. we can't say

Answer: C

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C.U.Q (Electrostatics of conductors)

1. If a conductor has a potential $V \neq 0$ and there are no charges anywhere else outside, then

A. there must be charges on the surface or inside it self

B. there cannot be any charge in the body of the conductor

C. there must be charges only on the surface

D. both1 and 2 are correct

Answer: C

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2. Which of the following statements is false for a perfect conductor?

A. the surface of the conductor is an equipotential surface

B. the electric field just outside the surface of a conductor is perpendicular to the surface

C. the charge carried by a conductor is always uniformly distributed over the surface of conductor

D. none of these

Answer: C

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3. On an isolated conductor of non-uniform curvature, the charge

A. has the greatest concentration on the parts of greatest radius

B. has the greatest concentration on the parts of least radius

C. is distributed uniform on the whole surface

D. is distributed uniform over its volume

Answer: B

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4. The net charge given to an isolated conducting solid sphere :

A. must be distributed uniformly on the surface

B. may be distributed uniformly on the surface

C. must be distributed uniformly in the volume

D. may be distributed uniformly in the volume

Answer: A

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5. A conducting sphere of radius r has a charge . Then .

A. the charge is uniformly districated over its surface if there is an external field

B. distribution of charge over its surface will be non-uniform if no external field exist in space

C. electric field strength in side the sphere will be equal to zero only when no external electric field exists

D. potential at every point of the sphere must be same.

Answer: D

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6. Two conductors when connected by a wire, charge flows if they have

A. different charges

B. different potenials

C. different capacities

D. different charge densities

Answer: B

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7. Identify the false statement

A. Inside a charged or neutral conductor, electrostatic field is zero

B. The electrostatic field at the surface of the charged conductor must be tangential to the surface at any point

C. There is no net charge at any point in side the conductor

D. Electrostatic potentail is constant through out the volume of the conductors

Answer: B

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8. Which among the following is an example of polar molecule ?

A. O_2

B. H_2

C. N_2

D. HCl

Answer: D

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9. Choose the correct statement

A. Polar molecules have permanent electric dipole moment

B. CO_2 molecule is a polar molecule

C. H_2O is a non-polar molecule

D. The dipole field at large distance falls of as

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

Answer: A

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10. If the dielectric constant and dielectirc strength be denoted by K and x respectively, then a meterial suitable for use as a dielectric in a capacitor must have

A. high K and high X

B. high K and low X

C. low K and high X

D. low K and low X

Answer: A

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11. The dielectric constant of a metal is

A. zero

B. infinite

C. 1

D. 40

Answer: B

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12. Read the following statements

(a) Non polar molecules have uniform charge distribution

(b) Polar molecules have non-uniform charge distribution

(c) Polar molecules are already polarized

(d) Molecules are not already polarized without electric field in Non-polar molecules.

A. only a & b are correct

B. only c & d are correct

C. only c is wrong

D. all are correct

Answer: D

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13. If a linear isotropic dielectric is placed in an electric field of strength E, then the polarization P is

A. in dependent of E

B. inversely proportional to E

C. directly proportional to $\sqrt{E}$

D. directly proportional to E

Answer: D

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C.U.Q (Capacitors and Capacitance)

1. A condenser stores.

A. potential

B. charge

C. current

D. energy in magnetic field

Answer: B

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2. Out of the following statements

(A) The capacity of a conductor is affected due to the presence of an uncharged isolated conductor

(B) A conductor can hold more charge at the same potential if it is surrounded by dielectric medium.

A. Both A and B are correct

B. Both A and B are wrong

C. A is correct and B is wrong

D. A is wrong and B is correct

Answer: A

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3. If an earthed plate is brought near positively charged plate, the potential and capacity of charged plate.

A. increases, decreases

B. decreases, increases

C. decreases, decreases

D. increases, increases

Answer: B

Watch Video Solution

4. The plates of charged condenser are connected by a conducting wire. The quantity of heat produced in the wire is

A. Inversely proportional to the capacity of the condenser.

B. Inversely proportional to the square of the potential of the condenser

C. proportional to the length of wire

D. independent of the resistance of the wire

Answer: D

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5. A capacitor works in

A. A.C. circuits only

B. D.C. circuits only

C. both A, C & D.C

D. neither A.C nor in D.C. circuit

Answer: C

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6. In order to increase the capacity of a parallel plate condenser one should introduce between the plates a sheet of (assume that the space is completely filled).

A. Mica

B. Tin

C. Copper

D. Stainless steel

Answer: A

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7. The capacitance of a capacitor depends on

A. the geometry of the plates

B. separation between plates

C. the dielectric between the plates

D. all the above

Answer: D

Watch Video Solution

8. In a parallel plate capacitor, the capacitance

A. increases with increase in the distance between the plates

B. decreases if a dielectric material is put between the plates

C. increases with decrease in the distance between the plates

D. increases with decrease in the area of the plates

Answer: C

Watch Video Solution

9. When a dielectric material is introduced between the plates of a charged condenser, after disconnected the battery the electric field between the plates

A. decreases

B. increases

C. does not change

D. may increase or decrease

Answer: A

Watch Video Solution

10. 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 in the capacitor becomes zero

B. the capacitance becomes infinite

C. the charge in the capacitor increases

D. the voltage across the plates increases

Answer: D

Watch Video Solution

11. The ratio of charge to potential of a body is known as

A. conductance

B. Capacitance will be doubled

C. inductance

D. reactance

Answer: B

Watch Video Solution

12. A parallel plate capacitor filled with a material of dielectric constant K is charged to a certain voltage and is isolated. The dielectric material is removed. Then

(a) The capacitance decreases by a factor K

(b) The electric field reduces by a factor K

(c) The voltage across the capacitor increases by a factor K

(d) The charge strored in the capacitor increases by a factor K

A. a and b are true

B. a and c are true

C. b and c are true

D. b and d are true

Answer: B

Watch Video Solution

13. Force acting upon charged particle kept between the plates of a charged condenser is F. If one of the plates of the condenser is removed, force acting on the same particle will become.

A. zero

B. F/2

C. F

D. 2F

Answer: B

Watch Video Solution

14. A condenser is charged and then battery is removed. A dielectric plate is put between the plates of condenser, then correct statement is

A. Q constant V and U decrease

B. Q constant V increases U decreases

C. Q increases V decreases U increases

D. Q, V and U increase

Answer: A

Watch Video Solution

15. If and uncharged capacitor is charged by connected it to a battery, then the amount of energy lost as heat is.

A. 1/2QV

B. QV

C. $1/2QV^2$

D. QV^2

Answer: A

Watch Video Solution

16. When air is replaced by a dielectric medium of constant K, the capacity of the condenser.

A. increases K times

B. increases K^{-2} times

C. remains unchanged

D. decreases K times

Answer: A

Watch Video Solution

17. If we increases the distance between two plates of the capacitor, the capacitance will.

A. decrease

B. remain same

C. increase

D. first decrease then increase

Answer: A

Watch Video Solution

18. In a charged capacitor, the energy is stored in

A. both in positive and negative charges

B. positive charges

C. the edges of the capacitor plates

D. the electric field between the plates

Answer: D

Watch Video Solution

19. A metal plate of thickness half the separation between the capacitor plates of capacitance C is inserted. The new capacitance is.

A. C

B. C/2

C. zero

D. 2C

Answer: D

Watch Video Solution

20. One plate of parallel plate capacitor is smaller than the other, the charge on the smaller plate will be.

A. less than other

B. more than other

C. equal to other

D. will depend upon the medium between them

Answer: C

Watch Video Solution

21. Two condensers of unequal capacities are connected in series across a constant voltage

$d.c$ source. The ratio of the potential difference across the condenser will be.

A. direct proportion to their capacities

B. inverse proportion to their capacities

C. direct proportion to the square of their capacities

D. inverse proportion to the square root of their capacities.

Answer: B

Watch Video Solution

22. A parallel plate copacitor is first charged and then isolated, and a dielelctric slab is introduced between the plates. The quantity that remains unchanged is.

A. Charge Q

B. Potential V

C. Capacity C

D. Energy U

Answer: A

23. The condenser used in the tuning circuit of radio receiver is.

A. paper condenser

B. electrolytic condenser

C. leyden jar

D. gang condenser

Answer: D

24. Space between the plates of a parallel plate capacitor is filled with a dielectric slab. The capacitor is charged and then the supply is disconnected to it. If the slab is now taken out then

A. work is not done to take out the slab

B. energy stored in the capacitor reduces

C. potential difference across the capacitor is decreases

D. potential difference across the capacitor is increased.

Answer: D

Watch Video Solution

25. A parallel plate condenser is charged by connected it to a battery. The battery is disconnected and a glass slab is introduced between the plates. Then

A. potential increases

B. electric intensity increases

C. energy decreases

D. capacity decreases

Answer: C

Watch Video Solution

26. A parallel plate condenser is charged by connected it to a battery. Without disconnected the battery, the space between the plates is completely filled with a medium of dielectric constant k. Then

A. potential becomes 1/k times

B. charge becomes k times

C. energy becomes 1/k times

D. electric intensity becomes k times

Answer: B

Watch Video Solution

27. A parallel plate capacitor of capacity C_0 is charged to a potential V_0. (i) The energy stored in the capacitor when the battery is disconnected and the plate separation is doubled is E_1.(ii) The energy stored in the capacitor when the charging battery is kept connected and the separation between the capacitor plates is doubled is E_2.Then, $\frac{E_1}{E_2}$, value is

A. 4

B. $3/2$

C. 2

D. $1/2$

Answer: A

Watch Video Solution

28. Select correct statements

(a) charge cannot be isolated

(b) Repulsion is the sure test to know the presence of charge

(c) Waxed paper is dielectric in paper capacitor

(d) Variable capacitor is used in tuning circuits in ratio.

A. a, b only

B. a, c only

C. a, b, c only

D. b, c, d only

Answer: D

Watch Video Solution

29. A variable parallel plate capacitor and an electroscope are connected in parallel to a battery. The reading of the electroscope would be decreased by.

A. increasing the area of overlap of the plates

B. placing a block of paraffin wax between the plates

C. decreasing the distance between the plates

D. decreasing the battery potential

Answer: D

Watch Video Solution

30. Three idential capacitors are combined differently. For the same voltage to each combination, the one that stores the greatest energy is

A. the three in series

B. the three in parallel

C. two in series and the third in parallel with it

D. two in parallel and the third in series with it

Answer: B

Watch Video Solution

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

A. is same throughout

B. is higher near the outer cylinder than near the inner cylinder

C. varies as 1/r where r is the distance from the axis

D. varies as r where r is the distance from the axis

Answer: C

Watch Video Solution

32. Two idential capacitors are joined in parallel, charged to a potential V and then separated and then connected in series i.e. the positive plate of one is connected to negative of the other

A. the charges on the free plates are enhanced

B. the charges on the free plates are decreased

C. the energy stored in the system increases

D. the potential difference between the free plates is 2V

Answer: D

Watch Video Solution

33. Two parallel plate air capacitors are construted, one by a pair of iron plates and the second by a pair of copper plates of same area and same spacings. Then

A. the copper plate capacitor has a greater capacitance than the iron one

B. both capacitors will have equal non zero capacitances, in the uncharged state

C. both capacitors will have equal capacitances only if they are charged equally

D. the capacitances of the two capacitors are unequal even they are unequally charged

Answer: B

Watch Video Solution

34. Select correct statement for a capacitor having capacitance C, is connected to a source of constant $emf E$

A. Almost whole of the energy supplied by the battery will be stored in the capacity, if resistance of connecting wire is negligibly small

B. Energy received by the capacitor will be half of energy supplied by the battery only when the capacitor was initially uncharged

C. Strain energy in the capacitor must increases even if the capacitor had an initial charge

D. Energy stored depends on type of the source of emf

Answer: C

Watch Video Solution

35. A number of spherical conductors of different radius have same potential. Then the surface charge density on them.

A. is proportional to their radii

B. is inversely proportional to their radii

C. are equal

D. is proportional to square of their radii

Answer: B

Watch Video Solution

36. The electric field $\left(\vec{E}\right)$ between two parallel plates of a capacitor will be uniform if.

A. the plate separation (d) is equal to area of the plate (A)

B. the plate separation (d) greater when compared to area of the plate (A)

C. the plate separation (d) is less when compared to area of the plate (A)

D. 2 or 3

Answer: C

Watch Video Solution

37. Two condensers of unequal capacities are connected in series across a constant voltage $d.c$ source. The ratio of the potential difference across the condenser will be.

A. direct proportion to their capacities

B. inverse proportion to their capacities

C. direct proportion to the square root of their capacities

D. inverse proportion to the square of their capacities.

Answer: A

Watch Video Solution

38. A parallel plate capacitor is charged and then isolated. On increasing the plate separation

A. Charge decreases, Potential constant, Energy decreases

B. Charge increases, Potential increases, Energy increases

C. Charge constant, Potential decreases, Energy decreases

D. Charge constant, Potential increases, Energy increases

Answer: D

Watch Video Solution

39. A parallel plate capacitor is charged by connecting is plates to the terminals of a battery. The battery remains connected to the condenser plates and a glass plate is interposed between the plates of the capacitor, then

A. the charge increases while the potential difference remains constant

B. the charge decreases while the potential difference remains constant

C. the charge decreases while the potential difference increases

D. the charge increases while the potential difference decreases.

Answer: A

Watch Video Solution

40. 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 capacitor increases

C. the energy stored in the capacitor decreases

D. the capacitance increases

Answer: B

Watch Video Solution

41. A parallel plate air condenser is charged and then disconnected from the charging battery. Now the space between the plates is filled with a dielectric then, it electric field strength between the plates

A. increases while its capacity increases

B. increases while its capacity decreases

C. decreases while its capacity increases

D. decreases while its capacity decreases

Answer: C

Watch Video Solution

42. When two identical condensers are connected in series choose the correct statement regarding the working voltage (the maximum $p.d$ that can be applied to a condenser) and the capacity.

A. working voltage increases, capacity increases

B. working voltage increases, capacity decreases

C. working voltage decreases, capacity increases

D. working voltage decreases. Capacity decreases

Answer: B

Watch Video Solution

43. Two unequal capacitors, initially uncharged, are connected in series across a battery. Which of the following is true.

A. The potential across each is the same

B. The charge on each is the same

C. The energy stored in each is the same

D. The equivalent capacitance is the sum of the two capacitances

Answer: B

Watch Video Solution

44. Which of the following will not increase the capacitance of an air capacitor ?

A. adding a dielectric in the space between the plates

B. increasing the area of the plates

C. moving the plates closer together

D. increasing the voltage

Answer: D

Watch Video Solution

45. In a parallel-plate capacitor, the region between the plates is filled by a dielectric slab.

The capacitor is connected to a cell and the slab is taken out. Then

A. some charge is drawn from the cell

B. some charge is returned to the cell

C. the potential difference across the capacitor is reduced

D. no work is done by an external agent in taking the slab out

Answer: B

Watch Video Solution

46. Which of the following statements are correct ?

(a) When capacitors are connected in parallel the effective capacitance is less than the individual capacitances

(b) The capacitances of a parallel plate capacitor can be increased by decreasing the separation of plates.

(c) When capacitors are connected in series the effective capacitance is less than the least of the individual capacities

(d) In a parallel plate capacitor the electrostatic energy is stored on the plates.

A. a& b

B. a & c

C. c & d

D. b & c

Answer: D

Watch Video Solution

47. Three identical condensers are connected together in four different ways. First all of them are connected in series and the equivalent capacity is C_1. Next all of them are connected in parallel and the equivalent capacity is C_2. Next two of them are connected in series and the third one connected in parallel to the combination and the equivalent capacity is C_3. Next two of them are connected in parallel and the third one connected in series with the combination and the equivalent capacity is C_4.

Which of the following is correct ascending order of the equivalent capacities ?

A. $C_1 < C_3 < C_4 < C_2$

B. $C_1 < C_4 < C_3 < C_2$

C. $C_2 < C_3 < C_4 < C_1$

D. $C_2 < C_4 < C_3 < C_1$

Answer: B

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C.U.Q (Van De Graff Generator)

1. Van de Graff generator is used to produce high energetic charged particles of energy of about

A. supply electricity for industrial use

B. produce intense magnetic fields

C. generate high voltage

D. obtain highly penetrating X-rays

Answer: C

Watch Video Solution

2. Which of the following statements is/are true about the principle of Van de Graaff generator ?

A. the action of sharp points

B. the charge given to a hollow cenductor transftered to outer surface and is distributed uniformly over it

C. it is used for acceleration unchargred paticle

D. both 2 and 3 are true

Answer: B

Watch Video Solution

Exercise -1 (C.W)

1. v24

A. $\frac{Q}{4\pi \in_0}$

B. $\frac{2Q}{4\pi \in_0}$

C. $\frac{3Q}{4\pi \in_0}$

D. $\frac{Q}{\pi \in_0}$

Answer: B

Watch Video Solution

2. A charge 'Q' is placed at each corner of a cube of side 'a'. The potential at the centre of the cube is

A. $\frac{8Q}{\pi\varepsilon_0 a}$

B. $\frac{4Q}{4\pi\varepsilon_0 a}$

C. $\frac{4Q}{\sqrt{3}\pi\varepsilon_0 a}$

D. $\frac{2Q}{\pi\varepsilon_0 a}$

Answer: C

Watch Video Solution

3. A uniform electric field poiting in poistive x-direction exists in a region. Let A be the origin, B be the point on the x-axis at $x = +1cm$ and C be the point on the y-axis at $y = +1cm$. Then the potentials at the points A, B and C satisfy:

A. $V_A < V_B$

B. $V_A > V_B$

C. $V_A < V_C$

D. $V_A > V_C$

Answer: B

Watch Video Solution

4. The electric field at the origin is along the +ve x-axis. A small circle is drawn with the centre at the origin cutting the axes at the points A, B, C and D having coordinates (a,0), (0,a), (-a,0), (0,-a) respectively. Out of points on the periphery of the circle, the potential is minimum at

A. A

B. B

C. C

D. D

Answer: A

View Text Solution

5. A particle A has chrage $+q$ and a particle B has charge $+4q$ with each of them having the same mass m. When allowed to fall from rest through the same electric potential difference, the ratio of their speed $\frac{v_A}{v_B}$ will become

A. $2:1$

B. $1:2$

C. $1:4$

D. $4:1$

Answer: B

Watch Video Solution

6. Let there be a uniform electric field "E" existing along the positive X-direction.Assume electric potential to be zero at the origin.Potential at the point $x = x_0$ is

A. E/X_0

B. $-E/X_0$

C. $-EX_0$

D. EX_0

Answer: C

Watch Video Solution

7. The potential at a point due to charge of $5 \times 10^{-7} C$ located 10 cm away is

A. $3.5 \times 10^5 V$

B. $3.5 \times 10^4 V$

C. $4.5 \times 10^4 V$

D. $4.5 \times 10^5 V$

Answer: C

Watch Video Solution

8. The potential at a point due to charge of $5 \times 10^{-7} C$ located 10 cm away is

In the above question work done in bringing a charge of $4 \times 10^{-9} C$ from infinity to that point is

A. $2.4 \times 10^{-4} J$

B. $1.8 \times 10^{-4} J$

C. $3.2 \times 10^{-5} J$

D. $4.1 \times 10^{-5} J$

Answer: B

Watch Video Solution

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

A. $12\pi \in_0 Q \times 10^{22} Vm^{-1}$

B. $4\pi \in_0 Q \times 10^{23} Vm^{-1}$

C. $12\pi \in_0 Q \times 10^{20} Vm^{-1}$

D. $4\pi \in_0 Q \times 10^{20} Vm^{-1}$

Answer: B

Watch Video Solution

10. Electric field intensity at a point B due to a point charge Q kept at point A is $24NC^{-1}$, and electric potential at B due to the same charge is $12JC^{-1}$. Calculate the distance AB and magnitude of charge.

A. $10^{-6}C$

B. $10^{-7}C$

C. $10^{-10}C$

D. $10^{-9}C$

Answer: D

Watch Video Solution

11. The electric potential in volts due to an electric dipole of dipole moment

$1 \times 10^{-8} C - m$ at a distance of 3m on a line making an angle of 30° with the axis of dipole is

A. zero

B. $5\sqrt{3}$

C. $10\sqrt{3}$

D. 5

Answer: B

Watch Video Solution

12. The electric potential in volts due to an electric dipole of dipole moment at a $2 \times 10^{-5} C - m$ distance of 2m on perpendicular bisector is

A. zero

B. 10

C. 20

D. 15

Answer: A

Watch Video Solution

13. The electric potential due to an electric dipole of dipole moment $2 \times 10^{-8} C - m$ at a distance of 3m on a line making an angle ? With the axis of dipole is 10 volts. Then ? Is

A. 0°

B. 30°

C. 90°

D. 60°

Answer: D

Watch Video Solution

14. There is an electric field E in x-direction. If the work done on moving a charge of $0.2C$ through a distance of 2w m along a line making a angle 60° with x-axis is 4 J, then what is the value of E?

A. 3

B. 4

C. 20

D. 60

Answer: C

Watch Video Solution

15. The electric potential V (in volt) varies with x (in metre) according to the relation $V = 5 + 4x^2$ The force experienced by a negative charge of 2×10^{-6} C located at $x = 0.5$ m is $z \times 10^{-6}$N then the value of z is ?

A. $2 \times 10^{-5} N$

B. $4 \times 10^{-6} N$

C. $6 \times 10^{-6} N$

D. $8 \times 10^{-6} N$

Answer: D

Watch Video Solution

16. The electric potential decreases unifromly from 120 V to 80 V as one moves on the x-axis from x=-1 cm to x=+1 cm. The electric field at the origin

A. must be equal to 20V/cm

B. may be equal to 20V/cm

C. may be greater than 20V/cm

D. may be less than 20V/cm

Answer: A

Watch Video Solution

17. Charges $+q-4q$ and $+2q$ are arranged at the corners of an equilateral triangle of side $0.15m$. If the $q=1\mu C$ their mutual potential energy is

A. 0.4J

B. 0.5J

C. 0.6J

D. 0.8J

Answer: C

Watch Video Solution

18. Three charges -q, Q and -q are placed at equal distances on a straight line. If the total potential energy of the system is zero, then what is the ratio $\frac{q}{Q}$?

A. $1:2$

B. $2:1$

C. $1:4$

D. $4:1$

Answer: C

Watch Video Solution

19. A system consists of two charges $4\mu C$ and $-3\mu C$ with no external field placed at $(-5cm, 0, 0)$ and $(5cm, 0, 0)$ respectively. The amount of work required to separated the two charges infinitely away from each other is

A. 3J

B. 2J

C. 2.5J

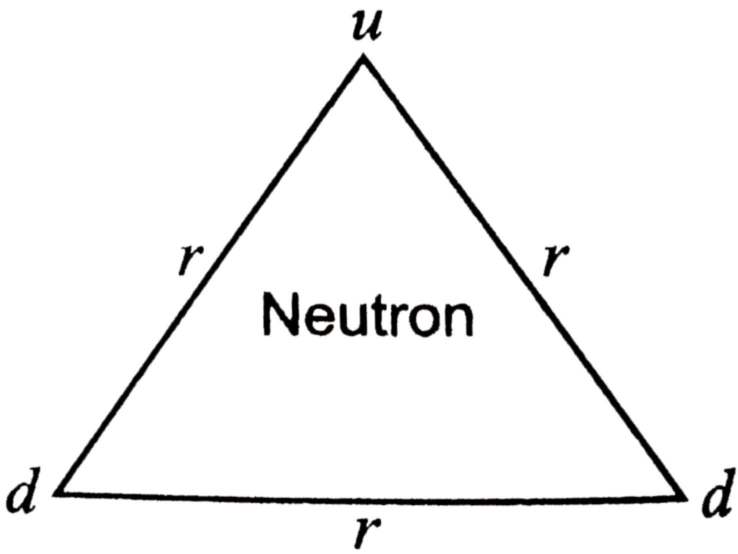
D. $-1.1J$

Answer: D

Watch Video Solution

20. (a) In a quark model of elementary particles, a neutron is made of one up quarks [charge $(2/3)$e] and two down quarks [charges - $(1/3)e$]. Assume that they have a triangle configuration with side length of the order of $10^{-15}m$. Calculate electrostatic potential energy of neutron and compare it with its mass 939 MeV.

(b) Repeat above exercise for a proton which is made of two up and one down quark.



A. 7.68

B. -5.21

C. 9.34

D. 9.34

Answer: C

Watch Video Solution

21. A dipole of electric dipole moment p is placed in a uniform electric field of strength E. If θ is the angle between positive direction of p and E, then the potential energy of the electric dipole is largest when θ is

A. $\frac{\pi}{4}$

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

C. π

D. zero

Answer: C

Watch Video Solution

22. The work done in deflecting a dipole through 180° from field direction is

A. perpendicular to each other

B. 2PE

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

D. zero

Answer: B

Watch Video Solution

23. Two conducting spheres of radii r_1 and r_2 are equally charged. The ratio of their potentral is-

A. $\frac{r_1}{r_2}$

B. $\frac{r_2^2}{r_1^2}$

C. $\frac{r_2}{r_1}$

D. $\frac{r_1^2}{r_2^2}$

Answer: C

Watch Video Solution

24. A conducting sphere of radius R is charged to a potential of V volts. Then the electric field at a distance $r(> R)$ from the centre of the sphere would be

A. $\frac{RV}{r^2}$

B. $\frac{V}{R}$

C. $\frac{rV}{R^2}$

D. $\frac{R^2 V}{r^2}$

Answer: A

Watch Video Solution

25. A non conducting sphere of radius R is charged uniformly. At what distance from its surface is the electrostatic potential is half the potential at its centre ?

A. R

B. R/2

C. R/3

D. 2R

Answer: C

Watch Video Solution

26. Two charged spherical conductors of radii R_1 and R_2 when connected by a connecting wire acquire charges q_1 and q_2 respectively. Find the ratio of their charge densities in terms of their radil ?

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

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

C. $\sqrt{\frac{R_1}{R_2}}$

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

Answer: B

Watch Video Solution

27. Consider two concentric spherical metal shells of radii r_1 and $r_2 (r_2 > r_1)$. If the outer shell has a charge q and the inner one is grounded, the charge on the inner shell is

A. zero

B. $-q\left(\frac{r_1}{r_2}\right)$

C. $r_1 r_2 q$

D. infinity

Answer: B

Watch Video Solution

28. The radii of two charged metal spheres are 5cm and 10cm both having the same charge 60mC. If they are connected by a wire

A. A charge of 20mC flows through the wire from larger to smaller sphere

B. A charge of 20mC flows through the wire from smaller to larger sphere

C. A charge of 20mC flows through the wire from smaller to larger sphere

D. No charge flows through the wire because both spheres have same charge

Answer: B

Watch Video Solution

29. The capacity of a parallel plate condenser consisting of two plates each $10cm$ square and are seperated by a distance of $2mm$ is (Take air as the medium between the plates).

A. $8.85 \times 10^{-13} F$

B. $4.42 \times 10^{-12} F$

C. $44.25 \times 10^{-12} F$

D. $88.5 \times 10^{-13} F$

Answer: B

Watch Video Solution

30. Sixty four spherical drops each of radius $2cm$ and carrying $5C$ charge combine to form a bigger drop. Its capacity is.

A. $\frac{8}{9} \times 10^{-11} F$

B. $90 \times 10^{-11} F$

C. $1.1 \times 10^{-11} F$

D. $9 \times 10^{11} F$

Answer: A

Watch Video Solution

31. A highly conducting sheet of aluminium foil of negligible thickness is placed between the plates of a parallel plate capacitor. The foil is parallel to the plates. If the capacitance before the insertion of foil was $10\mu F$, its value after the insertion of foil will be.

A. $20\mu F$

B. $10\mu F$

C. $5\mu F$

D. zero

Answer: B

Watch Video Solution

32. Two metal plates are separated by a distance d in a parallel plate condenser. A metal plate of thickness t and of the same area is inserted between the condenser plates. The value of capacitance increases by ....times.

A. $\frac{d-t}{d}$

B. $\left(1-\frac{t}{d}\right)$

C. $\left(t-\frac{t}{d}\right)$

D. $\frac{1}{\left(1-\frac{t}{d}\right)}$

Answer: D

Watch Video Solution

33. A radio capacitor of variable capacitance is made of n parallel plates each of area A and separated from each other by a distanced d. The alternate plates are connected together. The capacitance of the combination is.

A. $\dfrac{nA \in_0}{d}$

B. $\dfrac{(n-1)A \in_0}{d}$

C. $\dfrac{(2n-1)A \in_0}{d}$

D. $\dfrac{(n-2)A \in_0}{d}$

Answer: B

Watch Video Solution

34. The radius of the circular plates of a parallel plate condenser is $'r'$. Air is there as the dielectric. The distance between the plates if its capacitance is equal to that of an isolated sphere of radius r' is.

A. $\dfrac{r^2}{4r'}$

B. $\dfrac{r^2}{r'}$

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

D. $\frac{r^2}{4}$

Answer: A

Watch Video Solution

35. When two capacitors are joined in series the resultance capacity is $2.4\mu F$ and when the same two are joined in parallel the resultant capacity is $10\mu F$. Their individual capacities are.

A. $7\mu F, 3\mu F$

B. $1\mu F, 9\mu F$

C. $6\mu F, 4\mu F$

D. $8\mu F, 2\mu F$

Answer: C

Watch Video Solution

36. Three condensers $1\mu F, 2\mu F$ and $3\mu F$ are connected in series to a $p.d$ of 330 volt. The $p.d$ across the plates of $3\mu F$ is.

A. 180V

B. 300V

C. 60V

D. 270V

Answer: C

Watch Video Solution

37. The effective capacitance between the point P and Q in the given figure is

A. $4\mu F$

B. $16\mu F$

C. $26\mu F$

D. $10\mu F$

Answer: A

View Text Solution

38. The equivalent capacitance between P and Q is

A. $10\mu F$

B. $20\mu F$

C. $5\mu F$

D. $15\mu F$

Answer: C

View Text Solution

39. The equivalent capacity between the points X and Y in the circuit with $C = 1\mu F$

A. $2\mu F$

B. $3\mu F$

C. $1\mu F$

D. $0.5\mu F$

Answer: A

View Text Solution

40. The equivalent capacitance of the network given below is $1\mu F$. The value of 'C' is

A. $3\mu F$

B. $1.5\mu F$

C. $2.5\mu F$

D. $1\mu F$

Answer: B

View Text Solution

41. Three capacitors of $3\mu F, 2\mu F$ and $6\mu F$ are connected in series. When a battery of $10V$ is connected to this combination then charge on $3\mu F$ capacitor will be.

A. $5\mu C$

B. $10\mu C$

C. $15\mu C$

D. $20\mu C$

Answer: B

Watch Video Solution

42. Two spheres of radii $12cm$ and $16cm$ have equal charge. The ratio of their energies is.

A. $3:4$

B. $4:3$

C. $1:2$

D. $2:1$

Answer: B

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43. A condenser of capacity $10\mu F$ is charged to a potential of $500V$. Its terminals are then connected to those of an uncharged condenser of capacity $40\mu F$. The loss of energy in connecting them together is.

A. 1J

B. 2.5J

C. 10J

D. 12J

Answer: A

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44. A $2\mu F$ condenser is charged to $500V$ and then the plates are joined through a resistance. The heat produced in the resistance is joule is.

A. 50×10^{-2} Joule

B. 25×10^{-2} Joule

C. 0.25×10^{-2} Joule

D. 0.5×10^{-2} Joule

Answer: B

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Exercise -1 (H.W)

1. If 4×10^{20} eV of energy is required to move a charge of 6.25 C between two points, the potential difference between them is

A. 256

B. $\frac{1}{256}$

C. $256 \times 10^{+19}$

D. 250

Answer: A

Watch Video Solution

2. Two electric charges of $9\mu C$ and $-3\mu C$ are placed 0.16m apart in air. There are two points A and B on the line joining the two charges at distance of (1) 0.04m from $-3\mu C$ and in between the charges and (ii) 0.08 m from $-3\mu C$ and out side the two charges. The potentials at A and B are

A. 0V, 5V

B. 0V, 0V

C. 5V, 0V

D. 5V, 10V

Answer: B

Watch Video Solution

3. Four charges $+3\mu C, -1\mu C, +5\mu C$ and $-7\mu C$ are arranged on the circumference of a circle of radius 0.5m. The potential at the centre is

A. zero

B. $18 \times 10^4 V$

C. $-18 \times 10^4 V$

D. $18 \times 10^{-4} V$

Answer: A

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4. A positive point charge 'q' is carried from a point 'B' to a point charge +Q. If the permittivity of free space is $\in_0$, the work done in the process is given by

A. $\frac{qQ}{4\pi \in_0}\left[\frac{1}{a}-\frac{1}{b}\right]$

B. $\frac{qQ}{4\pi \in_0}\left[\frac{1}{a}+\frac{1}{b}\right]$

C. $\frac{qQ}{4\pi \in_0}\left[\frac{1}{a^2}-\frac{1}{b^2}\right]$

D. $\frac{qQ}{4\pi \in_0}\left[\frac{1}{a^2}+\frac{1}{b^2}\right]$

Answer: A

View Text Solution

5. A positive charge 'Q' is fixed at a point A negatively charged particle of mass ' 'm' and charge 'q' is revolving in a circular path of radius r_1 ,with Q' as the centre.The change in potential energy to change the radius of the circular path from r_1 to r_2 in joule is

A. 0

B. $\frac{Qq}{4\pi\varepsilon_0}\left[\frac{1}{r_1}-\frac{1}{r_2}\right]$

C. $\frac{1}{4\pi\varepsilon_0}\frac{Qq}{4\pi\varepsilon_0}\left[\frac{1}{r_1}-\frac{1}{r_2}\right]$

D. $\frac{Qq}{4\pi\varepsilon_0}\left[\frac{1}{r_2}-\frac{1}{r_1}\right]$

Answer: B

Watch Video Solution

6. Figure below shows a square array of charged particles, with distance d between adjacenet particle. What is the electric potential at point P at the centre of the square if the electric potential is zero at infinity?

A. zero

B. $\frac{-2q}{4\pi \in_0 d}$

C. $\frac{-4q}{4\pi \in_0 d}$

D. $\frac{q}{4\pi \in_0 d}$

Answer: C

View Text Solution

7. Four equal charges Q are placed at the four corners of a square of each side is 'a'. Work done in removing a charge $-Q$ from its centre to infinity is

A. zero

B. $\dfrac{\sqrt{2}q^2}{\pi \in_0 a}$

C. $\dfrac{\sqrt{2}q}{\pi \in_0 a}$

D. $\dfrac{q^2}{\pi \in_0 a}$

Answer: B

Watch Video Solution

8. Two tiny spheres carrying charges $1.8\mu C$ and $2.8\mu C$ are located at 40 cm apart.

The potential at the mid-point of the line joining the two charges is

A. $3.8 \times 10^4 V$

B. $2.1 \times 10^5 V$

C. $4.3 \times 10^4 V$

D. $3.6 \times 10^5 V$

Answer: B

Watch Video Solution

9. Two tiny spheres carrying charges $1.8\mu C$ and $2.8\mu C$ are located at 40 cm apart. The potential at the mid-point of the line joining the two charges is

In the above question, the potential at a point20cm from the mid-point of the line joining the two charges in a place normal to the line and passing through the mid-point is

A. $1.4 \times 10^5 V$

B. $4.2 \times 10^3 V$

C. $2.9 \times 10^4 V$

D. $3.7 \times 10^5 V$

Answer: A

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10. A hexagon of side 8 cm has a charge $4\mu C$ at each of its vertices. The potential at the centre of the hexagon is

A. $2.7 \times 10^6 V$

B. $7.2 \times 10^{11} V$

C. $2.5 \times 10^{12} V$

D. $3.4 \times 10^4 V$

Answer: A

Watch Video Solution

11. On the axis of a short electric dipole at a point potential is V. If the dipole is rotated through 90° potential at same point is

A. V

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

C. $Zero$

D. $2V$

Answer: C

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12. The potential at a point P' on the axial line of the short dipole on the side of positive charge is 10V. Then the potential at the same point when dipole was reversed will be

A. $10V$

B. $-10V$

C. 5V

D. $5V$

Answer: B

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13. The magnitude of electric field intensity at a point on the axis of short dipole is 30V/m. The distance of the point from the centre of the dipole is 2m. Then potential at that point is

A. 30V

B. 25V

C. 20V

D. 15V

Answer: A

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14. The distance between H^{+} and Cl^{-} ions in HCl molecules is 1.38Å. The potential due to this dipole at a sistance of 10Å on the axis of dipole is

A. 2.1V

B. 1.8V

C. 0.2V

D. 1.2V

Answer: C

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15. If the electric field is given by $\overrightarrow{E} = \left(\frac{100}{x^2}\right)i$ the potential difference between points x=10m and x=20m in volts is

A. -5

B. 5

C. -10

D. 10

Answer: A

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16. A charge of $5C$ experiences a force of $5000N$ when it is kept in a uniform electric field. What is the potential difference between two points separted by a distance of $1cm$?

A. 10V

B. 250V

C. 1000V

D. 2500V

Answer: A

Watch Video Solution

17. ABC is an equilateral triangle of side 2m. If $\overrightarrow{E} = 10NC^{-1}$, then $V_A - V_B$ is

A. 10V

B. $-10V$

C. 20V

D. $-20V$

Answer: B

View Text Solution

18. The electric potential at a point $(x, 0, 0)$ is given by $V = \left[\frac{1000}{x} + \frac{1500}{x^2} + \frac{500}{x^3}\right]$ "then the electric field at" $x = 1$ m is (in volt//m)

A. $-5500\hat{i}$

B. $5500\hat{i}$

C. $\sqrt{5500\hat{i}}$

D. zero

Answer: B

Watch Video Solution

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

A. 7.2J

B. 3.6J

C. 8.4J

D. 12.4J

Answer: A

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20. Two charges of magnitude $5nC$ and $-2nC$ are placed at points (2cm,0,0) and (x cm,0,0) in a region of space. Where there is no other external field. If the electrostatic potential energy of the system is $-0.5\mu J$. What is the value of x ?

A. 20cm

B. 80cm

C. 4cm

D. 18cm

Answer: A

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21. Three charges Q, +q and +q are placed at the vertices of a right angled isosceles triangle as shown in figure. If the net electrostatic energy of the configuration is zero, then Q is equal to

A. $\frac{-q}{1+\sqrt{2}}$

B. $\frac{-2q}{2+\sqrt{2}}$

C. $-2q$

D. $+q$

Answer: B

View Text Solution

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

A. qE and PE

B. zero and minimum

C. qE and maximum

D. 2qE and minimum

Answer: B

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23. An electric dipole of moment $\overrightarrow{p}$ is placed normal to the lines of force of electric intensity $\overrightarrow{E}$, then the work done in deflecting it through an angle of 180° is

A. PE

B. 2PE

C. $-2PE$

D. zero

Answer: D

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24. An insulated charged conducting sphere of radius 5cm has a potential of 10V at the surface. What is the potential at centre?

A. 10V

B. zero

C. same as that at 5 cms from the surface

D. same as that at 25 cms from the surface

Answer: A

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25. Two conducting spheres of radii $5cm$ and $10cm$ are given a charge of $15\mu F$ each. After the two spheres are joined by a conducting wire, the charge on the smaller sphere is

A. $20\mu C$

B. $5\mu C$

C. $10\mu C$

D. $15\mu C$

Answer: C

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26. The electric potential on the surface of a sphere of radius R due to a charge $3 \times 10^{-6} C$ is 500V. The intensity of electric field on the surface of the sphere is (NC^{-1}) is

A. < 10

B. > 20

C. between 10 and 20

D. < 5

Answer: A

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27. A soap bubble is charged to a potential of 16V. Its radius is then doubled. The potential of the bubble now will be

A. 16V

B. 8V

C. 4V

D. 2V

Answer: B

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28. The charge stored in a capacitor is 20μ C and the potential difference across the plates is $500V$ .Its capacity is ..?

A. $0.04\mu F$

B. $10^{-2}\mu F$

C. $2 \times 10^2\mu F$

D. $250\mu F$

Answer: A

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29. The oil condenser has a capacity of 100μF .The oil has dielectric constant 2. When the oil leaks out,its new capacity is????

A. $200\mu F$

B. $0.02\mu F$

C. $50\mu F$

D. $0.5\mu F$

Answer: C

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30. A dielectric of thickness 5cm and dielectric constant 10 is introduced between the plates of a parallel plate capacitor having plate area 500 sq. cm and separation between the plates 10cm. The capacitance of the capacitor with dielectric slab is

$$\left(\varepsilon_0 = 8.8 \times 10^{-12} C^2 / N - m^2\right)$$

A. 4.4pF

B. 6.2pF

C. 8pF

D. 10pF

Answer: C

Watch Video Solution

31. v36

A. $11 \times 10^{-6}F$

B. $11 \times 10^{-9}F$

C. $11 \times 10^{-12} F$

D. zero

Answer: C

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32. The ratio of the resultant capacities when three capacitors of $2\mu F, 4\mu F$ and $6\mu F$ are connected first in series and then in parallel is

A. $1:11$

B. $11:1$

C. $12 : 1$

D. $1 : 12$

Answer: A

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33. A condenser A of capacity $4\mu F$ has a charge $20\mu C$ and another condenser B of capacity $10\mu F$ has a charge $40\mu C$. If they are connected parallel, then

A. charge flows from B to A till the charges on them are equal

B. charge flows from B to A till common potential is reached

C. charged flows from A to B till common potential is reached

D. charge flow from A to B till charges on them are equal.

Answer: C

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34. A capacitor of 30μ F charged to $100V$is connected in parallel to capacitor of 20μ F charged to $50V$ .The common potential is ...?

A. 75V

B. 150V

C. 50V

D. 80V

Answer: D

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35. The equivalent capacity between the points 'A' and 'B' in the following figure will be

A. 3C

B. C/3

C. 3/C

D. 1/3C

Answer: A

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36. Two capacitors with capacities C_1 and C_2 ,are charged to potentials V_1 and V_2 respectively.When they are connected in parallel,the ratio of their respective charges is ....?

A. $\frac{C_1}{C_2}$

B. $\frac{V_1}{V_2}$

C. $\frac{V_1^2}{V_2^2}$

D. $\frac{C_1^2}{C_1^2}$

Answer: A

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37. The equivalent capacitance between P and Q of the given figure is (the capacitance of each capacitor is $1\mu F$)

A. $2\mu F$

B. $0.5\mu F$

C. $5\mu F$

D. $0.2\mu F$

Answer: B

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38. The resultant capacity between the points P and Q of the given figure is

A. $4\mu F$

B. $\frac{16}{3}\mu F$

C. $1.6\mu F$

D. $1 \mu F$

Answer: A

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39. Charge 'Q' taken from the battery of 12V in the circuit is

A. $72 \mu C$

B. $36 \mu C$

C. $156 \mu C$

D. $20\mu C$

Answer: A

View Text Solution

40. If three capacitors of values 1μ F,2μ F and 3 μF are available.The maximum and minimum values of capacitances one can obtain by different combinations of the three capacitors together are respectively ???

A. $6\mu F, \dfrac{6}{11}\mu F$

B. $6\mu F, \frac{11}{6}\mu F$

C. $3\mu F, 1\mu F$

D. $4\mu F, 2\mu F$

Answer: A

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41. A capacitor of 8 micro farad is charged to a potential of 1000V .The energy stored in the capacitor is

A. 8J

B. 12J

C. 2J

D. 4J

Answer: D

Watch Video Solution

42. A condenser is charged to a potential difference of $120V$,its energy is 10^{-5} J.If the battery is there and the space between the plates is filled up with a dielectric medium $(\varepsilon_r = 5)$,its new energy is .

A. $10^{-5} J$

B. $2 \times 10^{-5} J$

C. $3 \times 10^{-5} J$

D. $5 \times 10^{-5} J$

Answer: D

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43. The plates of a parallel plate capacitor have an area of $90 cm^2$ each and are separated by a $2 mm$ The capacitor is charged by connecting it to a $400 V$ supply.Then the density of the energy stored in the capacitor ....?

A. $0.113 Jm^{-3}$

B. $0.117 Jm^{-3}$

C. $0.152 Jm^{-3}$

D. $0.226 Jm^{-3}$

Answer: B

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Exercise-2(C.W)

1. Equal charges q are placed at the three corners B, C, D of a square ABCD of side a. The potential at A is

A. $\dfrac{q}{4\pi \in_0 a}$

B. $\dfrac{3q}{4\pi \in_0 a}$

C. $\dfrac{q}{4\pi \in_0 a}\left(2+\dfrac{1}{\sqrt{2}}\right)$

D. $\dfrac{q}{4\pi \in_0 a}(1+\sqrt{2})$

Answer: C

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2. A charge Q is placed at the centre of a circle of radius R. The work done in moving a charge q from A to B so as to complete a semi-circle is

A. zero

B. $\dfrac{Qq}{4\pi \in_0 R}$

C. $\dfrac{Qq}{2\pi \in_0 R}$

D. $\frac{Qq}{2\pi \in_0 R}$

Answer: A

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3. A pellet carrying a charge of 0.5 coulomb is accelerated through a P.D of 2000 volt. It attains a kinetic energy equal to

A. 1000 erg

B. 1000 joule

C. 1000 kwh

D. 500 erg

Answer: B

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4. Three charge $-q, +q$ and $-q$ are kept at the vertices of an equilateral triangle of $10cm$ side.The potential at the mid point in between $-q, -q,$ if $q = 5\mu C$ is

A. $-6.4 \times 10^5 V$

B. $-12.8 \times 10^4 V$

C. $-6.4 \times 10^4 V$

D. $-12.8 \times 10^5 V$

Answer: D

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5. An oil drop carrying charge Q is held in equilibrium by a potential difference of $600V$ between the horizontal plates.In order to hold another drop of double radius in equilibrium a potential drop of $1600V$ had to be maintained

.The charge on the second drop is

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

B. 2Q

C. $\frac{3Q}{2}$

D. 3Q

Answer: D

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6. The longer side of a rectangle is twice the length of its shorter side. A charge q is kept at one vertex. The maximum electric potential due to that charge at any other vertex is V, then the minimum electric potential at any other vertex will be

A. 2V

B. $\sqrt{3}V$

C. $V / \sqrt{5}$

D. $\sqrt{5}V$

Answer: C

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7. Two point charges $4\mu C$ and $9\mu C$ are separated by 50cm. The potential at the point between them where the field has zero strength is

A. $4.5 \times 10^5 V$

B. $9 \times 10^5 V$

C. $9 \times 10^4 V$

D. zero

Answer: A

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8. Two point charges $+5\mu C$ and $-2\mu C$ are kept at a distance of 1m in free space. The distance between the two zero potential points on the line joining the charges is

A. $\frac{2}{7}m$

B. $\frac{2}{3}m$

C. $\frac{22}{21}m$

D. $\frac{20}{21}m$

Answer: D

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9. In the figure shown, the electric field intensity at r=1m, r=6m, r= 9m in Vm^{-1} is

A. $-5, \ -1.67, \ +5$

B. $-5, 0, \ +5$

C. $0, 1, 67, 0$

D. $+5, 1.67, -5$

Answer: B

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10. A non-conducting ring of radius $0.5m$ carries a total charge of 1.11×10^{-10}C distributed non-uniformly on its circumference producing an electric field E everywhere is space. The value of the integral $\int_{l=\infty}^{l=0} - E.\, dI(l = 0$ being centre of the ring) in volt is

A. $+2$

B. -1

C. -2

D. zero

Answer: A

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11. A uniform electric field $400\frac{N}{C}$ acts along positive y-axis, P is a point having co-ordinates (0.6m,-0.2m) and R another point, with co-ordinates (-0.4m, 0.6m). If electric potential at P is 200V, potential at R will be.

A. 100

B. $-150V$

C. 80V

D. $-120V$

Answer: D

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12. Four equipotential curves in an electric field are shown in the figure. A, B,C ae three points in the field. If electric intensity at A,B, C are E_A, E_B, E_C then

A. $E_A = E_B = E_C$

B. $E_A > E_B > E_C$

C. $E_A < E_B < E_C$

D. $E_A > E_B < E_C$

Answer: C

View Text Solution

13. Electric potential is given by

$V = 6x - 8xy^2 - 8y + 6yz - 4z^2$

Then electric force acting on $2C$ point charge placed on origin will be

A. 2N

B. 6N

C. 8N

D. 20N

Answer: D

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14. Three charges each $20\mu C$ are placed at the corners of an equilateral triangle of side $0.4m$ The potential energy of the system is

A. $18 \times 10^{-6} J$

B. 9J

C. $9 \times 10^{-6} J$

D. 27J

Answer: D

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15. Two charge each Q are released when the distance between is d .Then the velocity of each charge of mass m each when the distance between them is $2d$ is

A. $\dfrac{Q}{\sqrt{8\pi\varepsilon_0 dm}}$

B. $\dfrac{Q}{\sqrt{4\pi\varepsilon_0 dm}}$

C. $\frac{Q}{4\sqrt{\pi\varepsilon_0 dm}}$

D. $\frac{Q}{\sqrt{2\pi\varepsilon_0 dm}}$

Answer: A

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16. A body of mass one gram and carrying a charge $10^{-8}C$ passes through two points P and Q .The electrostatic potential at Q is OV .The velocity of the body at Q is $0.2ms^{-1}$ and at P is $\sqrt{0.028}ms^{-1}$ .The potential at P is

A. 150V

B. 300V

C. 600V

D. 900V

Answer: C

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17. Here is a special parallelogram with adajacent side length $2a$ and a and the one of the possible angles between them as 60° .Two charges are to be kept across a diagonal only. The ratio of the minimum potential energyy of the system to the maximum potential energy is

A. $\sqrt{3}:\sqrt{7}$

B. $3:7$

C. $1:2$

D. $1:4$

Answer: A

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18. The closed distance of approach of an $\alpha -$ particle travelling with velocity V towards a stationary nucleus is d.For the closest distance to become $\frac{d}{3}$ towards a stationary nucleus of double of the charge,the velocity of projection of the $\alpha -$ particle has to be

A. 6V

B. $\sqrt{6}V$

C. $\frac{V}{56}$

D. $\frac{3V}{2}$

Answer: B

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19. Three point charges 1C, -2C and -2C are placed at the vertices of an equilateral triangle of side length one meter. The work done by an external force to increase the separation of the charges to 2 meters in joules is: ($\in_0$ is permittivity of air)

A. $\frac{1}{4\pi \in_0}$

B. $\dfrac{1}{8\pi \in_0}$

C. $\dfrac{1}{16\pi \in_0}$

D. 0

Answer: D

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20. Two equal point charges are fixed at $x = -a$ and $x = +a$ on the x-axis. Another point charge Q is placed at the origin. The change in the electrical potential energy of Q, when it is displaced by a small distance x along the x-axis, is approximately proportional to

A. x

B. x^2

C. x^3

D. $\frac{1}{x}$

Answer: B

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21. Three equal charges Q are placed at the three corners of an equilateral triangle of side length a. Work done in shifting a charge q from infinity to the centroid of the triangle is

A. $\frac{3Qq}{4\pi \in_0 a}$

B. $\frac{3Qq}{4\pi \in_0 \sqrt{3}a}$

C. $\frac{3\sqrt{3}Qq}{4\pi \in_0 a}$

D. $\frac{\sqrt{3}Qq}{4\pi \in_0 3a}$

Answer: C

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22. An electric dipole of length 20 cm having $\pm 3 \times 10^{-3}$ C charge placed at 60° with respect to a uniform electric field experiences a torque of magnitude 6 Nm. The potential energy of the dipole is

A. $-2\sqrt{3}J$

B. $5\sqrt{3}J$

C. $-3\sqrt{2}J$

D. $3\sqrt{5}J$

Answer: A

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23. A molecule of a substance has a permanent electric moment of magnitude $10^{-29}Cm.$ A mole of this substnace is polarised by applying a strong electrostatic field of magnitude $10^6 Vm^{-1}$. The direction of the field is suddenly changed by a angle of 60°. estimate the heat released by the substance in alighning its dipoles along the new direction of the field. for simplicity, assume 100% polarisation of the sample.

A. $-6J$

B. $-3J$

C. 3J

D. 6J

Answer: B

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24. Two opposite and equal chrages 4×10^{-8} coulomb when placed $2 \times 10^{-2} cm$ away, from a dipole. If dipole is placed in an ecternal electric field 4×10^{8} newton//coulomb, the value of maximum torque and the work done in rotating it through 180° will be

A. $32 \times 10^{-4} Nm$ and $32 \times 10^{-4} J$

B. $64 \times 10^{-4} Nm$ and $64 \times 10^{-4} J$

C. $64 \times 10^{-4} Nm$ and $32 \times 10^{-4} J$

D. $32 \times 10^{-4} J$ and $64 \times 10^{-4} Nm$

Answer: D

Watch Video Solution

25. Two thin wire rings each having a radius R are placed at a distance d apart with their axes coiciding. The charges on the two rings are $+q$ and $-q$. The potential difference between the centres of the two rings is

A. $\frac{QR}{4\pi\varepsilon_0 d^2}$

B. $\frac{Q}{2\pi\varepsilon_0}\left(\frac{1}{R}\frac{1}{\sqrt{R^2+d^2}}\right)$

C. $\dfrac{Q}{4\pi\varepsilon_0}\left(\dfrac{1}{R}-\dfrac{1}{\sqrt{R^2+d^2}}\right)$

D. 0

Answer: B

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26. Two metal spheres A and B have their capacities in the ratio $3:4$ they are put in contact with each other and an amount of charge $7\times10^{-6}C$ is given to the combination .Next the two spheres are separated and kept wide the apart so that one has no electrical influence on the other.The potential due to the smaller sphere at a distance of $50m$ from it is

A. 540V

B. 270V

C. 1180V

D. zero

Answer: A

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27. A conducting shell S_1 having a charge Q is surrounded by an uncharged concentric conducting spherical shell S_2.

Let the potential difference between S_1 and that S_2 be V. If the shell S_2 is now given a charge $-3Q$, the new potential difference between the same two shells is

A. $-2V$

B. 4V

C. V

D. 2V

Answer: C

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28. A spherical charged conductor has surface charge density σ.The intensity of electric field and potential on its surface are E and V .Now radius of sphere is halved keeping the charge density as constant .The new electric field on the surface and potential at the centre of the sphere are

A. 4E, V

B. E, V/2

C. E, V

D. 2E, 4V

Answer: B

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29. Figure shows three spherical and equipotential surface 1,2 and 3 round a point charge q. The potential difference $V_1 - V_2 = V_2 - V_3$. If t_1 and t_2 be the distance between them. Then

A. $t_1 = t_2$

B. $t_1 > t_2$

C. $t_1 < t_2$

D. $t_1 \le t_2$

Answer: C

30. A half ring of radius r has a linear charge density λ.The potential at the centre of the half ring is

A. $\frac{\lambda}{4\varepsilon_0}$

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

C. $\frac{\lambda}{4\pi\varepsilon_0 r}$

D. $\frac{\lambda}{4\pi\varepsilon_0 r^2}$

Answer: A

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31. A parallel plate condenser has initially air medium between the plates. If a slab of dielectric constant 5 having thickness half the distance of separation between the plates is introduced, the percentage increase in its capacity is.

A. $33.3\ \%$

B. $66.7\ \%$

C. 0.5

D. 0.75

Answer: B

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32. When a dielectric slab of thickness $4cm$ is introduced between the plates of parallel plate condenser, it is found the distance between the plates has to be increased by $3cm$ to restore to capacity to original value. The dielectric constant of the slab is.

A. $1/4$

B. 4

C. 3

D. 1

Answer: B

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33. The area of the positive plate is A_1 and the area of the negative plate is $A_2(A_2 < A_1)$. They are parallel to each other and are separated by a distance d. The capacity of a condenser with air dielectric is.

A. $\frac{\varepsilon_0 A_1}{d}$

B. $\frac{\varepsilon_0 A_2}{d}$

C. $\frac{\varepsilon_0 A_1 A_2}{d}$

D. $\frac{\varepsilon_0 A_1}{A_2 d}$

Answer: B

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34. The time in seconds required to produce a $P.D$ at $20V$ across a capacitor at $1000\mu F$ when it is charged at the steady rate of $200\mu C/\sec$ is.

A. 50

B. 100

C. 150

D. 200

Answer: B

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35. A parallel plate capacitor of capacity $5 \mu F$ and plate separation $6 cm$ is connected to a $1 V$ battery and is charged. A dielectric of dielectric constant 4 and thickness $4 cm$ is introduced into the capacitor. The additional charge that flows into the capacitor from the battery is.

A. $2 \mu C$

B. $3 \mu C$

C. $5 \mu C$

D. $10 \mu C$

Answer: C

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36. The force between the plates of a parallel plate capacitor of capacitance C and distance of separation of the plates d with a potential difference V between the plates, is.

A. $\dfrac{CV^2}{2d}$

B. $\dfrac{C^2V^2}{2d^2}$

C. $\dfrac{C^2V^2}{d^2}$

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

Answer: A

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37. Two identical capacitors are connected as show in the figure. A dielectric slab is introduced between the plates of one of the capacitors so as to fill the gap, the battery remaining connected. The charge on each capacitor will be (charge on each condenser is

$q_0, k =$ dielectric constant)

A. $\dfrac{2q_0}{1 + {}^{1}/_{k}}$

B. $\dfrac{q_0}{1 + {}^{1}/_{k}}$

C. $\dfrac{2q_0}{1 + k}$

D. $\dfrac{q_0}{1 + k}$

Answer: A

38. Two identical capacitors 1 and 2 are connected in series to a battery as shown in figure. Capacitor 2 contains a dielectric slab of dielectric constant K as shown. Q_1 and Q_2 are the charges stored in the capacitors. Now the dielectric slab is removed and the corresponding charges are Q_1 and Q_2. Then

A. $\frac{Q_1}{Q_2} = \frac{K+1}{K}$

B. $\frac{Q_2}{Q_2} = \frac{K+1}{2}$

C. $\frac{Q_2}{Q_2} = \frac{K+1}{2K}$

D. $\frac{Q_2}{Q_2} = \frac{K}{2}$

Answer: C

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39. A capacitor of capacitance $C_1 = 1\mu F$ withstand a maximum voltage of $V_1 = 6KV$, and another capacitor of capacitance $C_2 = 2\mu F$, can with stand a maximum voltage of $V_2 = 4KV$. If they are connected in series, what maximum voltage will the system withstand?

A. 3kV

B. 6kV

C. 10kV

D. 9kV

Answer: D

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40. Two condensers of capacity C and $2C$ are connected in parallel and these are charged upto V volt. If the battery is removed and dielectric medium of constant K is put between the plates of first condenser, then the potential at each condenser is.

A. $\frac{V}{k+2}$

B. $2+\frac{k}{3V}$

C. $\frac{2V}{k+2}$

D. $\frac{3V}{k+2}$

Answer: D

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41. Given a number of capacitors labelled as C, V. Find the minimum number of capacitors needed to get an arrangement equivalent to $C_{\text{net}}, V_{\text{net}}$.

A. $n = \frac{C_{\text{net}}}{C} \times \frac{V_{\text{net}}^2}{V^2}$

B. $n = \frac{C}{C_{\text{net}}} \times \frac{V^2}{V_{\text{net}}^2}$

C. $n = \frac{C}{C_{\text{net}}} \times \frac{V}{V_{\text{net}}}$

D. $n = \frac{C_{\text{net}}}{C} \times \frac{V_{\text{net}}}{V}$

Answer: A

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42. Two capacitors of capacitances $3\mu F$ and $6\mu F$ are connected in series and connected to $120V$. The potential difference across $3\mu F$ is V_0 and the charge here is q_0. We have

(A) $q_0 = 40\mu C$

(B) $V_0 = 60V$

(C) $V_0 = 80V$

(D) $q_0 = 240\mu C$.

A. A, C are correct

B. A, B are correct

C. B,D are correct

D. C, D are correct

Answer: D

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43. n Capacitors of $2\mu F$ each are connected in parallel and a $p.d$ of $200V$ is applied to the combination. The total charge on them was $1c$ then n is equal to.

A. 3333

B. 3000

C. 2500

D. 25

Answer: C

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44. An infinite number of identical capacitors each of capacitance 1mF are connected as shown in the figure. Then the equivalent capacitance between A and B is

A. 1mF

B. 2mF

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

D. 0.75mF

Answer: B

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45. Two capacitors of capacites $1 \mu F$ and $C \mu F$ are connected in series and the combination is charged to a potential difference of $120 V$. If the charge on the combination is $80 \mu C$, the energy stored in the capacitor C in micro joules is :

A. 1800

B. 1600

C. 14400

D. 7200

Answer: B

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46. A parallel capacitor of capacitance C is charged and disconnected from the battery. The energy stored in it is E. If a dielectric slab of dielectric constant 6 is inserted between the plates of the capacitor then energy and capacitance will become.

A. 6E, 6C

B. E,C

C. E/6, 6C

D. E, 6C

Answer: C

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47. In the circuit diagram given below, the value of the potential difference across the plates of the capacitors are

A. 17.5KV, 7.5KV

B. 10KV, 15KV

C. 5KV, 20KV

D. 16.5 KV, 8.5KV

Answer: A

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48. The equivalent capacity of the infinite net work shown in the figure (across AB) is (Capacity of each capacitor is $1 \mu F$)

A. ∞

B. $1\mu F$

C. $\left(\frac{\sqrt{3}-1}{2}\right)\mu F$

D. $\left(\frac{\sqrt{3}+1}{2}\right)\mu F$

Answer: C

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49. The extra charge flowing through the cell on closing the key k is equal to

A. $\frac{CV}{4}$

B. 4CV

C. $\frac{4}{3}CV$

D. $\frac{3}{4}CV$

Answer: A

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50. Energy $'E'$ is stored in a parallel plate capacitor $'C_1'$. An identical uncharged capacitor $'C_2'$ is connected to it, kept in contact with it for a while and then disconnected, the enegry stored in C_2 is.

A. E/2

B. E/3

C. E/4

D. zero

Answer: C

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51. A parallel plate capacitor has area of each plate A, the separation between the plates is d. It is charged to a potential V and then disconnected from the battery. The amount of work done in the filling the capacitor Completely with a dielectric constant k is.

A. $\frac{1}{2}\frac{\varepsilon_0 A V^2}{d}\left[1-\frac{1}{k^2}\right]$

B. $\frac{1}{2}\frac{V^2\varepsilon_0 A}{kd}$

C. $\frac{1}{2}\frac{V^2\varepsilon_0 A}{k^2 d}$

D. $\frac{1}{2}\frac{\varepsilon_0 A V^2}{d}\left[1-\frac{1}{K}\right]$

Answer: D

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52. A capacitor is filled with an insulator and a certain potential difference is applied to its pltaes. The energy stored in the capacitor is U. Now the capacitor is disconnected from the source and the insulator is pulled out of the capacitor. The work performed against the forces of electric field in pulling out the insulator is $4U$. Then dielectric constant of the insulator is.

A. 4

B. 8

C. 5

D. 3

Answer: C

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53. A fully charged capacitor has a capacitance 'C'. It is discharged through a small coil of resistance wire embedded in a thermally insulated block of specific heat capacity 's' and mass 'm'. If the temperature of the block is raised by 'DeltaT', the potential difference 'V' across the capacitance is

A. $\sqrt{\frac{2mC\Delta T}{s}}$

B. $\frac{mC\Delta T}{s}$

C. $\frac{ms\Delta T}{C}$

D. $\sqrt{\frac{2ms\Delta T}{C}}$

Answer: D

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EXERCISE -2 (H.W)

1. Equal charges q are placed at the three corners B, C, D of a square ABCD of side 'a'. The ratio of potential at A to centre O is

A. $\frac{2\sqrt{2}+1}{3\sqrt{2}}$

B. $\frac{2+\sqrt{2}}{6}$

C. $\frac{2\sqrt{2}+1}{6}$

D. $\frac{2\sqrt{2}+1}{3}$

Answer: C

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2. An electron having charge e located at A, in the presence of a point charge +q located at O, is moved to the point B such that OAB forms an equilateral triangle the work done in the process is equal to

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

B. $\frac{eq}{AB}$

C. $-eq(AB)$

D. zero

Answer: D

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3. The work done in moving an electron of charge 'e' and mass m from A to B along the circular path shown by arrow in figure in the vertical plane in the field of charge Q is

A. 2mgr

B. $\frac{2Qe}{r}$

C. $2mgr + \frac{2Qe}{r}$

D. zero

Answer: A

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4. Four charges $10^{-8}, -2 \times 10^{8}, +3 \times 10^{-8}$ and 2×10^{-8} coulomb are placed at the four corners of a square of side 1m the potential at the centre of the square is

A. zero

B. 360 volt

C. 180 volt

D. $360\sqrt{2}$ volt

Answer: D

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

A. 9 V

B. zero

C. 2 V

D. 4.5 V

Answer: B

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6. An electron travelling from infinity with velocity v into an electric field due to two stationary electrons separated by a distance of $2m$.if it comes to rest when it reaches the mid point of the line joining the stationary electrons.The initial velocity v of the electron is

A. 16 m/s

B. 32 m/s

C. $16\sqrt{2}$ m/s

D. $32\sqrt{2}$ m/s

Answer: B

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7. Two points P and Q are maintained at the potentials of 10V and -4V, respectively. The work done in moving 100 electrons from P to Q is:

A. $-2.24 \times 10^{-16} J$

B. $2.24 \times 10^{-16} J$

C. $-9.6 \times 10^{-17} J$

D. $9.6 \times 10^{-17} J$

Answer: B

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8. A charge +q is placed at the origin O of x-y axes as shown in the figure. The work done in taking a charge Q from A to B along the straight line AB is

A. $\frac{qQ}{4\pi \in_0}\left(\frac{a-b}{ab}\right)$

B. $\frac{qQ}{4\pi \in_0}\left(\frac{b-a}{ab}\right)$

C. $\frac{qQ}{4\pi \in_0}\left(\frac{b}{a^2}-\frac{1}{b}\right)$

D. $\frac{qQ}{4\pi \in_0}\left(\frac{a}{b^2}-\frac{1}{b}\right)$

Answer: A

9. Some equipotential surfaces are shown in figure. The electric field strength is

A. 100 V/m along x-axis

B. 100 V/m along y-axis

C. 400 V/m at an angle 120° with x-axis

D. $\frac{400}{\sqrt{3}}$ V/m an angle 120° with x-axis

Answer: C

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10. A field of $100 V m^{-1}$ is directed at 30° to positive x-axis. Find V_{BA} if OA = 2m and OB = 4m

A. $100(\sqrt{3}-2) V$

B. $100(2+\sqrt{3}) V$

C. $100(2-\sqrt{3}) V$

D. $200(2+\sqrt{3}) V$

Answer: A

11. A uniform electric field of magnitude $5 \times 10^3 N/C$ is directed along the negative x-direction. Co-ordinates of point A in the figure are (-40cm, 20cm) and those of point B are (20cm, -60cm) potential difference between A and B i.e $V_A - V_B$ along the arc of a circle of radius 2m is

A. 2400V

B. $-5000V$

C. $-2400V$

D. $3000V$

Answer: D

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12. Find the V_{ab} in an electric field $E = \left(2\hat{i} + 3\hat{j} + 4\hat{k}\right)\frac{N}{C}$, where $r_a = \left(\hat{i} - 2\hat{j} + \hat{k}\right)m$ and $r_b = \left(2\hat{i} + \hat{j} - 2\hat{k}\right)m$

A. $-2V$

B. $-1V$

C. $-4V$

D. $-6V$

Answer: B

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13. A charge $-2\mu C$ at the origin, $-1\mu C$ at $+7cm$ and $1\mu C$ at -7cm are placed on X-axis. The mutual potential energy of the system is

A. $-0.051J$

B. $-0.045J$

C. $0.045J$

D. $-0.064J$

Answer: D

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14. Four equal charges Q are placed at the four corners of a square of each side is 'a'. Work done in removing a charge $-Q$ from its centre to infinity is

A. zero

B. $\sqrt{2}Q^2 / 4\pi \in_0 a$

C. $\sqrt{2}Q^2 / \pi \in_0 a$

D. $Q^2 / 2\pi \in_0 a$

Answer: C

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15. 2q and 3q are two charges separated by a distance 12 cm on x-axis. A third charge q is placed at 5 cm on y-axis as shown in figure. Find the change in potential energy of the system if

3q is moved from initial position to a point on X-axis in circular path:

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

B. $\frac{6q^2}{4\pi\varepsilon_0(91)}$

C. $\frac{18q^2}{4\pi\varepsilon_0(91)}$

D. $\frac{3q^2}{4\pi\varepsilon_0}$

Answer: C

16. A particle of mass an charge q is projected vertically upwards .A uniform electric field $\vec{E}$ is acted vertically downwards.The most appropriate graph between potential energy U (gravitation plus electrostatic) and height h($<<$ radius of earth) is :(assume U to be zero on surface of earth)

A.

B.

C.

D.

Answer: A

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17. A positive charge 'Q' is fixed at a point A negatively charged particle of mass ' 'm' and charge 'q' is revolving in a circular path of radius r_1 ,with Q' as the centre.The change in potential energy to change the radius of the circular path from r_1 to r_2 in joule is

A. zero

B. $\frac{Qq}{4\pi \in_0}\left(\frac{1}{r_1}-\frac{1}{r_2}\right)$

C. $\frac{Qq}{\pi}\left(\frac{1}{r_1}-\frac{1}{r_2}\right)$

D. $\frac{Qq}{4\pi}\left(\frac{1}{r_2}-\frac{1}{r_1}\right)$

Answer: B

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18. 10 C & -10C are placed at y = 1 & y = -1 m on y - axis. 1C charge is placed on x-axis at x = +1m. The change in PE of system when 1C is displaced from x = +1 to x = -1m keeping other two charges

fixed is

A. $10^9 J$

B. $21 \times 10^9 J$

C. $10 \times 10^9 J$

D. zero

Answer: D

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19. Four particles, each of mass m and charge q, are held at the vertices of a square of side 'a'. They are released at t = 0 and move under mutual repulsive forces speed of any particle when its distance from the centre of square doubles is

A. $\left[\frac{1}{4\pi \in_0} \frac{q^2}{ma}\left(1+\frac{1}{2\sqrt{2}}\right)\right]^{\frac{1}{2}}$

B. $\left(\frac{1}{4\pi \in_0} \frac{q^2}{ma}\right)^{\frac{1}{2}}$

C. $\left[\frac{1}{4\pi \in_0} \frac{2q^2}{ma^2}\left(1+\frac{1}{2\sqrt{2}}\right)\right]^{\frac{1}{2}}$

D. $\left(\frac{1}{4\pi \in_0} \frac{q^2}{ma^2}\right)^{\frac{1}{2}}$

Answer: A

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

A. $100ms^{-1}$

B. $90ms^{-1}$

C. $60ms^{-1}$

D. $45ms^{-1}$

Answer: B

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21. v31

A. $-0.4J$

B. $-0.8J$

C. $0.4J$

D. zero

Answer: B

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22. An electric dipole of length $2cm$ is placed with its axis making an angle 30° to a uniform electric field $10^5\frac{N}{C}$ .If it experiences a torque of $10\sqrt{3}$Nm ,then potential energy of the dipole ..

A. $-10J$

B. $-20J$

C. $-30J$

D. $-40J$

Answer: C

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23. Two charges $+3.2\times10^{-19}C$ and $-3.2\times10^{-19}C$ placed 2.4 A^0 apart form an electric dipole. It is placed in a uniform electric field of intensity

$4 \times 10^5 V/m$ the work done to rotate the electric dipole form the equilibrium position by 180° is

A. $3 \times 10^{-23} J$

B. $6 \times 10^{-23} J$

C. $12 \times 10^{-23} J$

D. zero

Answer: C

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

A. $4:1$

B. $1:2$

C. $2:1$

D. $1:4$

Answer: C

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25. Two concentric spherical conducting shells of radii R and $2R$ carry charges Q and $2Q$ respectively.Change in electric potential on the outer shell when both are connected by a conducting wire is $\left(k = \frac{1}{4\pi\varepsilon_0}\right)$

A. zero

B. $\frac{3kQ}{2R}$

C. $\frac{kQ}{R}$

D. $\frac{2kQ}{R}$

Answer: A

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26. Work performed when a point charge $2 \times 10^{-8} C$ is transformed from infinite to a point at a distance of $1 cm$ from the surface charge density $\sigma = 10^{-8} C / cm^2$

A. $1.1 \times 10^{-4} J$

B. $11 \times 10^{-4} J$

C. $0.11 \times 10^{-4} J$

D. $113 \times 10^{-4} J$

Answer: B

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27. A conducting sphere A of radius a, with a charge Q, is placed concentrically inside conducting shell B of radius b. B is earthed. C is the common centre of A and B.

A. The field at a distance r from C, where

$a \leq r \leq b$, is $k\frac{Q}{r^2}$

B. The potential at a distance r from C, where

$a \leq r \leq b$, is $k\frac{Q}{r^2}$

C. The potential difference between A and B

is

D. The potential at a distance r from C, where

$a \leq r \leq b$, is

Answer: A

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28. Two identical thin ring, each of radius R meters, are coaxially placed a distance R metres apart. If Q_1 coulomb, and Q_2 coulomb, are repectively the charges uniformly spread on the two rings, the work done in moving a charge q from the centre of one ring to that of the other is

A. zero

B. $q(Q_1 - Q_2)(\sqrt{2} - 1) / (\sqrt{2}4_0 R)$

C. $q\sqrt{2}(Q_1 + Q_2) / (4_0 R)$

D. $q(Q_1 / Q_2)(\sqrt{2} + 1)(\sqrt{2}4_0 R)$

Answer: B

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29. The capacity of a condenser A is $10\mu F$ and it is charged to a battery of 100 volt. The battery is disconnected and the condenser A is connected to a condenser B the common potential is 40V. The capacity of B is

A. $8\mu F$

B. $15\mu F$

C. $2\mu F$

D. $1\mu F$

Answer: B

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30. A parallel plate capacitor has the space between its plates filled by two slabs of thickness $\frac{d}{2}$ each and dielectric constant K_1 and K_2. d is the plate separation of the capacitor. The capacitance of the capacitor is

A. $\frac{2\varepsilon_0 A}{d}\left(\frac{K_1+K_2}{K_1 K_2}\right)$

B. $\frac{2\varepsilon_0 A}{d}(K_1+K_2)$

C. $\frac{2\varepsilon_0 A}{d}\left(\frac{K_1 K_2}{K_1+K_2}\right)$

D. $\frac{2\varepsilon_0 d}{A}\left(\frac{K_1+K_2}{K_1 K_2}\right)$

Answer: C

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31. A capacitor of capacitance $10\mu F$ is charged to a potential $50V$ with a battery. The battery is now disconnected and an additional charge $200\mu C$ is given to the positive plate of the capacitor. The potential difference across the capacitor will be.

A. 50V

B. 80V

C. 100V

D. 60V

Answer: D

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32. A parallel plate capacitor with plate area 'A' and separation 'd' is filled with two dielectrics of dielectric constants K_1 and K_2. If the permittivity of free space is $\in_0$, the capacitance of the capacitor is given by

A. $\frac{A\in_0}{d}(K_1+K_2)$

B. $\frac{2A\in_0}{d}(K_1+K_2)$

C. $\frac{A\in_0}{2d}(K_1+K_2)$

D. $\frac{2A\in_0}{d}\cdot\frac{K_1K_2}{K_1+K_2}$

Answer: C

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33. A and B are two condensers of capacities $2\mu F$ and $4\mu F$. They are charged to potential differences of 12V and 6V respectively. If they are now connected (+ve to +ve), the charge that flows through the connecting wire is

A. $24\mu C$ from A to B

B. $8\mu C$ from A to B

C. $8\mu C$ from B to A

D. $24\mu C$ from B to A

Answer: B

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34. Force of attraction between the plates of a parallel plate capacitor is

A. $\frac{q^2}{2\varepsilon_0 A}$

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

C. $\frac{q}{2\varepsilon_0 A}$

D. $\frac{q^2}{2\varepsilon_0 A^2}$

Answer: A

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35. Seven capacitors each of capacitance $2\mu F$ are to be connected in a configuration to obtain an effective capacitance of $\left(\frac{10}{11}\right)\mu F$. Which of the combination (s) shown in figure will achieve the desired result?

A.

B.

C.

D.

Answer: A

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36. The equivalent capacitance between 'A' and 'B' in the adjoining figure is

A. $\frac{51}{30}\mu F$

B. $6\mu F$

C. $30\mu F$

D. $12\mu F$

Answer: B

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37. If metal section of shape H is inserted in between two parallel plates as shown in figure and A is the area of each plate then the equivalent capacitance is

A. $\frac{A \in_0}{a} - \frac{A \in_0}{b}$

B. $\frac{A \in_0}{a+b}$

C. $\frac{A \in_0}{a} + \frac{A \in_0}{b}$

D. $\frac{A \in_0}{a-b}$

Answer: D

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38. The equivalent capacitance C_{AB} of the circuit shown in the figure is

A. $\frac{5}{4}C$

B. $\frac{4}{5}C$

C. 2 C

D. C

Answer: A

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39. In the figure shown the effective capacity across P & Q is (the area of each plate is 'a')

A. $\frac{a \in_0}{d}\left[\frac{K_1}{2}+\frac{K_2 K_3}{K_2+K_3}\right]$

B. $\frac{a \in_0}{2d}\left[\frac{K_2}{2}+\frac{K_1 K_3}{K_1+K_3}\right]$

C. $\frac{a \in_0}{3d}\left[\frac{K_3}{2}+\frac{K_1 K_2}{K_1+K_2}\right]$

D. $\frac{a \in_0}{d}\left[\frac{K_1}{2}+\frac{K_1+K_2}{K_2 K_3}\right]$

Answer: A

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40. A capacitor $4\mu F$ charged to 50V is connected to another capacitor $2\mu F$ charged to 100V. The total energy of combination is

A. $13.3 \times 10^{-3} J$

B. $20 \times 10^{-3} J$

C. $5 \times 10^{-3} J$

D. $10 \times 10^{-3} J$

Answer: A

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41. A $4\mu F$ capacitor is charged by a 200 V supply. It is then disconnected from the supply . And is connected to another uncharged $2\mu F$ capacitor. How much electrostatic energy of the first capacitor is lost in the form of heat and electromagnetic radiation ?

A. Zero

B. 5.33×10^{-2}

C. 4×10^{-2}

D. 2.67×10^{-2}

Answer: D

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42. A capacitor of capacity C hasd charge Q and stored energy is W. if the charge is increased to 2Q, then the stored energy will be

A. $W/4$

B. $W/2$

C. $2W$

D. $4W$

Answer: D

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43. The equivalent capacitance between points M and N is

A. Infinity

B. $C_1 + \frac{C_2}{C_1}$

C. $\frac{C_1 C_2}{C_1 + C_2}$

D. $\frac{C_1 C_2}{C_1 - C_2}$

Answer: A

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44. Two capacitors $C_1 = 2\mu F$ and $C_2 = 6\mu F$ in series, are connected in parallel to a third capacitor $C_3 = 4\mu F$. This arrangement is then connected to a battery of e.m.f = 2V, as shown in figure. The energy lost by the battery in charging the capacitors is

A. $22 \times 10^{-6} J$

B. $11 \times 10^{-6} J$

C. $\left(\frac{32}{3}\right) \times 10^{-6} J$

D. $\left(\frac{16}{3}\right) \times 10^{-6} J$

Answer: B

45. A capacitor is chared to store an energy U. The charging battery is disconnected. An identical capacitor is now connected to the first capacitor in parallel. The energy in each capacitor is now.

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

B. U

C. $\frac{U}{4}$

D. $\frac{3U}{4}$

Answer: C

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46. A parallel plate condenser with a dielectric of dielectric constant K between the plates has a capacity C and is charged to a potential V volt. The dielectric slab is slowly removed from between the plates and then reinserted. The net work done by the system in this process is

A. $\frac{1}{2}(K-1)CV^2$

B. $CV^2(K-1)/K$

C. $(K-1)CV^2$

D. zero

Answer: D

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47. A parallel plate capacitor of capacitty $100\mu F$ is charged by a battery at 50 volts. The battery remains connected and if the plates of the capacitor are separated so that the distance between them is halved the original distance, the additional energy gives by the battery to the capacitor in Joules is .....

A. 125×10^{-3}

B. 12.5×10^{-3}

C. 1.25×10^{-3}

D. 0.125×10^{-3}

Answer: A

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48. One plate of a capacitor is connected to a spring as shown in figure. Area of both the plates is A. In steady state, separation between the plates is 0.8d (spring was unstretched and the distance between the plates was d, when the capacitor was uncharged). The force constant of the spring is approximately

A. $\frac{4 \in_0 AE^2}{d^3}$

B. $\frac{2 \in_0 AE}{d^2}$

C. $\frac{6 \in_0 E^2}{Ad^3}$

D. $\frac{\in_0 AE^3}{2d^3}$

Answer: A

49. A parallel plate capacitor of capacitance C is connected to a battery and is charged to a potential difference V. Another capacitor of capacitance 2C is ismilarly charged to a potential difference 2V. The charging battery is now disconnected and the capacitors are connected in parallel to each other in such a way that the poistive terminal of one is connected to the negative terminal of the other. The final energy of the configuration is

A. zero

B. $\frac{3}{2}CV^2$

C. $\frac{35}{6}CV^2$

D. $\frac{9}{2}CV^2$

Answer: B

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50. Two identical capacitors, have the same capacitance C. One of them is charged to potential V_1 and the other V_2. The negative ends of the capacitors are connected together. When the poistive ends are also connected, the decrease in energy of the combined system is

A. $1/4C\left(V_1^2 - V_2^2\right)$

B. $1/4C\left(V_1^2 + V_2^2\right)$

C. $1/4C(V_1 - V_2)^2$

D. $1/4C(V_1 + V_2)^2$

Answer: C

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EXERCISE - 3 (PREVIOUS AIPMT QUESTIONS)

1. A parallel plate air 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 isulating handle. As a result the potential difference between the plates

A. increases

B. decreases

C. does not change

D. becomes zero

Answer: A

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

A. $\frac{qQ}{2\pi \in_0 L}$

B. $\frac{qQ}{6\pi \in_0 L}$

C. $-\frac{qQ}{6\pi \in_0 L}$

D. $\frac{qQ}{4\pi \in_0 L}$

Answer: C

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3. Two condensers , one of capacity C and other of capacity $C/2$ are connected to a V- volt battery as shown in figure , the work done in charging fully both the condensers is

A. $\frac{1}{4}CV^2$

B. $\frac{3}{4}CV^2$

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

D. $2CV^2$

Answer: B

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

A. $4\pi \in_0 Q \times 10^{20}$ volt/m

B. $12\pi \in_0 Q \times 10^{22}$ volt/m

C. $4\pi \in_0 Q \times 10^{22}$ volt/m

D. $12\pi \in_0 Q \times 10^{20}$ volt/m

Answer: C

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5. The energy required to charge a parallel plate condenser of plate separtion d and plate area of cross-section A such that the unifom field between the plates is E is

A. $\varepsilon_0 E^2$ Ad

B. $\frac{1}{2}\varepsilon_0 E^2$ Ad

C. $\frac{1}{2}\varepsilon_0 E^2$ /Ad

D. $\varepsilon_0 E^2$ /Ad

Answer: B

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6. Three concentric spherical shells have radii a, b and $c(a < b < c)$ and have surface charge densities $\sigma, \ -sigam$ and σ respectively. If V_A, V_B and V_C denote the potentials of the three shells, then for $c = q + b$, we have

A. $V_C = V_B \neq V_A$

B. $V_C \neq V_B \neq V_A$

C. $V_C = V_B = V_A$

D. $V_C = V_A \neq V_B$

Answer: D

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7. Three capacitors each of capacitance C and of breakdown voltage V are joined in series. The capacitance and breakdown voltage of the combination will be

A. $3C, \frac{V}{3}$

B. $\frac{C}{3}, 3V$

C. $3C, 3V$

D. $\frac{C}{3}, \frac{V}{3}$

Answer: B

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8. The electirc potential at a point (x, y, z) is given by

$V = -x^2y - xz^3 + 4$

The electric field $\vec{E}$ at that point is

A. $\vec{E} = \hat{i}2xy + \hat{j}(x^2 + y^2) + \hat{k}(3xz - y^2)$

B. $\vec{E} = \hat{i}z^3 + \hat{j}xyz + \hat{k}z^3$

C. $\overrightarrow{E} = \hat{i}(2xy - z^3) + \hat{j}xy^2\hat{k}3z^2x$

D. $\overrightarrow{E} = \hat{i}(2xy + z^3) + \hat{j}x^2 + \hat{k}3xz^2$

Answer: D

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9. A series combination of n_1 capacitors, each of value C_1, is charged by a source of potential difference $4V$. When another parallel combination of n_2 capacitors, each of value C_2, is charged by a source of potential difference V, it has same (total) energy stored in it, as the first combination has. the value of C_2, in terms of C_1, is then

A. $\frac{2C_1}{n_1 n_2}$

B. $16\frac{n_2}{n_1}C_1$

C. $2\frac{n_2}{n_1}C_1$

D. $\frac{16C_1}{n_1 n_2}$

Answer: D

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10. Two parallel metal plates having charges $+Q$ and $-Q$ face each other at a certain distance between them.If the plates are now dipped in kerosene oil tank ,the electric field between the plates will

A. become zero

B. increases

C. decreases

D. remain same

Answer: C

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11. Four electric charges $+q, +q, -q$, are placed at the corners of a square of side 2 L (see figure) . The electric potential at point A , midway between the two charges +q and +q , is

A. $\frac{1}{4\pi\varepsilon_0}\frac{2q}{L}(1+\sqrt{5})$

B. $\frac{1}{4\pi\varepsilon_0}\frac{2q}{L}\left(1+\frac{1}{\sqrt{5}}\right)$

C. $\frac{1}{4\pi\varepsilon_0}\frac{2p}{L}\left(1-\frac{1}{\sqrt{5}}\right)$

D. zero

Answer: C

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12. Three charges , each + q are placed at the corners of an isosceles triangle ABC of sides BC and AC ,2a . D and E are the mid points of BC and CA . The work done in talking charge Q and D to E is

A. $\frac{3qQ}{4\pi\varepsilon_0 a}$

B. $\frac{3qQ}{8\pi\varepsilon_0 a}$

C. $\frac{qQ}{4\varepsilon\varepsilon_0 a}$

D. zero

Answer: D

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13. An electric dipole moment p is placed in an electric field of intensity $'E'$. The dipole acquires a position such that the axis of the dipole makes an angle θ with the direction of the field. Assuming that the potential energy of the dipole to be zero when $\theta = 90^\circ$, the torque and the potential energy of the dipole will respectively be

A. $pE\sin\theta, \ -pE\cos\theta$

B. $pE\sin\theta, \ -2pE\cos\theta$

C. $pE\sin\theta, 2pE\cos\theta$

D. $pE\cos\theta, \ -pE\sin\theta$

Answer: A

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14. Four point charges $-Q, -q, 2q$ and $2Q$ are placed, one at each corner of the square. The relation between Q and q for which the potential at the centre of the square is zero is

A. $Q = -q$

B. $Q = \frac{1}{q}$

C. $Q = q$

D. $Q = \frac{1}{q}$

Answer: A

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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 $5 \times 10^{-2} C$, respectively. If these are connected by a conducting wire, the final charge on the bigger sphere is

A. $2 \times 10^{-7} C$

B. $3 \times 10^{-2} C$

C. $4 \times 10^{-2} C$

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

Answer: B

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16. Two thin dielectric slabs of dielectric constants K_1 and $K_2(K_1 < K_2)$ are inserted between plates of a parallel plate capacitors , as shown in the figure . The variation of electric field E between the plates with distance d as measured from plate P is correctly shown by

A.

B.

C.

D.

Answer: C

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

A. zero and $\dfrac{Q}{4\pi\varepsilon_0 R^2}$

B. $\frac{Q}{4\pi\varepsilon_0 R}$ and zero

C. $\frac{Q}{4\pi\varepsilon_0 R}$ and $\frac{Q}{4\pi\varepsilon_0 R^2}$

D. both are zero

Answer: B

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18. In a region, the potential is represented by $V(x, y, z) = 6x - 8xy - 8y + 6yz$ where V is in volts and x,y,z are in metres. The electric force experienced by a charge of 2 coulomb situated at point (1, 1, 1) is

A. $6\sqrt{5}N$

B. $30N$

C. 24 N

D. $4\sqrt{35}N$

Answer: D

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19. A parallel plate air capacitor of capacitance C is connected to a cell of $emFV$ and then disconnected from it. A dielectric slab of dielectric constant K, which can just fill the air gap of the capacitor, is now inserted in it. Which of the following is incorrect ?

A. The change in energy stored is $\frac{1}{2}CV^2\left(\frac{1}{K}-1\right)$

B. The charge on the capacitor is not conserved

C. The potential differences between the plates and decrease K times

D. The energy stored in the capacitor decrease K times

Answer: B

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20. A parallel plate air capacitor has capcity C distance of separtion between plates is d and potential difference V is applied between the plates force of attraction between the plates of the parallel plate air capacitor is

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

B. $\frac{C^2V^2}{2d^2}$

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

D. $\frac{CV^2}{2d}$

Answer: D

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

A. $-\left(2\hat{i}+3\hat{j}+\hat{k}\right)$

B. $-\left(6\hat{i}+9\hat{j}+\hat{k}\right)$

C. $-\left(3\hat{i}+5\hat{j}+3\hat{k}\right)$

D. $-\left(6\hat{i}+5\hat{j}+2\hat{k}\right)$

Answer: D

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22. A capacitor of $2\mu F$ is charged as shown in the diagram . When the switch S is turned to position 2 , the percentage of its stored energy dissipated is

A. $75\ \%$

B. $80\ \%$

C. $0\ \%$

D. $20\ \%$

Answer: B

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23. A parallel plate capacitor of area A , plate separation d and capacitance C is filled with four dielectric materials having electric constants , k_1, k_2, k_3 and k_4 as shown in the figure below . If a single dielectric material is to be used to have the same capacitance C in this capacitor , then its dielectric constant K is given by

A. $k = k_1 + k_2 + k_3 + 3k_4$

B. $k = \frac{2}{3}(k_1 + k_2 + k_3) + 2k_4$

C. $\frac{2}{k} = \frac{3}{k_1 + k_2 + k_3} + \frac{1}{k_4}$

D. $\frac{1}{k} = \frac{1}{k_1} + \frac{1}{k_2} + \frac{1}{k_3} + \frac{3}{2k_4}$

Answer: C

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EXERCISE - 4 (NCERT EXAMPLAR PROBLEMS)

1. A capacitor of $4\mu F$ is connected as shown in the circuit . The internal resistance of the battery is 0.5Ω . The amount of charge on the capacitor plates will be

A. 0

B. $4\mu C$

C. $16\mu C$

D. $8\mu C$

Answer: D

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2. A positively charged particle is released from rest in a uniform electric field. The electric potential energy of the charge.

A. remains a constant because the electric field is uniform

B. increases because the charge moves along the electric field

C. decreases because he charge moves along the electric field

D. decreases because the charge moves opposite to the electric field

Answer: C

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3. Figure shows some equipotential lines distributed in space . A charged object is moved from point A to point B

A. The work done in figure (i) greatest

B. The work done in figure (ii) is least

C. The work done is same (i) , (ii) and (iii)

D. The work done in (iii) is greater than (ii) but equal to that in figure (i)

Answer: C

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4. The electrostatic potential on the surface of a charged conducting sphere is 100 V. Two statement are made in this regard -

S_1 : At any point inside the sphere, electric intensity is zero.

S_2: At any point inside the sphere, the electrostatic potential is 100V.

Which of the following is a correct statement?

A. S_1 is true but S_2 is false

B. Both S_1 and S_2 are false

C. S_1 is true , S_2 is also true and S_1 is the cause of S_2

D. S_1 is true , S_2 is also true but the statements are independent

Answer: C

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5. Equipotentials at a great distance from a collection of charges whose total sum is not zero are approximately

A. spheres

B. planes

C. para boloids

D. ellipsoids

Answer: A

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6. A parallel plate capacitor is made of two dielectric blocks in series . One of the blocks has thickness d_1 and dielectric constant K_1 and the other has thickness d_2 and dielectric constant K_2 as shown in figure . This arrangement can be though at a dielectric slab of thickness $d = (d_1 + d_2)$ and effective dielectric constant

K . The K is

A. $\dfrac{K_1 d_1 + K_2 d_2}{d_1 + d_2}$

B. $\dfrac{K_1 d_1 + K_2 d_2}{K_1 + K_2}$

C. $\dfrac{K_1 K_2 (d_1 + d_2)}{K_2 d_1 + K_1 d_2}$

D. $\dfrac{2K_1 K_2}{K_1 + K_2}$

Answer: A

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ADDITIONAL PROBLEMS

1. The equivalent capacity between the points A and B in the adjoining circuit will be

A. C

B. 2 C

C. 3 C

D. 4 C

Answer: B

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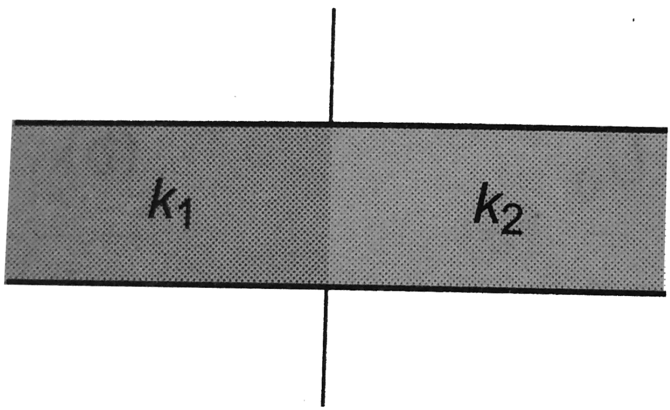
2. A parallel plate capacitor with air as medium between the plates has a capacitance of $10\mu F$. The area of capacitor is divided into two equal halves and filled with two media as shown in the figure having dielectric constnt $k_1 = 2$ and $k_2 = 4$. the capacitance of the system will now be



A. $10\mu F$

B. $20\mu F$

C. $30\mu F$

D. $40\mu F$

Answer: C

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3. The capacity of a parallel plate condenser with air medium is $60\mu F$ having distance of seperation d. If the space between the plates is filled with two slabs each of thickness $\hat{}\ (d)/_2$ and dielectric constant 4 and 8, the effective capacity becomes.

A. $160\mu F$

B. $320\mu F$

C. $640\mu F$

D. $360\mu F$

Answer: B

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4. In the adjoining diagram , the condenser C will be fully charged to potential V if

A. S_1 and S_2 both are open

B. S_1 and S_2 both are closed

C. S_1 is closed and S_2 is open

D. S_1 is open and S_2 is closed

Answer: C

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5. The capacity between the point A and B in the adjoining circuit will be

A. $\dfrac{2C_1C_2 + C_3(C_1 + C_2)}{C_1 + C_2 + 2C_3}$

B. $\dfrac{C_1C_2 + C_2C_3 + C_3C_1}{C_3 + C_2 + C_3}$

C. $\dfrac{C_1(C_2 + C_3) + C_2(C_1 + C_3)}{C_1 + C_2 + 3C_3}$

D. $\dfrac{C_1C_2C_3}{C_1C_2 + C_2C_3 + C_3C_1}$

Answer: A

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6. The capacitance C_{AB} in the given network

A. $7 \mu F$

B. $\frac{50}{7} \mu F$

C. $7.5 \mu F$

D. $\frac{7}{50} \mu F$

Answer: A

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7. In the following circuit , find the potentials at points A and B is

A. $10V, 0V$

B. $6V, -4V$

C. $4V, -6V$

D. $5V, -5V$

Answer: B

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8. The potential differences between the points A and B in the folllowing circuit in steady state will be

A. $V_{AB} = 100$ volt

B. $V_{AB} = 75$ volt

C. $V_{AB} = 25$ volt

D. $V_{AB} = 50$ volt

Answer: C

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9. In the following circuit two identical capacitors , a battery and a switch (s) are connected as shown . The switch (s) is opened and dielectric of constant (K = 3) are inserted in the condensers . The ratio of electrostatic energies of the system before and after filling the dielectric will be

A. $3:1$

B. $5:1$

C. $3:5$

D. $5:3$

Answer: C

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10. In the given figure a capacitor of plate area A is charged upto charge q . The mass of each plate is m_2 . The lower plate is rigidly fixed . The value of m_1 if the system remains in equilibrium is

A. $m_2 + \frac{q^2}{\in_0 \; Ag}$

B. m_2

C. $\frac{q^2}{2 \in_0 \; Ag} + m_2$

D. $2m_2$

Answer: C

11. Consider the situation shown in the figure . The capacitor A has a charge q on it whereas B is uncharged . The charge appearing on the capacitor B a long 7 time after the switch is closed is :

A. Zero

B. $q/2$

C. q

D. 2q

Answer: A

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12. Two charges Q1 and Q2 coulombs are shown in fig. A third charge Q3 coulomb is moved from point R to S along a circular path with P as centre . Change is potential energy is

A. $\frac{Q_1 Q_2 Q_3}{4\pi\varepsilon_0}$

B. $\frac{Q_1 Q_2}{\pi\varepsilon_0}$

C. $\dfrac{Q_2Q_3}{\pi\varepsilon_0}$

D. $\dfrac{4Q_1Q_2}{\pi\varepsilon_0}$

Answer: C

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13. For an infinite line of charge having charge density δ lying along x - axis , the work done in moving charge from C to A along are CA is

A. $\dfrac{q\lambda}{2\pi\varepsilon_0}\log_{e^2}$

B. $\frac{q\lambda}{4\pi\varepsilon_0}\log_{e\sqrt{2}}$

C. $\frac{q\lambda}{4\pi\varepsilon_0}\log_{e^2}$

D. $\frac{q\lambda}{2\pi\varepsilon_0}\log_{e^3}$

Answer: A

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14. A fixed uniformly charged ring of radius 3 m has a positive linear charge density $\frac{50}{3}\mu C/m$. A point charge $5\mu C$ is moving towards the ring along its axis such that its kinetic energy at A is

5 J . Its kinetic energy at the centre of ring will be nearly .

A. 1.3 J

B. 2.7 J

C. 3.1 J

D. 4.1 J

Answer: A

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