PHYSICS

BOOKS - MTG-WBJEE PHYSICS (HINGLISH)

ELECTROSTATICS

Wb Jee Workout Category 1 Single Option Correct Type 1 Mark

1. n small drops of same size are charged to V volts each .If they coalesce to from a single large drop, then its potential will be -

A. V/n

B. Vn

C. $Vn^{1/3}$

D. $V_n^{2/3}$

Answer: d

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2. Electrons are caused to fall through a potential difference of 1500 V. If they are initially at rest, their final speed is

A. $4.6 \times 10^7 ms^{-1}$

B. $2.3 \times 10^7 ms^{-1}$

C. $0.23 \times 10^2 ms^{-1}$

D. $5.1 \times 10^9 ms^{-1}$

Answer: b

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3. In a region of space, the electric field is given by $\overrightarrow{E} = 8\hat{i} + 4\hat{j} + 3\hat{k}$. The electric flux through a surface of area 100 units in the xy plane is

A. 800 units

B. 300 units

C. 400 units

D. 1500 units

Answer: b

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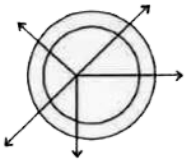
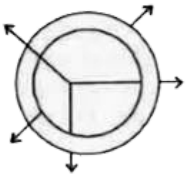
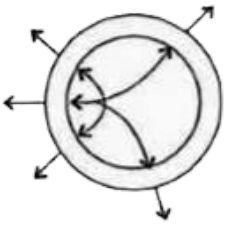
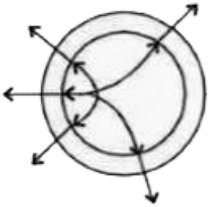
4. A metallic shell has a point charge 'q' kept inisde its cavity. Which one of the following diagrams correctly represents the electric lines of forces?

A. 

B. 

C. 

D. 

Answer: c

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5. A cylinder of radius R and length L is placed in a uniform electric field E parallel to the axis. The total flux for the surface of the cylinder is given by

A. $2\pi R^2 E$

B. $\pi R^2 / E$

C. $\frac{\pi R^2 + \pi R^2}{E}$

D. zero

Answer: d

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6. A parallel plate capacitor has plates with area A and separation d. A battery charges the plates to a potential difference V_0. The battery is then disconnected and a dielectric slab of

thikness d is introduced. The ratio of the enrgy stored in the capacitor before and after the slab is introduced, is

A. K

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

C. $\frac{A}{d^2K}$

D. $\frac{d^2K}{A}$

Answer: a

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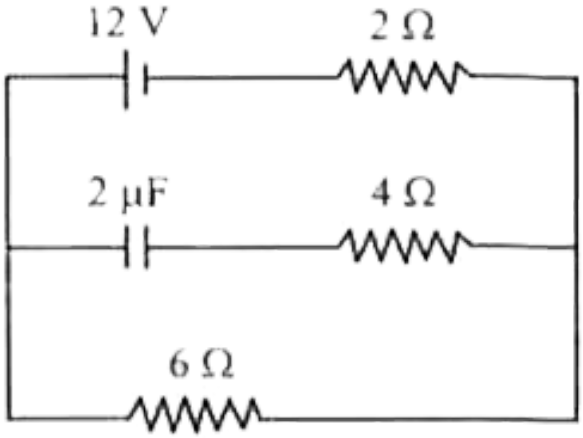
7. Find the charge on the capacitor in the following circuit.



A. $12\mu C$

B. $14\mu C$

C. $20\mu C$

D. $18\mu C$

Answer: d

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8. The electric field in a region is radially outward with magnitude $E = Ar_0$. The charge contained in a sphere of radius r_0 centred at the origin is

A. $\frac{Ar_0^3}{4\pi\varepsilon_0}$

B. $\frac{4\pi\varepsilon_0 A}{r_0}$

C. $4\pi\varepsilon_0 Ar_0^3$

D. $\frac{A}{4\pi r^3 \varepsilon_0}$

Answer: c

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9. If the gap between the plates of a parallel plate capacitor is filled with medium of dielectric constant k=2 , then the field between them

A. Increases by a factor 2

B. Increases by a factor $\sqrt{2}$

C. Decreased by a factor $\sqrt{2}$

D. Decreased by a factor $1/2$

Answer: d

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10. A hemispherical bowl of radius r is placed in uniform electric field E . The electric flux passing through the bowl is

A. $\pi r^2 E$

B. $2\pi r E^2$

C. $4\pi r^2 E$

D. $4\pi r E^2$

Answer: a

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11. A semicircular are of radius a is charged uniformly and the charge per unit length is λ. The electric field at its centre is

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

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

C. $\frac{\lambda}{4\varepsilon_0 a}$

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

Answer: c

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12. An infinite number of charges of equal magnitude q, but of opposite sign are placed along the x-axis at x =1, x = 2, x=4, x = 8 and so

on. The electric potential at the point x=0 due to these charges will be proportional to

A. Infinity

B. Zero

C. $3q/2$

D. $2q/3$

Answer: d

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13. The electric potential at a point (x, y) in the x-y plane is given by $V = -kxy$. The field intentisy at a distance r in this plane, from the origin is proportional to

A. r^2

B. r

C. $1/r$

D. $1/r^2$

Answer: b

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14. If 3 charges are placed at the vertices of equilateral triangle of charge 'q' each. What is the net potential energy, if the side of equilateral Δ is lcm ?

A. $\frac{1}{4\pi\varepsilon_0}\frac{q^2}{l}$

B. $\frac{1}{4\pi\varepsilon_0}\frac{2q^2}{l}$

C. $\frac{1}{4\pi\varepsilon_0}\frac{3q^2}{l}$

D. $\frac{1}{4\pi\varepsilon_0}\frac{4q^2}{l}$

Answer: c

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15. The mean electric energy density between the plates of a charged capacitor is (here $q =$ charge on the capacitor and $A =$ area o fthe capacitor plate)

A. $\frac{q^2}{2\varepsilon_0 A^2}$

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

C. $\frac{q^2}{2\varepsilon_0 A}$

D. None of these

Answer: a

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16. 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

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

A. 1

B. $\sqrt{\frac{\pi\varepsilon_0}{G}}$

C. $\sqrt{\frac{G}{4\pi\varepsilon_0}}$

D. $\sqrt{4\pi\varepsilon_0 G}$

Answer: d

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18. Let $P(r) = \frac{Q}{\pi R^4} r$ be the charge density distribution for a solid sphere of radius R and

total charge Q. For a point 'p' inside the sphere at distance r_1 from the centre of the sphere, the magnitude of electric field is:

A. 0

B. $\frac{Q}{4\pi\varepsilon_0 r_1^2}$

C. $\frac{Qr_1^2}{4\pi\varepsilon_0 R^4}$

D. $\frac{Qr_1^2}{3\pi\varepsilon_0 R^4}$

Answer: c

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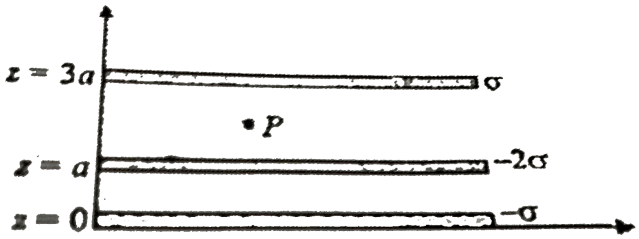
19. Three infinite long charged sheets of charge densities $-\sigma, -2\sigma$ and σ are placed parallel to,y-plane at z= 0, z= a, z= 3a. Electric field at point Pis given as :



A. $\frac{-2\sigma}{\varepsilon_0}\hat{k}$

B. $\frac{2\sigma}{\varepsilon_0}\hat{k}$

C. $\frac{-4\sigma}{\varepsilon_0}\hat{k}$

D. $\frac{4\sigma}{\varepsilon_0}\hat{k}$

Answer: a

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20. A parallel plate capacitor of capacitance 500 pF and plate area 0.05 m^2 is filled with porcelain . The following observations are recorded . Mark the one which is not correct .

A. The free charge on the plates is $0.1\mu C$.

B. The electric field in the porcelain is $3.4 \times 10^4 V/m$.

C. The induced surface charge is $8.4\mu C$.

D. The capacitance of the capacitor is $3.2 \times 10^{-3}\mu F$.

Answer: c

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21. What fraction of the energy drawn from the charging battery is stored in as capacitor

A. $100\ \%$

B. $75\ \%$

C. $50\ \%$

D. $25\ \%$

Answer: c

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22. 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. $\frac{4q}{d}$

C. $\frac{4d}{q}$

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

Answer: b

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23. Sixty four identical sphere of change q and capacitance C each are combined to form a

large sphere . The charge and capacitance of the large sphere is

A. 64 q, C

B. 16 q, 4C

C. 64 q, 4 C

D. 16 q , 4 C

Answer: c

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24. The number of electrons in 2 coulomb of charge is

A. 5×10^{29}

B. 12.5×10^{18}

C. 1.6×10^{19}

D. 9×10^{11}

Answer: b

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25. The work done in carrying a charge q once round a circle of radius r with a charge Q at the centre is

A. $\frac{qQ}{4\pi\varepsilon_0 r}$

B. $\frac{qQ}{4\pi\varepsilon_0}\frac{1}{\pi r}$

C. $\frac{qQ}{4\pi\varepsilon_0}\left(\frac{1}{2\pi r}\right)$

D. 0

Answer: d

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26. Four capacitors of equal capacitance have an equivalent capacitance C_1 when connected in series and an equivalent capacitance C_2 when connected in parallel. The ratio $\frac{C_1}{C_2}$ is

A. $1/4$

B. $1/6$

C. 1//8`

D. $1/12.$

Answer: b

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27. A charge +q is placed at the mid point of a cube of side L. The electric flux emerging from cube is

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

B. Zero

C. $\frac{6qL^2}{\varepsilon_0}$

D. $\frac{q}{6L^2\varepsilon_0}$

Answer: a

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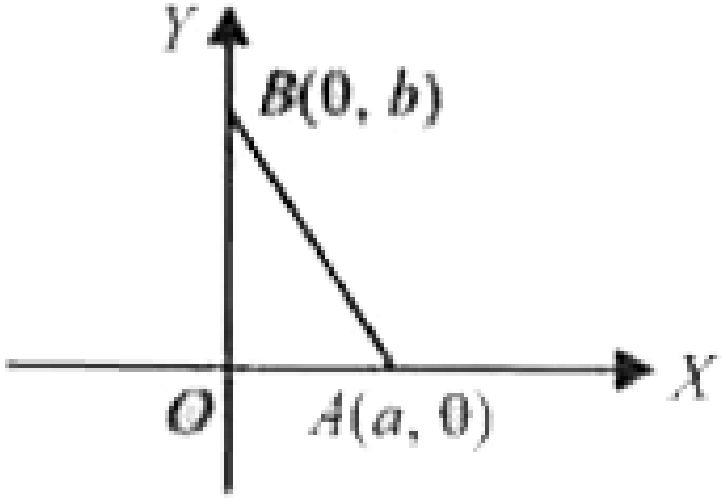
28. A charge $+q$ is placed at the origin O of X-Y axes as shown in the figure . The work done in taking a charge Q from A to B along the straight line AB is



A. $\frac{qQ}{4\pi\varepsilon_0}\left(\frac{a-b}{ab}\right)$

B. $\frac{qQ}{4\pi\varepsilon_0}\left(\frac{b-a}{ab}\right)$

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

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

Answer: a

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29. Two identical metal spheres charged with $+12\mu C$ and $-8\mu C$ are kept at certain distance in air . They are brought into contact and then kept at the same distance . The ratio

of the magnitudes of electrostatic forces between them before and after contact is

A. $24:1$

B. $4:1$

C. $12:1$

D. $8:1$

Answer: a

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

A. σ / ε_0 towards the positively charged plane

B. σ / ε_0 towards the negatively charged plane

C. $\sigma(2\varepsilon_0)$ towards the positively charged plane

D. 0 and towards any direction.

Answer: b

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Wb Jee Workout Category 2 Single Option Correct Type 2 Marks

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

A. $\frac{Q\left(R^2+r^2\right)}{4\pi\varepsilon_0(R+r)}$

B. $\frac{Q}{R+r}$

C. zero

D. $\frac{Q(R+r)}{4\pi\varepsilon_0(R^2+r^2)}$

Answer: d

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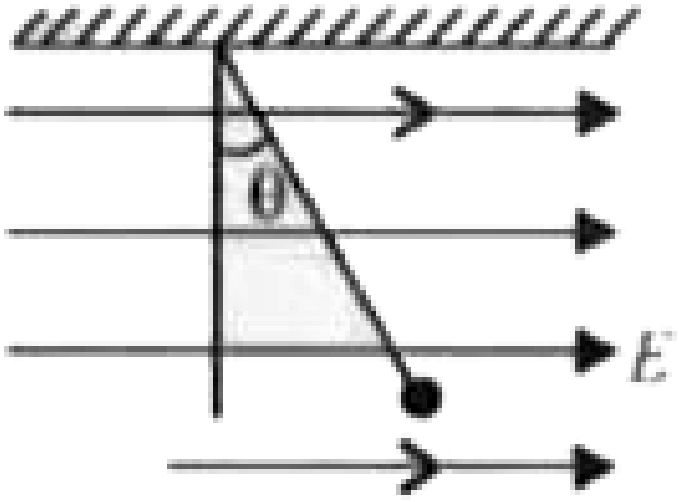
2. In the figure shown a ball is suspended from the ceiling of a room in a uniform electric field of magnitude 2×10^4 V/m . If the mass of the ball is 25 g and the charge on the ball is $3\mu C$. The angle θ is $\left(g = 9.8ms^{-2}\right)$



A. 14°

B. 22°

C. 34°

D. 76°

Answer: a

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3. A hollow charged metal sphere has radius r. If the potential difference between its surface and a point at a distance $3r$ from the centre is

V, then electric field intensity at a distance $3r$ is

A. $\frac{V}{6r}$

B. $\frac{V}{4r}$

C. $\frac{V}{3r}$

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

Answer: a

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4. A parallel plate air capacitor is connected to a battery. The quantities charge, voltage, electric field and energy associated with this capacitor are given by Q_0 , V_0, E_0 and U_0 respectively. A dielectric slab is now introduced to fill the space between the plates with battery still in connection. The corresponding quantities now given by Q, V, E and U are related to the previous one as

A. $Q > Q_0$

B. $V > V_0$

C. $E > E_0$

D. $U < U_0$

Answer: a

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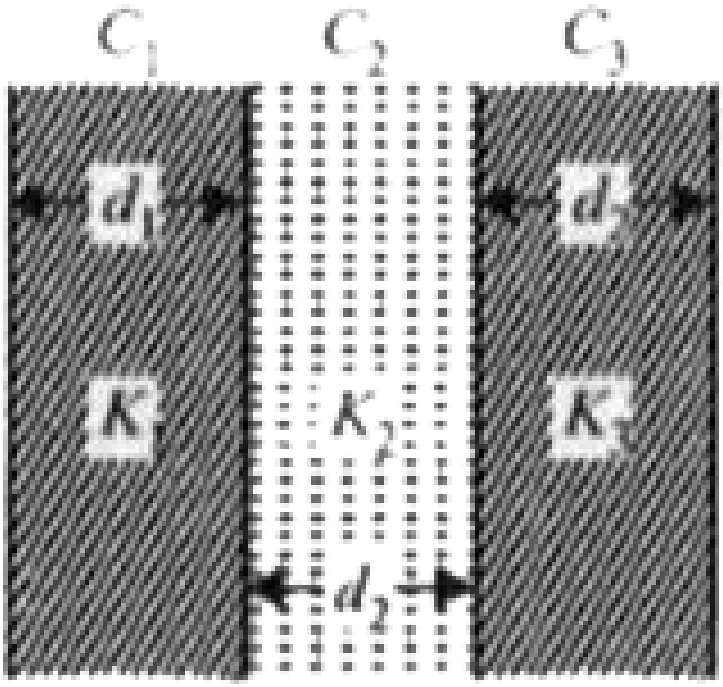
5. The expression for the capacity of a capacitor formed by placing a compound dieletric between the plates of a parallel plate capacitor, as shown in figure , will be (Given

area of plate = A)



A. $\dfrac{\varepsilon_0 A}{\left(\frac{d_1}{K_1}+\frac{d_2}{K_2}+\frac{d_3}{K_3}\right)}$

B. $\dfrac{\varepsilon_0 A}{\left(\frac{d_1}{K_1}+\frac{d_2}{K_2}+\frac{d_3}{K_3}\right)}$

C. $\dfrac{\varepsilon_0 A(K_1K_2K_3)}{(d_1d_2d_3)}$

D. $\varepsilon_0\left(\frac{AK_1}{d_1}+\frac{AK_2}{d_2}+\frac{AK_3}{d_3}\right)$

Answer: a

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6. A spherical capacitor consists of two concentric spherical conductors , the inner one of radius R_1 maintained at potential V_1 and the outer conductor of radius R_2 at potential V_2 . The potential at a point P at a

distance x from the centre (where $R_2 > x > R_1$) is

A. $\frac{(V_1 - V_2)(x - R_1)}{(R_2 - R_1)}$

B. $V_1 + \frac{V_2 x}{(R_2 - R_1)}$

C. $\frac{V_1 R_1 (R_2 - x) + V_2 R_2 (x - R_1)}{(R_2 - R_1)x}$

D. $\frac{(V_1 + V_2)}{(R_1 + R_2)} x$

Answer: c

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7. A parallel plate capacitor is charged and the charging battery is then disconnected. If the plates of the capacitor are moved farther apart by means of insulating handles:

A. The charge on the capacitor increases.

B. The voltage across the plates decreases.

C. The capacitance increases.

D. The electrostatic energy stored in the capacitor increases.

Answer: d

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8. Electric potential at any point is $V = -5x + 3y + \sqrt{15}z$, then the magnitude of the electric field is

A. $3\sqrt{2}$

B. $4\sqrt{2}$

C. $5\sqrt{2}$

D. 7

Answer: d

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9. The capacitance of a capacitor between$4/3$ times its original value if a dielectric slab of thickness $t = d/2$ is inserted between the plates (d is the separation between the plates). What is the dielectric consant of the slab?

A. 8

B. 4

C. 6

D. 2

Answer: d

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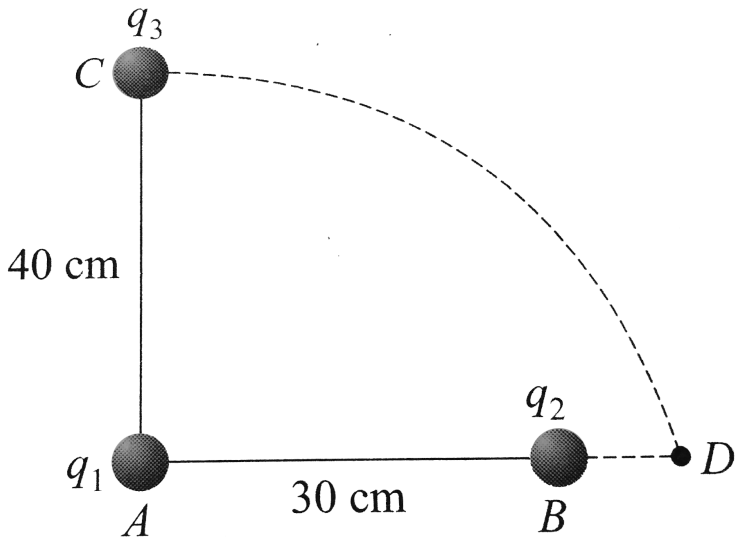
10. Two charges q_1 and q_2 are placed $30cm$ apart, as shown in the figure. A third charge q_3 is moved along the arc of a circle of radius $40cm$ from C to D. The change in the

potential energy o fthe system is $\frac{q_3}{4\pi\varepsilon_0}k.$,

where k is



A. $8q_1$

B. $6q_1$

C. $8q_2$

D. $6q_2$.

Answer: c

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11. If the charge on a capacitorn is increased by 2C, then the energy stored in it increases by 20 %. The original charge on the capacitor is

A. 10 C

B. 20 C

C. 30 C

D. 40 C

Answer: b

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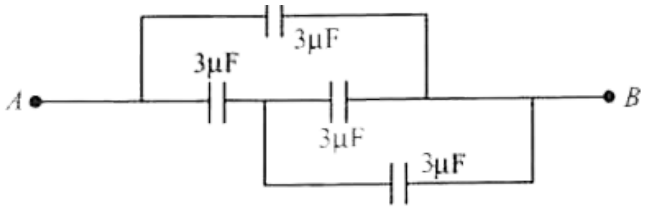
12. In the figure below , the capacitance of each capacitor is $3\mu F$. The effective capacitance between A and B is



A. $\frac{3}{4}\mu F$

B. $3\mu F$

C. $6\mu F$

D. $5\mu F$

Answer: d

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13. An infinite number of charges , each equal to q , are placed along the x - axis at x = 1, x=2,x=4,x=8 and so on . The potential at x = 0 due to this set of charges is

A. $\frac{4q}{2\pi\varepsilon_0}$

B. $2q/4\pi\varepsilon_0$

C. $\frac{q}{2\pi\varepsilon_0}$

D. $\frac{2q}{\pi\varepsilon_0}$

Answer: b

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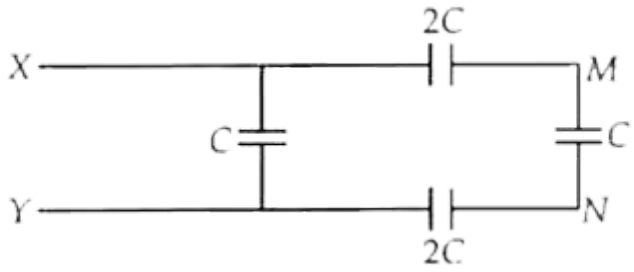
14. In the adjoining figure the potential difference between X and Y is 60 V . The potential difference between the points M and

N - will be



A. 10 V

B. 15 V

C. 20 V

D. 30 V

Answer: d

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15. The plates of a parallel plate capacitor with air as medium are separated by a distance of $8mm$. A medium of dielectric constant 2 and thickness $4mm$ having the same area is introduced between the plates. For the capacitance to remain the same, the distance between the plates is

A. 8 mm

B. 6 mm

C. 4 mm

D. 10 mm

Answer: d

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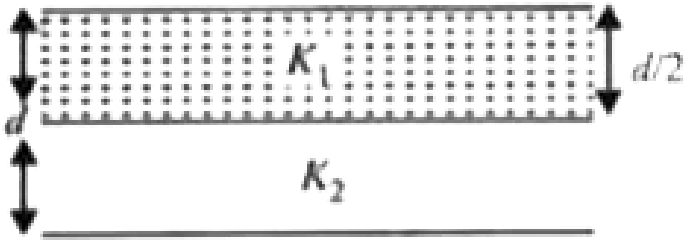
Wb Jee Workout Category 3 One Or More Than One Option Correct Type 2 Marks

1. The separation between two plates of a parallel plate condenser is filled with two dielectric media as shown in figure . The ratio

of its capacities , with and without dielectric , is



A. $K_1(K_1 + K_2)$

B. $2K_1K_2/(K_1 + K_2)$

C. $(K_1 + K_2)/2$

D. $K_2(K_1 + K_2)$

Answer: b

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2. A pendulum bob of mass m = 80 mg, carrying a charge of $q = 2 \times 10^{-8} C$, is at rest in a horizontal, uniform electric field of E = 20,000 V/m. The tension T in the thread of the pendulum and the angle α it makes with vertical, is (take $g = 9.8 m / s^2$)

A. $3.92 \times 10^{-8}, 72^{\circ}$

B. $7.84 \times 10^{-6}, 90^{\circ}$

C. $8.8 \times 10^{-4}, 27^{\circ}$

D. $1.96 \times 10^{-4}, 18^{\circ}$

Answer: c

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3. Four charges equal to Q are placed at the four comers of a square and a charge q is at its centre . If the system is in equilibrium , the value of q is

A. $\frac{-Q}{4}\left(1+2\sqrt{2}\right)$

B. $\frac{Q}{4}(1+2\sqrt{2})$

C. $\frac{-Q}{2}(1+2\sqrt{2})$

D. $\frac{Q}{2}(1+2\sqrt{2})$

Answer: b

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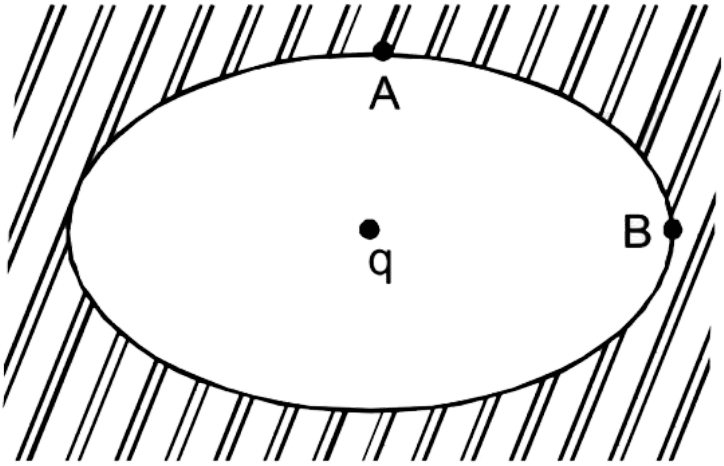
4. An ellipsoidal cavity is carved within a perfect conductor. A positive charge q is placed at the centre of the cavity. The points A and B are on the cavity surface as shown in

the figure. Then



A. electric field near A in the cavity = electric field near B in the cavity

B. charge density at A - charge density at B

C. potential at A = potential at B

D. total electric field flux through the surface of the cavity is q/ε_0.

Answer: (c,d)

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5. A non-conducting solid sphere of radius R is uniformly charged. The magnitude of the electric filed due to the sphere at a distance r from its centre

A. increases as r increases , for $r < R$

B. decreases as r increases , for

$0 < r < r < \infty$

C. decreases as r increases , for

$R < r < \infty$

D. is discontinous at r = R.

Answer: (a,c)

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6. 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

A. 0

B. $\dfrac{q}{8\pi\varepsilon_0 x_0 \ln 2}$

C. ∞

D. $\frac{q \ln 2}{4\pi\varepsilon_0 x_0}$

Answer: d

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7. A dielectric slab of thickness d is inserted in a parallel plate capacitor whose negative plate is at $x = 0$ and positive plate is at $x = 3d$. The slab is equidistant from the plates. The

capacitor is given some charge. As one goes from 0 to $3d$:

A. the magnitude of the electric field remains the same .

B. the direction of the electric field remains the same

C. the electric potential increases continuously

D. the electric potential increases at first , then decreases and again increases.

Answer: (b,c)

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8. A parallel plate capacitor of plate area A and plate separation d is charged to potential difference V and then the battery is disconnected. A slab of dielectric constant K is then inserted between the plates of the capacitor so as to fill the space between the plates. If Q, E and W denote respectively, the magnitude of charge on each plate, the

electric field between the plates (after the slab is inserted), and work done on the system, in question, in the process of inserting the slab, then

A. $Q = \frac{\varepsilon_0 AV}{d}$

B. $Q = \frac{\varepsilon_0 KAV}{d}$

C. $E = \frac{V}{Kd}$

D. $W = \frac{\varepsilon AV^2}{2d}\left[1 - \frac{1}{K}\right].$

Answer: (a,c,d)

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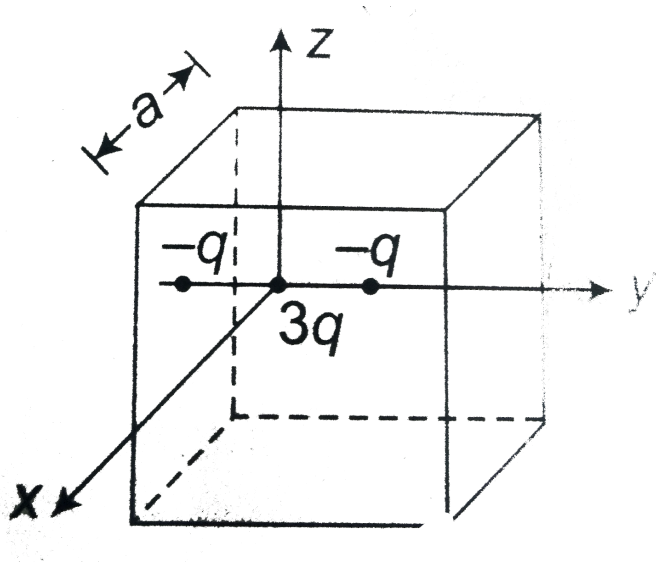
9. A cubical region of side a has its centre at the origin. It encloses three point charges , $-q$ at $(0, -a/4, 0)$, $+3qat(0, 0, 0)$ and $-q$ at $(0, +a/4, 0)$.

Choose the correct option (s)



(i) The net electric flux crossing the plane

$x = +\frac{q}{2}$ is equal to the net electric flux crossing the plane $x = -\frac{a}{2}$

(ii) The net electric flux crossing the plane $y = +\frac{a}{2}$ is more than the net electric flux crossing the plane $y = -\frac{a}{2}$

(iii) The net electric flux crossing the entire region is $\frac{q}{\varepsilon_0}$

(iv) The net electric flux crossing the plane $z = +\frac{a}{2}$ is equal to the net electric flux crossing the plane $x = +\frac{a}{2}$

A. The net electric flux crossing the plane $x = +\frac{a}{2}$ is equal to the net electric

flux crossing the plane $x = -\frac{a}{2}$

B. The net electric flux crossing the plane $y = +\frac{a}{2}$ is more than the net electric flux crossing the plane $y = -\frac{a}{2}$

C. The net electric flux crossing the entire region is $\frac{q}{\varepsilon_0}$

D. The net electric flux crossing the plane $z = +\frac{a}{2}$ is equal to the net electric flux crossing the plane $x = +\frac{a}{2}$

Answer: (a,c,d)

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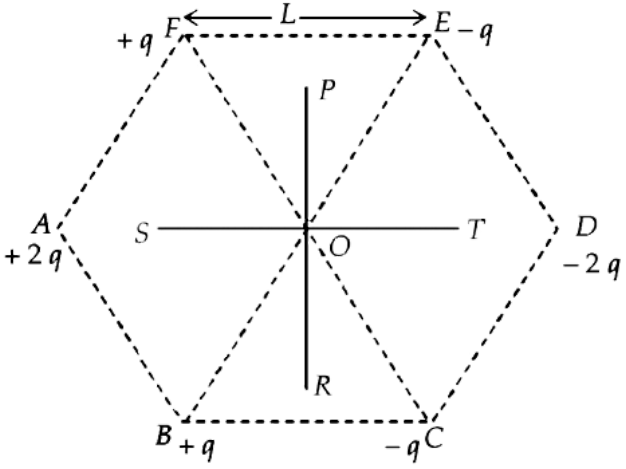
10. Six point charges are kept at the vertices of a regular hexagon of side L and centre O, as shown in the figure. Given that $K = \frac{1}{4\pi\varepsilon_0}\frac{q}{L^2}$, which of the following statements(s) is (are) correct?



A. The electric field at O is 6K along OD.

B. The potential at O is zero.

C. The potential at all points on the line PR is same.

D. The potential at all points on the line ST is same.

Answer: (a,b,c)

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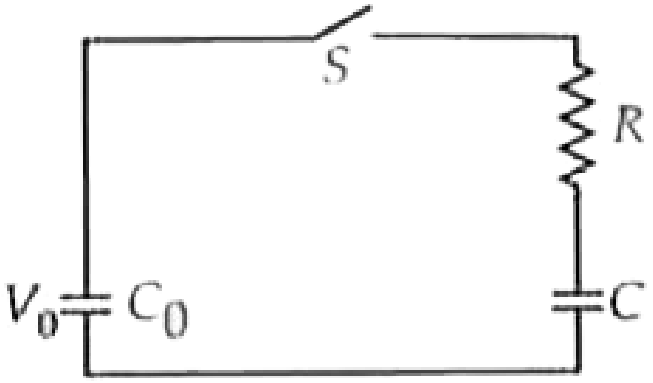
Wb Jee Previous Years Questions Category 1 Single Option Correct Type

1. A capacitor of capacitance C_0 is charged to a potential V_0 and is connected with another capacitor of capacitance C as Shown . After closing the switch S, the common potential across the two capacitors becomes V . The capacitance C is given by



A. $\frac{C_0(V_0 - V)}{V_0}$

B. $\frac{C_0(V - V_0)}{V_0}$

C. $\frac{C_0(V + V_0)}{V}$

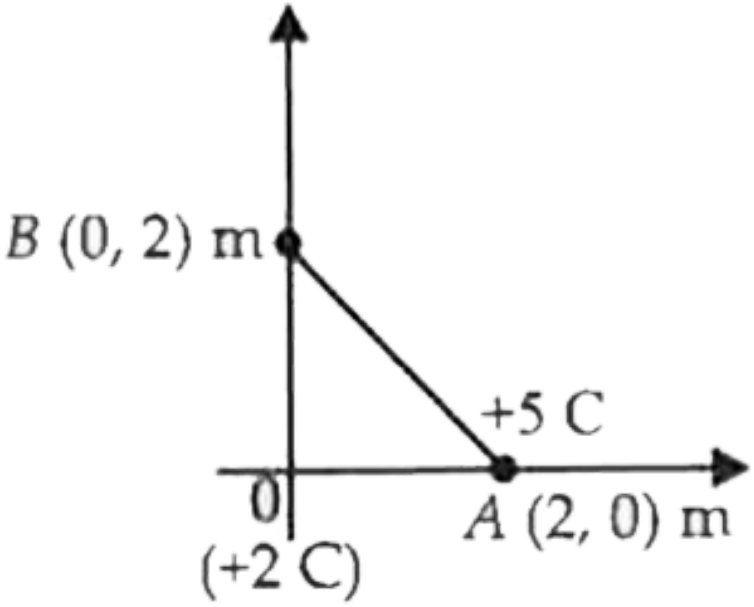
D. $\frac{C_0(V_0 - V)}{V}$

Answer: d

View Text Solution

2. As shown in the figure a charge $+2$ C is situated at the origin O and another charge $+5$ C is on the x -axis at the point A . The later

charge from the point A is then brought to a point Bon the y - axis . The work done is $\left(\text{given} \frac{1}{4\pi\varepsilon_0} = 9 \times 10^9\right)$



A. $45 \times 10^9 J$

B. $90 \times 10^9 J$

C. zero

D. $-45 \times 10^9 J$

Answer: c

Watch Video Solution

3. A particle of mass M and charge q is released from rest in a region of uniform electric field of magnitude E . After a time t, the distance travelled by the charge is S ad the

kinetic energy attained by the particle is T. Then , the ratio T/S

A. remains constant with time t

B. varies linearly with the mass M of the particle

C. is independent of the charge q

D. is independent of the magnitude of the electric field E.

Answer: a

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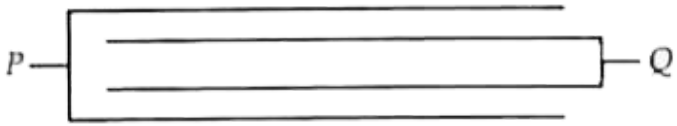
4. Four identical plates each of area a are separated by a distance d. The connection is shown below . What is the capacitance between P and Q?



A. $2a\varepsilon_0 / d$

B. $a\varepsilon_0 / (2d)$

C. $a\varepsilon_0 / d$

D. $4a\varepsilon_0 / d$

Answer: a

View Text Solution

5. A particle of mass M and charge q , initially at rest , is accelerated by a uniform electric field E through a distance D and is then allowed to approach a fixed static charge Q of the same sign . The distance of the closest approach of the charge q will then be

A. $\frac{Q}{4\pi\varepsilon_0 D}$

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

C. $\frac{qQ}{2\pi\varepsilon_0 D^2}$

D. $\frac{Q}{4\pi\varepsilon_0 E}$

Answer: b

View Text Solution

6. Three capacitors $3\mu F, 6\mu F$ and $6\mu F$ are connected in series to source of 120 V. The potential difference in volt, across the $3\mu F$ capacitor will be

A. 24

B. 30

C. 40

D. 60

Answer: d

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7. An infinite sheet carrying a uniform surface charge density $\sigma 1$ lies on the xy - plane . The work done to carry a charge q from the point

$\overrightarrow{A} = a\left(\hat{i} - 2\hat{j} + 6\hat{k}\right)$ to the point $\overrightarrow{B} = a\left(\hat{i} - 2\hat{j} + 6\hat{k}\right)$ (where a is a constant with the dimension of length and ε_0 is the permittivity of free space) is

A. $\frac{3\sigma aq}{2\varepsilon_0}$

B. $\frac{2\sigma aq}{\varepsilon_0}$

C. $\frac{5\sigma aq}{2\varepsilon_0}$

D. $\frac{3\sigma aq}{\varepsilon_0}$

Answer: a

View Text Solution

8. 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, then the charge on the inner shell is

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

B. zero

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

D. $-q$

Answer: c

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9. 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 energy stored in the capacitor decreases

B. the capacitance of the capacitor increases

C. the charge on the capacitor decreases

D. the voltage across the capacitor increases

Answer: d

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10. A $5\mu F$ capacitor is connected in series with a $10\mu F$ capacitor. When a 300 volt potential difference is applied across this combination, the total energy stored in the capacitors is

A. 15 J

B. $1.5J$

C. $0.15J$

D. $010J$

Answer: c

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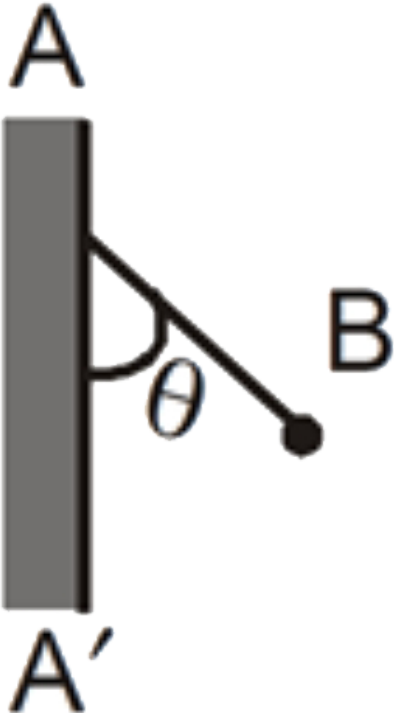
11. The line AA' is on a charged infinite conducting plane which is perpendicular to the plane of the paper. The plane has surface density of charge σ and B is a ball of mass m with a like charge of magnitude q. B is connected by a string from a point on the line AA'. The tangent of the angle (θ) formed between the line AA' and the string is (provided, the charge q does not affect the

distribution of charge on conducting plate)



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

B. $\frac{q\sigma}{4\pi\varepsilon_0 mg}$

C. $\frac{q\sigma}{4\pi\varepsilon_0 mg}$

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

Answer: d

Watch Video Solution

12. Angle between an equipotential surface and electric lines of force is

A. 0°

B. 90°

C. 180°

D. 270°

Answer: b

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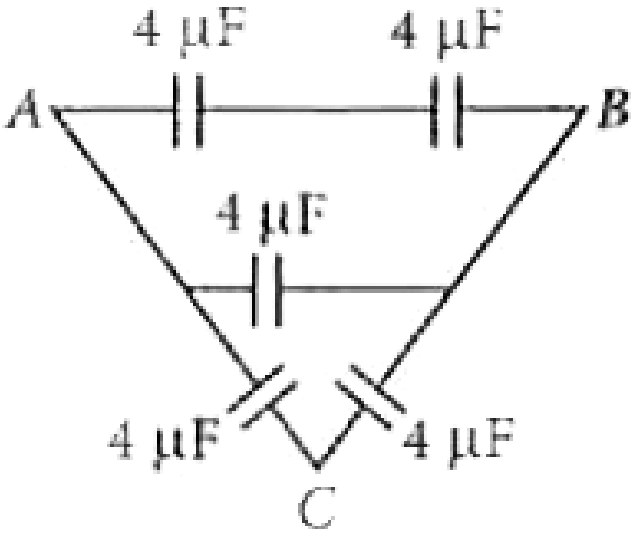
13. Equivalent capacitance between A and B in the figure is



A. $20\mu F$

B. $8\mu F$

C. $12\mu F$

D. $16\mu F$

Answer: b

View Text Solution

14. A hollow metal sphere of radius R is charged with a charge Q. The electric potential and intensity inside the sphere are respectively

A. $\frac{Q}{4\pi\varepsilon_0 R^2}$ and $\frac{Q}{4\pi\varepsilon_0 R}$

B. $\frac{Q}{4\pi\varepsilon_0 R}$ and $Zero$

C. Zero and Zero

D. $\frac{4\pi\varepsilon_0 Q}{R}$ and $\frac{Q}{4\pi\varepsilon_0 R^2}$

Answer: b

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15. A positive charge Q is situated at the centre of cube. The electric flux through any face of the cube is (in SI units)

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

B. $4\pi Q$

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

D. $\frac{Q}{6\pi\varepsilon_0}$

Answer: a

Watch Video Solution

16. Three capacitors of capacitacnce 1.0, 2.0 and $5.0\mu F$ are connected in series to a 10 V source. The potential difference across the $2.0\mu F$ capacitor is

A. $\frac{100}{17}V$

B. $\frac{20}{17}V$

C. $\frac{50}{17}V$

D. 10 V

Answer: c

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17. A charge of $0.8C$ is divided into two charges Q_1 and Q_2. These are kept at a separation of 30 cm. The force on Q_1 is maximum when

A. $Q_1 = Q_2 = 0.4C$

B. $Q_1 = 0.8C, Q_2$ negligible

C. Q_1 negligible ,$Q_2 = 0.8C$

D. $Q_1 = 0.2C, Q_2 = 0.6C$

Answer: a

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18. A point charge -q is carried from a point A to anther point B on the axis of a charged ring of radius r carrying a charge +q. If the point A is at a distance $\frac{4}{3}r$ from the centre of the ring

and the point B is $\frac{3}{4}r$ from the centre but on the opposite side, what is the net work that need to be done for this

A. $-\frac{7}{5}\frac{q^2}{4\pi\varepsilon_0 r}$

B. $-\frac{1}{5}\frac{q^2}{4\pi\varepsilon_0 r}$

C. $\frac{7}{5}\frac{q^2}{4\pi\varepsilon_0 r}$

D. $\frac{1}{5}\frac{q^2}{4\pi\varepsilon_0 r}$

Answer: b

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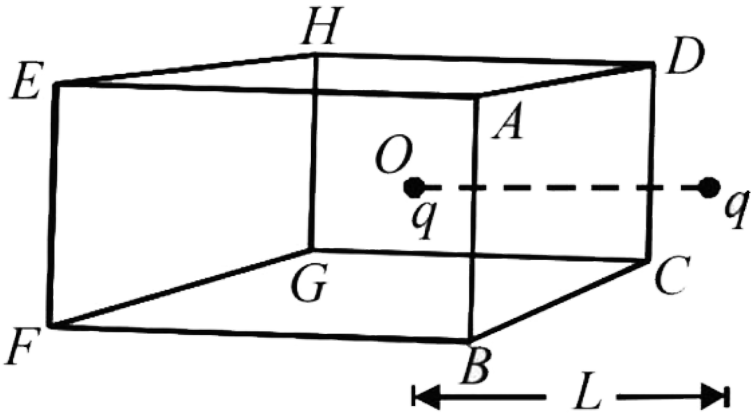
19. A charged particle q is placed at the centre O of cube of length L(A B C D E F G H). Another same charge q is placed at a distance L from O. Then the electric flux through ABCD is



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

B. $\frac{5Q}{6\varepsilon_0}$

C. $\frac{10Q}{6\varepsilon_0}$

D. zero

Answer: b

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20. Four equal charges of value +Q are placed at any four vertices of a regular hexagon of side a. By suitably choosing the vertices, what can be the maximum possible magnitude of electric field at the centre of the hexagon?

(A) $\frac{Q}{4\pi \in_0 a^2}$

(B) $\frac{\sqrt{2}Q}{4\pi \in_0 a^2}$

(C) $\frac{\sqrt{3}Q}{4\pi \in_0 a^2}$

(D) $\frac{2Q}{4\pi \in_0 a^2}$

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

B. $\frac{\sqrt{2}Q}{4\pi\varepsilon_0 a^2}$

C. $\frac{\sqrt{3}Q}{4\pi\varepsilon a^2}$

D. $\frac{2Q}{4\pi\varepsilon_0 a^2}$

Answer: c

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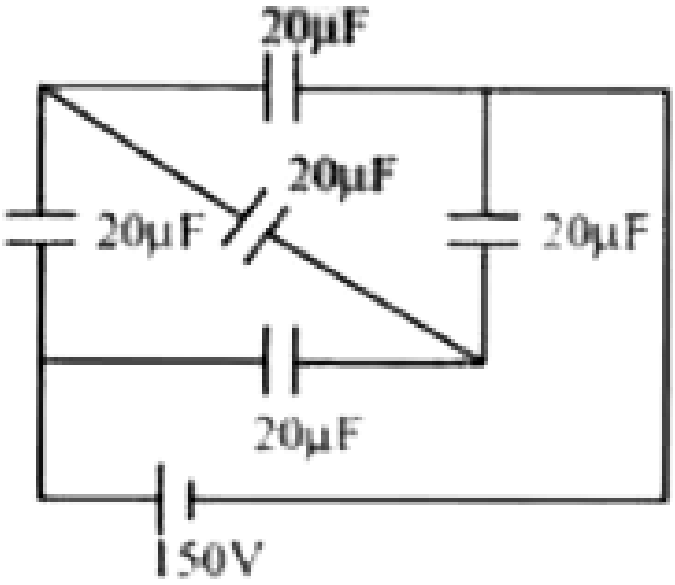
21. Five identical capacitors , of capacitance $20\mu F$ each , are connected to a battery of $150V$, in a combination as shown in the diagram . What is the total amount of charge stored ?



A. $15 \times 10^{-3} C$

B. $12 \times 10^{-3} C$

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

D. $3 \times 10^{-3} C$

Answer: d

View Text Solution

22. Eleven equal point charges , all of then having a charge $+Q$, are placed at all the hour positions of a circular clock of radius r,

except at the 10 hour position . What is the electric field strength at the centre of the clock ?

A. $\frac{Q}{4\pi\varepsilon_0 r^2}$ from the centre towards the mark 10

B. $\frac{Q}{4\pi\varepsilon_0 r^2}$ from the mark 10 towards the centre

C. $\frac{Q}{4\pi\varepsilon_0 r^2}$ from the centre towards the mark 6

D. Zero

Answer: a

View Text Solution

23. A negative charge is placed at the midpoint between two fixed equal positive charges , separated by a distance 2d . If the negative charge is given a small distancement $x(x << d)$ perpendicular to the line joining the positive charges , how the force (F) developed on it will approximately depend on x ?

A. $F \propto x$

B. $F \propto \frac{1}{x}$

C. $F \propto x^2$

D. $F \propto \frac{1}{x^2}$

Answer: a

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Wb Jee Previous Years Questions Category 2 Single Option Correct Type

1. A sphere of radius R has a volume density of charge $\rho = kr$, were r is the distance from the centre of the sphere and k is constant . The magnitude of the electric field which exists at the surface of the sphere is given by ($\varepsilon_0 =$ permittivity of free space)

A. $\frac{4\pi kR^4}{3\varepsilon_0}$

B. $\frac{kR}{3\varepsilon_0}$

C. $\frac{4\pi kR}{\varepsilon_0}$

D. $\frac{kR^2}{4\pi_0}$

Answer: d

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2. A particle of mass m and charge q is located midway between two fixed charged particles each having a charge q and a distance 2l apart. Prove that the motion of the particle will be SHM if it is displaced slightly along the line connecting them and released. Also find its time period.

A. $\sqrt{\frac{\pi^3 M\varepsilon_0 d}{Qq}}$

B. $\sqrt{\left(\pi^2 M\varepsilon_0 \frac{d^3}{Qq}\right)}$

C. $\sqrt{\frac{\pi^3 M\varepsilon_0 d^3}{Qq}}$

D. $\sqrt{\frac{\pi^3 M\varepsilon_0}{Qqd^3}}$

Answer: c

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3. A charge q is placed at one corner of cube.

The elctric flux through any of the three faces

adjacent of the charge is zero.

The flux through any one of the other three faces is

A. $q/3\varepsilon_0$

B. $q/6\varepsilon_0$

C. $\frac{q}{12}\varepsilon_0$

D. $q/24\varepsilon_0$

Answer: d

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4. A particle with charge Q coulomb, tied at the end of an inextensible string of length R metre, revolves in a vertical plane. At the centre of the circular trajectory, there is a fixed charge of magnitude Q coulomb . The mass of the moving charge M is such that $Mg = \frac{Q^2}{4\pi\varepsilon_0 R^2}$. If at the highest position of the particle, the tension of the string just vanishes, the horizontal velocity at the lowest point has to be

A. 0

B. $2\sqrt{gR})$

C. $\sqrt{2gR})$

D. $\sqrt{5gR})$

Answer: b

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5. A unit negative charge with mass resides at the midpoint of the straight line of length 2a adjoining two fixed charges of magnitude $+Q$ each. If it is given a very small displacement

$x(x << a)$ in a direction perpendicular to the straight line, it will

A. come back to its original position and stay there

B. execute oscillations with frequency $\frac{1}{2\pi}\sqrt{\frac{Q}{4\pi\varepsilon_0 Ma^3}}$

C. fly to infinity

D. execute oscillations with frequency $\frac{1}{2\pi}\sqrt{\frac{Q}{4\pi\varepsilon_0 Ma^2}}$

Answer:

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6. A particle with charge e and mass m, moving along the X-axis with a uniform speed u enters a region where a uniform electric field E is acting along the Y-axis. The particle starts to move in a parabola. Its focal length (neglecting any effect of gravity) is

A. $\frac{2mu^2}{eE}$

B. $\frac{eE}{2mu^2}$

C. $\frac{mu}{2eE}$

D. $\frac{mu^2}{2eE}$

Answer: d

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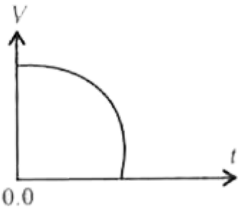
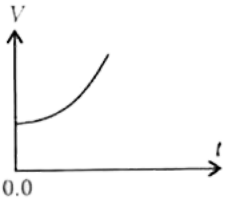
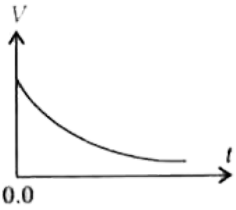
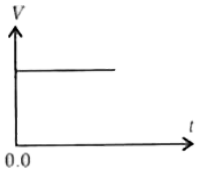
7. The insulated plates of a charged parallel plate capacitor (with small separation between the plates) are approaching each other due to electrostatic attraction . Assuming no other force to be operative and no radiation taking place , which of the

following graphs approximately shows the variation with time (t) of the potential difference (V) between the plates ?

A. 

B. 

C. 

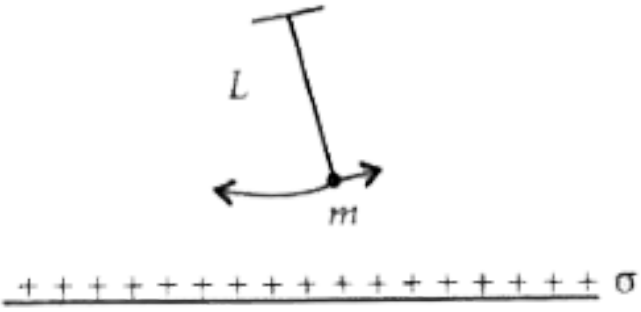
D. 

Answer: d

View Text Solution

8. The bob of a pendulum of mass 'm' suspended by an inextensible string of length L as shown in the figure carries a small charge 'q' . An infinite horizontal plane conductor with uniform surface charge density `sigma1 is placed below it . What will be the time period of the pendulum for small amplitude

oscillations ?



A. $2\pi\sqrt{\frac{L}{\left(g-\frac{mg}{\varepsilon_0\sigma}\right)}}$

B. $\sqrt{\frac{L}{\left(g-\frac{mg}{\varepsilon_0}\right)}}$

C. $\frac{1}{2\pi}\sqrt{\frac{L}{\left(g-\frac{q\sigma}{\varepsilon_0 m}\right)}}$

D. $2\pi\sqrt{\frac{L}{\left(g-\frac{q\sigma}{\varepsilon_0 m}\right)}}$

Answer: a

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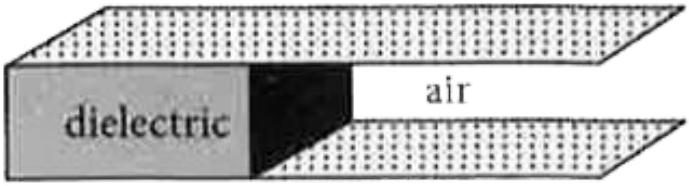
Wb Jee Previous Years Questions Category 3 One Or More Than One Opion Correct Type

1. Half of the space between the plates of a parallel plate capacitor is filled with a dielectric material of dielectric constant K . The ramaining half contains air as shown in the figure . The capacitor is now given a

charge Q . Then



A. electric field in the dielectric filled region is higher than that in the air - filled region.

B. on the two halves of the bottom plate the charge densities are unequal.

C. charge on the half of the top plate above the air filled part is $\frac{Q}{K+1}$.

D. capacitance of the capacitor shown above is $(1+K)\frac{C_0}{2}$, where C_0 is the capacitance of the same capacitor with dielectric removed.

Answer: d

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2. Two charges $+q$ and $-q$ are placed at a distance a in a uniform electric field. The dipole moment of the combination is

$2aq\left(\cos\theta\hat{i}+\sin\theta\hat{j}\right)$, where θ is the angle between the direction of the field and the line joining the two charges. which of the following statement (s) is/are correct ?

A. The torque exerted by the field on the dipole vanishes.

B. the net force on the dipole vanishes.

C. The torque is independent of the choice of coordinates.

D. The net force is independent of 'a'.

Answer: (b,c,d)

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3. A charged particle of mass m_1 and charge q_1 is revolving in a cricle of radius r. another charged particle of charge q_2 and mass m_2 is situated at the centre of the circle. If the velocity and time period of the revolving particle be v and T respectively, then,

A. $v = \sqrt{\frac{q_1 q_2 r}{4\pi\varepsilon_0 m_1}}$

B. $v = \frac{1}{m_1}\sqrt{\frac{q_1 q_2}{4\pi\varepsilon_0 r}}$

C. $T = \sqrt{\frac{16\pi^3\varepsilon_0 m_2 r^3}{q_1 q_2}}$

D. $T = \sqrt{\frac{16\pi^3\varepsilon_0 m_2 r^3}{q_1 q_2}}$

Answer:

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4. Two positive charges Q and 4Q are placed at points A and B respectively, where B is at a distance d units to the right of A. The total electric potential due to these charges is

minimum at P on the through A and B. What is (are) the distance(s) of P from A?

A. $\frac{d}{3}$ units to the right of A

B. $\frac{d}{3}$ units to the left of A

C. $\frac{d}{5}$ units to the right of A

D. d uints to the left of A.

Answer: a

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