



PHYSICS

BOOKS - DC PANDEY PHYSICS (HINGLISH)

ELECTROSTATICS

Jee Main

1. Figure represents a square carrying charges $+q$, $+q$, $-q$, $-q$ at its four corners as shown. Then the potential will be zero at points



A. A, B, C, P and Q

B. A, B and C

C. A, P, C and Q

D. P, B and Q

Answer: B



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2. A particle of charges Q and mass m travels through a potential difference V from rest. The final momentum of the particle is

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

B. $2Q\sqrt{mV}$

C. $\sqrt{2mQV}$

D. $\sqrt{\frac{2QV}{m}}$

Answer: C



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3. Three concentric conducting spherical shells carry charges as : $+4Q$ on the inner shell, $-2Q$ on the middle shell and $-5Q$ on the outer shell. The

charge on the inner surface of the outer shell is

- A. 0
- B. $4Q$
- C. $-Q$
- D. $-2Q$

Answer: D



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4. Figure shows thick metallic sphere. If it is given a charge $+Q$, then electric field will be present in the region



- A. $r < R_1$ only
- B. $r > R_2$ only
- C. $r < R_1$ and $r > R_2$

$$D. R_1 < r < R_2$$

Answer: C



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5. The work done against electric in increasing the potential difference of a condenser from 20 V to 40 V is W . The work done in increasing its potential difference from 40 V to 50 V will be

A. $4W$

B. $\frac{3W}{4}$

C. $2W$

D. $\frac{W}{2}$

Answer: C



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6. The plate separation in a parallel plate condenser and plate area is A. If it is charged to V volt battery is disconnected then the work done increasing the plate separation to 2d will be

A. $\frac{3}{2} \frac{\epsilon_0 AV^2}{d}$

B. $\frac{\epsilon_0 AV^2}{d}$

C. $\frac{2\epsilon_0 AV^2}{d}$

D. $\frac{\epsilon_0 AV^2}{2d}$

Answer: D



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7. The effective capacity with the following figure between the points P and Q will closest to



A. $3\mu F$

B. $5\mu F$

C. $2\mu F$

D. $1\mu F$

Answer: D



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8. A parallel plate condenser is connected to a battery of e.m.f. 4 volt. If a plate of dielectric constant inserted into it, then the potential difference on condenser will be

A. 0.5 V

B. 2 V

C. 4V

D. 32 V

Answer: C



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9. In the above problem, if the battery is disconnected before inserting the dielectric, then difference will be

A. 0.5 V

B. 2 V

C. 4 V

D. 32 V

Answer: A



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10. Two parallel plate condensers of capacity $20mF$ and $30mF$ are charged to the potentials of 30 V and respectively. If likely charged plates are conneted together then the common potential difference be

A. 100 V

B. 50 V

C. 24 V

D. 10 V

Answer: C



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11. The minimum number of condensers each capacitance of $2\mu F$, in order to obtain result capacitance of $5\mu F$ will be

A. 4

B. 5

C. 6

D. 3

Answer: A



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12. The equivalent capacitance between points P and Q of the combination shown in figure is



A. C

B. $2C$

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

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

Answer: B



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13. The total energy stored in the condenser system shown in the figure will be



A. $2 \times 10^{-6} J$

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

C. $8 \times 10^{-6} J$

D. $16 \times 10^{-6} J$

Answer: C



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14. Four charges are arranged at the corners of a square ABCD, as shown.

The force on a positive charge kept at the centre of the square is



A. zero

B. along diagonal AC

C. along diagonal BD

D. perpendicular to the side AB

Answer: A



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15. Figure shows the electric field lines around an electric dipole. Which of the arrows best represents the electric field at point P?



A. 

B. 

C. 

D. 

Answer: A



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16. Point P lies on the axis of a dipole . If the dipole is rotated by 90° anticlockwise , the electric field vector \vec{E} at P will rotate by .

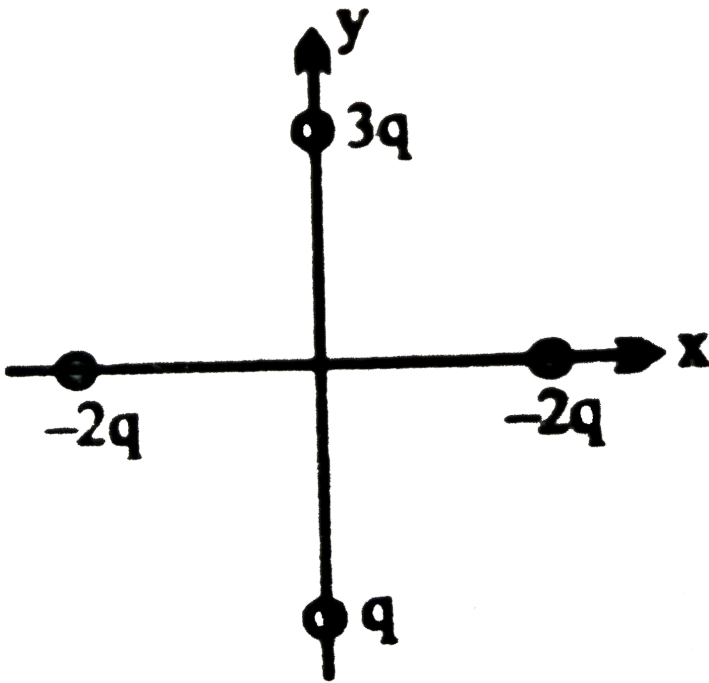
- A. 90° clockwise
- B. 180° clockwise
- C. 90° anticlockwise
- D. 180° anticlockwise

Answer: A



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17. 4 charges are placed each at a distance a from origin . The dipole moment of configuration is .

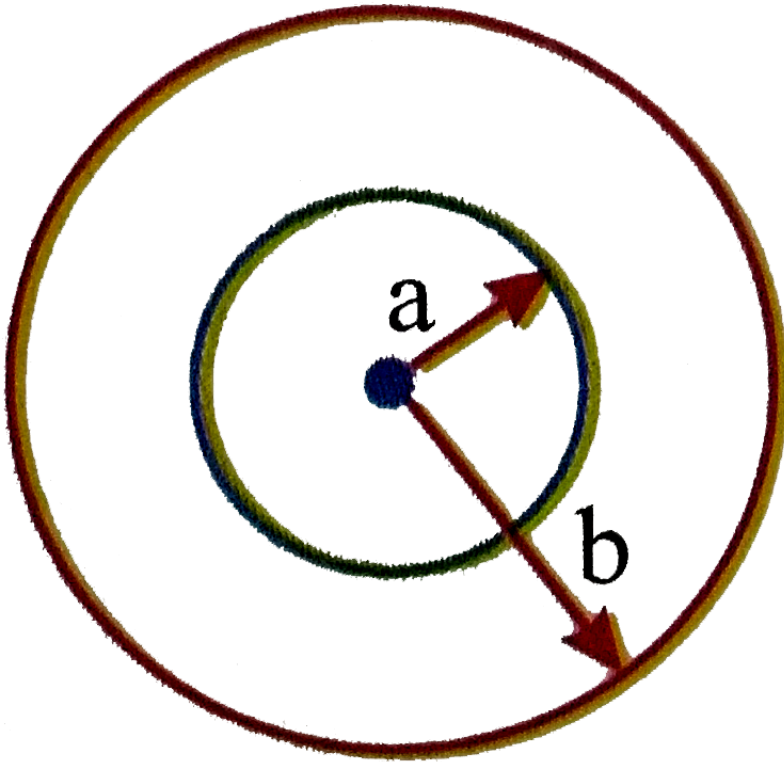


- A. $2qa\hat{j}$
- B. $3qa\hat{j}$
- C. $2aq(\hat{i} + \hat{j})$
- D. $2aq(\hat{i} - \hat{j})$

Answer: A

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18. If the electric potential of the inner metal sphere is 10 volt & that of the outer shell is 5 volt then the potential at the centre will be



A. 10 V

B. 5 V

C. 15 V

D. 0

Answer: A



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19. A solid sphere of radius R has charge q uniformly distributed over its volume. The distance from its surface at which the electrostatic potential is equal to half of the potential at the centre is

A. R

B. $R/2$

C. $R/3$

D. $2R$

Answer: C



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20. A particle of charge $1\mu C$ & mass $1mg$ moving with a velocity of $4m/s$ is subjected to a uniform electric field of magnitude $300Vm$ for 10 sec.

Then it's final speed cannot be :

A. 0.5 m/s

B. 4 m/s

C. 3 m/s

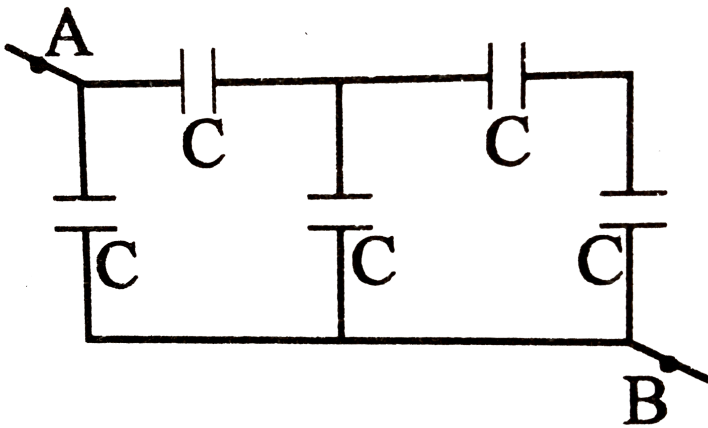
D. 6 m/s

Answer: A



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21. What is the equivalent capacitance of the system of capacitors between A & B



A. $\frac{7}{6}C$

B. $1.6C$

C. C

D. None of these

Answer: B

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22. Three capacitors $2\mu F$, $3\mu F$ and $5\mu F$ can withstand voltages to $3V$, $2V$ and $1V$ respectively. Their series combination can withstand a maximum

voltage equal to

A. 5 V

B. $31/6$ V

C. $26/5$ V

D. 6 V

Answer: B



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23. Two charged particles are placed at a distance 1.0 cm apart. What is the minimum possible magnitude of the electric force acting on each charge?

A. $2.3 \times 10^{-28} N$

B. $6.2 \times 10^{-34} N$

C. $1.02 \times 10^{-26} N$

$$D. 4.2 \times 10^{-27} N$$

Answer: A



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24. Electric field on the axis of a small electric dipole at a distance r is \vec{E}_1 and \vec{E}_2 at a distance of $2r$ on a line of perpendicular bisector is

A. $E_2 = -E_1/8$

B. $E_1 = -E_1/16$

C. $E_2 = -E_1/4$

D. $E_2 = E_1/8$

Answer: B



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25. The point charges $-2q$, $-2q$ and $+q$ are put on the vertices of an equilateral triangle of side a . Find the work done by some external force in increasing the separation to $2a$ (in joules).

A. $\frac{1}{4\pi\epsilon_0} \cdot \frac{2q^2}{a}$

B. negative

C. zero

D. $\frac{1}{4\pi\epsilon_0} \cdot \frac{3q^2}{a}$

Answer: C



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26. A point charge q is placed inside a conducting spherical shell of inner radius $2R$ and outer radius $3R$ at a distance of R from the centre of the shell. The electric potential at the centre of shell will (potential at infinity is zero).

A. $\frac{q}{2R}$

B. $\frac{4q}{3R}$

C. $\frac{5q}{6R}$

D. $\frac{2q}{3R}$

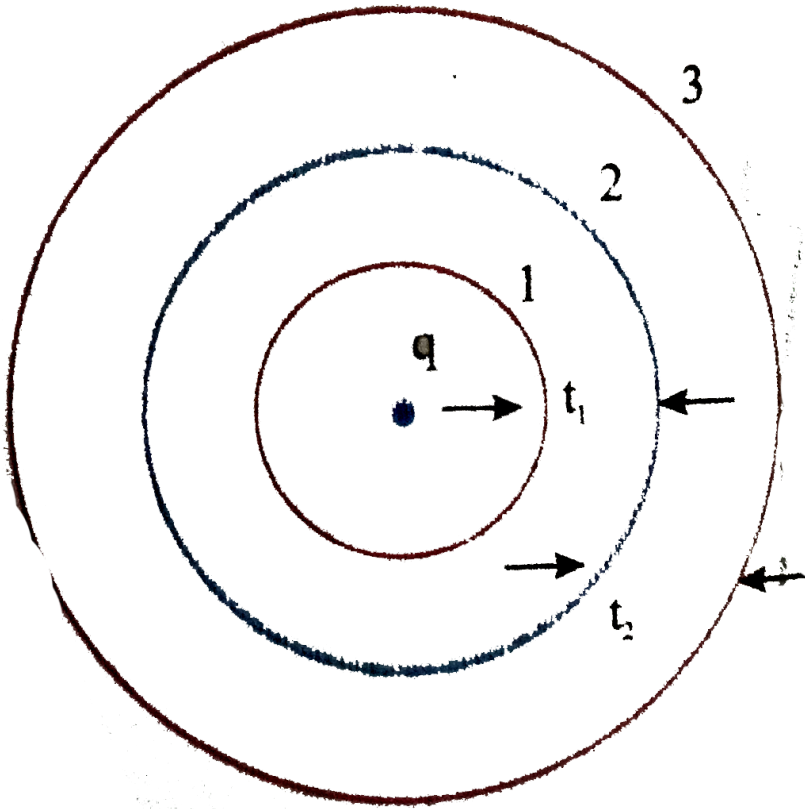
Answer: C



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27. Figures shows three spherical and equipotential surfaces 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. $t_1 = t_2$

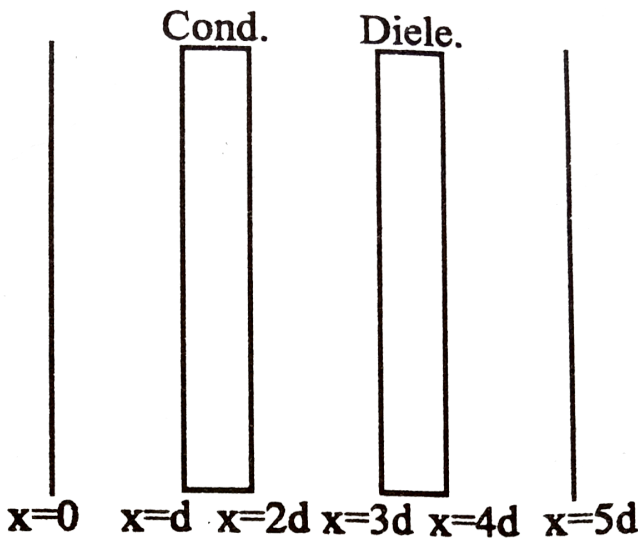
B. $t_1 > t_2$

C. $t_2 < t_2$

D. $t_1 \leq t_2$

Answer: C

28. The distance between plates of a parallel plate capacitor is $5d$. Let the positively charged plate is at $x = 0$ and negatively charged plate is at $x = 5d$. Two slabs one fo conductor and other of a dielectric of equal thickness d are inserted between the plates as shown in figure. Potential versus distance graph will look like:



A. 

B. 

C. 

D. 

Answer: B



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

A. zero

B. $\frac{1}{4\pi\epsilon_0} \frac{q}{r}$

C. $\frac{1}{4\pi\epsilon_0} \frac{qR}{r^2}$

D. $\frac{1}{4\pi\epsilon_0} \frac{qr^2}{R}$

Answer: B



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30. An electric field is given by $\vec{E} = (y\hat{i} + x\hat{j})\frac{N}{C}$. Find the work done (in J) in moving a $1C$ charge from $\vec{r}_A = (2\hat{i} + 2\hat{j})$ m to $\vec{r}_B = (4\hat{i} + \hat{j})$ m.

A. $+4J$

B. $-4J$

C. $+8J$

D. zero

Answer: D



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31. Capacity of a spherical capacitor is C_1 when inner sphere is charged and outer sphere is earthed and when inner sphere is earthed and outer sphere charged. Then $\frac{C_1}{C_2}$ is (a = radius of inner sphere b = radius of outer sphere)

A. 1

B. $\frac{a}{b}$

C. $\frac{b}{a}$

D. $\frac{a + b}{a - b}$

Answer: B



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32. The capacitance of a capacitor between $\frac{4}{3}$ times its original value if a dielectric slab of thickness $t = \frac{d}{2}$ is inserted between the plates (d is the separation between the plates). What is the dielectric constant of the slab?

A. 2

B. 4

C. 6

D. 8

Answer: A



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33. The plates of a parallel plate capacitor are charged up to 100v . Now, after removing the battery, a 2mm thick plate is inserted between the plates. Then, to maintain the same potential difference, the distance between the capacitor plates is increased by 1.6mm . The dielectric constant of the plate is .

A. 6

B. 8

C. 5

D. 4

Answer: C



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34. A capacitor is connected to a battery. The force of attraction between the plates when the separation between them is halved.

- A. remains the same
- B. becomes eight times
- C. becomes four times
- D. becomes two times

Answer: C



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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



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36. 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. $U_1 = U_2$

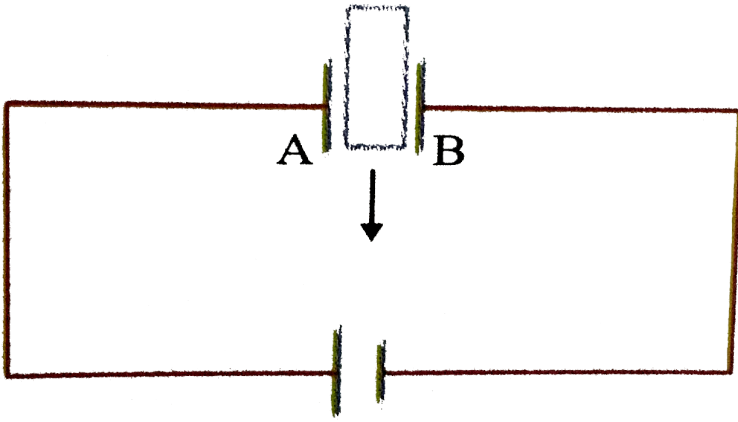
D. $U_2 \geq U_1$

Answer: A



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37. An insulator plate is passed between the plates of a capacitor. Then current



- A. always flows from A to B
- B. always flows from B to A
- C. first flows from A to B and then from B to A
- D. first flows from B to A and then from A to B

Answer: D

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38. Two point charges $2q$ and $8q$ are placed at a distance r apart. Where should a third charge $-q$ be placed between them so that the electrical potential energy of the system is a minimum

- A. at a distance of $r/3$ from $2q$
- B. at a distance of $2r/3$ from $2q$
- C. at a distance of $r/16$ from $2q$
- D. None of the above

Answer: D



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39. 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. 50 V

B. 80 V

C. 100 V

D. 60 V

Answer: D



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40. A parallel plate capacitor has two layers of dielectrics as shown in figure. This capacitor is connected across a battery, then the ratio of potential difference across the dielectric layers is



A. $4/3$

B. $1/2$

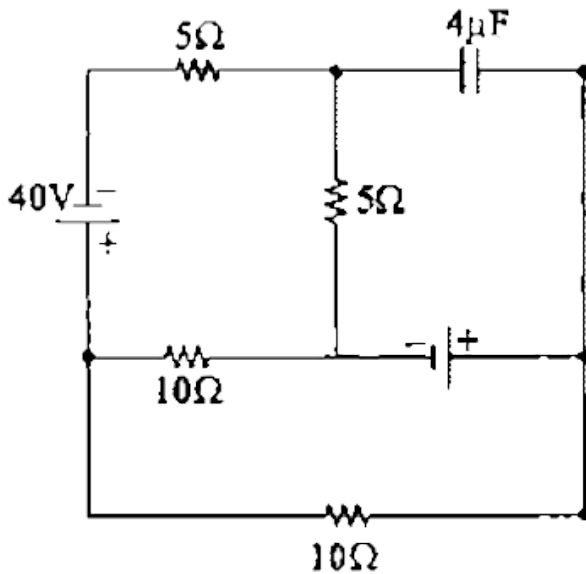
C. $1/3$

D. $3/2$

Answer: D

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41. In the circuit shown in figure 3.141, find the energy stored in $4\mu F$ capacitor in steady state.



A. $20\mu C$

B. $40\mu C$

C. $10\mu C$

D. $120\mu C$

Answer: A



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42. In the given arrangement of the capacitors, one $3\mu F$ capacitor has got $600\mu J$ of energy. Then the potential difference across $2\mu F$ capacitor is



A. 40 V

B. 15 V

C. 60 V

D. 45 V

Answer: D



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43. An alpha particle of energy $5MeV$ is scattered through 180° by a heavy nucleus. The distance of closest approach is of the order of

A. 1 \AA

B. 10^{-10} cm

C. 10^{-12} cm

D. 10^{-15} cm

Answer: C



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44. A hollow metal sphere of radius 5 cm is charged such that the potential on its surface is $10V$. The potential at the distance 3 cm from the centre of the sphere is:

A. zero

B. 10 V

C. same as at a point 5 cm away from the surface

D. same as at a point 25 cm away from the surface

Answer: B



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45. Two equal negative charges $-q$ are fixed at points $(0, -a)$ and $(0, a)$ on y-axis. A positive charge Q is released from rest at point $(2a, 0)$ on the x-axis. The charge Q will

A. execute simple harmonic motion about the origin move to the origin and remain at rest

B. move to infinity

C. execute oscillatory but not simple of the harmonic motion

D.

Answer: D



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

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

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

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

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

Answer: B



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47. A charge q is placed at the centre of the cubical vessel (with one face a open) as shown in figure. The flux of the electric field through the complete vessel is



A. $q/6\epsilon_0$

B. q/ϵ_0

C. $5q/6\epsilon_0$

D. $q/4\epsilon_0$

Answer: C



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

- | | | | |
|----|----------------------------|--|--------------------------|
| A. | Charge
remains constant | Potential Difference
remains constant | Capacitance
decreases |
|----|----------------------------|--|--------------------------|

- | | | | |
|----|------------------|----------------------|-------------|
| | Charge | Potential Difference | Capacitance |
| B. | remains constant | increases | decreases |
| | Charge | Potential Difference | Capacitance |
| C. | remains constant | decreases | increases |
| | Charge | Potential Difference | Capacitance |
| D. | increases | decreases | increases |

Answer: B



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49. On placing dielectric slab between the plates of an isolated charged condenser its

A.

Capcitanace decreases	Potential Difference decreases	Energy stored increases	Electric F increas
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B.

Capcitanace increases	Potential Difference increases	Energy stored increases	Electric F decreas
--------------------------	-----------------------------------	----------------------------	-----------------------

C.

Capcitanace increases	Potential Difference decreases	Energy stored decreases	Electric F decreas
--------------------------	-----------------------------------	----------------------------	-----------------------

D.

Capcitance
decreases

Potential Difference
decreases

Energy stored
increases

Electric F
remain

Answer: C



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50. The time constant of charging of the capacitor charging of the capacitor shown in figure is



A. $\frac{2}{3}RC$

B. $2RC$

C. $3RC$

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

Answer: B



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51. Time constant of a C-R circuit is $\frac{2}{\ln(2)}$ second. Capacitor is discharged at time $t = 0$. The ratio of charge on the capacitor at time $t = 2s$ and $t = 6s$ is

A. 3:1

B. 8:1

C. 4:1

D. 2:1

Answer: C

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52. In the circuit shown in figure $C_1 = 2C_2$. Capacitance C_1 is charged to a potential of V . The current in the circuit just after the switch S is closed is



A. zero

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

C. infinite

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

Answer: D



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53. A $4\mu F$ capacitor, a resistance of $2.5M\Omega$ is in series with $12V$ battery.

Find the time after which the potential difference across the capacitor is

3 times the potential difference across the resistor. [Given $\ln(2) = 0.693$]

A. 13.86 s

B. 6.93 s

C. 7 s

D. 14 s

Answer: A



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54. A certain charge Q is divided into two parts q and $Q - q$, which are then separated by a certain distance. What must q be in terms of Q to maximize the electrostatic repulsion between the two charges?

A. $(Q/q) = (4/1)$

B. $(Q/q) = (2/1)$

C. $(Q/q) = (3/4)$

D. $(Q/q) = (5/1)$

Answer: B



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55. Two particles (free to move) with charges $+q$ and $+4q$ are a distance L apart. A third charge is placed so that the entire system is in equilibrium.

(a) Find the location, magnitude and sign of the third charge.

(b) Show that the equilibrium is unstable.

A. $Q = \frac{4}{9}q$ (negative) at $\frac{l}{3}$

B. $Q = \frac{4}{9}q$ (positive) at $\frac{l}{3}$

C. $Q = q$ (positive) at $\frac{l}{3}$

D. $Q = q$ (negative) at $\frac{l}{3}$

Answer: A



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56. Four equal positive charge are fixed at the vertical of a square of side L . Z-axis is perpendicular to plane of the square. The point $Z = 0$ is the other. The plot of electric field due to the charges, as one moves on the Z-axis is

A. 

B. 

C. 

D. 

Answer: D

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57. Four equal charges of magnitudes q each are placed at four corners of a square with its centre at origin and lying in y - z plane. A fifth charge $+Q$ is moved along x -axis. The electrostatic potential energy (U) varies on x -axis as

A. 

B. 

C. 

D. 

Answer: B



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58. Two small conductors A and B are given charges q_1 and q_2 respectively. Now they are placed inside a hollow metallic conductor C carrying a charge Q . If all the three conductors A, B and C are connected by a conducting wire as shown, the charges on A, B and C will be respectively :



A. $\frac{q_1 + q_2}{2}, \frac{q_1 + q_2}{2}, Q$

B. $\frac{Q + q_1 + q_2}{3}, \frac{Q + q_1 + q_2}{3}, \frac{Q + q_1 + q_2}{3}$

C. $\frac{q_1 + q_2 + Q}{2}, \frac{q_1 + q_2 + Q}{3}, 0$

D. $0, 0, Q + q_1 + q_2$

Answer: D



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59. Find power produced in 5Ω resistance in steady state after closing the switch S :



- A. 10 W
- B. 20 W
- C. 30 W
- D. zero

Answer: D

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60. Two particles are held in equilibrium by the gravitational and electrostatic forces between them. Particle-A has mass m_a and charge q_a and particle-B has mass m_b and charge q_b . The distance between the charges may cause the charges to accelerate towards one another ?

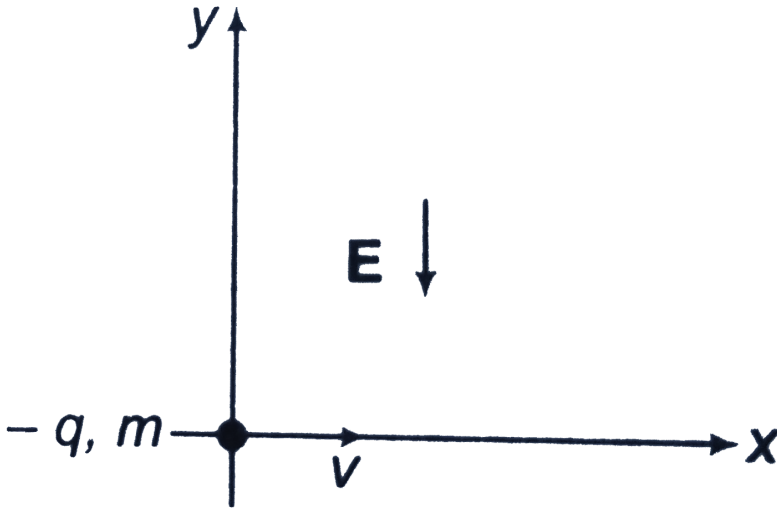
- A. m_a is doubled and m_b is halved
- B. m_a is doubled and m_b is doubled
- C. q_a is doubled and q_b is doubled
- D. d is doubled

Answer: B

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61. A particle of mass m and charge $-q$ is projected from the origin with a horizontal speed v into an electric field of intensity E directed downward.

Choose the wrong statement. Neglect gravity



- A. The kinetic energy after a vertical displacement y is qEy
- B. The horizontal and vertical components of acceleration are

$$a_x = 0, a_y = \frac{qE}{m}$$

- C. The equation of trajectory is $y = \frac{1}{2} \left(\frac{qEx^2}{mv^2} \right)$
- D. The horizontal a time t $x = vt$ and $y = \frac{1}{2} a_y t^2$

Answer: A



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62. A proton a deuteron and an α particle are accelerated through potentials of V , $2V$ and $4V$ respectively. Their velocity will bear a ratio

- A. 1:1:1
- B. $1:\sqrt{2}:1$
- C. $\sqrt{2}:1:1$
- D. $1:1:\sqrt{2}$

Answer: D



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63. Four charges of $6\mu C$, $2\mu C$, $-12\mu C$ and $4\mu C$ are placed at the corners of a square of side 1m. The square is in x-y plane and its centre is at origin. Electric potential due to these charges is zero everywhere or the line

- A. $x = y, z = 0$

B. $z = 0 = z$

C. $x = 0 = y$

D. $x = z, y = 0$

Answer: C



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64. Four point charges $+q, +q, -q$ and $-q$ are placed on the corners of a square of side length 'a' as shown in the figure. The magnitude of electric field at a point which is at a distance $x (> a)$ from the centre along a line perpendicular to the plane of the square and passing through the centre is



A. $\frac{\sqrt{2}qa}{4\pi\epsilon x^2}$

B. $\frac{qa}{2\pi\epsilon_0 x^3}$

C. $\frac{\sqrt{2}qa}{2\pi\epsilon_0 x^3}$

D. $\frac{qa}{4\pi\epsilon_0 x^3}$

Answer: B

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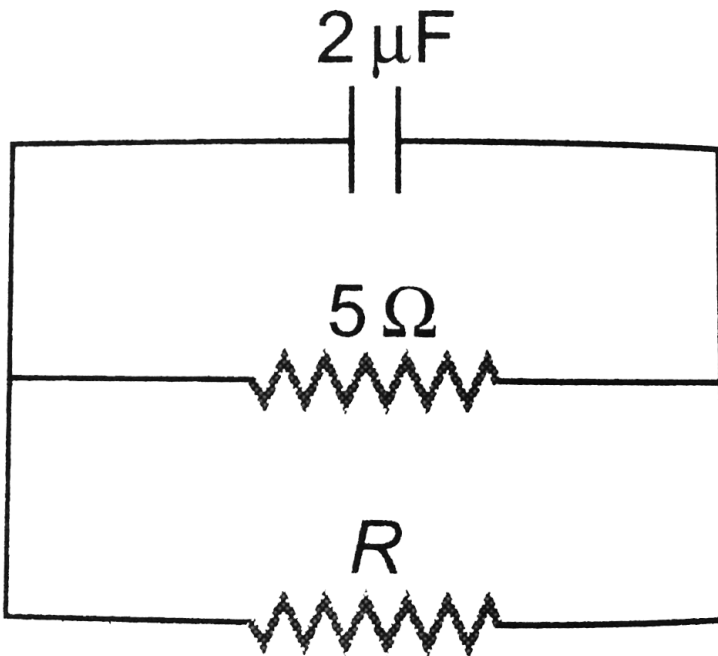
65. Two identical small conducting spheres having unequal positive charges q_1 and q_2 are separated by a distance r . If they are now made to touch each other and then separated again to the same distance, the electrostatic force between them in this case will be

- A. less than before
- B. same as before
- C. more than before
- D. can't predict

Answer: C

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66. A capacitor of capacitance $2\mu F$ is charged to a potential difference of $5V$. Now, the charging battery is disconnected and the capacitor is connected in parallel to a resistor of 5Ω and another unknown resistor of resistance R as shown in figure. If the total heat produced in 5Ω resistance is $10\mu J$ then the unknown resistance R is equal to



- A. 10Ω
- B. 15Ω
- C. $(10/3)\Omega$

D. 7.5Ω

Answer: C



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67. In the figure, two point charges $+q$ and $-q$ are placed on the x-axis at $(+a, 0)$ and $(-a, 0)$ respectively. A tiny dipole of dipole moment (p) is kept at the origin along the y-axis. The torque on the dipole equals



A. zero

B. $\frac{qp}{2\pi\epsilon_0 a^2}$

C. $\frac{qp}{4\pi\epsilon_0 a^2}$

D. $\frac{qp}{\pi\epsilon_0 a^2}$

Answer: B



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68. Four point charges are kept on y-axis at $(0, a)$, $(0, 2a)$, $(0, -a)$ and $(0, -2a)$ as shown in the figure. Which of the following graphs, best represents the variation of electrostatic potential V as a function of distance x from the origin, on the x-axis.



A.

B.

C.

D. None of these

Answer: D



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69. An electron goes from one equi-potential surface another along one of the four paths shown in diagram. Rank the paths according to the

work by the electrostatic force from the least to greatest.



A. 1,2,3,4

B. 4,3,2,1

C. 1,3 (4 and 2 equal)

D. (4 and 2 equal),3,1

Answer: D



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70. Three large conducting plates carrying charges Q , $2Q$ and $3Q$ on them, are placed parallel to each other as shown in the figure. If U_1 and U_2 denote electrostatic potential energy in the space between 1^{st} and 2^{nd} plane and 2^{nd} and 3^{rd} plate respectively as indicated, then $\frac{U_2}{U_1}$ equals

\`

A. 1

B. 0

C. $2/3$

D. $3/2$

Answer: B



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71. A metal sphere of radius 'a' is having charge $+Q$. Now it is connected by a conducting wire concentric spherical shell of radius '2a'. Then the potential at the surface of outer shell is



Here, $K = \frac{1}{4\pi\epsilon_0}$

A. $\frac{KQ}{a}$

B. $\frac{KQ}{2a}$

C. $\frac{3}{2} \frac{KQ}{a}$

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

Answer: B



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Jee Advanced

1. The potential field of an electric field $\vec{E} = (y\hat{i} + x\hat{j})$ is

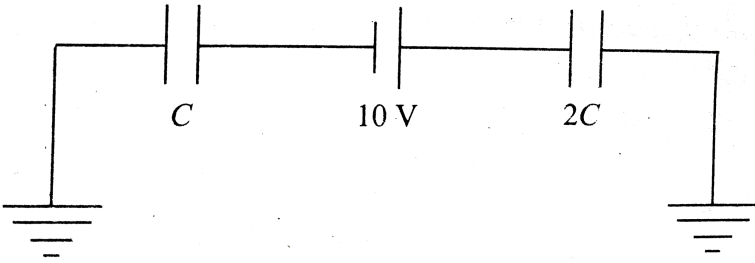
- A. $V = -xy + \text{constant}$
- B. $V = -(x + y) + \text{constant}$
- C. $V = -(x^2 + y^2) + \text{constant}$
- D. $V = \text{constant}$

Answer: A



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2. In the circuit shown in, $C = 6\mu F$. The charge stored in the capacitor of capacity C is`



- A. zero
- B. $90\mu C$
- C. $40\mu C$
- D. $60\mu C$

Answer: C



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3. A capacitor of capacity $C_1 = 1\mu F$ is charged to a potential of 100 V. The charging battery is then removed and it is connected to another

capacitor of capacity $C_2 = 2\mu F$. One plate of C_2 is earthed as shown in figure. The charges on C_1 and C_2 in steady state will be



A. $50\mu C, 50\mu C$

B. $100\mu C, zero$

C. $\frac{100}{3}\mu C, \frac{200}{3}\mu C$

D. zero, zero

Answer: B



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4. Assuming an expression for the potential of an isolated conductor, show that the capacitance of such a sphere will be increased by a factor n , if it is enclosed within an earthed concentric sphere, the ratio of the spheres being $\frac{n}{n-1}$.

A. $\frac{n^2}{n-1}$

B. $\frac{n}{n-1}$

C. $\frac{2n}{n+1}$

D. $\frac{2n+1}{n+1}$

Answer: B



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5. Three conducting spheres A, B and C are shown in figure. The radii of the spheres are a , b and c respectively. A and B connected by a conducting wire. The capacity of the system is



A. $4\pi\epsilon_0(a + b + c)$

B. $4\pi\epsilon_0\left(\frac{bc}{c-b}\right)$

C. $4\pi\epsilon_0\left(\frac{1}{a} + \frac{1}{b} + \frac{1}{c}\right)$

D. $4\pi\epsilon_0\left(\frac{abc}{ab + bc + ca}\right)$

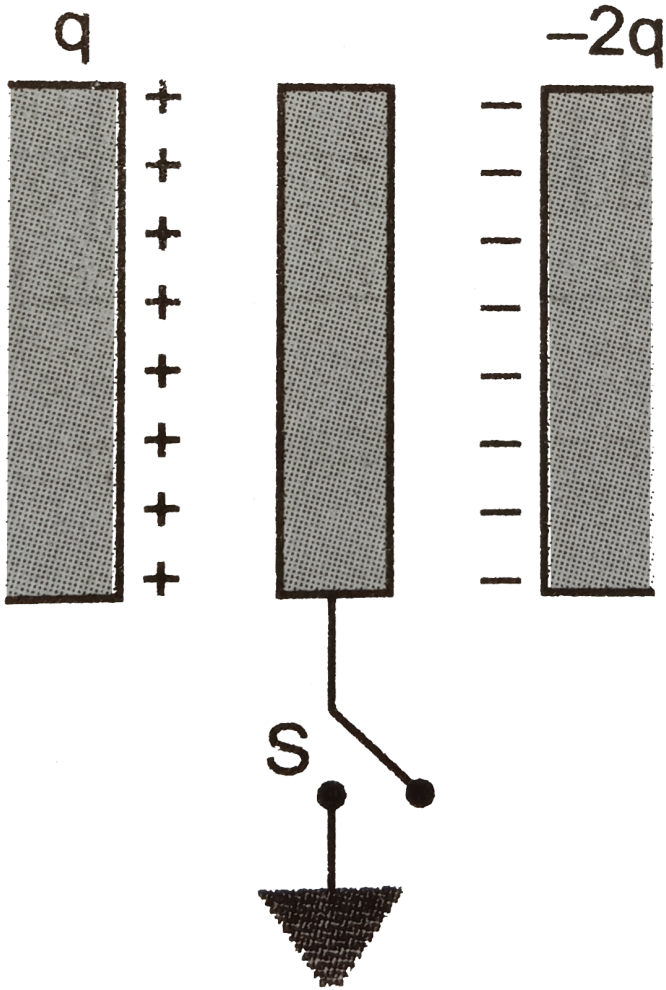
Answer: B



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6. The metal plate on the left in Fig, carries a charge $+q$. The metal plate on the right has a charge of $-2q$. What charge will flow through S when

it is closed if the central plate is initially neutral ?



A. zero

B. $-q$

C. $+q$

D. $+2q$

Answer: C



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7. A particle of mass m and 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 ($h < R$, R = radius of earth) is : (assume U to be zero on surface of earth)

A. 

B. 

C. 

D. 

Answer: A



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8. 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. $\frac{V}{r}$

B. $\frac{R^2V}{r^3}$

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

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

Answer: C



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9. 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. $2E, 2V$

B. $4E, 2V$

C. $4E, 4V$

D. $2E, 4V$

Answer: B



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10. In the above problem, radius is halved keeping surface charge density to be constant. Then the new values will be

A. $E, \frac{V}{2}$

B. $W, 2V$

C. $2E, V$

D. $\frac{E}{2}, V$

Answer: A

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11. Two concentric spherical conducting shells of radii R and $2R$ are carrying charges q and $2q$, respectively. Both are now connected by a conducting wire. Find the change in electric potential (inV) on the outer shell.

A. zero

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

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

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

Answer: A

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12. A conducting shell of radius R carries charge $-Q$. A point charge $+Q$ is placed at the centre. The electric field E varies with distance r (from the

centre of the shell) as

A. 

B. 

C. 

D. 

Answer: A



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13. The gap between the plates of a parallel plate capacitor is filled with glass of resistivity ρ . The capacitance of the capacitor without glass equals C . The leakage current of the capacitor when a voltage V is applied to it is

A. $\frac{V\rho}{C\varepsilon_0}$

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

C. $\frac{V\varepsilon_0}{C\rho}$

D. $\frac{CV\rho}{\epsilon_0}$

Answer: B



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14. If the capacitance of each capacitor is C , then effective capacitance of the shown network across any two junction is



A. $2C$

B. C

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

D. $5C$

Answer: A



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15. Two identical positive charges are fixed on the y -axis, at equal distances from the origin O . A particle with a negative charge starts on the x -axis at a large distance from O . It moves along the x -axis, passes through O , and moves far away from O on the other side. Its acceleration a is taken as positive along its direction of motion. Plot acceleration a of the particle against its x -coordinate.

A. 

B. 

C. 

D. 

Answer: B



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16. Two identical point charges are placed at a separation of d . P is a point on the line joining the charges, at a distance x from any one charge. The field at P is E , E is plotted against x for value of x from

close to zero to slightly less than d . Which of the following represents the resulting curve

A. 

B. 

C. 

D. 

Answer: D

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17. An air capacitor consists of two parallel plates B as shown in the figure. Plate A is given a charge and plate B is given a charge $3Q$. P is the plane of the capacitor. If C_0 is the capacitor capacitor, then



A. $V_P - V_A = \frac{Q}{4C_0}$

B. $V_P - V_A = \frac{Q}{2C_0}$

$$C. V_P - V_A = -\frac{Q}{C_0}$$

$$D. V_P - V_B = -\frac{Q}{4C_0}$$

Answer: B



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18. A hollow sphere of radius $2R$ is charged to V volts and another smaller sphere of radius R is charged to $V/2$ volts. Now the smaller sphere is placed inside the bigger sphere without changing the net charge on each sphere. The potential difference between the two spheres would be

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

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

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

D. V

Answer: B



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19. A point charge q is placed at a distance of r from the centre O of an uncharged spherical shell of inner radius R and outer radius $2R$. The electric potential at the centre of the shell will be



A. $\frac{q}{4\pi\epsilon_0} \left(\frac{1}{r} - \frac{1}{2R} \right)$

B. $\frac{q}{4\pi\epsilon_0 r}$

C. $\frac{q}{4\pi\epsilon_0} \left(\frac{1}{r} + \frac{1}{2R} \right)$

D. None of these

Answer: A



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20. Find the equivalent capacitance between A and B



A. $5\mu F$

B. $4\mu F$

C. $3\mu F$

D. $2\mu F$

Answer: A



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21. A small electric dipole is placed at origin with its dipole moment directed along positive x-axis .The direction of electric field at point $(2, 2\sqrt{2}, 0)$

A. along z-axis

B. along y-axis

C. along negative y-axis

D. along negative z-axis

Answer: B



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22. Four equal charges of magnitudes q each are placed at four corners of a square with its centre at origin and lying in y - z plane. A fifth charge $+Q$ is moved along x -axis. The electrostatic potential energy (U) varies on x -axis as

A. 

B. 

C. 

D. 

Answer: B



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23. A solid conducting sphere of radius 10cm is enclosed by a thin metallic shell of radius 20cm . A charge $q = 20\mu\text{C}$ is given to the inner sphere is connected to the shell by a conducting wire.

A. 12 J

B. 9 J

C. 24 J

D. zero

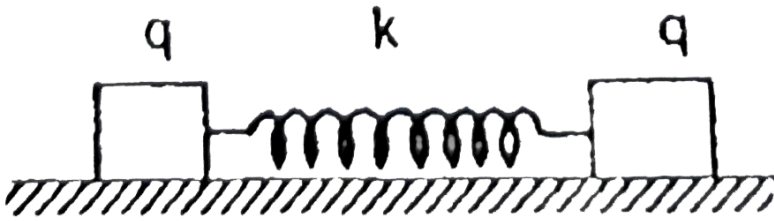
Answer: B



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24. 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)



A. $\frac{q}{4r} \sqrt{\frac{1}{\pi\epsilon_0 r}}$

B. $\frac{q}{2r} \sqrt{\frac{1}{\pi\epsilon_0 r}}$

C. $\frac{2q}{r} \sqrt{\frac{1}{\pi\epsilon_0 r}}$

D. None of these

Answer: D



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25. A capacitor is filled with an insulator and a certain potential difference is applied to its plates. 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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26. In the circuit shown in figure potential difference between A and B is



A. 30 V

B. 60 V

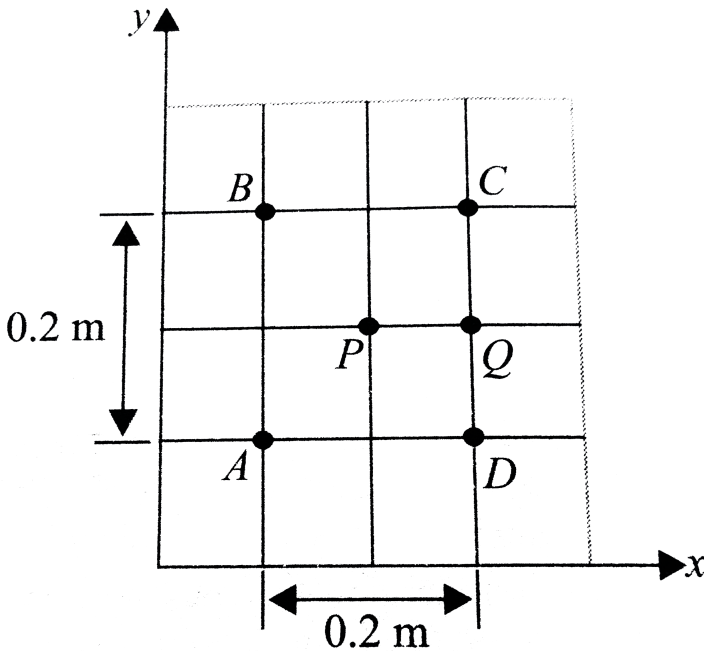
C. 10 V

D. 90 V

Answer: C

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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.



A. 10Vm^{-1} along PQ

B. $15\sqrt{2}\text{Vm}^{-1}$ along PA

C. 5Vm^{-1} along PC

D. 5Vm^{-1} along PA

Answer: B



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28. The dipole moment of a system of charge $+q$ distributed uniformly on an arc of radius R subtending an angle $\pi/2$ at its centre where another charge $-q$ is placed is :

A. $\frac{2\sqrt{2}qR}{\pi}$

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

C. $\frac{qR}{\pi}$

D. $\frac{2qR}{\pi}$

Answer: A



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29. There are four concentric shells A, B, C and D of radii a , $2a$, $3a$ and $4a$ respectively. Shells B and D are given charges $+q$ and $-q$ respectively.

Shell C is now earthed. The potential difference $V_A - V_C$ is $k = \left(\frac{1}{4\pi\epsilon_0} \right)$

A. $\frac{Kq}{2a}$

B. $\frac{Kq}{3a}$

C. $\frac{Kq}{4a}$

D. $\frac{Kq}{6a}$

Answer: D



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30. Two capacitor having capacitances $8\mu F$ and $16\mu F$ have breaking voltage $20V$ and $80V$. They are combined in series. The maximum charge they can store individually in the combination is

A. $160\mu C$

B. $200\mu C$

C. $320\mu C$

D. $480\mu C$

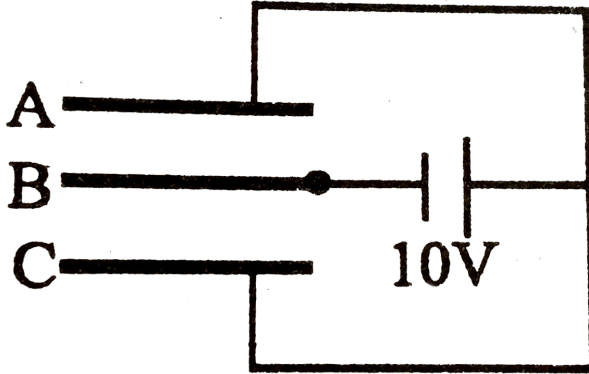
Answer: A



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31. Three plates A , B and C each of area $0.1m^2$ are separated by $0.885mm$ from each other as shown in the figure. A $10V$ battery is used

to charge the system. The energy stored in the system is



- A. $1\mu J$
- B. $10^{-1}\mu J$
- C. $10^{-2}\mu J$
- D. $10^{-3}\mu J$

Answer: B



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32. A capacitor of capacitance C is initially charged to a potential difference of V volt. Now it is connected to a battery of $2V$ with opposite polarity. The ratio of heat generated to the final energy stored in the capacitor will be

A. 1.75

B. 2.25

C. 2.5

D. 0.5

Answer: B



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33. A capacitor stores $60\mu C$ charge when connected across a battery. When the gap between the plates is filled with a dielectric, a charge of $120\mu C$ flows through the battery. The dielectric constant of the material inserted is:

A. 1

B. 2

C. 3

D. 4

Answer: C



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34. A charged capacitor is allowed to discharge through a resistor 2Ω by closing the switch S at the $t = 0$. At time $t = 2\mu s$, the reading of the falls half of its initial value. The resistance of ammeter is equal to



A. 0

B. 2Ω

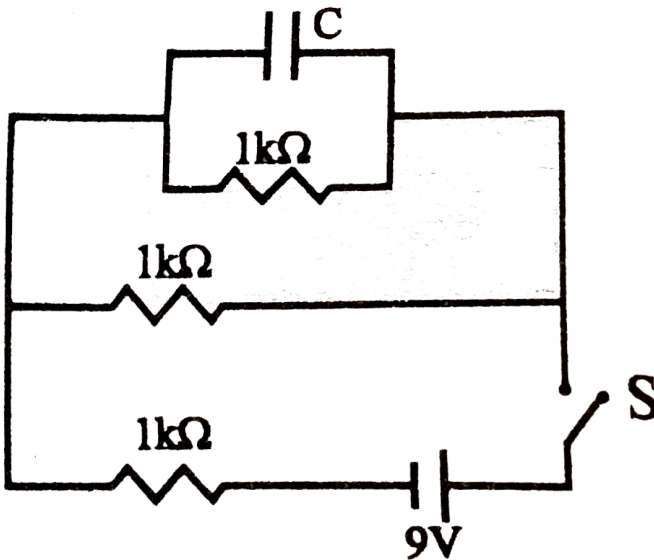
C. 4Ω

D. None of these

Answer: D

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35. A capacitor $C = 100\mu F$ is connected to three resistor each of resistance $1k\Omega$ and a battery of $emf 9V$.



The switch S has been closed for long time so as to charge the capacitor.

When switch S is opened, the capacitor discharges with time constant

A. 33 ms

B. 5 ms

C. 100 ms

D. 50 ms

Answer: D



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36. A charged particle of charge 'Q' is held fixed and another charged particle of mass 'm' and charge 'q' (of the same sign) is released from a distance 'r'. The impulse of the force exerted by the external agent on the fixed charge by the time distance between 'Q' and 'q' becomes $2r$ is

A. $\sqrt{\frac{Qq}{4\pi\epsilon_0 mr}}$

B. $\sqrt{\frac{Qqm}{4\pi\epsilon_0 r}}$

C. $\sqrt{\frac{Qqm}{\pi\epsilon_0 r}}$

D. $\sqrt{\frac{Qqm}{2\pi\epsilon_0 r}}$

Answer: B

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37. In a regular polygon of n sides, each corner is at a distance r from the centre. Identical charges are placed at $(n - 1)$ corners. At the centre, the intensity is E and the potential is V . The ratio V / E has magnitude

A. m

B. $r(n - 1)$

C. $(n - 1) / r$

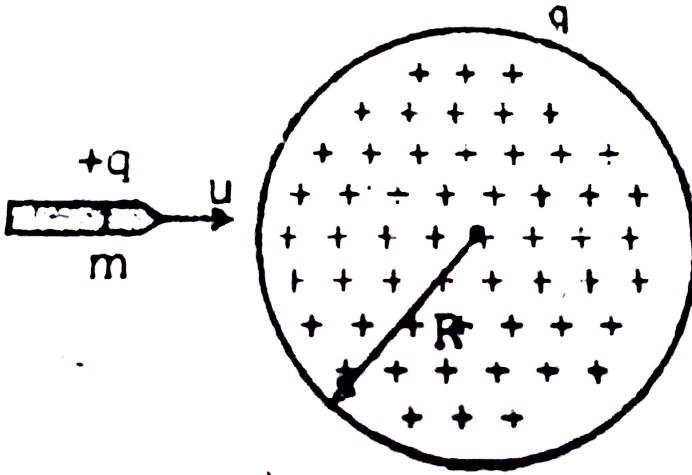
D. $r(n - 1) / n$

Answer: B

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38. A bullet of mass m and charge q is fired towards a solid uniformly charge sphere of radius R and total charge $+q$. If it strikes the surface of sphere with speed u , find the minimum value of u so that it can penetrate

through the sphere. (Neglect all resistance force or friction acting on bullet except electrostatic forces)



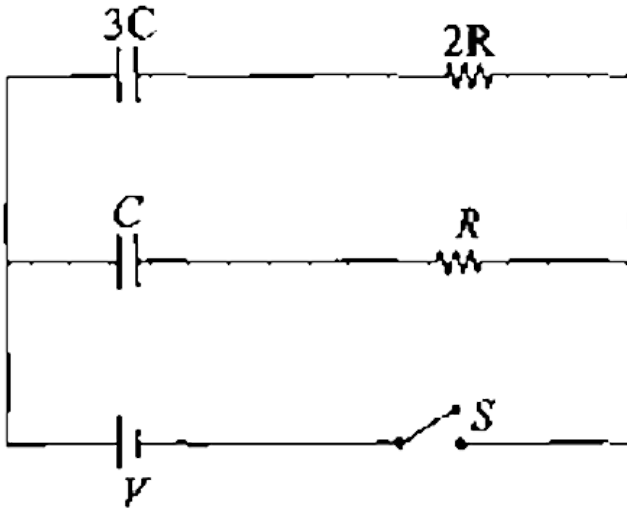
- A. $\frac{q}{\sqrt{2\pi\epsilon_0 m R}}$
- B. $\frac{q}{\sqrt{4\pi\epsilon_0 m R}}$
- C. $\frac{q}{\sqrt{8\pi\epsilon_0 m R}}$
- D. $\frac{\sqrt{3}q}{\sqrt{4\pi\epsilon_0 m R}}$

Answer: B



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39. In the circuit shown, switch S is closed at $t=0$. Let i_1 and i_2 be the current at any finite time t , then the ratio i_1/i_2 is



- A. is constant
- B. increases with time
- C. decreases with time
- D. first increases and then decreases

Answer: B

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40. A capacitor of capacitance C is allowed to discharge through a resistance R . The net charge flown through resistance during one time constant is (I_0 is the maximum current)

A. $CRl_0 \left(\frac{1}{e} + 1 \right)$

B. $CRl_0 \left(1 - \frac{1}{e} \right)$

C. CRl_0

D. $\frac{CRl_0}{e}$

Answer: B



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41. A capacitor of capacitance $3\mu F$ is first charged by connecting it across a 10 V battery by closing key K_1 . Then it is allowed to get discharged through 2Ω and 4Ω resistors by closing the key K_2 . The total energy dissipated in the 4Ω resistor is equal to



A. 0.5 mj

B. 0.05 mj

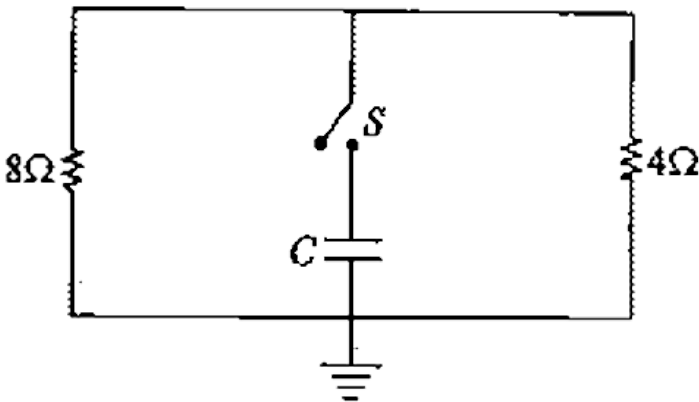
C. 0.1 mj

D. 0.2 mj

Answer: C

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42. A capacitor of capacitance $6\mu F$ and initial charge $160\mu C$ is connected with a switch S and resistors as shown in figure-3.346. If switch is closed at $t = 0$, then the current through resistor of 4Ω at $t = 16\mu s$ is



A. $\frac{10}{3e}A$

B. $\frac{10}{e}A$

C. $\frac{20}{3e}A$

D. None of these

Answer: C

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43. In the given circuit the quantity of charge that flows to ground long time after the swicth is closed is



A. $12\mu C$

B. $9\mu C$

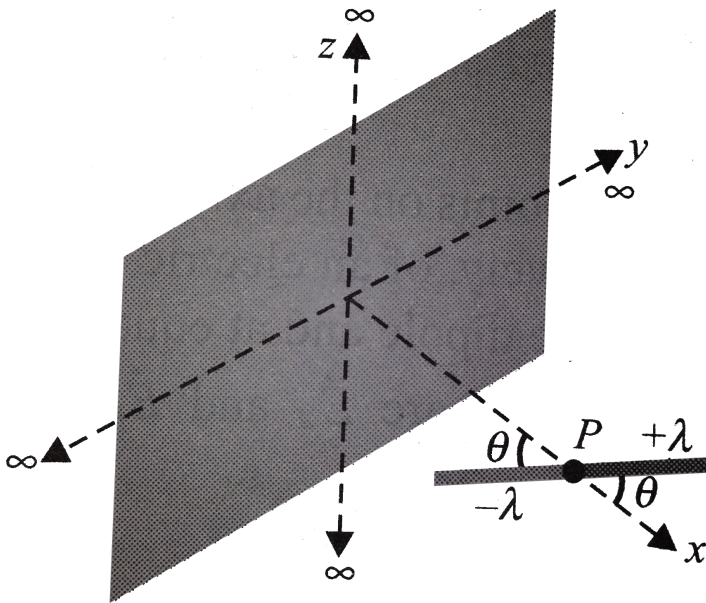
C. $13\mu C$

D. zero

Answer: D

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44. A large sheet carries uniform surface charge density σ . A rod of length $2l$ has a linear charge density λ on one half and $-\lambda$ on the second half. The rod is hinged at the midpoint O and makes an angle θ with the normal to the sheet. The torque experience by the rod is



A. $\frac{\sigma \lambda l}{2\epsilon_0}$

B. $\frac{\sigma \lambda l^2}{2\epsilon_0}$

C. $\frac{\sigma \lambda l^2}{\epsilon_0}$

D. $\frac{\sigma \lambda l}{\epsilon_0}$

Answer: B



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Comprehension

1. Two concentric spherical shells of radii R and $2R$ have charges Q and $2Q$ as shown in figure



If we draw a graph between potential V and distance r from the centre, the graph will be like

A. 

B. 

C. 

D. 

Answer: C



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2. Two concentric spherical shells of radii R and $2R$ have charges Q and $2Q$ as shown in figure



If we draw a graph between electric field E and distance r from the centre, it will be like

A. 

B. 

C. 

D. 

Answer: A



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3. Two concentric spherical shells of radii R and $2R$ have charges Q and $2Q$ as shown in figure



Choose the correct option $\left(K = \frac{1}{4\pi\epsilon_0} \right)$

A. At a distance r ($R < r < 2R$) from the centre electric potential is

$$\frac{KQ}{R}$$

B. At the same distance, electric field is $\frac{KQ}{r^2}$

C. Both (a) and (b) are correct

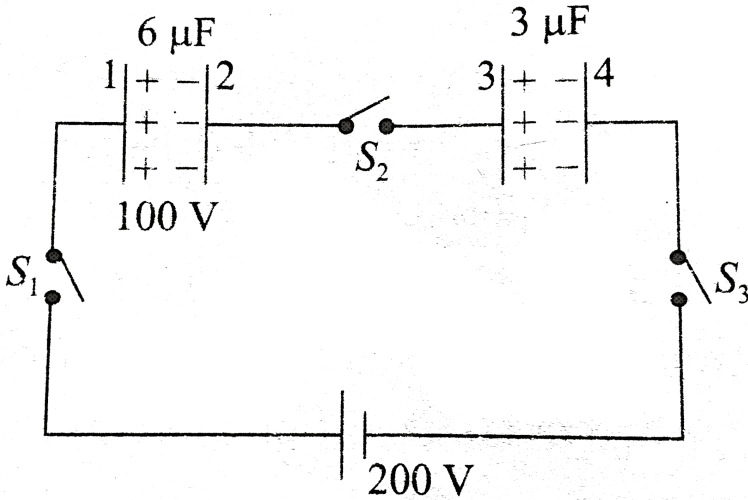
D. Both (a) and (b) are wrong

Answer: B



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4. Two capacitors of capacity $6\mu F$ and $3\mu F$ are charged $\geq 100\text{ V}$ and 50 V separately and connected as shown. Now all the three switches $S_1, S_2,$ and S_3 are closed.



Which plates form an isolated system?

- A. plate 1 and plate 4 separately
- B. plate 2 and plate 3 separately
- C. plates 1 and 4 jointly
- D. plates 2 and 3 jointly

Answer: D





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5. Two capacitors of capacity $6\mu F$ are charged to 100 V and 50 V separately and connected as shown. Now all the three switches S_1 , S_2 and S_3 are closed.



Charges on both the capacitors in steady state will be (on $6\mu F$ first)

A. $400\mu C$, $400\mu C$

B. $700\mu C$, $250\mu C$

C. $800\mu C$, $350\mu C$

D. $300\mu C$, $450\mu C$

Answer: B



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6. Two capacitors of capacity $6\mu F$ are charged to 100 V and 50 V separately and connected as shown. Now all the three switches S_1 , S_2 and S_3 are closed.



Suppose q_1 , q_2 and q_3 be the magnitudes of charge flown from switches S_1 , S_2 and S_3 after they closed. Then

A. $q_1 = q_3$ and $q_2 = 0$

B. $q_1 = q_3 = \frac{q_2}{2}$

C. $q_1 = q_3 = 2q_2$

D. $q_1 = q_2 = q_3$

Answer: D



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7. A charge $q = (-2 \times 10^+)$ is placed at $(1\text{ m}, 2\text{m}, 3\text{m})$. There is a point $P = (l^2 - 3\text{m}, 4\text{m})$

A unit vector in the direction of electric field at P due to charge q will be

A. $\frac{1}{3\sqrt{3}} (\hat{i} - 5\hat{j} + \hat{k})$

B. $\frac{1}{3\sqrt{3}} (-\hat{i} + 5\hat{j} - \hat{k})$

C. $\frac{1}{5\sqrt{2}} (3\hat{i} - 4\hat{j} + 5\hat{k})$

D. $\frac{1}{5\sqrt{2}} (-3\hat{i} + 4\hat{j} - 5\hat{k})$

Answer: B



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8. A charge $q = (-2 \times 10^+)$ is placed at (1 m, 2m, 3m). There is a point

$$P = (2 - 3m, 4m)$$

Component of electric field along x-axis at point would be

A. $\frac{1}{5\sqrt{3}} N/C$

B. $\frac{9}{5\sqrt{3}} N/C$

C. $\frac{2}{9\sqrt{3}} N/C$

D. $8\sqrt{3}N/C$

Answer: C



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9. Electric potential is a scalar quantity. Due to a point charge charge q at distance r , the potential is given by $V = \frac{q}{4\pi \epsilon_0 r}$. A point charge q is placed at $(3a, 0)$ and another charge $-2q$ is placed at $(-3a, 0)$.

At how many points on the x-axis, (at finite distance) electric potential will be zero?

A. 1

B. 2

C. 3

D. 4

Answer: B



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10. Electric potential is a scalar quantity. Due to a point charge charge q at distance r , the potential is given by $V = \frac{q}{4\pi \epsilon_0 r}$. A point charge q is placed at $(3a, 0)$ and another charge $-2q$ is placed at $(-3a, 0)$.

If we plot a graph of potential (V) on x-axis it will be like:

A. 

B. 

C. 

D. 

Answer: D



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11. A capacitor is connected to a variable source of potential. Current flowing in the circuit and potential across the plates of capacitor at time t are shown in figure.



Capacity of the capacitor is

A. 1 F

B. 2 F

C. 3 F

D. 4 F

Answer: B



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12. A capacitor is connected to a variable source of potential. Current flowing in the circuit and potential across the plates of capacitor at time t are shown in figure.



At $t = 2s$, energy is stored in the capacitor at a rate of

A. 50 J/s

B. 100 J/s

C. 150 J/s

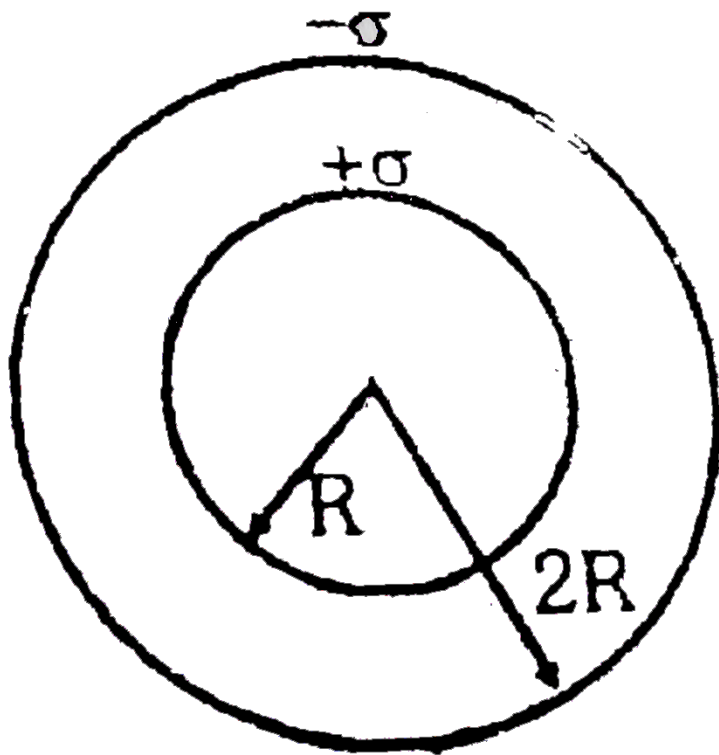
D. 200 J/s

Answer: B



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13. When two concentric shells are connected by a thin conducting wire, whole of the charge of inner shell transfers to the outer shell and potential difference between them becomes zero. Surface charge densities of two thin concentric spherical shells are σ and $-\sigma$ respectively. Their radii are R and $2R$. Now they are connected by a thin wire.



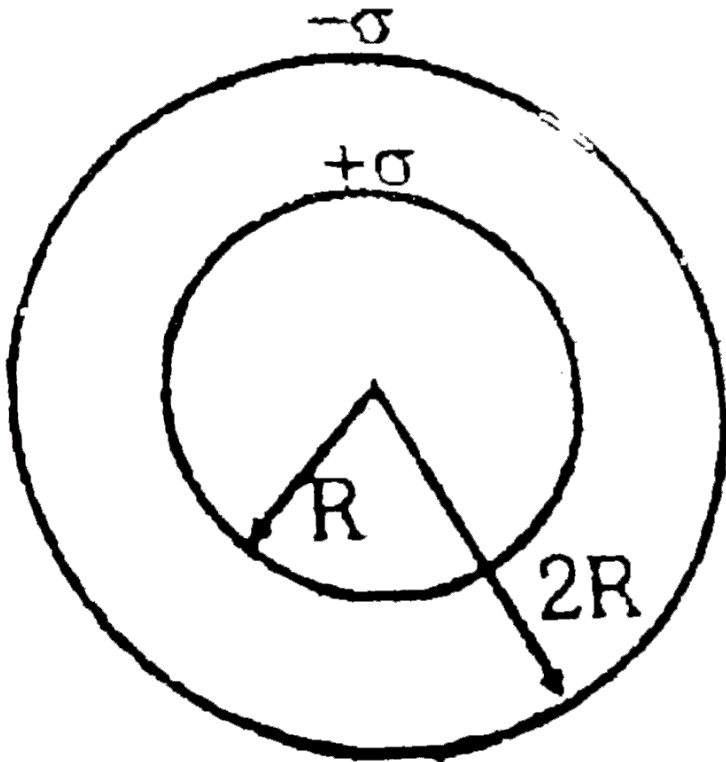
Potential on either of the shells will be :-

- A. $-\frac{3\sigma R}{2\epsilon_0}$
- B. $\frac{2\sigma R}{\epsilon_0}$
- C. $-\frac{\sigma R}{2\epsilon_0}$
- D. zero

Answer: A



14. When two concentric shells are connected by a thin conducting wire, whole of the charge of inner shell transfers to the outer shell and potential difference between them becomes zero. Surface charge densities of two thin concentric spherical shells are σ and $-\sigma$ respectively. Their radii are R and $2R$. Now they are connected by a thin wire.



Suppose electric field at a distance $r (> 2R)$ was E_1 before connecting the two shells and E_2 after connecting the two shells, then $\left| \frac{E_2}{E_1} \right|$ is :-

A. zero

B. 1

C. 2

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

Answer: B



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15. In $C - R$ circuit, answer the following two questions

During charging of $C - R$ circuit let t_1 and t_2 be the time constant and initial charging current when capacitor is assumed to be filled by a perfect insulator and t_2 and i_2 be the corresponding values when it is assumed imperfect. Then

A. $t_1 < t_2$

B. $i_1 > i_2$

C. Both (a) and (b) are correct

D. Both (a) and (b) are wrong

Answer: C



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16. In $C - R$ circuit, answer the following two questions

Dielectric constant of the slab between plates of a capacitor is 18 and its resistivity is $(4\pi \times 10^3)\Omega - m$. Then time constant of this capacitor when directly connected to a battery will be

A. $2\mu s$

B. $3\mu s$

C. $1\mu s$

D. $9\mu s$

Answer: A



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17. In the figure $m_A = m_B = 1\text{kg}$. Block A is neutral while $q_B = -1C$. Sizes of A and B are negligible. B is released from rest at a distance 1.8 m from A. Initially spring is neither compressed nor elongated.



If collision between A and B is perfectly inelastic, what is velocity of combined mass just after collision ?

A. 6 m/s

B. 3 m/s

C. 9 m/s

D. 12 m/s

Answer: B



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18. In the figure $m_A = m_B = 1\text{kg}$. Block A is neutral while $q_B = -1\text{C}$. Sizes of A and B are negligible. B is released from rest at a distance 1.8 m from A. Initially spring is neither compressed nor elongated.



Equilibrium position of the combined mass is at $x = \dots\dots\dots\text{m}$.

A. $-\frac{2}{9}$

B. $-\frac{1}{3}$

C. $-\frac{5}{9}$

D. $-\frac{7}{9}$

Answer: C



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19. In the figure $m_A = m_B = 1\text{kg}$. Block A is neutral while $q_B = -1\text{C}$. Sizes of A and B are negligible. B is released from rest at a distance 1.8 m

from A. Initially spring is neither compressed nor elongated.



The amplitude of oscillation of the combined mass will be

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

B. $\frac{\sqrt{124}}{3}m$

C. $\frac{\sqrt{72}}{9}m$

D. $\frac{\sqrt{106}}{9}m$

Answer: D



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20. A solid conducting sphere of radius ' a ' is surrounded by a thin uncharged concentric conducting shell of radius $2a$. A point charge q is placed at a distance $4a$ from common centre of conducting sphere and shell. The inner sphere is then grounded



The charge on solid sphere is

A. $-\frac{q}{2}$

B. $-\frac{q}{4}$

C. $-\frac{q}{8}$

D. $-\frac{q}{16}$

Answer: B



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21. A solid conducting sphere of radius ' a ' is surrounded by a thin uncharged concentric conducting shell of radius $2a$. A point charge q is placed at a distance $4a$ from common centre of conducting sphere and shell. The inner sphere is then grounded



Pick up the correct statement.

A. Charge on surface of inner sphere is non-uniformly distributed

B. Charge on inner surface of outer shell is non-uniformly distributed

C. Charge on outer surface of outer shell is non-uniformly distributed

D. All the above statement are false

Answer: C



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22. A solid conducting sphere of radius 'a' is surrounded by a thin uncharged concentric conducting shell of radius $2a$. A point charge q is placed at a distance $4a$ from common centre of conducting sphere and shell. The inner sphere is then grounded



The potential of outer shell is

A. $\frac{q}{32\pi\epsilon_0 a}$

B. $\frac{q}{16\pi\epsilon_0 a}$

C. $\frac{q}{8\pi\epsilon_0 a}$

D. $\frac{q}{4\pi\epsilon_0 a}$

Answer: A



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23. Capacitor C_3 in the circuit is a variable capacitor (its capacitance can be varied). Graph is plotted between potential difference V_1 (across capacitor C_1) versus C_3 . Electric potential V_1 approaches to 10 V as $C_3 \rightarrow \infty$. Given that $C_1 + C_2 = 10\mu F$



EMF of the battery is equal to

- A. 10 V
- B. 12 V
- C. 16 V
- D. 20 V

Answer: A



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24. Capacitor C_3 in the circuit is a variable capacitor (its capacitance can be varied). Graph is plotted between potential difference V_1 (across capacitor C_1) versus C_3 . Electric potential V_1 approaches to 10 V as $C_3 \rightarrow \infty$. Given that $C_1 + C_2 = 10\mu F$



The capacitance of the capacitor C_1 value

A. $2\mu F$

B. $6\mu F$

C. $8\mu F$

D. $4\mu F$

Answer: B

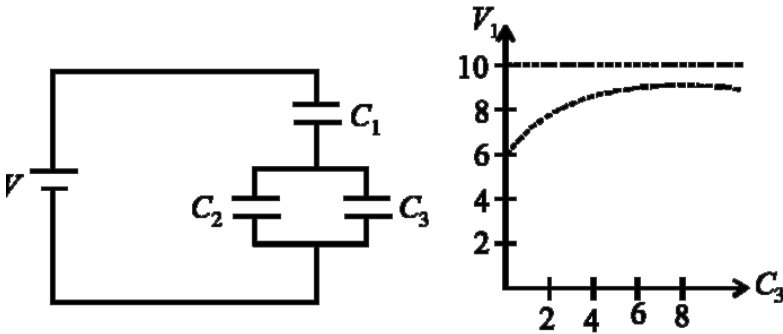


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25. Capacitor C_3 in the circuit is variable capacitor (its capacitance can be varied). Graph is plotted between potential difference V_1 (across capacitor C_1) versus C_3 .

Electric potential V_1 approaches on asymptote of 10 volts as $C_3 \rightarrow \infty$

The value of C_3 for which potential difference across C_1 will become 8V, is



- A. $2\mu F$
- B. $6\mu F$
- C. $8\mu F$
- D. $4\mu F$

Answer: A



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26. Four metallic plates placed as shown in the figure. Plate 2 is given a charge Q whereas all other plates are uncharged. Plates 1 and 4 are joined together. The area of each plate is same



The charge appearing on the right side of plate 3 is

- A. zero
- B. $+Q/4$
- C. $-3Q/4$
- D. $Q/2$

Answer: B



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27. Four metallic plates placed as shown in the figure. Plate 2 is given a charge Q whereas all other plates are uncharged. Plates 1 and 4 are joined

together. The area of each plate is same



The charge appearing on the right side of plate 4 is

- A. zero
- B. $-Q/4$
- C. $-3Q/4$
- D. $Q/2$

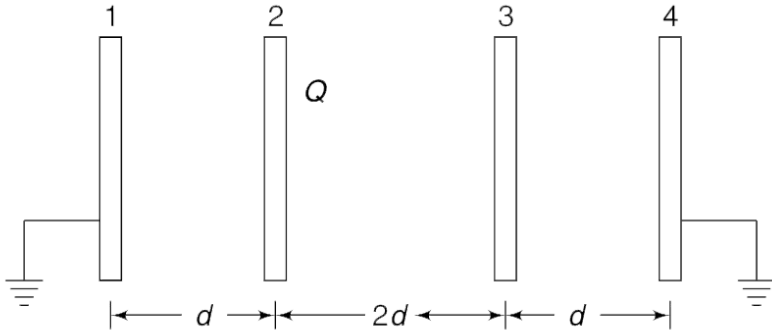
Answer: D



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- 28.** Four large identical metallic plates are placed as shown in the Figure. Plate 2 is given a charge Q . All other plates are neutral. Now plates 1 and 4 are earthed. Area of each plate is A .
- (a) Find charge appearing on right side of plate 3.

(b) Find potential difference between plates 1 and 2.



A. $\frac{3 Qd}{2 \epsilon_0 A}$

B. $\frac{Qd}{\epsilon_0 A}$

C. $\frac{3 Qd}{4 \epsilon_0 A}$

D. $\frac{3Qd}{\epsilon_0 A}$

Answer: C

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29. The figure shows a arrangement of capacitors and a battery.



Identify the correct statements

A. Both the $4\mu F$ capacitors carry different charges

B. Both the $4\mu F$ capacitors carry equal charges

C. $V_B = V_D > 0$

D. $V_D - V_B > 0$

Answer: B::C

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30. The figure shows an arrangement of capacitors and a battery.



If the potential of C is zero, then

A. $V_A = +20V$

B. $4(V_A - V_B) + 2(V_D - V_B) = 2V_B$

C. $2(V_A - V_D) + 2(V_B - V_D) = 4V_D$

D. $V_A = V_B + V_D$

Answer: A



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31. The figure shows a arrangement of capacitors and a battery.



The potential of the points B and D are (if $V_C = 0$)

A. $V_B = 8V$

B. $V_B = 12V$

C. $V_D = 8V$

D. $V_D = 12V$

Answer: B::C



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32. In the circuit shown in the figure, in steady state:



The charge on $5\mu F$ capacitor is

A. $30\mu C$

B. $40\mu C$

C. $50\mu C$

D. $60\mu C$

Answer: A



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33. In the circuit shown in the figure, in steady state:



The current drawn from the battery is

A. $2A$

B. $3A$

C. $4A$

D. $1A$

Answer: D



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34. Four large metallic plates of area A each are kept parallel to each other with a small separation between them as shown in the figure. A cell of emf V is connected across the two outermost plates through a switch K_1 . The two inner plates are similarly connected with a cell of emf $2V$ through a switch K_2 . Initially both switches are open and the plates, starting from left to right (i.e. number 1 to 4) are given charges $Q, 2Q, -2Q$ and $-Q$ respectively. Now answer the following questions



The charge appearing on the outer surface of plate -1, when switches K_1, K_2 are open

A. zero

B. Q/e number of electrons will flow from outer to inner shell, where

' e ' is the charge on an electron

C. $-Q$

D. $-3Q$

Answer: A



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35. Four large metallic plates of area A each are kept parallel to each other with a small separation between them as shown in the figure. A cell of emf V is connected across the two outermost plates through a switch K_1 . The two inner plates are similarly connected with a cell of emf $2V$ through a switch k_2 . Initially both switches are open and the plates, starting from left to right (i.e. number 1 to 4) are given charges $Q, 2Q, -2Q$ and $-Q$ respectively. Now answer the following questions



If K_1 is closed and K_2 is open the charge appearing on the right surface of plate-2 is

A. $\frac{Q}{2} + \left(\frac{\epsilon_0 A}{d}\right) \frac{V}{4}$

B. $\left(\frac{\epsilon_0 A}{d}\right) \frac{V}{4} + \frac{3Q}{2}$

C. $\left(\frac{\epsilon_0 A}{d}\right) \frac{V}{4} - \frac{Q}{2}$

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

Answer: B



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36. Four large metallic plates of area A each are kept parallel to each other with a small separation between them as shown in the figure. A cell of emf V is connected across the two outermost plates through a switch K_1 . The two inner plates are similarly connected with a cell of emf $2V$ through a switch k_2 . Initially both switches are open and the plates, starting from left to right (i.e. number 1 to 4) are given charges $Q, 2Q, -2Q$ and $-Q$ respectively. Now answer the following questions



If both switches are closed, the charge appearing on the plate 4 is

A. $\left(\frac{\epsilon_0 A}{d}\right)V$

B. $Q + \frac{\epsilon_0 A}{d} \left(\frac{V}{2}\right)$

C. $Q - \frac{\epsilon_0 A}{d} \left(\frac{V}{2}\right)$

D. $\left(\frac{\epsilon_0 A}{d}\right) \left(\frac{V}{3}\right)$

Answer: D



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Matrix Matching

1. Match the following

Table - 1

(A) σ^2 / ϵ_0

(B) ϵ_0

(C) $\frac{\text{ampere - second}}{\text{Volt}}$

(D) $\frac{V}{E}$

Table - 2

(P) $C^2 / J - m$

(Q) Farad

(R) J/m^3

(S) metre



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2. Match the following . When an independent positive charge moves from higher potential to lower potential, then

Table - 1

Table - 2

- | | |
|---------------------------|--------------------------|
| (A) its kinetic energy | (P) will remain constant |
| (B) its potential energy | (Q) will decrease |
| (C) its mechanical energy | (R) will increase |



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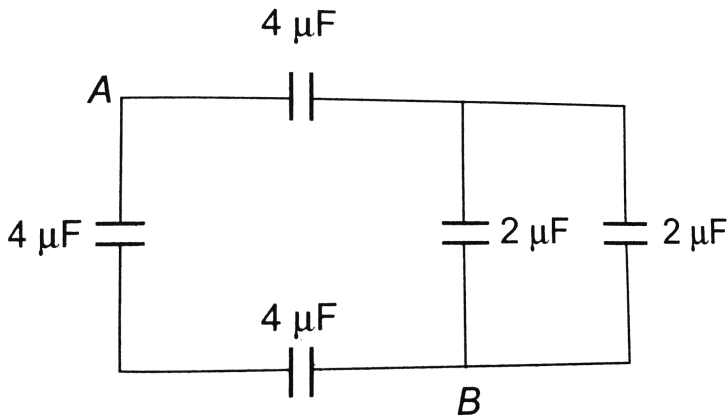
Integer

1. The centres of two identical small conducting sphere are 1 m apart. They carry charge of opposite kind and attract each other with a force F . when they connected by conducting thin wire they repel each other with a force $F/3$. The ratio of magnitude of charges carried by the spheres initially in $n : 1$. Find value of n



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2. In the circuit as shown in the figure the effective capacitance between A and B is



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3. A $2\ \mu\text{F}$ condenser is charged upto 200 volt and then battery is removed. On combining this with another uncharged condenser in parallel, the potential difference is found to be 40 volt. Find the capacity of second condenser (in μF)

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4. A hollow sphere of radius $2R$ is charged to V volts and another smaller sphere of radius R is charged to $V/2$ volts. Then the smaller sphere is placed inside the bigger sphere without changing the net charge on each sphere. The potential difference between the two spheres would become V/n . find value of n

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5. Consider the circuit shown in the figure. Capacitors A and B, each have capacitance $C = 2F$. The plates of capacitor A are connected by a wire of resistance $R = 1\Omega$ while capacitor B is given an initial charge $Q = 4C$. The switch is closed at time $t = 0$. what will be the initial current (in ampere) drawn from the battery immediately after the switch is closed ?

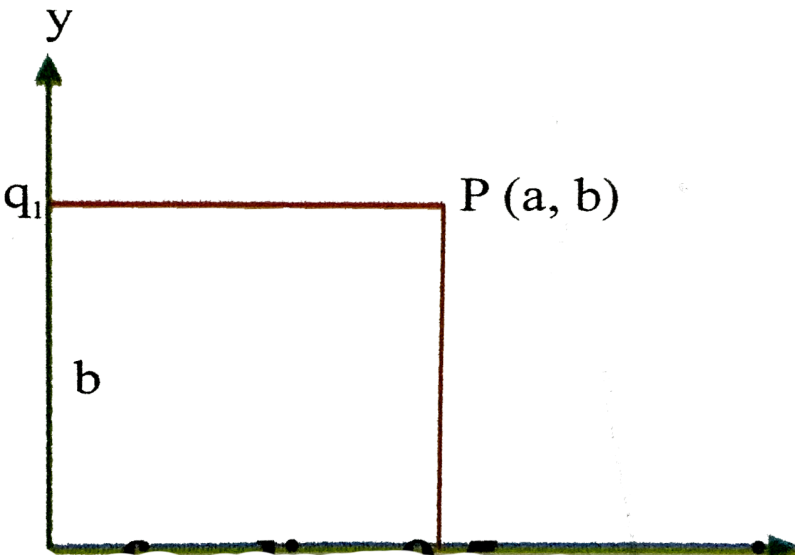


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6. Four point charge q , $-q$, $2Q$ and Q are placed in order at the corners A, B, C and D of a square. If the field at the midpoint of CD is zero then the value of q/Q is $\frac{5\sqrt{5}}{x}$. Find the value of x .

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7. Two point charge $q_1 = 2\mu C$ and $q_2 = 1\mu C$ are placed at distance $b = 1$ and $a = 2cm$ from the origin on the y and x axes as shown in figure .The electric field vector at point $(a), (b)$ will subtend on angle θ with the "x-axis" given by



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8. Two identical charges are placed at the two corners of an equilateral triangle. The potential energy of the system is U . The work done in bringing an identical charge from infinity to the third vertex is

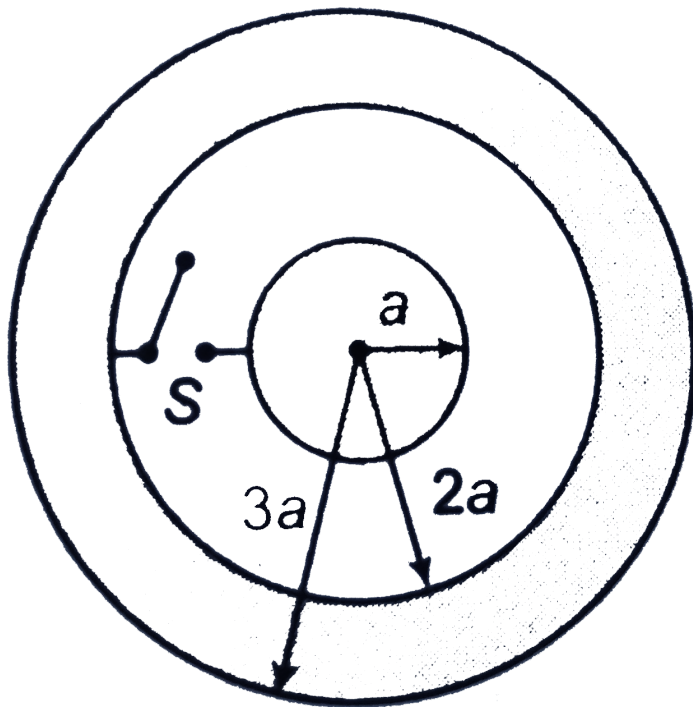
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9. There are four concentric shells A, B, C and D of radii a , $2a$, $3a$ and $4a$ respectively. Shells B and D are given charges $+q$ and $-q$ respectively. Shell C is now earthed. The potential difference $V_A - V_C$ is $k = \left(\frac{1}{4\pi\epsilon_0} \right)$

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10. A solid conducting sphere of radius a having a charge q is surrounded by a concentric conducting spherical shell of inner radius $2a$ and outer radius $3a$ as shown in figure. Find the amount of heat produced when

switch is closed $\left(k = \frac{1}{4\pi\epsilon_0}\right)$



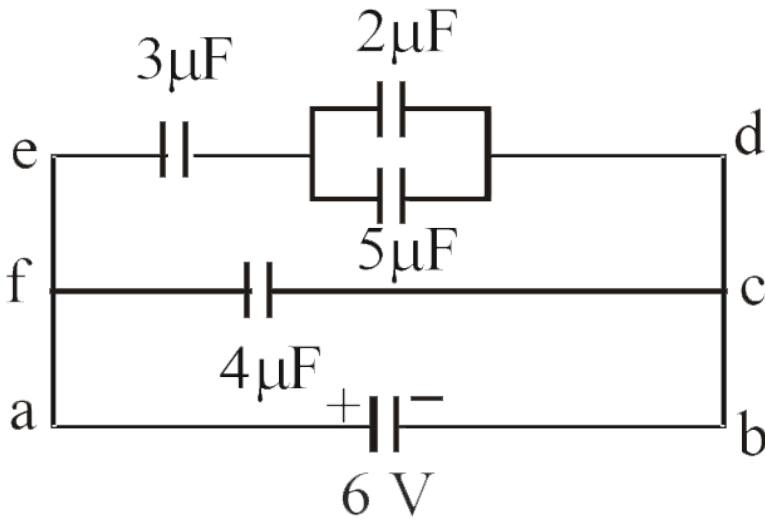
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11. Electric field at the centre of uniformly charge hemispherical shell of surface charge density σ is $\frac{\sigma}{n\epsilon_0}$ then find the value of n .



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12. In the circuit given below, the charge in μC , on the capacitor having $5\mu F$ is



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13. A parallel plate capacitor is connected to a battery of emf V volts as shown. Now a slab of dielectric constant $k = 2$ is inserted between the plates of capacitor without disconnecting the battery. The electric field between the plates of capacitor after inserting the slab is $E = \frac{PV}{2d}$. Find the value of P .





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14. Four identical metal plates are arranged as shown plates 1 and 4 are connected by a connecting wire. A battery of emf V volts is connected between plates 2 and 3. The electric field between plates 3 and 4 is $\frac{2V}{Kd}$.

Find the value of K



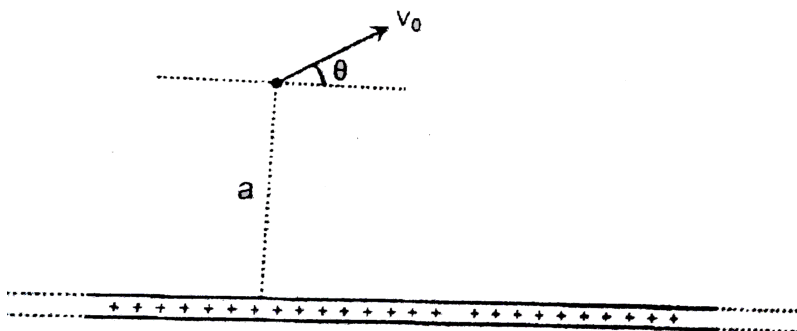
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15. Four identical positive point charges Q are fixed at the four corners of a square of side length l . Another charged particle of mass m and charge $+q$ is projected towards centre of square from a large distance along the line perpendicular to plane of square. The minimum value of initial velocity v_0 (in m/s) required to cross the square is ?

$$(m = 1gm, l = 4\sqrt{2}m, Q = 1\mu c, q = 0.5\mu c)$$



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16.

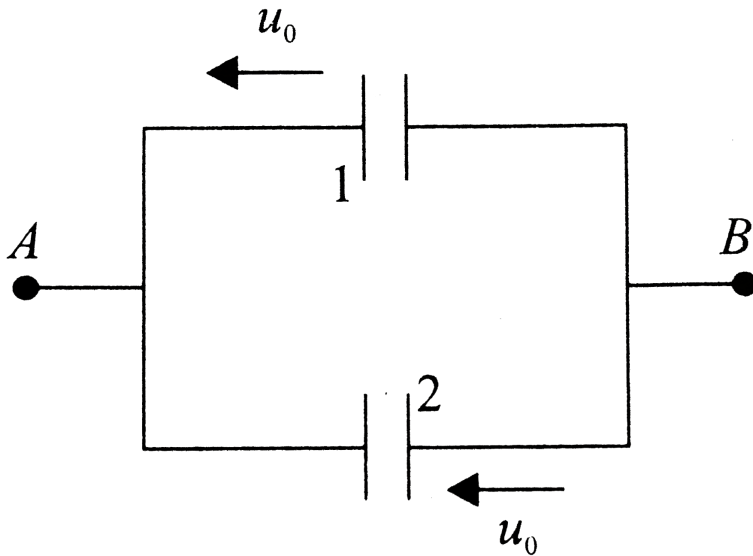
There is an infinite line of uniform linear density of charge $+\lambda$. A particle of charge $-q$ & mass m is projected with initial velocity v_0 at an angle θ with the line of charge from a distance a from it. The point charge moves in plane containing line charge and point of projection. The speed of the particle is found to be minimum when its distance from the line of charge is $a e^{(n\pi m \epsilon_0^2 / q\lambda)}$. The value of n is (ignore gravity)



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17. Two identical capacitors having plate separation d_0 are connected parallel to each other across the points A and B as shown in. A charge Q is imparted to the system by removed. Now the first plate of the first

capacitor and the second plate of the second capacitor start moving with constant velocity u_0 toward left. Find the magnitude of the current flowing in the loop during this process.



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Others

1. Which of the following is/are incorrect statement ?

A. Electric field is always conservative

B. Electric field due to a varying magnetic field is non-conservative

C. Electric field due to stationary charge is conservative

D. Electric field lines are always closed loops

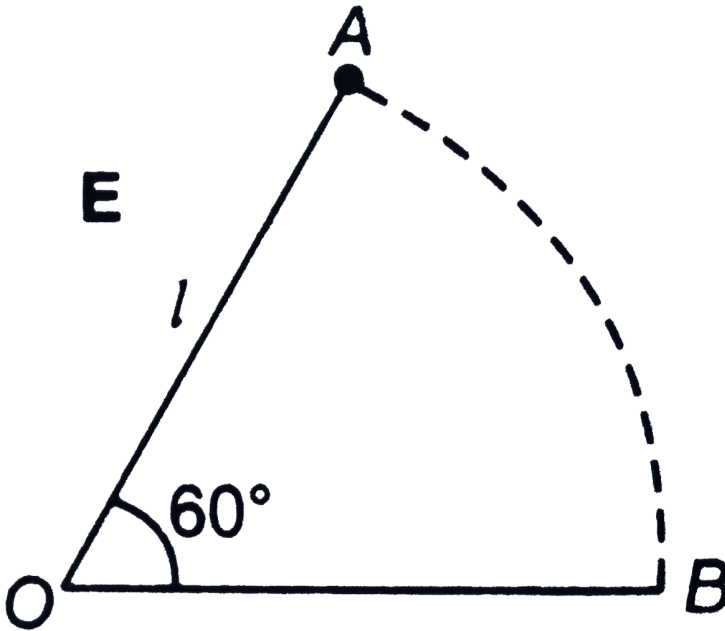
Answer: A::D



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2. A particle of mass m and charge q is fastened to one end of a string of length l . The other end of the string is fixed to the point O . The whole system lies on a frictionless horizontal plane. Initially, the mass is at rest at A . A uniform electric field in the direction shown in then switched on.

Then



- A. the speed of the particle when it reaches B is $\sqrt{\frac{2qEl}{m}}$
- B. the speed of the particle when it reaches B is $\sqrt{\frac{qEl}{m}}$
- C. the tension in the string when particle reaches at B is $2qE$
- D. the tension in the string when the particle reaches at B is qE

Answer: B::C



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3. An electric dipole moment $\vec{P} = (2.0\hat{i} + 3.0\hat{j})\mu Cm$ is placed in a uniform electric field

$$\vec{E} = (3\hat{i} + 2.0\hat{k}) \times 10^5 NC^{-1}.$$

- A. The torque that E exerts in p is $(0.6\hat{i} - 0.4\hat{j} - 0.9\hat{k})Nm$
- B. The potential energy of the dipole is $-0.6J$
- C. The potential energy of the dipole is $0.6J$
- D. If the dipole is rotated in the electric field, the maximum potential energy of the dipole is $1.3J$

Answer: A::B::D



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4. A capacitor C is charged to a potential V by a battery. It is then disconnected from the battery and again connected with its polarity reversed to the battery

- A. The work done by the battery is CV^2
- B. The total charge the passes through battery is $2 CV$
- C. The initial and final energy of the capacitor is same
- D. The work done by the battery is $2CV^2$

Answer: B::C::D

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5. Five charges each q are placed at five corners regular pentagon.

Distance from corner to the centre of pontagon is r . Then $\left(K = \frac{1}{4\pi\epsilon_0} \right)$

- A. potential at centre is $\frac{5kq}{r}$
- B. potential at centre is zero
- C. electric field at centre is non-zero
- D. electric field at centre is zero

Answer: A::D



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6. Two point charges q each are fixed at $(a,0)$ and $(-a,0)$. A third charge Q is placed at origin. Electrons potential energy of the system will

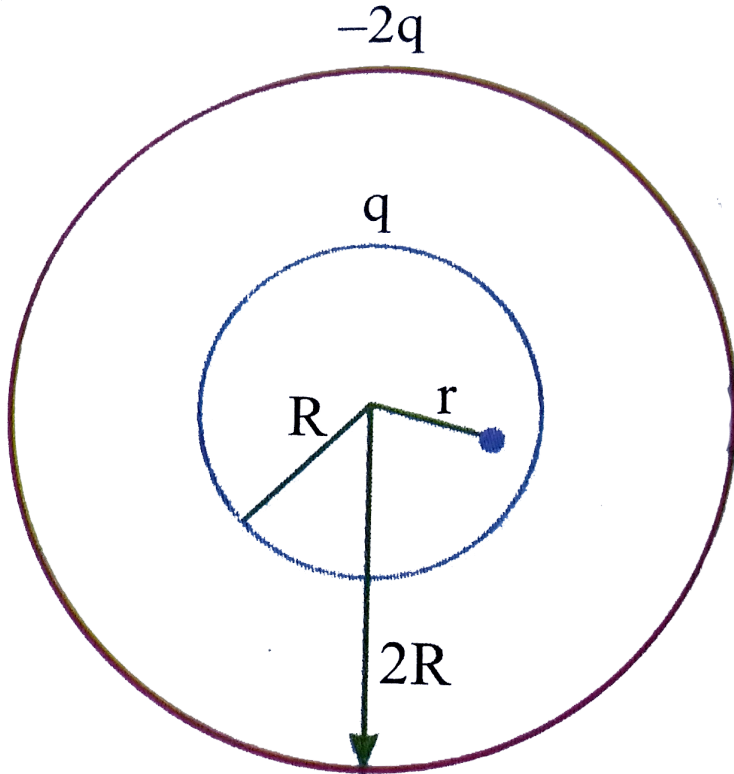
- A. increase if Q is slightly displaced along x-axis
- B. decrease if Q is slightly displaced along x-axis
- C. increase if Q is slightly displaced along y-axis
- D. decrease if Q is slightly displaced along y-axis

Answer: A::D



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7. Two concentric shells of radii R and $2R$ have given charge q and $-2q$ as shown in figure in a region $r < R$



(a) $E = 0$, (b) $E \neq 0$, (c) $V = 0$ (d) $V \neq 0$

A. $E = 0$

B. $E \neq 0$

C. $V = 0$

D. $V \neq 0$

Answer: A::C

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

- A. its potential energy must decrease
- B. it potential energy may decrease
- C. its kinetic energy must increase
- D. its kinetic energy may increase

Answer: A::D



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9. A block of mass m is attached to a spring of force constant k . Charges on the block is q . A horizontal electric field E is acting in the directions as shown. Block is released with the spring in unstretched position



(a) block will execute *SHM*

(b) time period of oscillation is $2\pi \frac{\sqrt{m}}{k}$

(c) amplitude of oscillation is $\frac{qE}{k}$

(d) Block will oscillate but not simple harmonically

choose the correct answer

A. Block will execute SHM

B. Time period of oscillation is $2\pi \sqrt{\frac{m}{k}}$

C. Amplitude of oscillation is $\frac{qE}{k}$

D. Block will oscillate but not simple harmonically.

Answer: A::B::C



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10. An electric dipole of dipole moment 10^{-6} C-m is released from rest in uniform electric field 10^2 V/m at angle $\theta = 60^\circ$. Maximum rotational kinetic energy of the dipole is say K and maximum torque during the motion is τ , then

A. $K = 5.0 \times 10^{-5} J$

B. $K = 2.0 \times 10^{-4} J$

C. $\tau = 5.0 \times 10^{-4} \text{ N-m}$

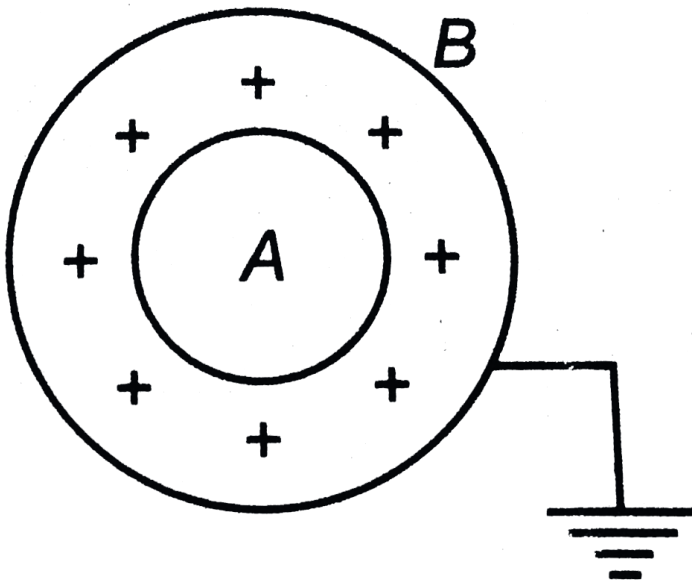
D. $\tau = 8.7 \times 10^{-5} \text{ N-m}$

Answer: A::D



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11. A and B are two concentric spherical shells. If A is given a charge $+q$ while B is earthed as shown in figure then



- A. the charge appearing on inner surface of B is $-Q$
- B. the field inside and outside A is zero
- C. the field between A and B is not zero
- D. the charge appearing on outer surface of B is zero

Answer: A::C::D



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12. Rows of capacitors 1, 2, 4, 8, ... ∞ capacitors, each of capacitance $2\mu F$, are connected in parallel as shown in figure. The potential difference across AB = 10 V, then



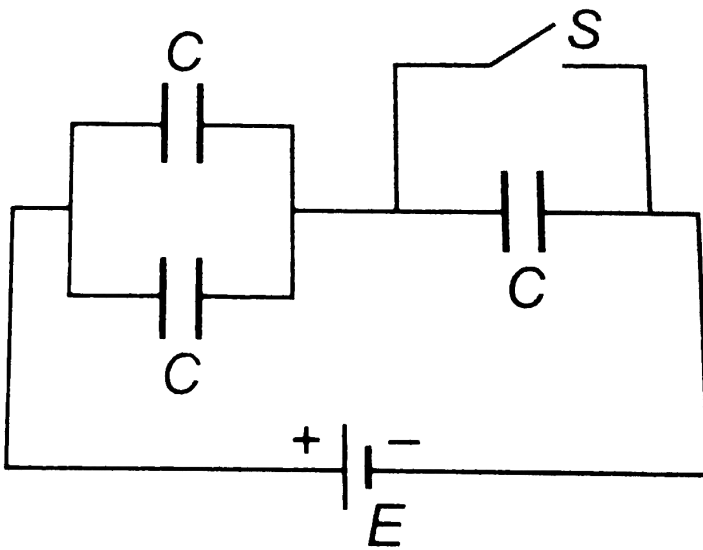
- A. Total capacitance across AB is $4\mu F$
- B. Charge of each capacitor will be same
- C. Charge on the capacitor in the first row is more than on any other capacitor
- D. Energy of all the capacitors is $200\mu J$

Answer: A::C::D



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13. In the circuit shown each capacitor has a capacitance C . The emf of the cell is E . If the switch S is closed then

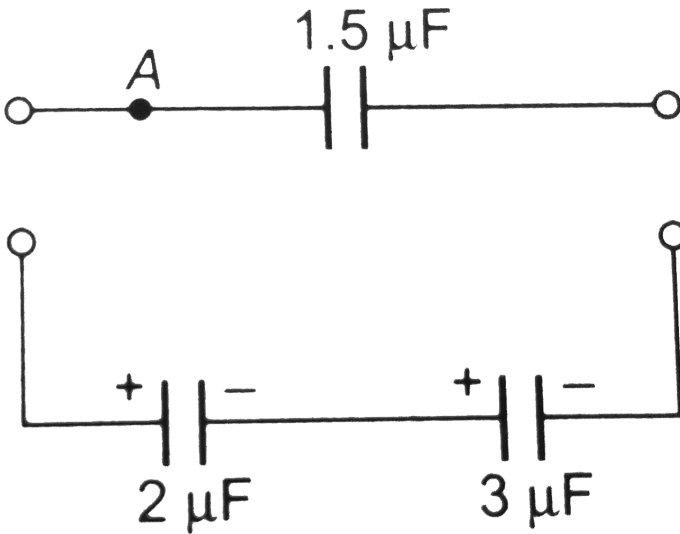


- A. positive charge will flow out of the positive terminal of the cell
- B. positive charge will enter the positive terminal of the cell
- C. the amount of charge flowing through the cell will be CE
- D. the amount of charge flowing through the cell will be $\frac{4}{3}CE$

Answer: A::D

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14. Two capacitors of $2\mu F$ and $3\mu F$ are charged to $150V$ and $120V$, respectively. The plates of capacitor are connected as shown in the figure. An uncharged capacitor of capacity $1.5\mu F$ falls to the free end of the wire. Then

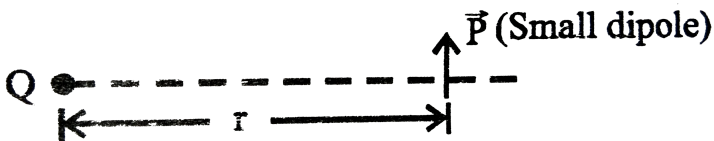


- A. charge on the $1.5\mu F$ capacitor is $20\mu C$
- B. charge on the $2\mu F$ capacitor is $280\mu C$
- C. positive charge flows through A from right to left
- D. positive charge flows through A from left to right

Answer: A::B::C

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15. For the situation shown in the figure below ("assume " $r \gg$ length of dipole ") mark out the correct statement (s) -



A. Force acting on the dipole is zero

B. Force acting on the dipole is approximately $\frac{pQ}{4\pi\epsilon_0 r^3}$

C. Torque acting on the dipole is $\frac{pQ}{4\pi\epsilon_0 r^2}$ in clockwise direction

D. Torque acting on the dipole is $\frac{pQ}{4\pi\epsilon_0 r^2}$ in anticlockwise direction

Answer: B::C

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16. Units of electric flux are

A. $\frac{N \cdot m^2}{C}$

B. $\frac{N}{C \cdot m^2}$

C. Volt-m

D. Volt-m³

Answer: A:C



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17. A circuit shown in the figure consists of a battery of emf $10V$ and two capacitance C_1 and C_2 of capacitances $1.0\mu F$ and $2.0\mu F$ respectively.

The potential difference $V_A - V_B$ is $5V$



A. charge on capacitor C_1 is equal to charge on Capacitor C_2

B. voltage across capacitor C_1 is 5 V

C. voltage across capacitor C_2 is 10 V

D. energy stored in capacitor C_1 is two times the energy stored in capacitor C_2

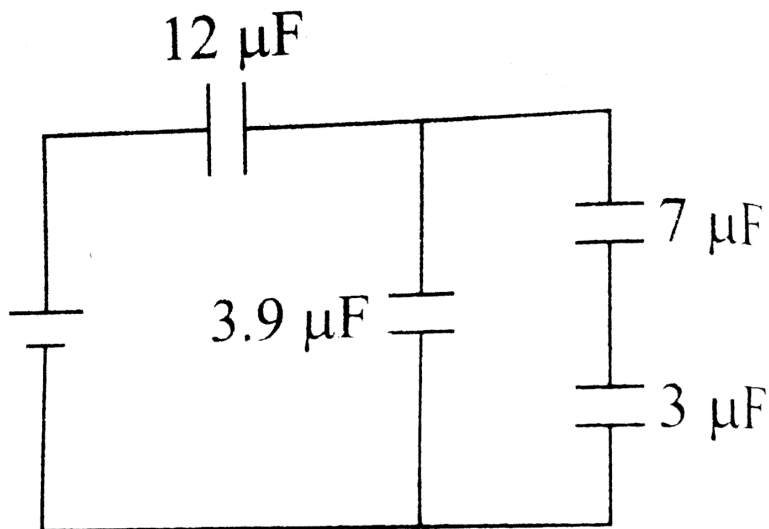
Answer: A:D



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18. Four capacitors and a battery are connected as shown in. If the potential difference across the $7\mu F$ capacitor is $6V$, then which of the

following statement(s) is//are correct?



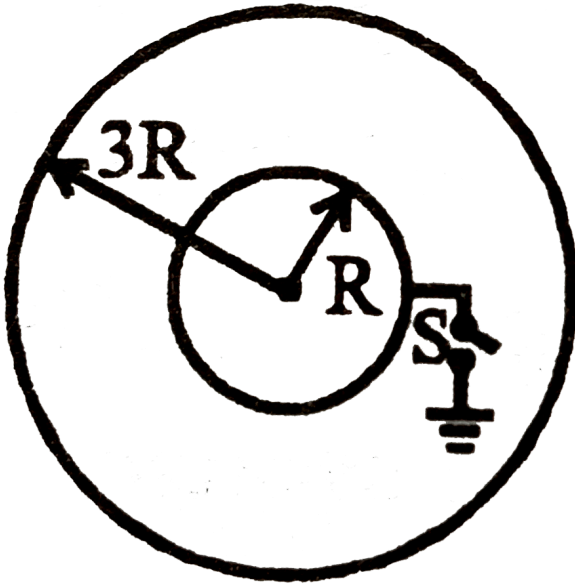
- A. potential difference across the $3\ \mu\text{F}$ capacitor is $10\ \text{V}$
- B. charge on the $3\ \mu\text{F}$ capacitor is $42\ \mu\text{C}$
- C. emf of the battery is $30\ \text{V}$
- D. potential difference across the $12\ \mu\text{F}$ capacitor is $10\ \text{V}$

Answer: B::C::D



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19. Two thin conducting shells of radii R and $3R$ are as shown in the fig. External shell carries a charge $+Q$ and inner shell neutral. The inner shell is earthed with the help of a switch S . Then



- A. When the switch S is open, the potential of the inner sphere is equal to that of the outer
- B. When the switch S is closed, the potential of the inner sphere becomes zero

C. When the switch S is closed, the charge attained by the inner sphere is $-Q/3$

D. By closing the switch the capacitance of the system increases.

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



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20. A parallel-plate capacitor is connected to a cell. Its positive plate A and its negative plate B have charges $+Q$ and $-Q$ respectively. A third plate C , identical to A and B , with charge $+Q$, is now introduced midway between A and B , parallel to them. Which of the following are correct?

A. The charge on the inner face of B is now $-\frac{3Q}{2}$

B. There is no change in the potential difference between A and B

C. The potential difference between A and C is non-third of the potential difference between B and C

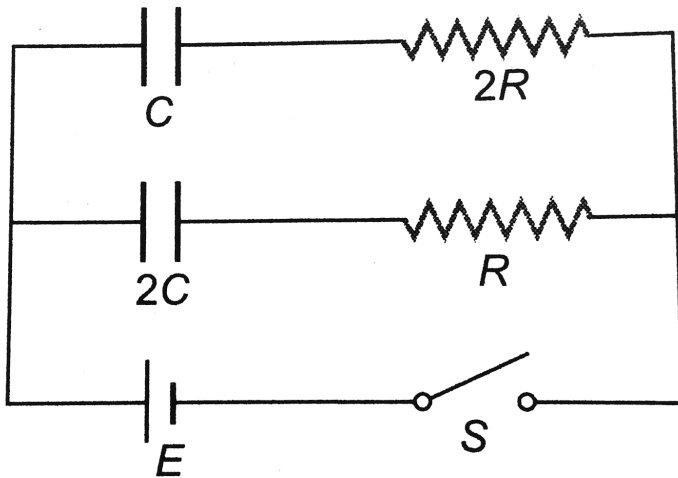
D. The charge on the inner face to A is now $Q/2$

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

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21. In the circuit shown in the figure, switch S is closed at time $t = 0$.

Select the correct statements.



A. Rate of increase of charge is same in both the capacitors

B. Ratio of charge stored in capacitors C and $2C$ at time t would be

1:2

C. Time constant of both the capacitors are equal

D. Steady state charge in capacitors C and 2C are the ratio of 1: 2

Answer: B::C::D



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22. A capacitance C is connected to two equal resistance as shown in the figure. Then



- A. at the time of charging of capacitor time constant the circuit is $2CR$
- B. at the time of discharging of capacitor time constant of the circuit is CR
- C. at the time of discharging of the capacitor the time constant of the circuit is $2CR$
- D. at the time of charging of capacitor the time constant of the circuit is CR

Answer: C::D



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23. A metal sphere is electrically charged to Q_0 and hangs on an insulating cord. The sphere slowly loses its charge because the air has a non zero resistivity ρ . The potential of sphere of radius r_0 is to be calculated with reference to infinity. Assume that resistivity of air is every where the same.

Mass the correct statements

A. Capacitance of sphere is $4\pi\epsilon_0 r_0$

B. Electrical resistance of air is $R = \frac{\rho}{4\pi r_0}$

C. Initial current is $\frac{Q_0}{\rho\epsilon_0}$

D. Time in which charge gets halved is $\rho\epsilon_0 \ln 2$

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



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24. A parallel plate capacitor of area 100cm^2 and plate separation 8.85 mm is charged to a potential difference of 100 V when air is used between the plates. The capacitor is now isolated and air is replaced by glass ($\epsilon_r = 5$), then:

- A. The original capacity will be 10 pF
- B. The new capacity will be 50 pF
- C. The new potential difference is 200 V
- D. The new energy stored is $50\ \mu\text{J}$

Answer: A::B



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25. Consider two concentric metallic shells of radii R and $2R$. The inner shell is having charge Q and outer shell is uncharged. If they are connected with a conducting wire. Then,

- A. Q amount of charge will flow from inner to outer shell

B. Q/e number of electrons will flow from outer to inner shell, where

'e' is the charge on an electron

C. $\frac{KQ^2}{4R}$ amount of heat is produced in the process

D. $\frac{KQ^2}{2R}$ amount of heat is produced in the process

Answer: A::B::C



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26. A particle of mass 2 kg charge 1 mC is projected vertically with velocity 10ms^{-1} . There is a uniform horizontal electric field of 10^4N/C , then

A. the horizontal range of the particle is 10 m

B. the time of the particle is 2 s

C. the maximum height reached is 5 m

D. the horizontal range of the particle is 0

Answer: A::B::C

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27. In the given circuit diagram, initial charge on capacitor is zero. Choose the correct option (s):



- A. Current through battery just after closing of switch is 12 A
- B. Current through capacitor just after closing of switch is 8 A
- C. In steady state current through battery is 9 A
- D. In steady state current through 6Ω resistance is 4.5 A

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

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28. Graph shows magnitude of electric field (E), charge enclosed ($q_{enclosed}$) within the concentric sphere and net flux (ϕ) through a concentric spherical Gaussian surface as a function of distance (r) from

centre of a uniformly positive charged solid sphere of radius R . Choose the correct option (s):

A. 

B. 

C. 

D. 

Answer: B::C

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29. Two capacitors C_1 and C_2 are charged to same potential V , but with opposite polarity as shown in the figure. The switches S_1 and S_2 are then closed



A. Potential difference across two capacitors are same and is given by

$$\frac{(C_1 - C_2)V}{C_1 + C_2}$$

B. Potential difference across two capacitors are same and is given by

$$\left(\frac{C_1 + C_2}{C_1 - C_2} \right) V$$

C. Ratio of final energy to initial energy of the system is given by

$$\frac{(C_1 - C_2)^2}{(C_1 + C_2)^2}$$

D. Ratio of final energy to initial energy of the system is given by

$$\frac{(C_1)^2}{(C_1 + C_2)^2}$$

Answer: A::C



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30. Figure shows an arrangement of four identical rectangular plates A, B, C and D each of area S. Thickness of plates is negligible. Then :



A. Potential difference between plates A and B is independent of Q_1

B. Potential difference between plates C and D is independent of Q_1

C. Potential difference between plates A and B is independent of Q_2

D. Potential difference between plates C and D is independent of Q_2

Answer: A::B



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31. A uniform electric field of $500V/m$ is directed at 150° to the positive X-axis, in the $X - Y$ plane as shown in figure



A. If the coordinates of two points A and B be $(4\text{ cm}, 0)$ and $(-3\text{ cm}, 0)$, then the potential difference $V_A - V_B$ will be 30.3 V

B. If the coordinates of two points A and B be $(4\text{ cm}, 0)$ and $(3\text{ cm}, 0)$, then the potential difference $V_A - V_B$ will be 4.3 V

C. The electric field could be due to infinite thin sheet of charge

D. The electric field could be in a spherical cavity of a uniformly charged sphere

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



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32. In a uniformly positively charged sphere a very thin tunnel has been made along the diameter as shown in the figure below. A charged particle - q having mass m is released from rest at one end of tunnel. For the situation described, mark out the correct statement (s) : [Neglect gravity]



A. Charged particle will perform SHM about centre of the sphere as mean position

B. Time period of the particle is $2\pi\sqrt{\frac{4\pi\epsilon_0 m R^3}{qQ}}$

C. Particle will perform oscillation but not SHM

D. Speed of the particle while crossing mean position is $\sqrt{\frac{Qq}{4\pi\epsilon_0 m R}}$

Answer: A::B::D



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33. A conducting sphere of radius b has a spherical cavity with its centre displaced by ' a ' from centre of sphere O_1 . A point charged q is placed at the centre of cavity O_2 . Q charge is given to conducting sphere and charge q_0 is placed at P, a distance c from centre O_1 . Further O_1, O_2 and P are collinear



A. Charge distribution on inner surface of cavity is uniform

B. Potential of conductor is $\left(\frac{q_0}{4\pi\epsilon_0 c} + \frac{Q + q}{4\pi\epsilon_0 b} \right)$

C. Charge distribution on outer surface of conducting sphere is non uniform

D. Charge distribution on outer surface of conducting sphere is uniform

Answer: A::B::C



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34. The figure shown a graph of current in a discharge circuit of a capacitor through a resistor of resistor 10Ω . Choose the correct option

(s)



A. The initial potential difference across the capacitor 100 Volts

B. The capacitance of the capacitor is $\frac{1}{10In2} F$

C. The total heat produced in the circuit is $\frac{1000}{In2} J$

D. The total heat produced in the circuit is $\frac{500}{In2} J$

Answer: A::B::D



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35. In the shown figures (1) and (2), capacitors are in steady state. Charging batteries are removed a switches S_1 and S_2 are closed at time $t = 0$. The plot $\ln I$ (I is the current in the resistor) against time t the

resistors R_1 and R_2 are shown in the figure. Choose the correct option (s)

(1) 

A. If $\varepsilon_1 = 2\varepsilon_2$, R_1 must be equal to $2R_2$

B. If $R_1 = R_2$, C_1 must be less than C_2

C. If $C_1 = C_2$, R_1 must be less than R_2

D. R_1C_1 is equal to R_2C_2

Answer: A::B::C



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36. A capacitance balance is shown in figure. The balance has a weight attached on one side and capacitor that has a variable gap width on other side. Assume the upper plate of the capacitor has negligible mass. When the potential difference between the plates is V_0 , the attractive force between the plates balance the weight of the hanging mass, Then:



A. Equilibrium of weight is stable

B. Equilibrium of weight is unstable

C. Value of V_0 required to balance the weight is given by

$$V_0 = d \sqrt{\frac{2Mg}{\epsilon s \pi_0 A}}$$

D. for a small displacement block of mass M executes simple harmonic motion

Answer: B::C



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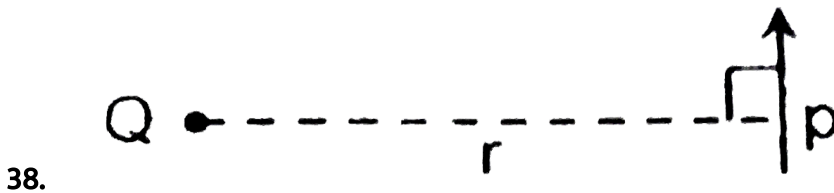
37. Three concentric spherical shells of radius a , $2a$ and $4a$ having positive charges Q_1 , Q_2 and Q_3 respectively are placed as shown. Now, shell of radius 'a' and '4a' are earthed through switch S_1 and S_2 . A point 'P' lies at a distance $5a$ from the centre and a point R inside the inner most shell. Now, choose the correct option (s) when switch S_1 and S_2 are closed.



- A. The magnitude of electric field at 'P' and at 'R' is equal
- B. The potential of inner most shell and outermost shell must be equal
- C. The magnitude of charge on shell of radius $2a$ remains unchanged
- D. Potential must drop in moving from inner most shell to middle shell

Answer: A::B::C

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A point charge $+Q$ is placed at a distance r from a short dipole of dipole moment \vec{p} as shown in figure. The line joining the point charge Q to the centre dipole is perpendicular to dipole moment \vec{p} , which of the following statement are true?

A. The net electrostatic force on the dipole is zero

B. The electrostatic force on the dipole is $\frac{Qp}{4\pi\epsilon_0 r^3}$ and is acting along the dipole moment p

C. Torque acting on the dipole is $\frac{Qp}{4\pi\epsilon_0 r^2}$ in the inward direction

D. Torque acting on the dipole is $\frac{Qp}{2\pi\epsilon_0 r^2}$ in the outward direction

Answer: B::C



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