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XII PHYSICS
ELECTROSTATIC POTENTIAL AND CAPACTENCE

1 **Mark Questions**:

Q.1. What is the electrostatic potential due to an electric dipole at an equatorial point?

Q.2. Name the physical quantity whose S.I. unit JC^{1}. Is it a scalar or a vector quantity?

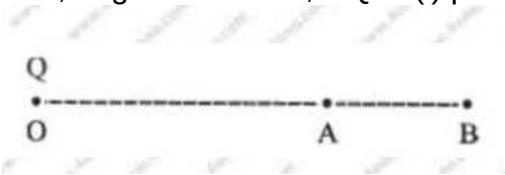
Q.3. A hollow metal sphere of radius 5 cm is charged such that the potential on its surface is 10 V. What is the potential at the center of the sphere?

Q.4. Two bar magnets are quickly moved towards a metallic loop connected across a capacitor 'C' as shown in the figure. Predict the polarity of the capacitor.

Q.5. A 500 C charge is at the center of a square of side 10 cm. Find the work done in moving a charge of 10 C between two diagonally opposite points on the square.

Q.6. In which orientation, a dipole placed in a uniform electric field is in (i) stable, (ii)unstable equilibrium?

Q.7. A point charge Q is placed at point O as shown in the figure. Is the potential difference V_A — V_B positive, negative or zero, if Q is (i) positive (ii) negative?



Q.8. What is geometrical shape of equipotential surfaces due to a single isolated charge?

Q.9. A capacitor has been charged by a dc source. What are the magnitudes of conduction and displacement current, when it is fully charged?

Q.10. For any charge configuration, equipotential surface through a point is normal to the electric field. Justify.

2 **Mark Questions**:

Q.11. Two point charges, qx= 10 x 10^{8} C and $q\pm$ = — 2x 10^{8}C are separated by a distance of 60 cm air.

(i) Find at what distance from the 1st charge, q1, would the electric potential be zero.
(ii) Also calculate the electrostatic potential energy of the system.

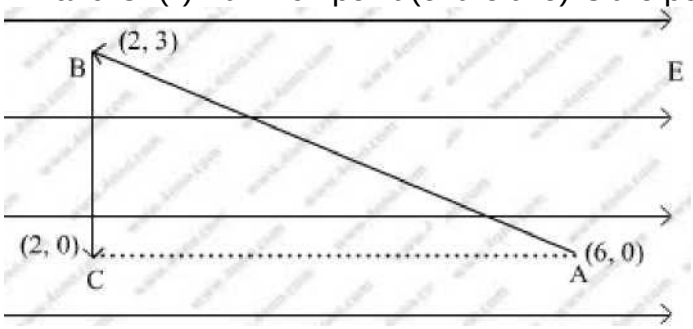
Q.12. Two point charges 4Q, Q are separated by 1m in air. At what point on the line joining the charges is the electric field intensity zero?
Also calculate the electrostatic potential energy of the system of charges, taking the value of charge, Q = 2 x 10^{-7}C.

Q.13. Draw 3 equipotential surfaces corresponding to a field that uniformly increases in magnitude but remains constant along Z-direction. How are these surfaces different from that of a constant electric field along Z-direction?

Q.14. What is the area of the plates of a 2F parallel plate capacitor having separation between the plates is 0.5 cm?

Q.15. Net capacitance of three identical capacitors in series is 1 What will be their net capacitance if connected in parallel? Find the ratio of energy stored in the two configurations if they are both connected to the same source.

Q.16. A test charge ‘q’ is moved without acceleration from A to C along the path from A to B and then from B to C in electric field E as shown in the figure. (i) Calculate the potential difference between A and C. (ii) At which point (of the two) is the potential more and why?



Q.17. A capacitor of capacitance ‘C’ is being charged by connecting it across a dc source along with an ammeter. Will the ammeter show a momentary deflection during the process of charging? If so, how would you explain this momentary deflection and the resulting continuity of current in the circuit? Write the expression for the current inside the capacitor.

Q.18. A slab of material of dielectric constant K has the same area as that of the plates of a parallel plate capacitor but has thickness d/2, where d is the separation between the plates. Find out the expression for its capacitance when the slab is inserted between the plates of the capacitor.

Q.19. A capacitor, made of two parallel plates each of plate area A and separation d, is being charged by an external ac source. Show that the displacement current inside the capacitor is the same as the current charging the capacitor.

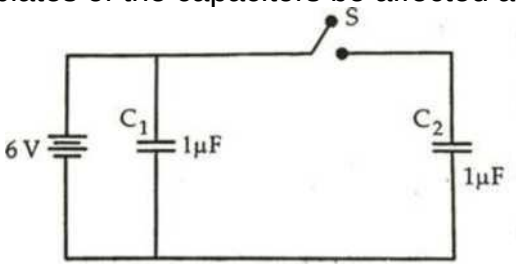
Q.20. A parallel plate capacitor of capacitance C is charged to a potential V. It is then connected to another uncharged capacitor with the same capacitance. Find out the ratio of the energy stored in the combined system to that stored initially in the single capacitor.

Q.21. Derive the expression for the electric potential at any point along the axial line of an electric dipole?

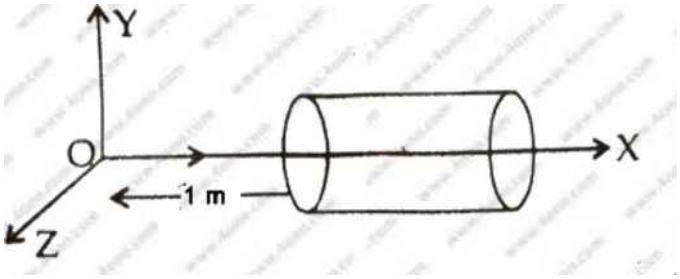
Q.22. (i) Can two equipotential surfaces intersect each other? Give reasons. (ii) Two charges - q and +q is located at points A (0, 0, - a) and B (0, 0, +a) respectively.
How much work is done in moving a test charge from point P (7, 0, 0) to Q (- 3, 0, 0)?

Q.23. Two uniformly large parallel thin plates having charge densities +o and -o are kept in the X-Z plane at a distance 'd' apart. Sketch an equipotential surface due too electric field between the plates. If a particle of mass m and charge '-q' remains stationary between the plates, what is the magnitude and direction of this field?

Q.24. Figure shows two identical capacitors, C_x and C_2 , each of 1 pF capacitance connected to a battery of 6 V. Initially switch 'S' is closed. After sometime 'S' is left open and dielectric slabs of dielectric constant K = 3 are inserted to fill completely the pace between the plates of the two capacitors. How will the (i) charge and (ii) potential difference between the plates of the capacitors be affected after the slabs are inserted?



Q.25. A capacitor of unknown capacitance is connected across a battery of V volts. The charge stored in it is 360pC. When potential across the capacitor is reduced by 120 V, the charge stored in it becomes 120pC. Calculate: (i) The potential V and the unknown capacitance C. (ii) What will be the charge stored in the capacitor, if the voltage applied had increased by 120V?

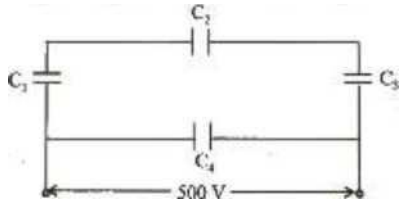


3 <u>Mark Questions:</u>

Q.26. A positive point charge (+q) is kept in the vicinity of an uncharged conducting plate. Sketch electric field lines originating from the point on to the surface of the plate. Derive the expression for the electric field at the surface of a charged conductor.

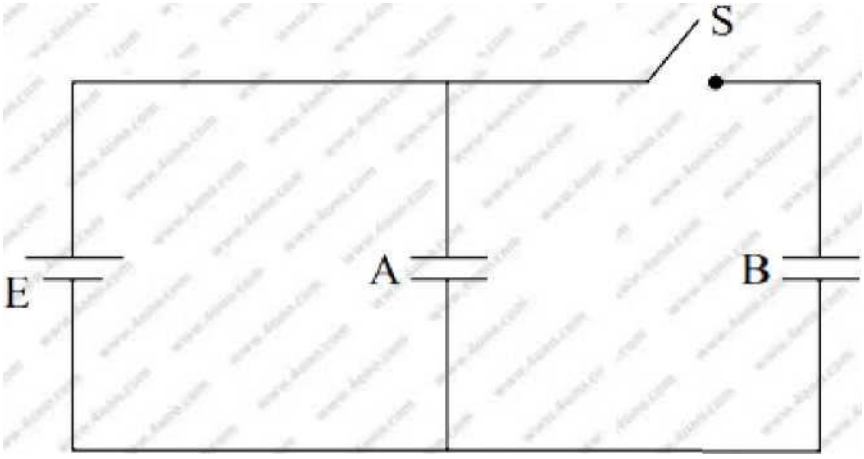
Q.27. A parallel plate capacitor is charged by a battery. After some time, the battery is disconnected and a dielectric slab of dielectric constant K is inserted between the plates. How would (i) the capacitance, (ii) the electric field between the plates and (iii) the energy stored in the capacitor, be affected? justify your answer.

Q.28. A network of four capacitors each of 12^F capacitance is connected to a 500 v supply as shown in the figure. Determine (a) equivalent capacitance of the network and (b) charge on each capacitor.

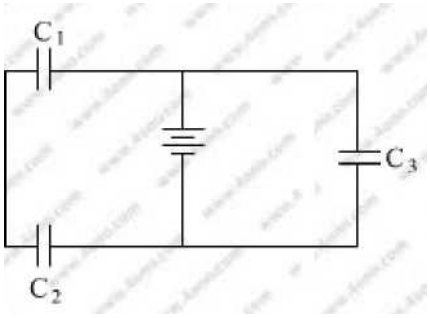


Q.29. Deduce the expression for the electrostatic energy stored in a capacitor of capacitance ‘C’ and having charge ‘Q’. How will the (i) energy stored and (ii) the electric field inside capacitor be affected when it is completely filled with a dielectric material of dielectric constant ‘K’?

Q.30. Two identical parallel plate capacitors A and B are connected to a battery of V volts with the switch S closed. The switch is now opened and the free space between the plates of the capacitors is filled with a dielectric of dielectric constant K. Find the ratio** of the total electrostatic energy stored in both capacitors before and after the introduction of the dielectric.



Q.31. Three identical capacitors C_1, C_2 and C_3 of capacitance 6^F each are connected to a 12 V battery as shown.



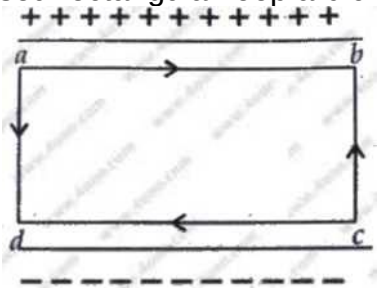
Find

(i) charge on each capacitor
(ii) equivalent capacitance of the network
(iii) energy stored in the network of capacitors

Q.32. A parallel plate capacitor is charged by a battery. After sometime the battery is disconnected and a dielectric slab with its thickness equal to the plate separation is inserted between the plates. How will (i) the capacitance of the capacitor, (ii) potential difference between the plates and (iii) the energy stored in the capacitor be affected? Justify your answer in each case.

Q.33. (a) Depict the equipotential surfaces for a system of two identical positive point charges placed a distance ‘d’ apart.
(b) Deduce the expression for the potential energy of a system of two point charges q-i and q_2 brought from infinity to the points and respectively in the presence of external electric field.

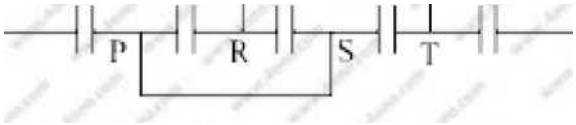
Q.34. (a) Obtain the expression for the energy stored per unit volume in a charged parallel plate capacitor.
(b) The electric field inside a parallel plate capacitor is E. Find the amount of work done in moving a charge q over a closed rectangular loop a b c d a.



Q.35. (a) Derive the expression for the capacitance of parallel plate capacitor having plate area A and plate separation d.
(b) two charged spherical conductors of radii R-L and R_2 when connected by a conducting wire acquire charges q± and q_2 respectively. Find the ratio of their surface charge densities in terms of their radii.

Q.36. (i) Find equivalent capacitance between A and B in the combination given below. Each capacitor is of 2 pF capacitance.

c'; r, r, t



(iii) If a dc source of 7 V is connected across AB, how much charge is drawn from the source and what is the energy stored in the network?

Q.37.Four point charges Q, q, Q and q are placed at the corners of a square of side ‘a’ as shown in the figure.

Find the

(a) Resultant electric force on a charge Q, and
(b) Potential energy of this system.

5 Marks Questions:

Q.38. Derive an expression for the energy stored a parallel plate capacitor. On charging a parallel plate capacitor to a potential V, the spacing between the plates is halved, and dialect medium of G_r= 10 is introduced between the plates, without disconnecting the d.c. source. Explain, using suitable expressions, how the (i) capacitance, (ii) electric field and (iii) energy density of the capacitor change.

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