CHAPTER-2

ELECTROSTATIC POTENTIAL AND CAPACITANCE

One mark questions

1. Is Coulomb force between two stationary charges a conservative or non-conservative force? (K)
2. Write the expression for the work done by an external force in moving a charge q through a distance 'dr' (U)
3. Define electric potential energy. (U)
4. Is the work done by electrostatic field in moving a charge from one point to another depend on the path that it moves? (K)
5. While defining the electrostatic potential due to a point charge, the reference of unit positive charge moving from infinity is considered. Why? (U)
6. Define electrostatic potential at a point. (U)
7. Mention SI unit of electric potential. (K)
8. Write the expression for work done in moving a charge from one point to another in an electric field. (K)
9. Write the expression for electric potential due to a point charge. (K)
10. How does electric potential due to a point charge vary with distance from it? (U)
11. Write the expression for electric potential due to a short electric dipole. (K)
12. How does electric potential due to a short electric dipole vary with distance? (U)
13. What is the potential at a point which is at a distance of 9 cm from a point charge 1nC? (A)
14. What is the work done in bringing a charge of 3mC through a potential difference of 4000 V? (A)
15. Write the expression for electric potential at a point outside a uniformly charged spherical shell. (K)
16. What is the electric potential inside a uniformly charged spherical shell? (K)
17. Write the expression for electric potential due to system of charges. (K)
18. What is an equipotential surface? (U)
19. Draw equipotential surfaces for a uniform electric field. (S)
20. Draw equipotential surfaces for a dipole. (S)
21. Draw equipotential surfaces for two identical positive charges. (S)
22. What is the work done to move a charge from one point to another point on an equipotential surface? (K)
23. Write the relation between the electric field and potential. (U)
24. Write the expression for potential energy of system of three charges. (U)
25. Define potential energy of a point charge 'q' kept in an external electric field. (U)
26. Define electron volt. (U)
27. Write the energy equivalence between electron volt and joule. (U)
28. Write the expression for potential energy of system of two charges in an external electric field. (U)
29. What are the mobile charges in a metallic conductor? (K)
30. Which electrons are free to move in metallic conductor? (K)

31. What are the charge carriers in electrolytic conductors? (K)
32. What is the value of electrostatic field inside a charged conductor? (K)
33. What is the direction of electric field on the surface of a charged conductor? (U)
34. If V is the electric potential on the surface of a spherical conductor, what is the value of electric potential inside it? (U)
35. What is electrostatic shielding? (U)
36. Where electrostatic shielding is made use of? (U)
37. What is a dielectric? (K)
38. What is polarization of a dielectric? (U)
39. What happens when a dielectric is placed in an external electric field? (U)
40. What is the direction of induced electric field in the dielectric medium when it is placed in a uniform electric field? (U)
41. What are polar molecules? (K)
42. What are non-polar molecules? (K)
43. Give an example of non-polar molecule. (K)
44. Give an example of polar molecule. (K)
45. What are linear isotropic dielectrics? (K)
46. Define electric polarization for linear isotropic dielectrics. (U)
47. Define electric susceptibility of a dielectric medium. (U)
48. What is the effect of external electric field on a dielectric? (K)
49. Define electric capacitance of a capacitor. (U)
50. What is a capacitor? (K)
51. Draw the circuit symbol of a capacitor. (S)
52. Draw the circuit symbol of a variable capacitor. (S)
53. Give SI unit of electrical capacitance. (K)
54. Define dielectric strength of a dielectric medium. (U)
55. Mention the SI unit of dielectric strength. (K)
56. What is the value of dielectric strength of air? (K)
57. Define farad, the unit of capacitance. (U)
58. Write the expression for electric field between the two plates of parallel plate capacitor. (U)
59. What is the value of electric field outside the charged parallel plate capacitor? (K)
60. What is 'fringing of the field' in case of parallel plate capacitor? (U)
61. Mention the expression for the capacitance of a parallel plate capacitor. (K)
62. Express dielectric constant in terms of permittivity of free space. (U)
63. When do we say that the two capacitors are in series? (U)
64. When do we say that the two capacitors are in parallel? (U)
65. Write the expression for equivalent of capacitance of two capacitors connected in series combination. (U)
66. Write the expression for equivalent capacitance of two capacitors connected in parallel combination. (K)
67. Write the expression for energy stored in a capacitor. (U)
68. Which form of energy is stored in the capacitor? (K)

69. Write the expression for energy stored in the capacitor in terms of electric field. (U)
70. What is energy density? (K)
71. What is Van de Graaff generator? (K)
72. What is the approximate order of the voltage that can be built using Van de Graaff generator? (K)
73. Write an application of Van de Graaff generator. (K)

Two mark questions

1. Draw the curves representing the variation of electrostatic potential and field with the distance from a point charge. (S)
2. Find the potential at a point P due to a charge of 4×10-9 C located 9 cm away from it. (A)
3. Write the expression for the potential at any point due to an electric dipole and explain the terms. (U)
4. Why the electrostatic field is zero inside a conductor? (U)
5. What work is done in moving any charge from the center of a charged spherical shell to any point inside it? Justify your answer. (U)
6. In the expression for the relation between electric field and potential which are the two important conclusions we arrive at? (U)
7. Write the expression for potential energy of system of two charges and generalize it for a system of three charges. (U)
8. Show that the work done to move a charge on an equipotential surface is zero. (U)
9. Justify that the electric field is normal to the equipotential surface at every point. (U)
10. What are the two important conclusions we can draw by the relation, $\vec{E} = -\delta V/\delta l$ (U)
11. Justify that the electric field lines on the surface of a conductor are always normal. (U)
12. Justify the statement, "There is no net charge at any point inside the conductor and any excess charge must reside at the surface." (U)
13. What are the two main factors on which the extent of polarization of a dielectric medium depends? (K)
14. Distinguish between polar and non-polar dielectrics. (U)
15. What are the factors on which capacitance of a capacitor depend? (K)
16. Write the expression for capacitance of a parallel plate capacitor and explain the terms. (K)
17. Mention any two factors on which the capacitance of a parallel plate capacitor depends? (K)
18. A material of dielectric constant 2 is inserted between the plates of a capacitor 3 micro F. calculate the new value of the capacitance. (A)
19. Find the energy stored in a capacitor of capacitance 5nF when connected to a potential of 6V source. (A)
20. Write the expression for energy density in case of a charged capacitor and explain the symbols used. (K)
21. What are two principles used to construct the Van de Graff generator? (K)
22. Draw the neat schematic labeled diagram of Van de Graaff generator. (S)

Three mark questions

1. Derive the expression for potential due to a system of charges. (U)
2. Obtain the expression for the relation between electric field and electric potential. (U)
3. Arrive at the expression for the potential energy of a system of two charges in the absence of an external electric field.(U)
4. Obtain the expression for the potential energy of a system of two charges in the presence of an external electric field. (U)
5. Obtain an expression for electric field at the surface of a charged conductor of arbitrary shape. (U)
6. Explain how a dielectric develops a net dipole moment in an external electric field. (U)
7. Mention any three factors on which the capacitance of a parallel plate capacitor depends? (K)
8. Capacitance of a parallel plate capacitor is 1 F and the plates are separated by 1 cm. Find the area of each plate of the capacitor. (A)
9. Obtain an expression for the capacitance of a parallel plate capacitor. (U)
10. Derive the expression for the effective capacitance of a series combination of two capacitors. (U)
11. Arrive at the expression for the effective capacitance of a parallel combination of two capacitors. (U)
12. Derive the expression for the energy stored in a capacitor. (U)
13. Explain how Van de Graaff generator is charged. (U)
14. What is Van de Graaff generator? Explain its working with a neat diagram. (S)

Five mark questions

1. Define electrostatic potential due to a point charge and arrive at the expression for electric potential at a point due to a point source charge. (U)
2. Obtain the expression for electrostatic potential at any point due to a short electric dipole. (U)
3. List out the important results regarding the (static charges) electrostatics of a conductor. (K)
4. Arrive at the expression for the capacitance of a parallel plate capacitor when a dielectric is introduced between its plates. (U)
5. Describe the construction and working of Van-de-Graaff generator with schematic diagram (S)

Numerical problems

1. PQRS is a square of side 1m. Four charges +10nC, -20nC, +30nC & +20nC are placed at the corners PQRS respectively. Calculate the electric potential at the intersection of the diagonals. (A) **[509V]**
2. Charges +2nC, +4nC, and +8nC are placed at the corners ABC respectively of a square of side 0.2m. Calculate the work done to transfer a charge of +2nC from the corner D to the center of the square. (A) **[627.4×10^{-9}J]**
3. A battery of 10V is connected to a capacitor of capacitance 0.1F. The battery is now removed and this capacitor is connected to a second uncharged capacitor. If the charge distributes equally on these two capacitors, find the total energy stored in each capacitor, and compare with the initial energy of the first capacitor. (A) **[2.5J, 0.5 times]**

4. A spherical drop of water carrying a charge of 3 $X10^{-10}$C has a potential of 500V at its surface. Find the radius of the drop. If two such drops of the same charge and radius combine to form a single spherical drop, calculate the potential at the surface of the new drop. (A) **[$5.4X10^{-3}$m, 794V]**
5. Two capacitors of capacitances 2μF and 8μF are connected in series and the resulting combination is connected across a 300V battery. Calculate the charge, potential difference and the energy stored in each capacitor**. (A) [charge=$4.8X10^{-4}$C, potential=240V, 60V, energy=$5.76X10^{-2}$J & $1.44X10^{-2}$J]**

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