CHAPTER-1

ELECTRIC CHARGES AND FIELDS

One mark questions

1. What is the cause for seeing the spark or hearing the crackle when, we take off our synthetic clothes particularly in dry weather? (K)
2. Which phenomenon is responsible for lightning in the sky during thunder storm? (K)
3. We experience a sensation of electric shock while opening the door of a car or while holding the iron bar of a bus after sliding from our seat. Why? (K)
4. Who discovered the fact that amber rubbed with wool or silk attracts light objects? (K)
5. What happens when insulating surfaces are rubbed with each other? (K)
6. When amber is rubbed with wool or silk, it attracts light objects. Who is credited as the discoverer of this phenomenon? (K)
7. How the name electricity is coined? (U)
8. How many kinds of electrification are there in nature? (K)
9. What is the meaning of the Greek word 'elektron' form which the name 'electricity' is coined? (K)
10. How many types of charges exist in nature? (K)
11. What is the nature of force between like charges? (K)
12. What is the nature of force between unlike charges? (K)
13. What is meant by polarity of charges? (U)
14. What would happen when two oppositely charged objects are brought in contact? (K)
15. Who has named two types of charges as positive and negative? (K)
16. Why does a pair of objects get electrified on rubbing on each other? (U)
17. What is the cause of electrification of an object? (U)
18. When do we say that an object is charged or electrified? (U)
19. Name the instrument which detects the charge on an object. (K)
20. Name the instrument which detects the nature of the charge of the object. (K)
21. What is gold leaf electroscope? (K)
22. What does the degree of divergence of gold leaves in gold leaf electroscope indicate? (U)
23. How an object does acquire positive charge? (U)
24. How an object does acquire negative charge? (U)
25. When glass rod is rubbed with silk, glass rod acquires positive charge. Give reason. (U)
26. When plastic rod is rubbed with cat's fur it acquires negative charge. Give reason. (U)
27. Why do electrostatic experiments not work well on humid days? (U)
28. When we walk briskly on the carpet in dry whether we are electrically charged. What type of charge accumulates on us? (K)
29. Why can we not charge metal rod when held in hand and rubbed with wool? (U)

30. What are electric conductors? (K)
31. What are electric insulators? (K)
32. Electric charge can be transferred from one object to the other object using copper wire but not with nylon thread. Give reason. (U)
33. Give an example of electric conductor. (K)
34. Given an example of electric insulator. (K)
35. What is meant by grounding/earthing? (K)
36. Name the three wires in household electrical wire systems (K)
37. Why do we connect the metal parts of the electrical appliances to the earthing wire? (U)
38. Why is it recommended that you touch the metal frame of your personal computer before installing any internal accessories? (U)
39. If we rub a coin briskly between your fingers, it will not seem to become charged by friction. Why? (U)
40. The number of electrons in an insulator is of the same order as the number of electrons in a conductor. What is then the basic difference between a conductor and an insulator? (U)
41. Is pure water a conductor or insulator? (U)
42. What is charging by induction? (K)
43. When a charged comb is brought near a small piece of paper, it attracts the piece. Does the paper become charged when the comb is brought near it? (K)
44. When do we treat a charged object as a point charge? (U)
45. What is meant by additive property of charge? (K)
46. What is meant by quantization property of charge? (K)
47. State the conservation property of charge. (K)
48. Why a charge on an object is said to be quantized? (U)
49. Write the expression for quantization property of charge. (K)
50. What is the nature of charge on an electron? (K)
51. What is the nature of charge on a proton? (K)
52. Name the scientist who suggested the quantization property of charge. (K)
53. Name the scientist who experimentally proved the quantitation nature of charge. (K)
54. Name the SI unit of charge. (K)
55. Give the value of the basic unit of charge. (K)
56. How many electrons make -1 C of charge? (A)
57. A glass rod rubbed with silk loses 108 electrons. What is the charge on glass rod? (K)
58. What is the least possible value of charge that an object can have? (K)
59. When do we neglect the quantization property of charge? (U)
60. How many electrons make -1 μC charge? (A)
61. What is the lower limit of the electric force between two charged particles placed at a separation of 1 cm in vacuum? (A)
62. Initially sphere A has a charge of -50e and sphere B has a charge of +20e. The spheres are made of conducting material and are identical in size. If the spheres are then touch, what is the resulting charge on sphere A? (A)
63. State Coulomb's law in electrostatics. (K)

64. Give the mathematical expression of Coulomb's law in electrostatics. (U)
65. Name the device used by Coulomb to measure the electric force between two charged spheres.(K)
66. How does the Coulomb force between the two point charges vary with the distance of separation between them? (U)
67. What is the value of proportionality constant k, in Coulomb's law in SI unit? (U)
68. What is the physical significance of proportionality constant k in Coulomb's law? (U)
69. Define 1 C of charge. (U)
70. Express the proportionality constant k in terms of permittivity of free space in Coulomb's law. (U)
71. Write the value of permittivity of free space in SI system. (K)
72. Two point charges of unknown magnitude and sign are at a distance d apart. The electric field is zero between them at a point on the line joining the two charges. What can you conclude about the charges? (A)
73. If the electrons in a metal plate such as copper are free to move about, they must often find themselves headed toward the metal surface. Why do they not keep on going and leave the metal? (A)
74. An electron (charge =$-e$) circulates around a helium nucleus (charge =+2e) in a helium atom. Which particle excerts the larger force on the other? (U)
75. Charges of 10 μC and 15 μC are separated by a certain distance. Which charge repels the other with greater force? (A)
76. State the principle of superposition of Coulomb's force. (U)
77. Write the expression for electric field at a point due to point charge. (U)
78. Define intensity of electric field. (U)
79. How does the electric field at a point vary with distance from a point electric charge? (U)
80. How electric field at a point does vary with the magnitude of source charge? (U)
81. Write the SI unit of intensity of electric field. (K)
82. What is source charge? (K)
83. What is test charge? (K)
84. What is the direction of electric field due to a positive point charge? (K)
85. What is the direction of electric field due to a negative point charge? (K)
86. Who first introduced the concept of electric field? (K)
87. An electron is located in the uniform electric field established between two parallel plates. Where would the electron experience greatest force? (U)
88. A positively charged ball hangs from a long silk thread. We wish to measure E the electric field at a point in the same horizontal plane as that of the hanging charge. To do so, we put a positive test charge q_0 at that point and measure F/q_0. Will F/q_0 be less than, equal to, or greater than E at the point in question? (U)
89. Represent the variation of electric field with the distance from a point charge graphically. (S)
90. A point charge is taken from a point A to a point B in an electric field. Does the work done by the electric field depend on the path of the charge? (U)
91. What is an electric field line? (K)

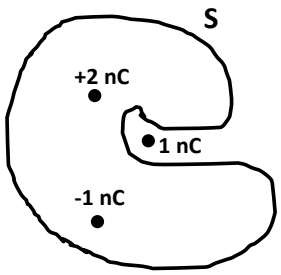
92. Draw electric field lines due to a point positive charge. (S)
93. Draw electric field lines due to a point negative charge. (S)
94. Draw electric field lines due to two equal but unlike charges. (S)
95. Draw electric field lines due to two equal but like charges. (S)
96. Draw electric field lines due to two like but unequal charges. (S)
97. Draw electric field lines due to two unlike but unequal charges. (S)
98. Draw electric filed lines of a uniform electric field. (S)
99. What is the polarity of test charge which is used to draw electric field lines? (K)
100. What does the relative density of electric field lines represent? (U)
101. Who invented picture of electric field lines? (K)
102. A point charge is moving in an electric field at right angles to the electric field lines. Does any force act on it? (U)
103. Define electric flux through a surface. (U)
104. Write the SI unit of electric flux. (K)
105. Write the expression for electric flux. (U)
106. Is electric flux a vector or a scalar quantity? (K)
107. What is an electric dipole? (K)
108. Define electric dipole moment. (U)
109. Give the SI unit of electric dipole moment. (K)
110. What is the net charge on an electric dipole? (U)
111. How does the electric field at a point due to a short dipole vary with distance? (U)
112. What is meant by electric dipole axis? (K)
113. What is meant by equatorial plane of the electric dipole? (U)
114. What is the direction of electric dipole moment? (K)
115. Write the expression for the electric field at a point on its axial line due to an electric dipole. (U)
116. Write the expression for the electric field at a point on the equatorial plane of an electric dipole. (U)
117. In the equatorial plane of an electric dipole, is the electric field parallel or antiparallel to the electric dipole moment $\vec{p}$? (U)
118. Write the expression for torque experienced by a dipole when placed in a uniform electric field.(U)
119. An electric dipole is placed antiparallel to the uniform electric field. What is the magnitude of the torque on it? (U)
120. An electric dipole is placed parallel to the uniform electric field. What is the magnitude of the torque on it? (U)
121. Write the expression for electric field at a point due to continuous charge distribution over a small volume element with charge density ρ. (U)
122. State Gauss law in electrostatics. (K)
123. What is Gaussian surface? (K)
124. Write the mathematical expression for Gauss law in electrostatics. (U)
125. What is the electric flux through a cubicle Gaussian surface enclosed on an electric dipole? (U)

126. Write the expression for the electric field due to a uniformly charged, infinitely long straight wire. (U)
127. Write the expression for the electric field due to a uniformly charged, infinite plane sheet. (U)
128. Write the expression for the electric field due to a uniformly charged thin spherical shell. (U)
129. Does the electric field exist inside a charged spherical shell? (U)

Two mark questions

1. Explain what happens when long thin strips of paper lightly ironed brought near a TV screen or Computer monitor which is switched on. (U)
2. Name the two types of electric charge. (K)
3. A glass rod is rubbed with silk. Name the type of charges acquired by each of them. (K)
4. A cat fur is rubbed with plastic rod. Name the type of charges acquired by each of them. (K)
5. Which type of charge is acquired by a plastic rod and wool when they are rubbed with each other? (K)
6. Which are the two types of charges named by Benjamin Franklin? (K)
7. Draw the neat, labeled diagram of gold leaf electroscope. (S)
8. A charged rod attracts bits of dry cork dust which after touching the rod, often jump violently away from it. Explain. (U)
9. What are electric conductors? Give an example. (K)
10. What are electric insulators? Give an example. (K)
11. Distinguish between electric conductors and electric insulators. (U)
12. Explain the additive property of electric charge. (U)
13. Explain the conservation property of electric charge. (U)
14. Explain the quantization property of electric charge. (U)
15. Justify with an example to prove the conservation property of charge. (U)
16. A plastic rod rubbed with cat's fur gains 10^{13} electrons. Find the charge on plastic rod. (A)
17. An ion contains 12 electrons and 18 protons on. Find the net charge on the object. (A)
18. Find the electric charge in coulomb, contributed by 12.5×10^{8} electrons. (A)
19. A glass is rubbed by silk cloth acquires a charge of 1.6×10^{-13} C. What is the charge on silk cloth? (A)
20. How many electrons enter in an ordinary 100 W, 230 V bulb per second when it is connected to DC supply? (A)
21. Write Coulomb's law in vector form and explain the terms.(U)
22. The force between two point charges is F. What is the new force when the distance between them is halved? (U)
23. In Coulomb's law $F = k\frac{q_1 q_2}{r^2}$, what are the factors on which k depends? (U)
24. Write the expression for intensity of the electric field in vector form and explain the terms. (U)
25. Find the electric field at a point located at 2 cm from a charge of 1 nC. (A)
26. What are the factors on which electric field at a point due to a point source charge depend? (U)
27. Write the physical significance of electric field. (U)
28. Two field lines never intersect each other. Give reason. (U)

29. Charge of 1 μC, -2 μC, 1 μC, -2 μC is placed at A, B, C and D respectively of a square of side 1.234 cm. What is the electric field intensity at the center of the square? (A)
30. The electric field $\boldsymbol{E}$ due to a point charge at any point near it is defined as $\vec{E} = \lim_{q\to 0} \frac{\vec{F}}{q}$ where q is the test charge and $\vec{F}$ is the force acting on it. What is the physical significance of limit as $q \to 0$ in this expression? (U)
31. When do we say that electric flux is either positive or negative? (U)
32. Define electric flux through an area element. Mention the SI unit of electric flux. (U)
33. Write the physical significance of electric dipole moment. (U)
34. An electric dipole of 2×10^{-9} Cm is placed at an angle of 30° with uniform electric field of 4 N/C. Find the magnitude of torque experienced by it. (A)
35. When does an electric dipole placed in a uniform electric field experiences a) maximum b) minimum torque? (U)
36. What happens to a free electric dipole when placed in a non-uniform electric field? Explain. (U)
37. Define linear charge density. Write its SI unit. (U)
38. Define surface charge density. Write its SI unit. (U)
39. Define volume charge density. Write its SI unit. (U)
40. Find the electric flux through a parallelepiped Gaussian surface which encloses one micro coulomb charge. (A)
41. Find the electric flux through a closed surface, S in the following diagram. (A)



42. A charge of 1 μC is distributed on a circular ring of radius 5 cm. Find the linear charge density. (A)
43. A charge of 1 μC is distributed over a metallic spherical shell whose radius is 5 cm. Find the surface charge density. (A)
44. 1 μC of charge is placed at one corner of a cube of side 1 cm. Find the electric flux through the cube. (A)

Three mark questions

1. Describe an experiment to demonstrate that there are two types of charges using glass rod and plastic rod. (U)
2. Describe an experiment to demonstrate there are two types of charges using pith balls. (K)
3. Describe how we use gold leaf electroscope to detect the presence of charge on an object. (U)
4. Describe how we can use gold leaf electroscope to detect the nature of charges on a charged object. (U)

5. Explain how we can construct a simple electroscope? (K)
6. Explain the working of electroscope using paper strip experiment. (K)
7. Describe how two metal spheres can be oppositely charged by method of induction. (K)
8. How can we charge a metal sphere positively without touching it? (U)
9. Write the three basic properties of electric charge. (K)
10. If 10^9 electrons move out of an object to another object every second, how much time is required to get a total charge of 1C on the other object? (A)
11. Obtain the expression for the force on a point charge due to multiple charges using principle of superposition. (U)
12. Obtain the expression for electric field at a point due to system of charges. (U)
13. Write three properties of electric field lines. (K)
14. Derive the expression for the torque experienced by an electric dipole placed in a uniform electric field. (U)
15. Find the electric flux though cylindrical Gaussian surface placed parallel to uniform electric field. (U)

Five mark questions

1. Obtain the expression for electric field at a point on the axial line of an electric dipole. (U)
2. Derive the expression for electric field at a point on the equatorial plane of an electric dipole. (U)
3. Using Gauss law derive the expression for the electric field due to an infinitely long straight uniformly charged wire. (U)
4. Obtain the expression for electric field due to a uniformly charged infinite plane sheet using Gauss law. (U)
5. Arrive at the expression for the electric field due to a thin spherical shell at a point outside the sphere using Gauss law and write the expression for electric field on its surface. (U)

Numerical problems

1. Two point charges 20 μC and 10μC are separated by 0.05m in free space. Find the force between them. Also calculate the force when a dielectric medium of dielectric constant 3 is introduced between them. (A) **[720N, 240N]**

2. Two point charges 16nC and 8nC are situated at the corners B and C of an equilateral triangle of side 0.03m. Find the magnitude and direction of the resultant electric field at the vertex A of the triangle. (A) **[$21.2X10^4 NC^{-1}$, $40^0 53'$ angle with E_1]**

3. Two pith balls of mass 10mg each are suspended by two threads from the same support are charged identically. They move apart by 0.08m and threads make an angle 60^0 with each other. Find the charge on each pith ball. (A) **[6.33nC]**

4. Two identically oppositely charged metallic spheres placed 0.5m apart attract each other with a force of 0.108N., when they are connected to each other by a copper wire for a short while, they begin to repel with a force of 0.036N. Calculate the initial charges on the spheres. (A) **[+3μC, -1μC]**

5. Two positively charged particles each of mass $1.7X10^{-27}$Kg, carrying a charge of $1.6X10^{-19}$C are kept at a certain distance in air. If each charge experiences a repulsive force equal to its weight, find the distance of separation between the charges. (A) **[0.117m]**

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