



PHYSICS

BOOKS - JEEVITH PUBLICATIONS

PHYSICS (KANNADA ENGLISH)

ELECTRIC CHARGES AND FIELDS

One Mark Questions With Answers

1. Define charge on a body.



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2. Mention the SIU of electric charge.



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3. What is the nature of charge carried by an electron?



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4. What is the value of quantised unit of charge or what is the smallest unit of charge?



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5. Mention the value of charge on an electron.



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6. Mention the value of charge on a proton.



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7. What is the nature of charge induced on a conductor brought closer to a positively charged body?



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8. An uncharged conductor is brought in contact with a positively charged body. What is the nature of charge acquired by the conductor?





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9. Can an insulator be charged by the method of conduction?



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10. Say whether charge on a body varies with speed or not.



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11. What will happen to the mass of a charged body?



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12. What is the charge on an atomic nucleus?



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13. A surface encloses $+10\text{nC}$ and -2nC of charge. What is the net charge enclosed by it?



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14. Is charge a scalar or a vector?



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15. Can charge be created?



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16. Define Electric field.



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17. Define electric intensity at a point in an electric field.



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18. Give the SI unit of Electric field intensity.



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19. Say whether Electric field intensity is a scalar physical quantity or not.



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20. When can a point charge serve as a test charge?



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21. When is the electric field said to be uniform?



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22. State and explain Gauss's theorem in Electrostatics.



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23. What is the value of Electric field intensity at any point inside a charged hollow spherical conductor?



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24. Define Electric flux.



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25. What is a neutral point in a combined electric field?



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26. A closed surface has an electric dipole. What will be the flux passing through the surface?



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27. Write the expression for electric field at a point on the axis of a short electric dipole.



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28. Mention the method of electrification of silk withh glass rod.



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29. What helps the electrification of insulators?



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30. Give the sign convention for charge as given by Benjamin Fraklin.



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31. Name the apparatus to detect the charge on a body.



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32. Mention any one method of charging a body



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33. Can an insulator be charged by the method of conduction?



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34. Can a metal be charged by induction?



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35. What are the point charges?



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36. Mention the value of electrical permittivity of free space.



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37. Give the mathematical form of the combined forces acting on the given charge due to a number of discrete point charges.



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38. Express electric force in terms of electric field intensity.



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39. What is the direction of electric field due to a positive charge?



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40. What is the direction of electric field due to a negative charge?



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41. What is the amount of electric flux through a closed surface due to an electric dipole?



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Two Marks Questions With Answers

1. How many electrons are transferred to a body in order to charge it to $-5C$?



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2. Represent vectorially the direction of force between the charge for (i) $q_1 q_2 > 0$ (ii) $q_1 q_2 < 0$



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3. Write the expression for the electric field at a point on the perpendicular bisector due to a short electric dipole. Give the meaning of the symbols used.



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4. Write the expression for the electric field at any point due to a short electric dipole. Give the meaning of the symbols used.



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5. Write the expression for torque experienced by an electric dipole in a uniform electric field. Give the meaning of the symbols used.



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6. Why is that gravitational force negligible compared to the electrostatic force between a proton and an electron? (Assume the distance between them as 1\AA)



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7. Give the mathematical form of the combined forces acting on the given charge due to a number of discrete point charges.



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8. Given the expression for electric field intensity at a point due to a thin infinitely long straight wire. Give the meaning the of symbols used.



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9. Give the expression for electric field intensity due to an infinite thin plane sheet. Give the meaning of the symbols used.



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10. Write the expression for electric field intensity at any point outside and inside due to a charged spherical shell.



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11. Why is an atom electrically neutral?



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12. Give the expression for torque experienced by an electric dipole in an uniform electric field in a vector form. Give the meaning of the symbols used.



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13. Why is that electric field intensity at a point on the equatorial line due to an electric dipole taken as negative?



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14. Give the expression for electric field intensity at a point due to a discrete and continuous distribution of charges.



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15. Do electrostatic field lines form (electrostatic) closed loops? Give reason.



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16. An electrically charged oil drop remains static at a point in an electric field. Represent the situation by a mathematical equation.



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17. Why is electrostatic force conservative and central?



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18. Calculate the number of electrons to be transferred from a material body in order to charge it to +5.5 nC.



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19. Show graphically: $E \propto \frac{1}{r^2}$



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Three Marks Questions With Answers

1. Represent electric field lines around (i) a positive point charge (ii) a negative point charge and (iii) an electric dipole.



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2. Mention any three properties of an electric charge.



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3. Write any three characteristics of electrostatic force.



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4. What decreases of a mass of a body is observed when charged to $+10C$?



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5. If the distance between the two point charges is doubled then what will be percentage change in the force?



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6. The sum of charge on two point charges is Q . What should be the values of charges on them for a maximum force between them for a given separation?



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7. For a given separation between the two point charges, the force between them is $64 \times 10^{-4} N$. If the distance is decreased by 0.25 m then the force between them is $100 \times 10^{-4} N$. Find the initial separation between the charges.



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8. Represent the force between the two point charges in terms of position vector graphically.



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9. Represent the resultant force acting on a charge q_0 due to point charges q_1, q_2, q_3, q_4 .

Assume the position vectors as

$\vec{r}_0, \vec{r}_1, \vec{r}_2, \vec{r}_3, \vec{r}_4$ respectively. Give the

expression for net force on q_0



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10. Represent the electric field intensity at a point (where a unit positive charge is assumed to be) due to system of charges.



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11. Represent pictorially how electric flux may be taken as the dot product as \vec{E} and $\vec{\Delta s}$



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12. State and explain Gauss's theorem in Electrostatics.



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Five Marks Questions With Answers

1. State Gauss's theorem. Obtain an expression for electric field at any point outside a charged spherical hollow conductor (shell).



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2. Mention and five properties of electric field lines.



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3. Write the expression for torque experienced by an electric dipole in an uniform electric field. Give the meaning of the symbols used.



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4. Given the expression for electric field intensity at a point due to a thin infinitely long straight wire. Give the meaning the of symbols used.



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5. Write the expression for electric field at a point on the axis of a short electric dipole.



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6. Obtain an expression for the electric field intensity at a point on the equatorial line of an electric dipole.



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7. Give the expression for electric field intensity due to an infinite thin plane sheet. Give the meaning of the symbols used.



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Numericals With Solutions

1. Two point charges $-2nC$ and $+8nC$ are separated in air by a distance of 0.10m. Find the position of the neutral point along the line joining the 2 point charges.



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2. Two point charges $q_1 = +4\mu c$ and $q_2 = +32\mu c$ are separated in air at a distance of 0.12 m apart. Find the position of

the neutral point along the line joining the 2 point charges.



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3. Two point charges $+10\mu C$ and $-15\mu C$ are placed at the vertices A and B of a right angle $\Delta^{le} ABC$, such that $AB = 0.05m$, $BC = 0.12m$. Calculate the result field intensity at the point C. If $+100\mu C$ of charge is palced at C, then what force will be experienced by the point charge at C?



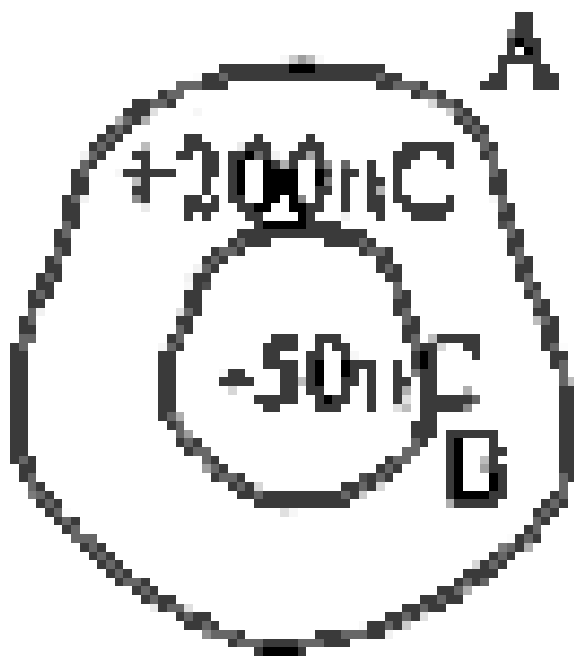
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4. Four point charges $+2nC$, $-3nC$, $+4nC$, $-5nC$ are placed at the vertices A,B,C,D of a square ABCD of side 0.2 m respectively. Calculate the electric field intensity at a point of intersection of the diagonals.



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5. In the given figure, what is the Flux enclosed by A and B?



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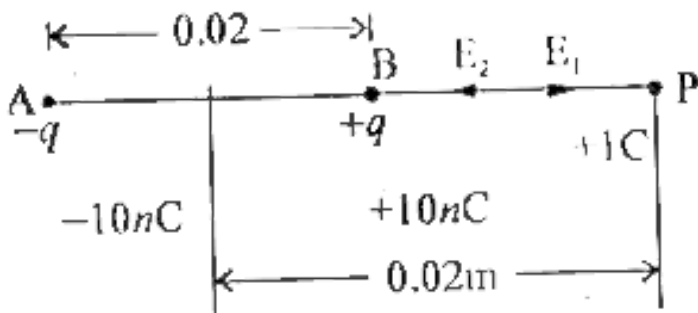
6. A system has two charges $q_A = 2.5 \times 10^{-7} C$ and $q_B = -2.5 \times 10^{-7} C$ located at points $A \equiv (0, 0, -15cm)$ and $B = (0, 0, +15cm)$ respectively. What are the total charge and electric dipole moment of the system?



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7. Two point charges $+10nC$ and $-10nC$ are separated by a distance of $0.02m$. Calculate

the electric field intensity at a point P on the axis of the dipole at 0.01 from $+10\text{nC}$.



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8. Two point charges $+20\text{nC}$ and -20nC are separated by a distance of 0.10m . Calculate the electric field intensity at a perpendicular distance 0.10m from the centre of a dipole.



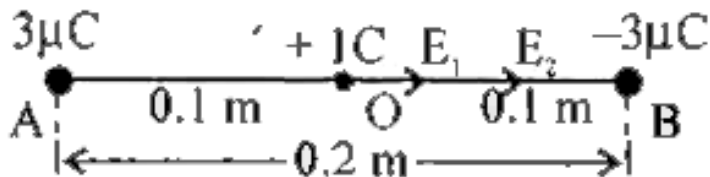
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9. Two point charges $q_A = 3\mu C$ and $q_B = -3\mu C$ are located 0.2 m apart in vacuum.

a. What is the electric field at the mid point O of the line AB joining the two charges?

b. If a negative test charge of magnitude $1.5 \times 10^{-9} C$ is placed at this point, what is

the force experienced by the test charge?



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10. A system has two charges

$$q_A = 2.5 \times 10^{-7} C \text{ and } q_B = -2.5 \times 10^{-7} C$$

located at points $A \equiv (0, 0, -15\text{cm})$ and

$B = (0, 0, +15\text{cm})$ respectively. What are the

total charge and electric dipole moment of the

system?



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11. An electric dipole with dipole moment 4×10^{-9} cm is aligned at 30° with the direction of a uniform electric field of magnitude $5 \times 10^4 \text{ NC}^{-1}$. Calculate the magnitude of the torque acting on the dipole.



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12. a. Two insulated charged copper spheres A and B have their centres separated by a distance of 0.5 m. What is the mutual force of electrostatic repulsion if the charge on each is $6.5 \times 10^{-7} \text{ C}$? Assume that the radii of A and B are negligible compared to the distance of separation.

b. What is the force of repulsion if each sphere is charged double the above amount and the distance between them is halved?



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13. Two insulated charged copper spheres A and B have their centres separated by a distance of 0.5 m. The charge on each spheres is $6.5 \times 10^{-7} C$. A third sphere c of identical shape and size is brought in contact with A and then brought in contact with B and finally removed. What is the new force between A and B?



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14. Consider a uniform electric field

$$\vec{E} = 3 \times 10^3 \hat{i} \text{ NC}^{-1}$$

a. What is the flux of this field through a square of 0.1 m on a side whose plane is parallel to the y-z plane?

b. What is the flux through the same square if the normal to its plane makes a 60° angle with the x-axis?



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15. A uniformly charged conducting sphere of 2.4 m diameter has a surface charge density of $80 \times 10^{-6} \text{ cm}^{-2}$

a. Find the charge on the sphere.

b. What is the total electric flux leaving the surface of the sphere?



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16. An infinite line charge produces a field of $9 \times 10^4 \text{ NC}^{-1}$ at a distance of $2 \times 10^{-2} \text{ m}$.

Calculate the linear charge density.



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17. Two large, thin metal plates are parallel and close to each other. On their inner faces, the plates have surface charge densities of opposite signs and magnitude $17.0 \times 10^{-22} \text{ C m}^{-2}$. What is the electric field
- in the outer region of the first and the second plates?
 - between the plates?



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18. An oil drop of 12 excess electrons is held stationary under a constant electric field of $2.55 \times 10^4 \text{ NC}^{-1}$ in Millikan's oil drop experiment. The density of the oil is $1.26 \times 10^3 \text{ kgm}^{-3}$. Estimate the radius of the drop ($g = 9.81 \text{ ms}^{-2}$, $e = 1.60 \times 10^{-19} \text{ C}$).



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19. In a certain region of space, electric field is along the z-direction throughout. The magnitude of electric field is, however not constant but increases uniformly along the positive z-direction at the rate of $10^5 \text{ NC}^{-1} \text{ m}^{-1}$. What are the force and torque experienced by a system having a total dipole moment equal to 10^{-7} Cm in the negative z-direction?



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20. The electric field components are

$$E_x = ax^{1/2}, E_y = E_z = 0 \quad \text{in which}$$

$a = 800 \text{NC}^{-1}\text{m}^{-1/2}$. Calculate a. the flux

through the cube, and b. the charge within the

cube. Assume that $a = 0.1 \text{m}$



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21. An electric field is uniform and

$$E = 200\hat{i} \text{NC}^{-1} \quad \text{along } +x \text{ and}$$

$$E = -200\hat{i} \text{NC}^{-1} \quad \text{along } -x \text{ direction. A}$$

right circular cylinder of length 0.20 m and

radius 0.05 m has its centre at the origin and its axis along the x -axis so that one face is $x = +0.10\text{ m}$ and the other $= x - 0.10\text{ m}$.

a. What is the net outward flux through each flat face?

b. What is the flux through the side of the cylinder?

c. What is the net outward flux through the cylinder?

d. What is the net charge inside the cylinder?



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