PHYSICS

NCERT - FULL MARKS PHYSICS(TAMIL)

ELECTRIC CHARGES AND FIELDS

Example

1. How can you charge a metal sphere negatively without touching it?

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2. If 10^9 electrons move out of a body to another body every second, then the time required to get a total charge of 1 C on the other body is

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3. How much positive and negative charge is there in a cup of water ?

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4. Coulomb's law for electrostatic force between two point charges and Newton's law for gravitational

force between two stationary point masses, both have inverse square dependence on the distance between the charges/masees (a) compare the strength of these forces by determining the ratio of their maagnitudes (i) for an electron and as proton (ii) for two protons (b) estimate the accelerations for election and proton due to electrical force of their mutal attraction when they are 1 A apart.

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5. A charged metallic spere A is suspended by a nylon thread another charged metallic spere b held by an insulating centres is 10 cm c and d are then removed

and b is brought closer to a to a what is txpectd repulsion of a on the basis of columb law sphere a and c speres b and d have indentical sizes ignore the sizes of a and b in comparision to the separation between their centres

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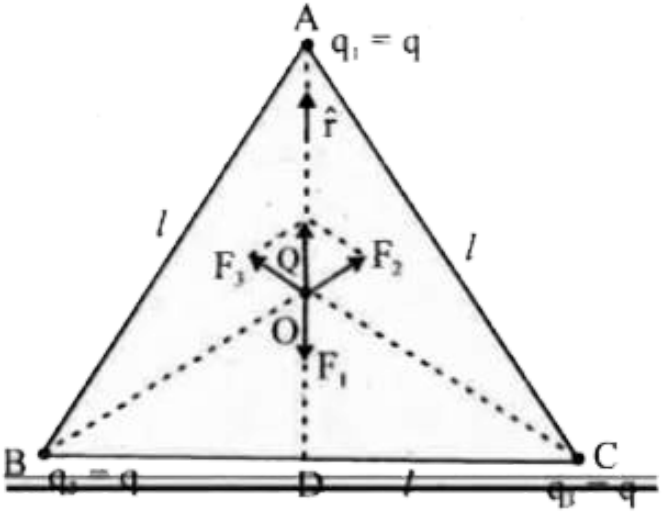
6. Consider three charges q_1, q_2, q_3 each equal to q at the vertices of an equilateral triangle of side l. what is the force on a charges Q (with the same sign as q) placed at the centroid of the triangle,as shown

in figure?



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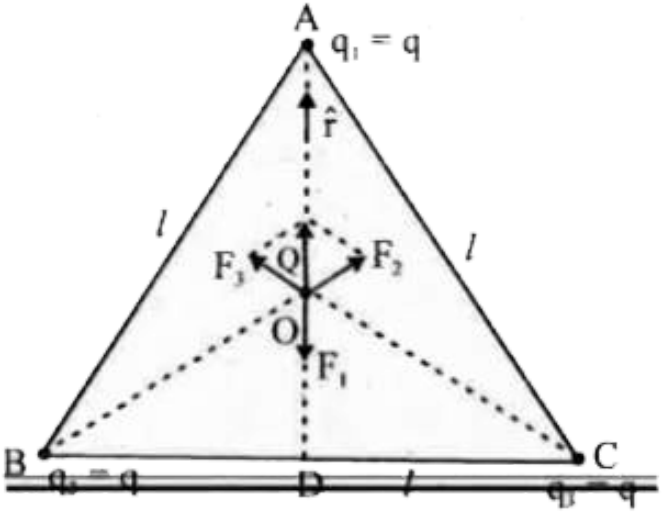

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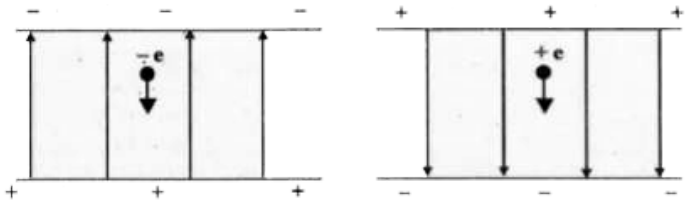
8. An electron falls through distance of 1.5 cm in a uniforth electric field of magnitude $2.0 \times 10^4 NC^{-1}$ The direction of the field is reversed keeping its magnitude unchanged and a proton falls through

the same distance compute the time of falls in each case . Contrast the situation with that of 'free fall under gravity'



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9. Two point charges q_1 and q_2 of magnitude + 10^{-8} c and -10^{-8} c respectively are placed 0.1 m apart calculate the electric field between the point charges

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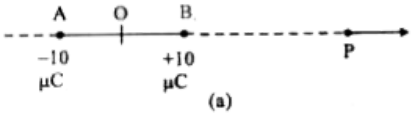
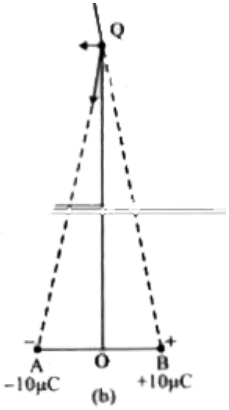
10. Two charges $\pm 10\mu C$ are placed 5.0 mm apart. Determine the electric field at (a) a point P on the axis of the dipole 15 cm away from its centre O on the side of the positive charges, as shown in Fig. (a) and (b) be a point Q, 15 cm away from O on a line passing through O and normal to the axis of the dipole, as shown in Fig (b).



(a)



(b)

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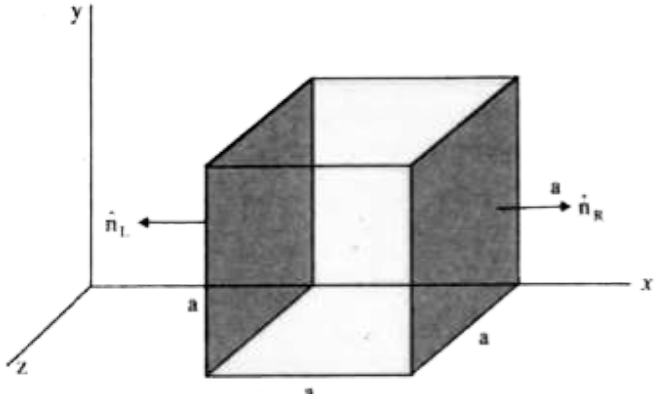
11. The electric field components in Figure are $E_x = \alpha x^{\frac{1}{2}}, E_y = E_z = 0$ in which $\alpha = 800 N/Cm^{\frac{1}{2}}$. Calculate (a) the flux through the cube, and (b) the charge within the cube. Assume that a=0.1m.



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12. An electric field is uniform, and in the positive x-direction for positive x, and uniform with the same magnitude , but in the negative x-direction for negative x. It is given that $\vec{E} = 200\hat{i}N/Cf$ or $x > 0$ and $\vec{E} = -200\hat{i}N/C$ for x gt 0. A right circular cylinder of length 20 cm and raidus 5cm has its center at the origin and its axis along the x-axis so that one face is at $x = +10cm$ and the other is at $x = -10cm$.

(a) What is the net outward flux through the side of the cylinder ? (b) What is the net outward flux through the cyclinder ? (c) what is net charge inside the cylinder ?

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13. An early model for an atom consider it to have a positively charged point inucleus of charges ze surronded by a whole is neutral for this model what is the electric field at a distance r from the nucleus

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Exercises

1. What is the force between two small charged spheres having charges of

$2 \times 10^{-7} C$ and $3 \times 10^{-7} C$ placed 30cm apart in air ?

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2. The electrostatic force on a small sphere of charge $0.4 \mu C$ due to another small sphere of charge $-0.8 \mu C$ in air is 0.2 N.

What is the distance between the two spheres?

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3. A mass m_1 is moving on a plane surface along a straight path under the action of a force F. Another mass m_2 is added on to m_1 and the acceleration drops to 1/5 of the ear her value of the acceleration. Assuming that F remains constant, what is the ratio $m_1 : m_2$?

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4. a. Explain the meaning of the statement 'electric charge of a body is quantised'.

b. Why can one ignore quantisation of electric

charge when dealing with macroscopic i.e., large scale charges?

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5. When a glass rod is rubbed with a silk cloth, charges appear on both. A similar phenomenon is observed with many other pairs of bodies. Explain how this observation is consistent with the law of conservation of charge.

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6. Four point charges $q_A = 2\mu C, q_B = -5\mu C, q_C = 2\mu C$ and $q_D = -5\mu C$ are located at the corners of a square ABCD of side 10 cm. What is the force on a charge of $1\mu C$ placed at the center of the square ?

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7. (a) An electrostaic field line is a continous curve. That is a field line cannot have sudden breaks. Why not ?

(b) explain why two filed lines never cross each other at any point.

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8. Two point charges $q_A = 3\mu C$ and $q_B = -3\mu C$ are located 20 cm apart in vaccum (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 the point, what is the force experienced by the test charge ?

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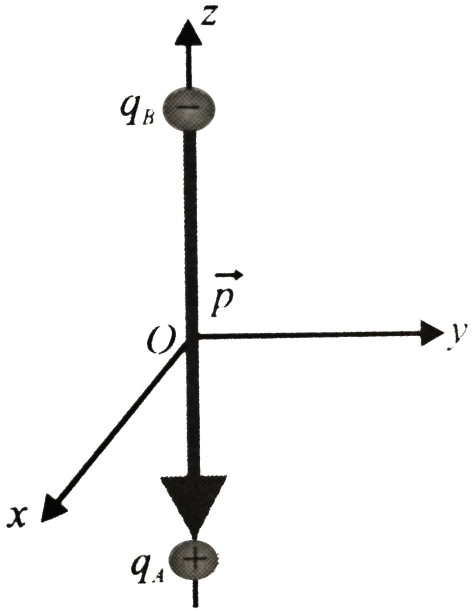
9. A system has two charges $q_A = +2.5 \times 10^{-7} C$ and $q_B = -2.5 \times 10^{-7} C$

located at point A: (0,0,-15 cm)and B: (0,0,+15 cm)`, respectively. What are the total charge and electric dipole moment of the system?



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10. An electrtic dipole with dipole moment $4 \times 10^{-9} Cm$ is aligned at 30° with the direction of

a uniform electric field of magnitude $5 \times 10^4 NC^{-1}$. Calculate the magnitude of the torque acting on the dipole .

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11. A polythene piece rubbed will wool is found to have a negative charge of $3.0 \times 10^{-7} C$.

(a) Estimate the number of electrons transferred (from which to which)?

(b) Is there a transfer of mass from wool to polythene?

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12. Two insulated charged copper spheres A and B have their centres separated by a distance of 50 cm. What is the mutual force of electrostatic repulsion if the charge on each is $6.5 \times 10^{-2} C$? 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 identically sized charged copper spheres A and B have their centers separated by a distance of 50 cm.$q = 6.5 \times 10^{-7} C$. A third sphere of the same size but uncharged is brought in contact with the first, then brought in contact with the second, and finally removed from both. What is the new force of repulsion between A and B?

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14. Track of three charged particles in a uniform electrostatic field suggest two particle named 1 and 2 goes towards a positive charge and 3 goes towards

the negative charge with high deflection. Give the sign of the three charges which particle has the highest charge to mass ratio .

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15. Consider a uniform eleceric field $= 3 \times 10^3 \hat{i} N/C.$

a. What is the flux of this field through a square of 10cm on a slide whose plane is parallel to the yz plane?

b. What is the flux through the same square if the moral to its plane makes a 60° and with the satis?

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16. What is the net flux of the uniform electric field of Exercise 1.15 through a cube of side 20 cm oriented so that its faces are parallel to the coordinate planes?

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17. Careful measurement of the electric field at the surface of a black box indicates that the net outward flux through the surface of the box is $8.0 \times 10^3 Nm^2/C$ (a) what is the net charge inside the box ? (b) If the net outward flux through the

surface of the box were zero, could you conclude that there were no charges inside the box ? Why or why not?

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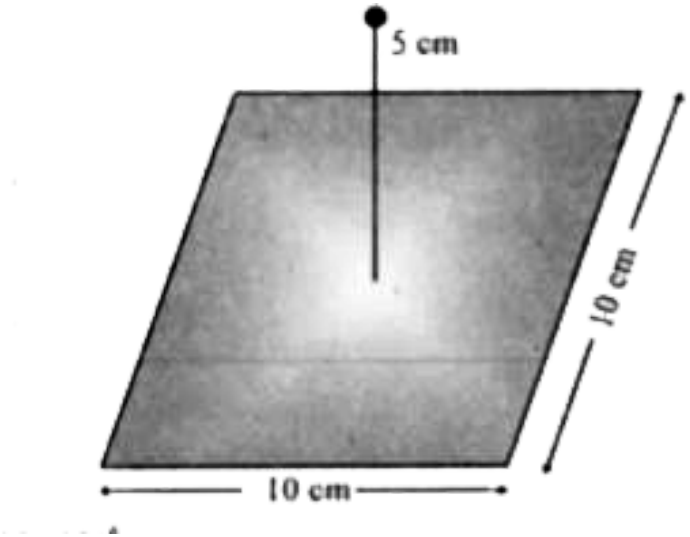
18. A point charge $+10\mu C$ is at a distance 5 cm directly above the centre of a square of side 10 cm, as shown in figure. What is the magnitude of the electric flux through the square? (Hint: Think of the

square as one face of a cube with edge 10cm)



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19. A point charge of 2.0 μ c is at the centre of a cubic gaussian surface 9.0 cm on edge what is the net electric flux through the surface

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20. A point charge causes an electric flux of $-1.0 \times 10^3 Nm^2/C$ to pass through a spherical Gaussian surface of 10.0 cm radius centred on the charge. (a) If the radius of the Gaussian surface were doubled, how much flux would pass through the surface ? (b) What is the is the value of the point charge ?

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21. A conducting sphere of radius 10 cm has an unknown charge if the electric field 20 cm from the

centre of the sphere is 1.5×10^3 N/C and points radialy inward what is the net charge on the sphere

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22. A uniformaly charged conducting sphere of diameter 2.4 m has a surface charge density of $80.0 \mu C m^{-2}$. What is the total electric flux leaving the surface of the sphere ?

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23. An infinite line charge produces a field of $9 \times 10^4 N/C$ at a distance of 2cm. Calculate the linear charge density.

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24. Two large, thin metal plates are parallel and close to each other. On their inner faces, the plates have surface charge densities of opposite sign and of magnitude $17.0 \times 10^{-11} C/m^2$. What is E

(a) in the outer region of the first plate,

(b) in the outer region of the second plate, and (c) between the plates?

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25. An oil drop of 12 excess electrons is field stationary under constant clectric field of $2.55 \times 10^4 NC^{-1}$ in Millikan's oil drop experiment. Then density of the oil is 1.26g cm^{-3}. Estimate the radius of the drop. $\left(g = 9.81 ms^{-2}, e = 1.60 \times 10^{-19} C\right)$.

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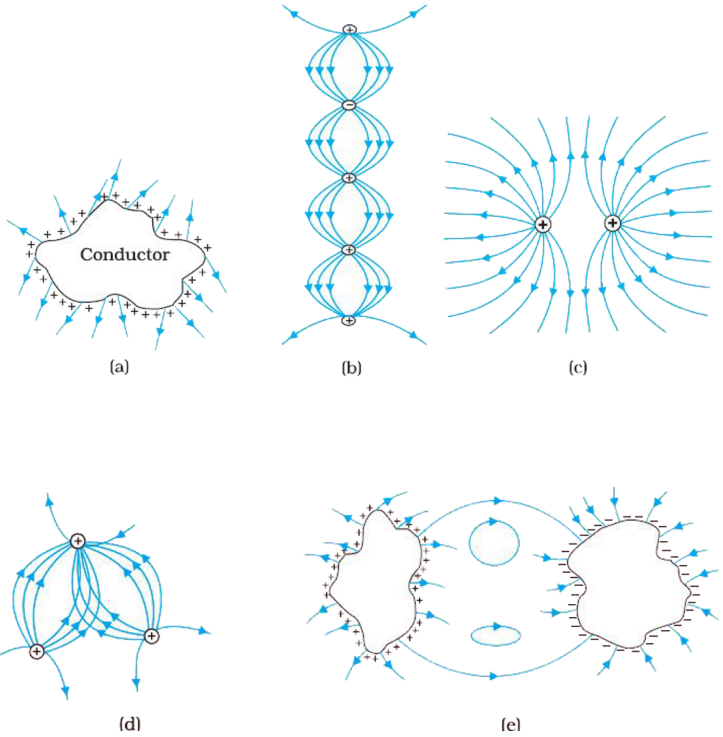
26. Which among the curves cannot possibly represent electrostatic field lines ?



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27. 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 $10^5 NC^{-1}$ per metre. 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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28. (a) a conductor a with a cavity given a charge Q show that the entire charge must appear on the outer surface of the conductor (b) another condluctor B with charge q is sensitive instrument is to be shielded from the strong electrosatitic fields in

its environment suggest a possible way

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29. A hollow charged conductor has a tiny hole cut in to its surface show that the electric field in the hole is n where n is the charge density near the hole

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30. Obtain the formula for the electric field due to a long thin wire of uniform linear charge density E

without using gauss law

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31. It is now established that protons and neutrons are themselves built out of more elementary units called quarks a proton and a neutron consist of three quarks each. Two types of quarks , the so called 'up' quark, (denoted by U) of charge + (2//3) e and the 'down' quark (denoted by d) of charge (-1//3) e together with electrons build up ordinary matter. Suggest a possible quark composition of a proton and neutron

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32. (a) consider an arbitrary electrostic field configuration a small test charge is placed at a null point of the configuration show that the equailibrium of the test charge is necessarly unstable

(b) verify this result for the simple configuration of two charges of the same mangnitude and sign placed a certain distance apart

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33. A particle of mass m and charge enters the region between the two charged plates initally moving along x axis with speed v_x the length of plate is l and an uniform electric field E is maintained between the plates. Show that the vertical deflection of the particle at the far edge of the plate is $qEL^2 / 2mv_x^2$

compare this motion with motion of a projectile in gravitational field

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34. Suppose that the particle is an electron projected with velocity $v_x = 2.0 \times 10^6 ms^{-1}$ if E between the plates seperated by 0.5 cm is 9.1×10^2 N/C where will the electron strike the upper plate $\left(|e| = 1.6 \times 10^{-19} c, m_e = 9.1 \times 10^{-31} kg\right)$

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