PHYSICS

BOOKS - DHANPAT RAI & CO PHYSICS (HINGLISH)

ELECTROSTATIC FORCES, CHARGES AND FIELDS

Example

1. Which is bigger, a coulomb or charge on an electron ? How many electronic charges from one coulomb of charge ?

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2. A person combs his hair on a dry day. The comb causes 10^{22} electrons to leave the person's hair and stick to the comb. Calculate

the charge the comb carries.

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3. A polythene piece rubbed with wool is found to have a negative charge of 3.2×10^{-7}C (i) Estimate the number of electrons transferred. (ii) Is there a transfer of mass from wool to polythene ?

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4. It is now believed that protons and neutrons (which constitute nuclei of ordinary matter) 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. (Quarks of each other types have also been found

which give rise to different unusual varieties of matter). Suggest a possible quark composition of a proton and neutron.

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5. In a Millikan's oil drop experiment, six oil drops were observed to have charges of $16 \times 10^{-19} C$, 8.0×10^{-19}C, 6.4×10^{-19} C, 2.4×10^{-18}C and 3.2×10^{-18} C, respectively. What conclusion can be drawn from these observations ?

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6. What is the Coulomb's force between two α-particles separated by a distance of $3.2 \times 10^{-15} m$.

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7. The electrostatics force of repulsion between two positively charged ions carrying equal charge is $3.7 \times 10^{-9} N$ when these are separated by a distance of $5 Å$. How many electrons are missing from each ion?

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8. Calculate the distance between two protons such that the electrical repulsive force between them is equal to the weight of either.

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9. A pith-ball A of mass 9×10^{-5} kg carries a charge of $5 \mu C$. What must be the magnitude and sign of the charge on a pith-ball B held

2 cm directly above the pith-ball A, such that the pith-ball A remains stationary ?

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10. The distance between the electron and proton in hydrogen atom is 5.3×10^{-11} m. Determine the magnitude of the ratio of electrostatic and gravitational force between them. Given $m_e = 9.1 \times 10^{-31}$ kg, $m_p = 1.67 \times 10^{-27}$ kg, $e = 1.6 \times 10^{-19} C$ and $G = 6.67 \times 10^{-11} Nm^2 kg^2$.

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11. Two particles, each having a mass of 5 g and charge. 1.0×10^{-7} C, stay in limiting equilibrium on a horizontal. table with a separation of 10 cm between them. The coefficient of friction

between each particle and the table. is the same. Find the value of this coefficient.

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12. (a) Two insulated charged copper spheres A and B have their centers speparated by a distance of 50 cm. What is the mutal force of electrostatic repulsion if the charge on each is $6.5 \times 10^{-7} C$? The radill of A and B are negalible 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 identical point charges Q are kept at a distance r from each other. A third point charge is placed on the line joining the above

two charges such that all the three charges are in equilibrium. The third charge

(a) should be of magnitude q=.....

(b) should be of sign .....

(c) should be placed ..... .

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14. Two point electric charges of value q and $2q$ are kept at a distance d apart from each other in air. A third charge Q is to be kept along the same line in such a way that the net force action on q and $2q$ is zero. Calculate the position of charge Q in terms of q and d.

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15. Two identical conducting spheres, fixed in space, attract each other with an electrostatic force of $0.108N$ when separated by $50.0cm$, centre-to-centre. A thin conducting wire then connects the spheres. When the wire is removed, the spheres repel each other with an electrostatic force of $0.0360N$. What were the initial charges on the spheres?

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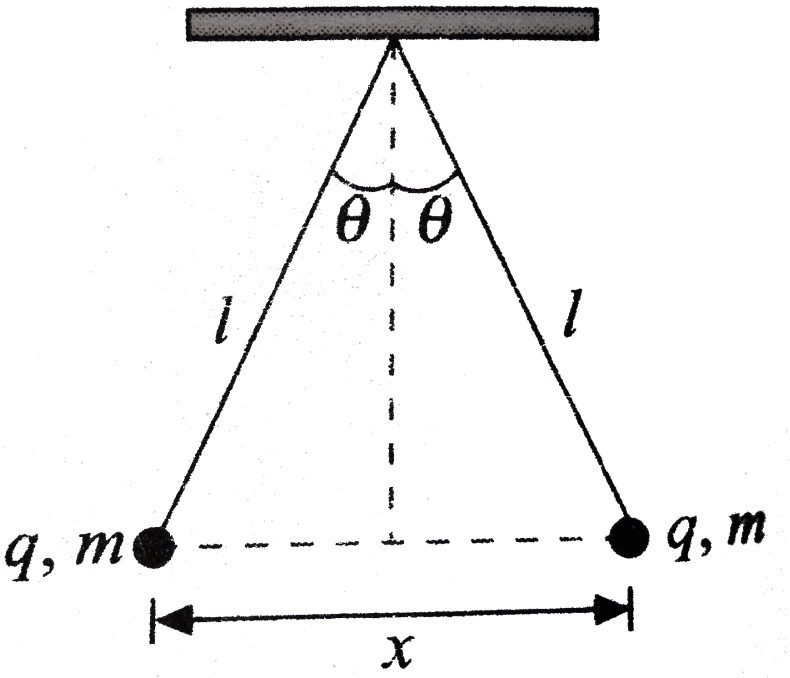
16. Two similar balls, each of mass m and charge q, are hung from a common point by two silk threads, each of length l. Prove that separation between the ball is $x = \left[\frac{q^2 l}{2\pi\varepsilon_0 mg}\right]^{1/3}$, if θ is small

Find the rate $\frac{dq}{dt}$ with which the charge should leak off each sphere if the velocity of approach varies as $v = a/\sqrt{x}$, where a is a

constant.



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17. Two small spheres each of mass m kg and charge q coulomb are suspended from a point by insulating threads each of l length, but of negligible mass. If θ is the angle which each string makes with the vertical vertical when equilibrium has been reached, show that $q^2 = 4mgl^2 \sin^2\theta \tan\theta(4\pi \in_0)$

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18. Two pith balls, each weighting 10mg are suspended from the same point by silk threads, each of length 0.25m. When equal and similar charges are placed on them they repel each other and are 10m apart. Find the charge on the each pith ball.

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19. A charge Q is to be divided on two objects. What shouold. be the values of the charges on the objects so that the. force between the objects can be maximum?.

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20. A charged spherical conductor has a surface charge density of $0.7C/m^2$ .When its charge is increased by $0.44C$ the charge density changes by $0.14C/m^2$ the radius of the sphere is

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21. Sixty four spherical drops each of radius $2cm$ and carrying $5C$ charge combine to form a bigger drop. Its capacity is.

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22. Ten positively charged particles are kept fixed on the x-axis at points x=10cm, 20cm, 30cm, ..., 100cm. The first particle has a charge $1.0 \times 10^{-8}C$, the second 8×10^{-8} C, the third $27 \times 10(-8)$C and so on. The tenth particle has a charge $1000 \times 10^{-8}C$. find the

magnitude of the electric force acting on a 1 C charge placed at the origin.

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23. 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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24. Charges of $+5\mu C, +10\mu C$ and $-10\mu C$ are placed in air at the corners A,B and C of an equilateral triangle ABC, having each side equal to 5 cm. Determine the resultant force on the charge at A.

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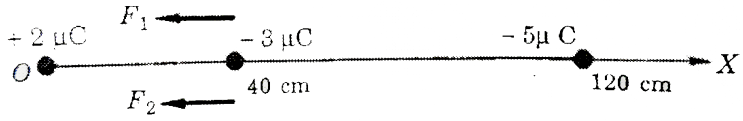
25. Three point charges are placed at the following points on the x-axis

: $2\mu C$ at $x = 0$, $-3\mu C$ at $x = 40cm$ and $-5\mu C$ at $x = 120$ cm. Calculate the force on the $-3\mu C$ charge.



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26. Four equal point harges each $16\mu C$ are placed on the four corners of a square of side 0.2 m. Calculate the force on any one of the charges.

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27. A charge of $0.33 \times 10^{-7} C$ is brought in an electric field. It experiences a force of 1.0×10^{-5} N. Find the intensity of the electric field at this point.

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28. An α-particle is situated in an electric field of $1.5 \times 10^{5} NC^{-1}$. Determine the force exerted on it.

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29. An oil drop of mass 5×10^{-15} kg carries a charge Q. The drop is stationary between two parallel metal plates 25 mm apart with a p.d. of 1000 V between them. Determine Q. Take $g = 10ms^{-2}$.

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

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31. An electron is liberated from the lower of the two large parallel metal plates separated by a distance of 20 mm. the upper plate has a potential of $+2400V$ relative to the lower plate. How long does the electron take to reach the upper plate ? Take $\frac{e}{m}$ of electrons $1.8 \times 10^{11} Ckg^{-1}$

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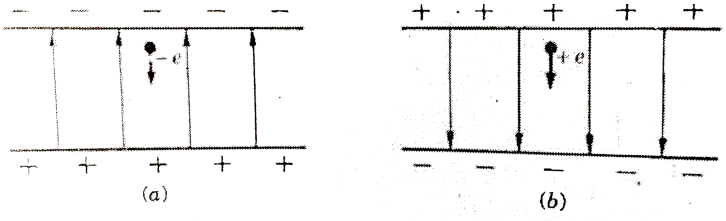
32. An electron falls through a distance of 1.5 cm in a uniform electric field of magnitude $2.4 \times 10^4 NC^{-1}$ [Fig.1.12 (a)]`. The direction of the field is reversed keeping its magnitude unchagned and a proton falls through the same distance [Fig. 1.12 (b)]. Complute the time of fall in each case. Contrast the situation (a) with that of free fall under gravity.



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33. A pendulum bob of mass 80mg and carrying a charge of $2 \times 10^{-8} C$ is at rest in a uniform, horizontal electric field of 20k Vm^{-1}. Find the tension in the thread.

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34. Assuming that the charge on an atom is distributed uniformly is a sphere of radius 10^{-10} m, what will be the electric field at the surface of the gold atom ? For gold, Z=79.

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35. An electorn is separated from the proton through a distance of 0.53 Å. Calculate the electric field at the location of the electron.

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36. Two point charges of $+16\mu C$ and $-9\mu C$ are placed 8 cm apart in air. Determine the position of the point at which the resultant electric field is zero.

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37. Two equal charges of -10^{-16} each are kept 20 cm apart in air. Calculate :

(a) electric field at a point midway between them.

(b) force acting on a charge of -10^{-16} C kept at point midway between them.

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38. Four charges $+q,\ +q,\ -q,\ \text{and}\ -q$ are placed, respectively, at the corners $A, B, C,\ \text{and}\ D$ of a square of side a, arranged in the given order. $E\ \text{and}\ F$ are the midpoints of sides $BC\ \text{and}\ CD$, respectively, O is the center of square.

The electric field at O is.

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39. Two charges, one $+5\mu C$ and another $-5\mu C$ are placed 1 mm apart. Calculate the dipole moment.

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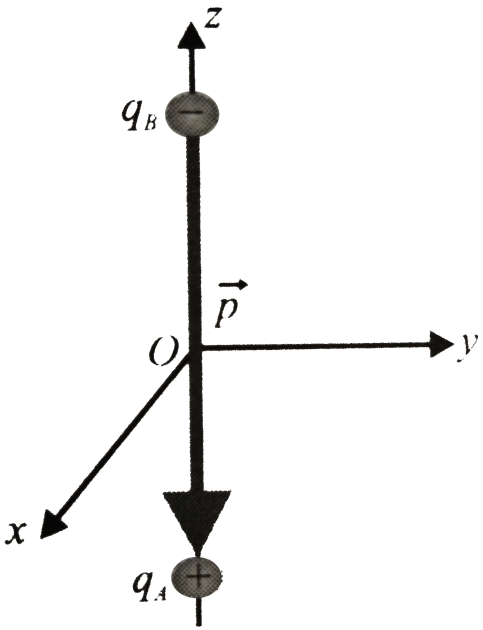
40. A system has two charges $q_A = +2.5 \times 10^{-7} C$ and $q_B = -2.5 \times 10^{-7} C$ located at point A: (0,0,-15 cm)and B: (0,0,+15 cm)`, respectively. What are the total charge and electric dipole moment of the system?



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41. 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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42. An electric dipole consisting of two opposite charges of $2 \times 10^{-6} C$ each separated by a distance of $3cm$ is placed in an electirc field of $2 \times 10^{5} N/C$. The maximum torque on the dipole is will be

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43. Caleulate the electric field due to an electric dipole of length 10 cm having charges of $1\mu C$ at a point 12 cm from the centre of the dipole.

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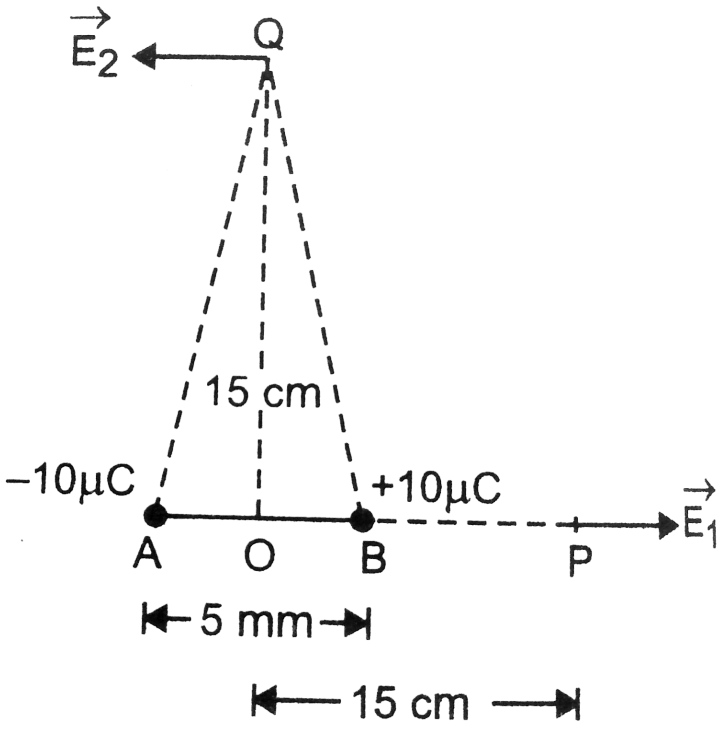
44. Two charges $\pm 10\mu C$ are placed $5 \cdot 0mm$ apart. Determine the electric field at (a) point P on the axis of dipole $15cm$ away from its center on the side of the positive charge. As shown in Figure and at (b) a point Q. $15cm$ away form O on a line passing through O and a line passing through O and normal to the axis of the dipole as

shown in Fig.



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Problems

1. Five point charges, each of value +q are placed on five vertices of a regular hexagon of side Lm. What is the magnitude of the force

on a point charge of value -q coulomb placed at the centre of the hexagon?

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2. Four particles each having a charge q, are placed on the four vertices of a regular pentagon. The distance of each corner from the centre is a. Find the electric field at the centre of the pentagon.

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3. A charges Q is placed at each of the two opposite corners of a square. A charge q is placed to each of the other two corners. If the resultant force on each charge q is zero, then

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4. Two similarly and equally charged identical metal spheres A and B repel each other with a force of $2 \times 10^{-5} N$. A third identical uncharged sphere C is touched with A and then placed at the midpoint between A and B. Find the net electric force on C.

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5. A copper ball of density $8.6 gcm^{-3}$ and 1 cm in diameter is immersed in oil of density $0.8 gcm^{-3}$. What is the charge on the ball, if it remains just suspended in oil in electric field of intensity $3600 V/m$ acting in the upward direction ?

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6. A charged particle of radius $5 \times 10^{-7} m$ is located in a horizontal electric field of intensity $6.28 \times 10^{5} V m^{-1}$. The surrounding

medium has the coefficient of viscosity $\eta = 1.6 \times 10^5 Nsm^{-2}$. The particle starts moving under the effect of electric field and finally attains a uniform horizontal speed of $0.02ms^{-1}$. Find the number of electrons on it. Assume gravity free space.

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7. Two identical charged spheres are suspended by strings of equal lengths. The strings make an angle of 30° with each other. When suspended in a liquid of density $0.8gcm^{-3}$, the angle remains the same. If density of the material of the sphere is $1.6gcm^{-3}$, the dielectric constant of the liquid is

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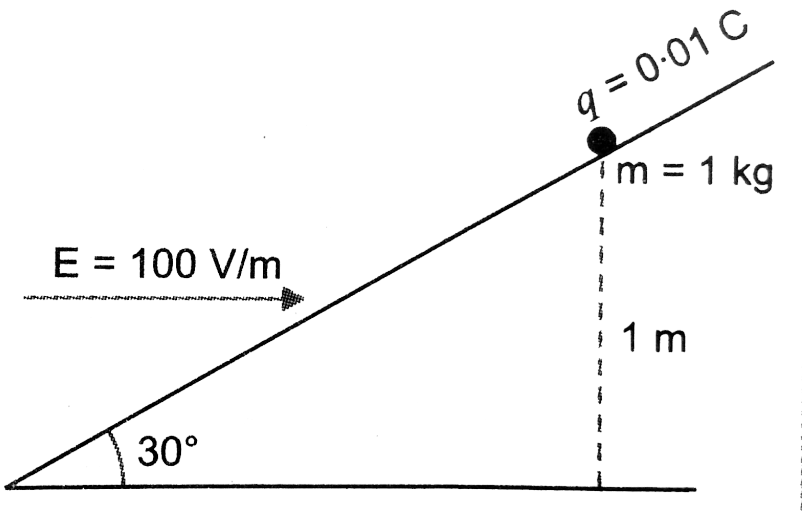
8. An inclinded plane making an angle of 30° with the horizontal electric field of $100Vm^{-1}$ as shown in Figure. A particle of mass

$1kg$ and charge $0 \cdot 01C$ is allowed to slide down from rest from a height of $1m$. If the coefficient of friction is 0.2, find time taken by the particle to reach the bottom.



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9. Two point charges+ q and-q are placed at distanced apart. What are the points at which the resultant field is parallel to the line joining the two charges ?

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10. Three particles, each of mass m and carrying a charge q each, are suspended from a common point by insulating mass-less strings each of length L. If the particles are in equilibrium and are located at the corners of an equilateral triangle of side a, calculate the charge q on each particle. Assume $L > > a$.

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11. A ball of mass $10^{-2}kg$ and having charge $+3 \times 10^{-6}C$ is tied at one end of a $1m$ along thread. The other end of the thread is fixed and a charge $-3 \times 10^{-6}C$ is placed at this end. The ball can move in the circulr orbit of radius $1m$ in the vertical plane. Initially, the ball is at the bottom. Find the monimum initial horizontal velocity of the ball, so that it will be able to complete the full circle.

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12. A charge $+10^{-9}C$ is located at the origin in free space & another charge Q at $(2, 0, 0)$. If the X-component of the electric field at (3,1,1) is zero , calculate the value of Q, Is the Y-component zero at (3,1,1) ?

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13. Consider the classical model of an electron such that a nucleus of charge +e is uniformly distributed within a sphere of radius2Å. An electron of charge -e at a radial distance 1Å moves inside this sphere. Find the force a!tracting the electron on to the centre of the sphere. Calculate the frequency with which the electron would oscillate about the centre of the sphere, if released from rest at this radial distance.

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14. A uniform electric field of intensity $E = 10^6 V/m$ exist in vertically downwards direction in a region. A particle of mass m = 0.01 kg andcharge $q = 10^{-6} C$ is suspended byan inextensible thread oflength $I = 1m$. The particle is displaced slightly from its mean position and released. Calculate the time period ofits oscillation. What minimum velocity should be given to the particle at rest from its equilibrium position so that it completes a full circle in vertical plane? Calculate the maximum and minimum tension in the thread in its circular motion in vertical plane. $[0.6s, 23.42m/s, 6.59N, 0]$

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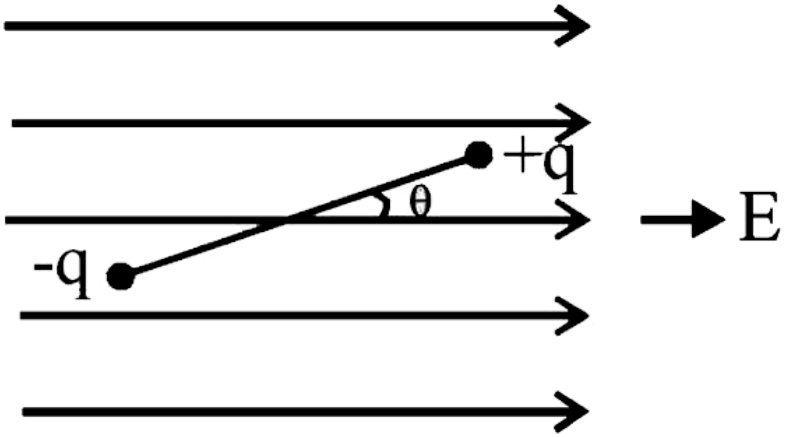
15. A point particle of mass M is attached to one end of a massless rigid non-conducting rod of length L. Another point particle of the same mass is attached to the other end of the rod. The two particles carry charges $+q$ and $-q$ respectively. This arrangement

is held in a region of a uniform electric field E such that the rod makes a small angle θ (say of about 5 degree) with the field direction, fig. Find an expression for the minimum time needed for the rod to become parrallel to the field after it is set free.



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16. A charge of $4 \times 10^{-9} C$ is distributed uniformly over the circumference of a conducting ring of radius 0.3m. Calculate the field intensity at a point on the axis of the ring at 0.4m from its centre, and also at the centre.

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17. A ring of radius 0.1m is made out of thin metallic wire of area of cross section $10^{-6}m^2$. The ring has a uniform charge of π coulombs. Find the change in the radius of the rig when a charge of $10^{-8}C$ is placed at the center of the ring. Young's modulus of the metal is $2 \times 10^{11}Nm^{-2}$.

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18. Two charges, each equal to q, aer kept at $x = -a$ and $x = a$ on the x-axis. A particle of mass m and charge $q_0 = \frac{q}{2}$ is placed at the origin. If charge q_0 is given a small displacement (ylt lt a) along the y-axis, the net force acting on the particle is proportional to

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Problems For Self Practice

1. How many electrons are there in one coulomb of negative charge?

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Others

1. Calculate the charge carried by 12.5×10^8 electrons.

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2. How many electrons would have to be removed from a copper penny to leave it with a positive charge of $10^{-7} C$?

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3. Calculate the charge on an alpha particle. Given on a proton $= 1.6 \times 10^{19} C.$

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4. Calculate the charge on ${}_{.26}F^{56}$ nucleus. Given charge on a proton $= 1.6 \times 10^{-19}$ C.

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5. Obtain the dimensional formula of ε_0.

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6. 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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7. Calculate the coulomb force between two electrons separated by $0.8 \times 10^{-15} m$.

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8. Two identical metal spheres A and B have equal and similar charges. They repel each other with a force 103N, when they are placed 10cm apart in a medium of dielectric constant 7. Determine the charge on each sphere.

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9. How far two electrons should be placed so that the force of repulsion between them is equal to the weight of an electron ?

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10. Two charged particles having charge $2.0 \times 10^{-8} C$ each are joined by an insulating string of length 1 m and the system is kept on a smooth horizontal table. Find the tension in the string.

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11. A free pith ball of mass $6g$ carries a positive charge of $(1/3) \times 10^{-7} C$. What is the nature and magnitude of charge that should be given to a second pith ball fixed $5cm$ vertically below the former pith ball so that the upper pith ball is stationary.

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12. A ball hanging from a beam is balanced against weight placed on the other pan. Another ball is so placed that its centre is 2 cm vertically below the centre of the first ball. The two spheres are now charged equally and balancing weight has to be changed by 2.55 gwt to restore the balance. Calculate charge on each sphere.

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13. If F_g and F_e are gravitational and electrostatic forces between two electrons at a distance $0.1m$ then F_g / F_e is in the order of

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14. A small brass having a positive charge of 1.7×10^{-8} C is made to touch another sphere of the same radius having a negative

charge of $3.0 \times 10^{-9} C$. Find the force between them when they are separated by a distance of 20 cm. What will be the force between them when they are immersed in an oil of dielectric constant 3 ?

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15. Two point charges $+9e$ and $+e$ are kept $16cm$. Apart from each other. Where should a third charge q be placed between them so that the system is in equlibrium state:

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16. Two particles (free to move) with charges $+q$ and $+4q$ are a distance L apart. A third charge is placed so that the entire system is in equilibrium.

(a) Find the location, magnitude and sign of the third charge.

(b) Show that the equilibrium is unstable.

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17. Two pith ball of mass 0.5 each are suspended from a common point O by means of silk threads, each of length 20 cm. When the balls are given equal and similar charges, they repel each other so that the two threads make an angle of 60° with each-other. Determine the charge on each ball.

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18. Two small spheres each of mass m are suspended from a common point by threads 0.5 m long. They are equally charged and repel each other to a distance of 0.28m. If $= g10ms^{-2}$, what is the charge on each sphere?

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19. A uniformly charged sphere carries a total charge of $2\pi \times 10^{-12}$ C. Its radius is 5 cm and is placed in vacuum. Determine its surface charge density.

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20. What charge would be required to electrify a sphere of radius 15 cm so as to get a surface charge density of $\frac{7}{11}\mu Cm^{-2}$?

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21. A metal cube of length 0.1 is charged by $12\mu C$. Calculate its surface charge density.

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22. Two equal drops of water with the same and similar charge coalesce to form a large single drop. Show how the surface density, capacity, potential and energy change.

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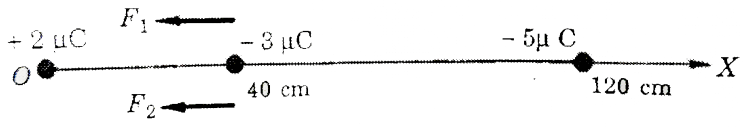
23. Three point charges are placed at the following points on the x-axis

: $2\mu C$ at $x = 0$, $-3\mu C$ at $x = 40cm$ and $-5\mu C$ at $x = 120$ cm. Calculate the force on the $-3\mu C$ charge.



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24. Equal charges of $+4\mu C$ are placed at the three corners of an equilateral triangle of side 2m. Calculate the magnitude and direction of the force on one of the charges.

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25. Two point charges of $+1.5\mu C \text{ and } -1.5\mu C$ are placed at the corners A and B of an $-6\mu C$ placed at the third corner of the triangle ?

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26. ABC is an equilateral triangle of side 10 m and D is the midpoint of BC. Charges of $+100C, -100C \text{ and } +75C$ are placed at B, C and D respectively. What is the force experienced by $+cC$ charge placed at point A ?

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27. 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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28. If an oil drop of weight $3.2 \times 10^{-13} N$ is balanced in an electric field of $5 \times 10^5 Vm^{-1}$, find the charge on the oil drop.

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29. A charged oil drop remains stationary when situated between two parallel plates 20 mm apart and a p.d. of 500 V is applied to

the plates. Find the charge on the drop if it has a mass of $2 \times 10^{-4} kg$. Take $g = 10 ms^{-2}$.

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30. Calculate the voltage needed to balance on all drop carrying 10 electrons when located between the plates of a capacitor which are 5 mm apart. Mass of oil drop is $3 \times 10^{-16} kg$(take $g = 10 m/s^2$)

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31. In Millikan's experiment, an oil drop of radius 10^{-4} cm remains suspended between the plates which are 1 cm apart. If the drop has charge of 5e over it, calculate the potential difference between the plates. The density of oil may be taken as $1.5 gcm^{-3}$.

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32. An electron moves a distance of 6.0 cm when accelerated from rest by an electric field of strength $2 \times 10^{-4} NC^{-1}$. Calculate the time of travel.

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33. When the terminals of a 100 V battery are connected to two large parallel plates 1 cm apart, a uniform field $\vec{E}$ is set up inside the region between the two plates. If the direction of the filed $\vec{E}$ is vertically upwards, determine the force on the electron in this field. Compare this force with the weight of the electron.

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34. A proton falls dwon through a distance of 2 cm in a uniform electric field of magnitude $3.34 \times 10^{3} NC^{-1}$. Determine (i) the

acceleration of the electron (ii) the time taken by the proton to fall through the distance of 2 cm, and (iii) the direction of the electric field.

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35. A stream of electrons moving with a velocity of $3 \times 10^7 ms^{-1}$ is deflected by 2 mm in traversing a distance of 0.1 m in a uniform electric field of strength $18Vm^{-1}$ in Fig. 1.42. An electron enters the field symmetrically between the plates with a speed v_0. The length of each plate is l. Find the angle of deviation of the bath of the electron as it comes out of the field.

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36. A uniform electric field E is created between two parallel

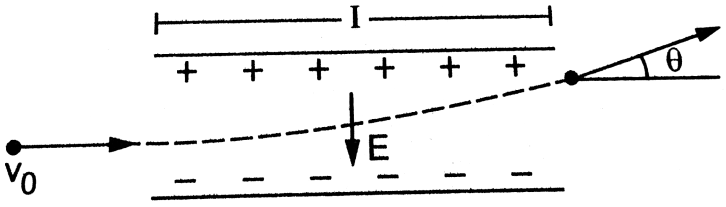
., charged plates as shown in figure . An electron

. enters the field symmetrically between the plataes with a

. speed `v_0. The length of each plate is l. Find the angle of

. deviation of the path of the electron as it comes out

. of the field.



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37. A simple pendulum consists of a small sphere of mass m suspended by a thread of length l. the sphere carries a positive charge q. The pendulum is placed in a uniform electric field of strength E directed vertically upwards. With what period will pendulum oscillate if the electrostatic force acting on the sphere is less than the gravitational force ?

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38. Determine the electric field produced by a helium nucleus at a distance of 1 Å from it.

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39. A point charge q produces an electric field of magnitude $2.0NC^{-1}$ at a point distant 50 cm from it. From the value of q.

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40. Two electric $+q$ and $+4q$ are placed at a distance 6a apart on a horizontal plane. Find the position of the point on the line joining the two charges where the electric field is zero.

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41. Two pont chargees q_1 and q_2 of $2 \times 10^{-8} C$ and $-2 \times 10^{-8} C$ respectively are placed 0.4 m apart. Calculate the electric field at the centre of the line joining the two charges.

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42. Two point charges of $100 \mu C$ and another of $-400 \mu C$, are kept 3.0 cm apart. Find the point where the electric field due to the two charges vanishes.

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43. A positive charge of $20 \mu C$ is placed 2 m away from a negative charge of $20 \mu C$. Determine the electric field at a point 2 m away from each charges.

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44. ABCD is a square of side 4 cm. Charges of $16 \times 10^{-9} C$, $-16 \times 10^{-9} C$ and $32 \times 10^{-9} C$ are placed at the points A, C and D, respectively. Determine the electric field at point B.

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45. Two point charges of $+2 \times 10^{-8} C$ are placed 6 apart. Determine the force on a point charge of $+1 \times 10^{-8} C$ placed at a distance of 5 cm from each of the two given charges.

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46. Two point charges $5\mu C$ and $10\mu C$ are separated by a distance 'r' in air. If an additional charge of $-4\mu C$ is given to each, by what factor does the force between the charges change ?

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47. Eight identical point charges of q coulomb each are placed at the corners of a cube side 0.1m. Calculate electric field at the centre of the cube. Calculate the field at the center when one of the corner charges is removed.

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48. Three charges, each equal to q, are placed at the three. corners of a square of side a . Find the electric field at. the fourth corner.

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49. Two charges, one $+5\mu C$ and another $-5\mu C$ are placed 1 mm apart. Calculate the dipole moment.

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50. An electric dipole consists of two opposite charges of magnitude $1/3 \times 10^{-7}C$, separated by 2 cm. The dipole is placed in an external field of $3 \times 10^{7}NC^{-1}$. What maximum torque does the electrc field exert on the dipole ?

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51. An electric dipole is placed at an angle of 60° with an electric field of magnitude $4 \times 10^{5}NC^{-1}$, It experiences a torque of

$8\sqrt{3}Nm$. If length of dipole is 2 cm, determine the magnitude of either charge of the dipole.

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52. A positive charge of $20\mu C$ is placed 2 m away from a negative charge of $20\mu C$. Determine the electric field at a point 2 m away from each charges.

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53. A dipole consists of two charges separated by 6cm. The electric field at a point on the equatorial line at a distance of 4 cm from the centre of the dipole is $10^5 NC^{-1}$. What are the two charges on the dipole ?

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54. The force experienced by a unit charge when placed at a distance of 0.10 m from the middle of an electric dipole on its axial line is 0.025 N and when it is placed at a distance of 0.2 m, the force is reduced to 0.002 N. Calculate the dipole length.

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