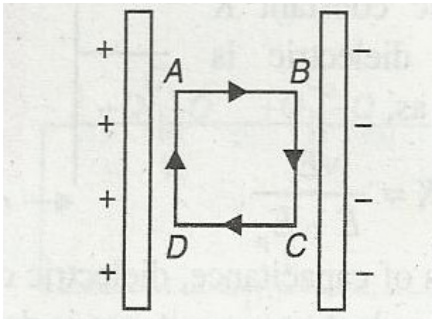
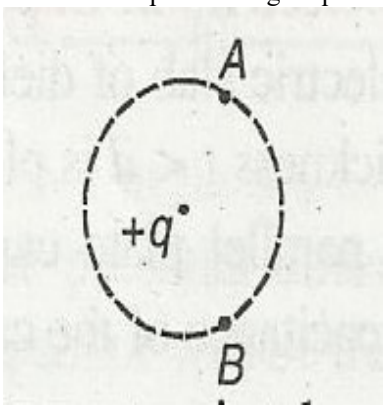
LJPS **Class – XII**

Gurgaon Assignment

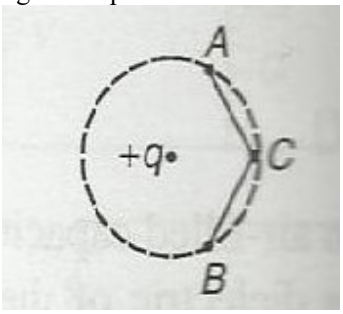
1. A uniform electric field E exists between two charged plates as shown in figure. What would be the work done in moving a charge 'q' along the closed rectangular path ABCDA ?



2. What would be the work done if a point charge +q, is taken from a point A to the point B on the circumference of a circle drawn with another point charge +q at the centre?



3. If a point charge +q taken first from A to C and then from C to B of a circle drawn with another point – charge +q as centre, then along which path more work will be done ?



4. Sketch the electric lines of force for two positive charges Q_1 and Q_2 ($Q_1 > Q_2$) separated by a distance d.

5. Figure given below shows three points A,B and C in a uniform electrostatic field. At which of the points will the electric potential be maximum?

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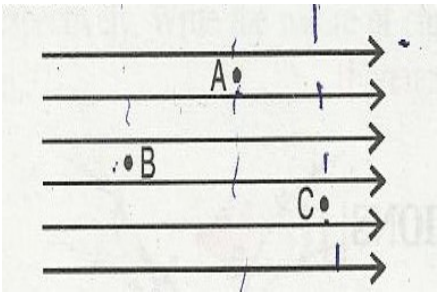


6 A parallel plate capacitor is to be designed with a voltage rating 1kV using a material of dielectric constant 3 and dielectric strength about $10^7 Vm^{-1}$. For safety we would like the field never to exceed say, 10% of the dipole strength. What minimum area of the plates is required to have a capacitance of 50pF?

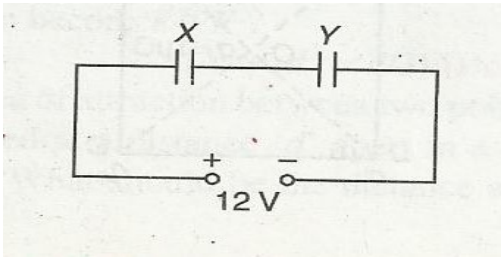
[**Ans.** 19cm^2]

7. A charge q is placed at the center of the line joining two equal charges Q. Show that the system of three charges will be in equilibrium if q = -Q/4

8. Two fixed point charges +4e and +e units are separated by a distance 'a'. Where should the third point charge be placed for it to be in equilibrium?

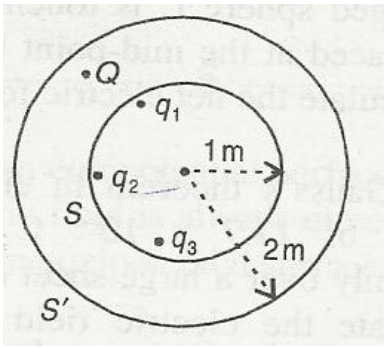
9. X and Y are two parallel plate capacitors having the same area of plates and same separation between the plates. X has air between the plates and Y contains a dielectric medium of $\epsilon_r = 5$

(i) Calculate the potential difference between the plates of X and Y
(ii) What is the ratio of electrostatic energy stored in X and Y



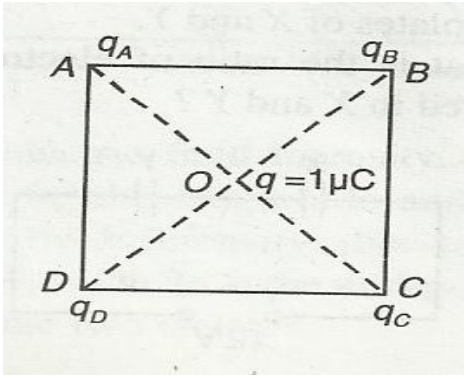
10. The flux of the electrostatic field, through the closed spherical surface S' is found to be four times that through the closed spherical surface S. Find the magnitude of the charge Q.

Given : $q_1 = 1\mu C, q_2 = -2\mu C$ and $q_3 = 9.854\mu C$

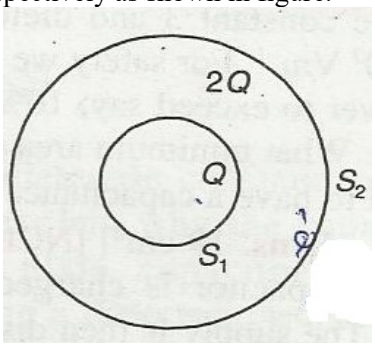


11. Two similarly and equally charged identical metal spheres A and B repel each other with a force of

$2\times10^{-5}\,N$. A third identical uncharged sphere C is touched with A and then placed at the mid- point between A and B. Calculate the net electric force on C.



12. S_1 and S_2 are two hollow concentric sphere enclosing Q and 2Q respectively as shown in figure.



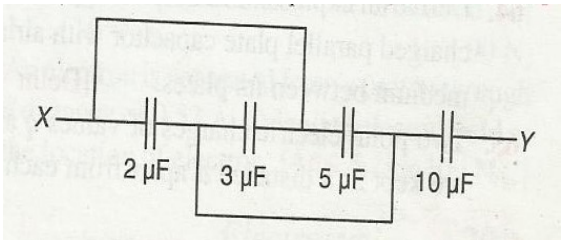
(i) What is the ratio of electric flux through S_1 and S_2 ?
(ii) How will the electric flux through the sphere S_1 change, if a medium of dielectric constant 5 is introduced in the space inside S_1 in place of air?
[**Ans:** (i) 1/3 (ii) reduces to 1/5 of original value]

13. Four point charges of $q_A = 2\mu C$ and $q_B = -5\mu C$, $q_C = 2\mu C$ and $q_D = -5\mu C$ are located at the corners of a Square ABCD of side 10 cm. Find the force on a charge of $1\mu C$ placed at the centre O of the square.
[**Ans:** Zero N]

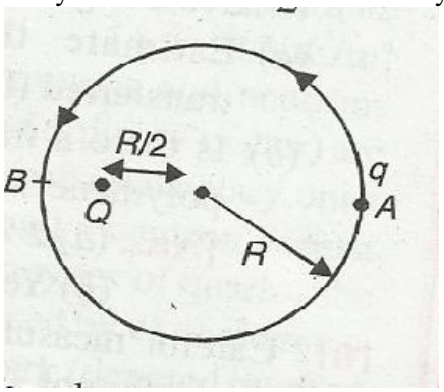
14. A spherical Gaussian surface encloses a charge of $17.7\times10^{-8}C$
(i) Calculate the electric flux passing through the Gaussian surface.
(ii) If the radius of the Gaussian surface is doubled, how much flux would pass through the surface?

[**Ans:** (i) $2\times10^{4}\,Nm^{2}C^{-1}$ (ii) No change in flux]

15. Four capacitors are connected as shown in the figure given below:
Calculate the equivalent capacitance between the points X and Y
(**Ans :** $C_{eq} = 5\mu F$]

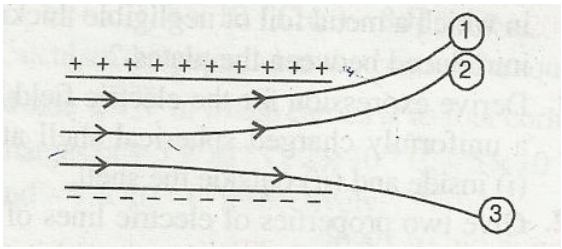


16. There is a point charge Q at a distance R/2 from the centre of a circle of radius R. Another point charge q is to be moved from A to B, where A and B are two points on the circle diametrically opposite to each other. How much work is done by the electrostatic force exerted by Q on q.

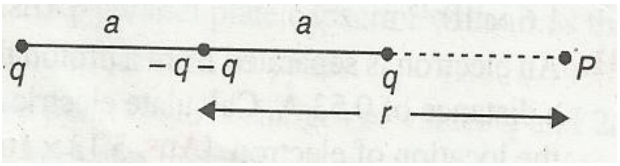


17. A capacitor of capacitance C is charged fully by connecting it to a battery of e.m.f. ε. It is then disconnected from the battery. If the separation between the plates of the capacitor is now doubled, what will happen to
(a) charge stored by the capacitor?
(b) potential difference across it?
(c) field strength between the plates.
(d) energy stored by the capacitor.

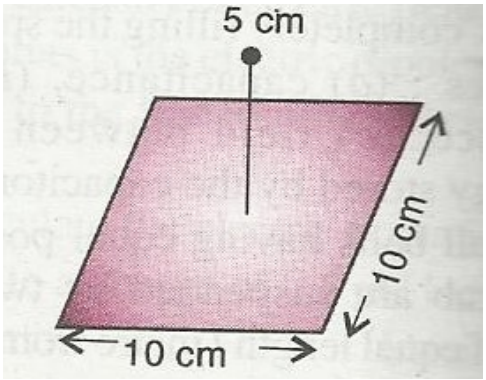
18.. Figure given below shows tracks of three charged particles in a uniform electrostatic field. Give the sign of the three charges. Which particle has the highest charge to mass ratio? Explain



19. Adjoining figure shows a charge array known as an 'electric quadrupole'. For a point on the axis of the quadrupole, obtain the dependence of potential on r for r/a>>1, and contrast your results with that due to an electric dipole, and an electric monopole (i.e, a single charge)



20.. A point charge of +10 μC is at distance of 5cm directly above the centre of square of side 10 cm as shown in figure. What is the magnitude of the electric flux through the square?



{Ans : $1.88\times10^{5}\,Nm^{2}C^{-1}$]

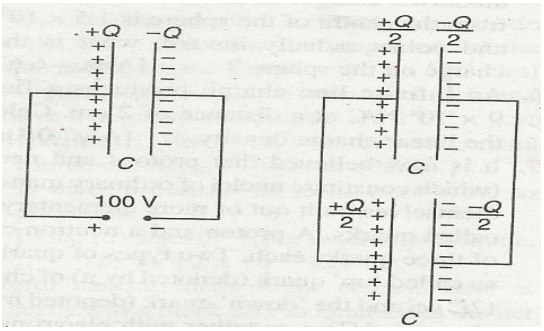
21..A charge of 8mc is located at the origin. Calculated the work in taking a small charge of $-2\times10^{-9}C$ from a point P (0,0,3 cm) to a point Q (0, 4cm, 0), via a point R (0, 6cm, 9cm)

[**Ans :** 1.2J]

22.. An electrical technician requires a capacitance of 2 μF in his circuit across a potential difference of 1kV. A large number of 1 μF capacitors are available to him each of which can withstand a potential difference of not more than 400 V. Suggest a possible arrangement that requires the minimum number of capacitors.

[**Ans**: 6 rows with 3 capacitors in each row]

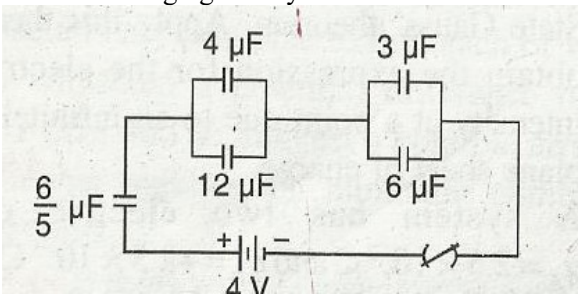
23. (a) A 900pF capacitor is charged by 100V battery. How much electrostatic energy is stored by the capacitor? (b) The capacitor is disconnected to another 900pF capacitor. What is the electrostatic energy stored by the system?



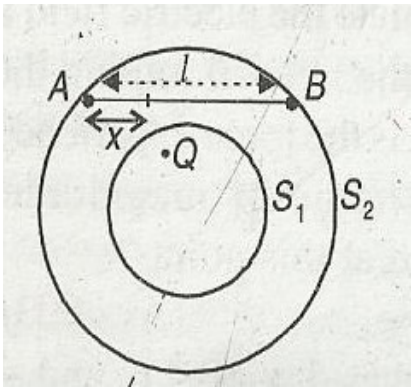
24. A system has two electric charges $q_A = 2.5\times10^{-7}C$ and $q_B = -2.5\times10^{-7}C$ located at the points A (0,0,-15 cm) and B (0,0, +15 cm) respectively. Calculate the electric dipole moment of the system . What is its direction?

25. A 10 μF capacitor is charged by a 30 V d.c supply and then connected across an uncharged 50 μF capacitor. Calculate (i) the final potential difference across the combination, and (ii) the initial and final energies. How will you account for the difference in Energy?

26. Find : (i) the equivalent capacitance and (ii) the total energy stored in the system of capacitor given in the network. The charging battery has an emf of 4V.

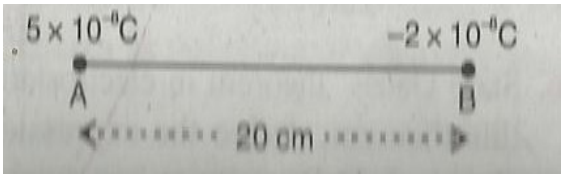


27 In the figure shown, calculate the total flux of the electrostatic field through the spheres S_1 and S_2. The wire AB, shown here has a linear charge density λ, given by λ = kx where x is the distance measured along the wire from the end A



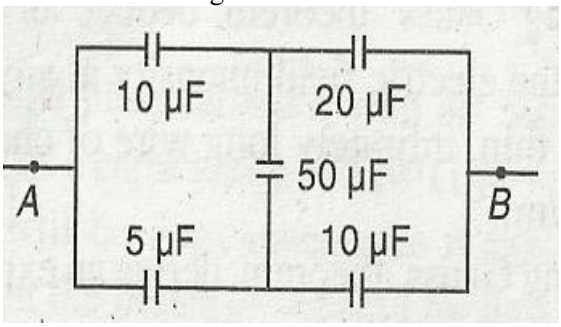
28. Two point charges $5\times10^{-8}C$ and $-2\times10^{-8}C$ are separated by a distance of 20 cm in air as shown in the figure

(i) Find at what distance from point A would the electric potential be zero

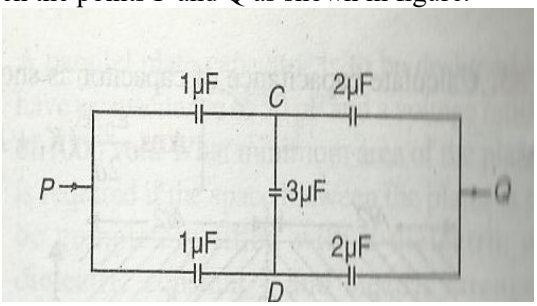


(ii) Also calculate the electrostatic potential energy of the system.

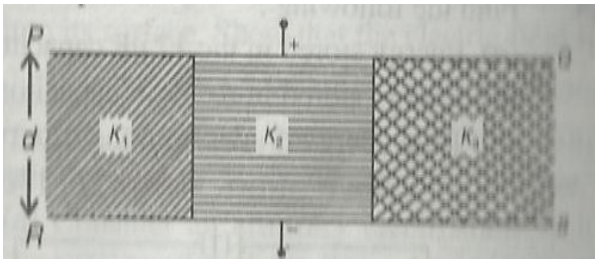
29. Calculate the equivalent capacitance between the points A and B of the circuit given below. If a battery of emf 10 V is connected between the points A and B , Calculate the total charge in circuit.



30. What is the function of dielectric in a capacitor? Calculate the equivalent capacitance of the combination between the points P and Q as shown in figure.



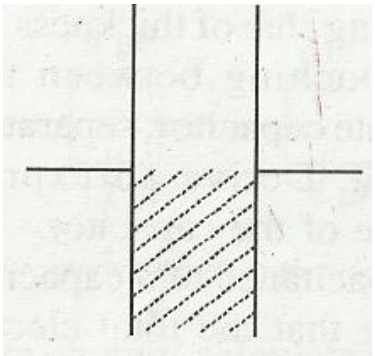
31. Define the capacitance of a parallel plate capacitor. Two parallel plated PQ and RS are kept distance‘d’ apart. Area of each plate is ‘A’ The space between them is filled with three dielectric slabs of identical size having dielectric constants K_1, K_2 and K_3 respectively as shown in figure. Find the capacitance of the capacitor.



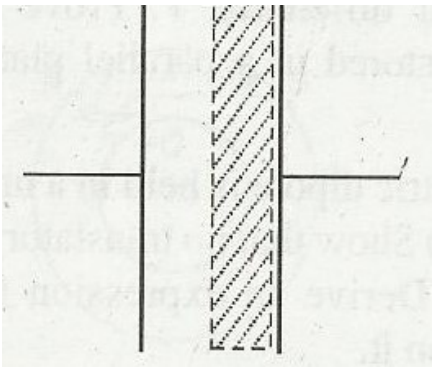
[**Ans:** $C = \frac{\varepsilon_0 A}{3d}(K_1 + K_2 + K_3)$]

32. Define 'electric potential '. Deduce an expression for the electric potential at a point distant 'r' from a point charge (Q > 0)

33. A capacitor half filled with dielectric of dielectric constant 4 has a capacitance without the dielectric?
[**Ans:** $C_0 = 4\mu F$]

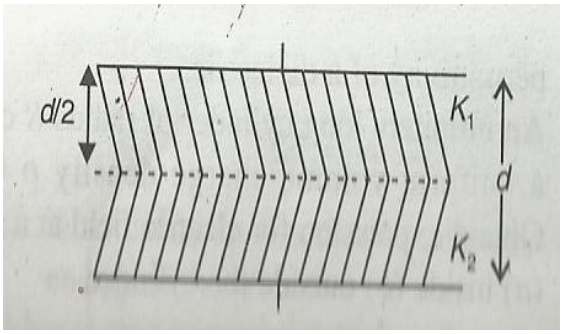


34. Capacitance of an air filled parallel plate capacitor is $10\ \mu F$. What will its capacitance become when it is half filled with dielectric slab of dielectric constant 4?



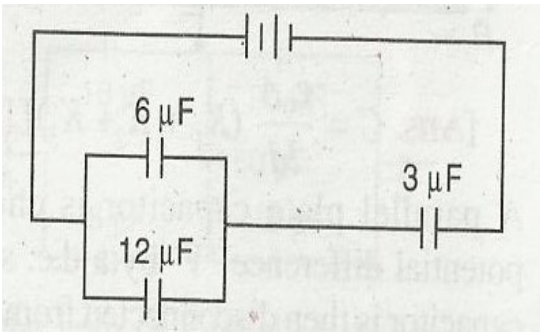
35. Calculate capacitance of capacitor as shown

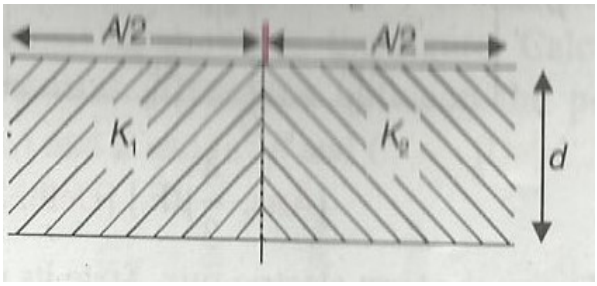
[**Ans :** $\frac{2\varepsilon_0 A}{d}\left(\frac{K_1 K_2}{K_1 + K_2}\right)$]



36. Calculate capacitance of capacitor as shown

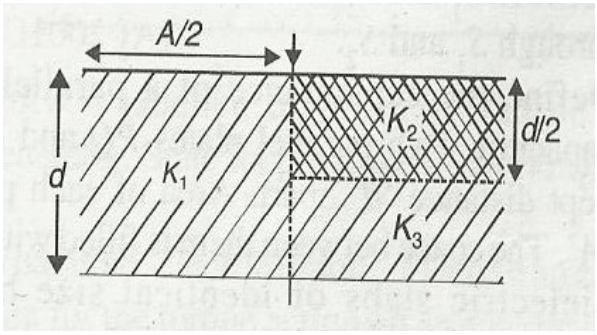
[**Ans :** $\frac{\varepsilon_0 A}{2d}(K_1 + K_2)$]





37. Calculate capacitance of capacitor as shown

[**Ans :** $\frac{\varepsilon_0 A}{d}\left(\frac{K_1}{2}+\frac{K_2 K_3}{K_2+K_3}\right)$]



38. In the arrangement of capacitors shown here, the energy stored in the 6 μF capacitor is E. Find the following:

(i) Energy stored in the 12 μF capacitor

(ii) Energy stored in the 3 μF capacitor

(iii) Total energy drawn from the battery

[**Ans :** 2E, 18 E, 21 E]

39. In a certain region of space the electric field is along the z direction through out. The magnitude of electric field is however, not constant but increases uniformly along the positive z direction at the rate of $1010^{-5}\,NC^{-1}$ per meter. What are the forces and torque experienced by a system having a total dipole moment equal to $1010^{-7}\,Cm$ in the negative z direction?

40. Consider a uniform electric field E =$3\times10^3 \underset{i}{\Lambda}$ N/C

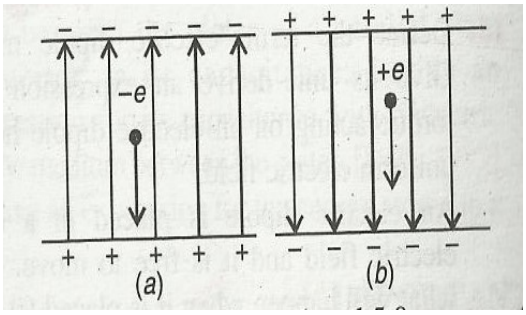
a. What is the flux of this field. Through a square of 10 cm on a side whose plane is parallel to the yz plane?

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

[**Ans :** a. $30\,Nm^2C^{-1}$ b. $15\ Nm^2/C$]

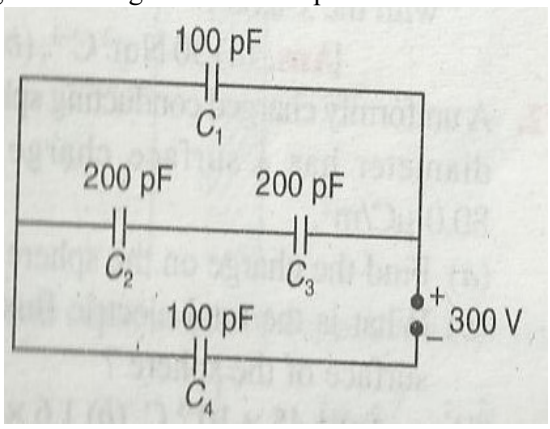
41. An oil drop of 12 excess electrons is held stationary under constant electric field of $2.55\times10^4\,NC^{-1}$ in Millikan oil drop experiment . The density of the oil is $1.26\,g.cm^{-3}$. Estimate the radius of the drop.

$[\, g = 9.81 ms^{-2}, e = 1.60 \times 10^{-19} C \,]$



[**Ans** : $9.81 \times 10^{-4} mm$]

42. Obtain the equivalent capacitance of the network in adjoining figure . For a 300 v supply, determine the charge and voltage across ech capacitor.



[Ans :
$C_{eq} = 200/3 pF, Q_1 = 10^{-8} C, V_1 = 100V,$
$Q_2 = Q_3 = 10^{-8} C, V_2 = V_3 = 50V, Q_4 = 2.0 \times 10^{-8} C, V_4 = 200V]$

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

43. An electron falls through a distance of 1.5 cm in a uniform electric field of magnitude $2.0 \times 10^8 NC^{-1}$. The direction of the field is reversed keeping its magnitude unchanged and proton falls through the same distance. Compute the time of fall in each case. Contrast the situation with that of ' free fall under gravity'

45.. Draw electric field lines between the plates of a parallel plate capacitor with (i) air and (i) dielectric as the medium
A parallel plate capacitor with air as dielectric is connected to a power supply and charged to a potential difference V_0. After disconnecting from power supply, a sheet of insulating material is inserted between the plates. Completely filling the space between them . How will its (i) capacity, (ii) electric field and (iii) energy change? Given that the capacity of capacitor with air and medium is C_0 and permittivity for air and medium are ε_0 and ε respectively.

46.. Derive an expression for the electric potential at a point along the axial line of an electric dipole. at a point due to a point charge, the values of electric field intensity and potential are 32 N/C and 16 J/C respectively. Calculate (i) magnitude of the charge and (ii) distance of the charge from the point of observation.

47.. Figures a and b shows the field lines of a positive and negative point charge respectively.
a. Give the signs of the potential difference
$V_P - V_Q . V_B - V_A$
b. Give the sign of the potential energy difference of a small negative charge between the points Q and P, A and B.
c. Give the sign of the work done by the field in moving a small positive charge from Q and P

d. Give the sign of the work done by the external agency in moving a small negative charge from B to A

e. Does the kinetic energy of a small negative charge increase or decrease in going from B to A