Delhi Public School Indirapuram, Ghaziabad

PHYSICS - XII

Chapter - 1, 2 & 3

Q1. What does $q_1 + q_2 = 0$ signify electrostatics?

Q2. In an electric field an electron kept freely. If the electron is replaced by a proton, what will be the relationship between the forces experienced by them?

Q3. Point out right or wrong for the following statements

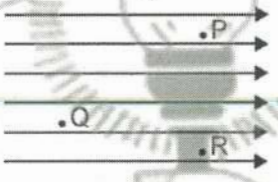
(a) The mutual forces between two charges do not get affected by the presence of other charges.

(b) The potential, due to a dipole, at any point on its axial line, is zero.

Q4. Can electric potential any point in space be zero while intensity of electric field at that point is not zero?

Q5. The electric potential is constant in a region, What can you say about electric field there?

Q6. As shown in figure three points *P*, *Q* and *R* in a uniform electrostatic field. At which point will be electric potential be maximum?



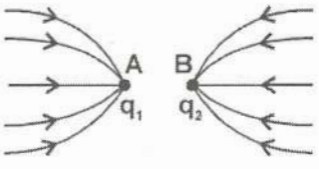
Q7. In what orientation does an electric dipole experience a zero torque and non-zero force in a non-uniform electric field?

Q8. A 500 μC charge is at the centre of a square of side 10 cm. Find the work done in moving a charge of 10 μC between two diagonally opposite points on the square.

Q9. A steady current flows in a metallic conductor of non-uniform cross-section. Explain which of these quantities is constant along the conductor : current, current density, electric field and drift speed?

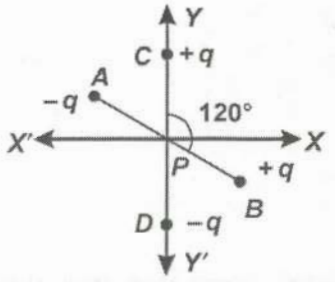
Q10. Two insulated charged sphere of radii 7 cm and 13 cm and having the same charge are connected by a conductor and then they are separated? Which of the two spheres will carry greater charge?

Q11. Figure shows electric lines of force due to two point charge q_1 and q_2 placed at points *A* and *B* respectively. Write the nature of charge on them.



Q12. If the electrostatic field at a given point is zero, must the electrostatic potential be also zero at that point?

Q13. Two small identical dipoles *AB* and *CD*, each of dipole moment '*p*' are kept at an angle of 120° as shown in the figure. What is the resultant dipole moment of this combination? If this system is subjected to electric field (*E*) directed along +*X*-direction, what will be the magnitude and direction of the torque acting on this?

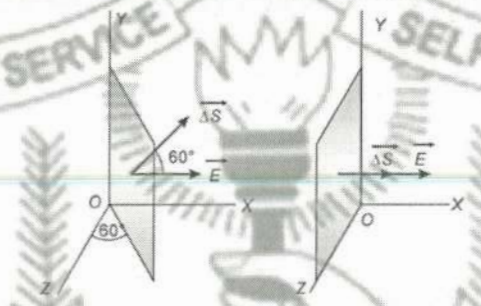


Q14. Plot a graph showing the variation of Coulomb's force (*F*) versus $1/r^2$, where *r* is the distance between the two charges of each pair of charges : (1 μC, 2 μC) and (1 μC, −3 μC). Interpret the graphs obtained.

Q15. Sketch the pattern of electric field lines due to (a) a conducting sphere having negative charge on it and (b) an electric dipole.

Q16. Two opposite corners of a square carry *Q* charge each and the other two opposite corners of the square carry *q* charge each. If the resultant force on *Q* is zero, how are *Q* and *q* related?

Q17. Consider a uniform electric field $\vec{E} = 3 \times 10^3 \hat{i}\ NC^{-1}$. (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 some square, if the normal to its plane makes a 60° angle with the *X*-axis?



Q18. Two point charges of +2 μC and +6 μC repel each other with a force of 12 N. If each is given additional charge of −4μC, what will be the new force?

Q19. A particle of mass 2×10^{-3} kg and charges 4 μC is thrown at a speed 24 ms^{-1} against a uniform electric field of strength $4 \times 10^5\ NC^{-1}$. How much distance will it travel before coming to rest momentarily?

Q20. The electric field in a region is radially outward and varies with distance *r* as

$$E = 250\, r\ V\, m^{-2}$$

Calculate the charge contained in a sphere of radius 0.2 m centred at the charge contained in a sphere of radius 0.2 m centred at the origin.

Q21. The electric field *E* due to a point charge at any point near it is defined as

$$E = \lim_{q_0 \to 0} \frac{F}{q_0}$$

Where *q* is the test charge and F is the force acting on it. What is the physical significance of $q_0 \to 0$ in this expression?

Q22. An infinite line charge produces a field of $3 \times 10^4\ N\, C^{-1}$ at a distance of 4 cm. Calculate the linear charge density.

Q23. A spherical conducting shell of inner radius r_1 and outer radius r_2 has a charge Q. A charge q is placed at the centre of the shell.

(a) What is the surface charge density on the (i) inner surface, (ii) outer surface of the shell?

(b) Write the expression for the electric field at a point $x > r_2$ from the centre of the shell.

Q24. Show that the electric field at the surface of a charged conductor is given by $E = \frac{\sigma}{\varepsilon_0}\hat{n}$, where σ is the surface charge density and $\hat{n}$ is a unit vector normal to the surface in the outward direction.

Q25. Force of attraction between two point electric charge placed at a distance r in a medium is F. What distance apart should these be kept in the same medium, so that force between them becomes $F/4$.

Q26. The capacitances of three capacitors are in the ratio 1 : 2 : 3. Their equivalent capacitance in parallel is greater than their equivalent capacitance in series by 60/11 μF. Calculate their individual capacitances.

Q27. A parallel plate capacitor has a capacitance of 2 μF. A slab of dielectric constant 5 is inserted between the plates and the capacitor is charged to 100 V and then isolated,

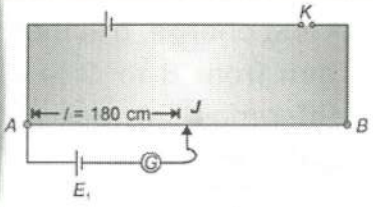
(a) What is the new potential difference, if the dielectric slab is removed?

(b) How much work is required to remove the dielectric slab?

Q28. In the circuit shown in figure below, AB is a resistance wire of uniform cross-section in which a potential gradient of 0.01 V cm^{-1} exists.

(a) If the galvanometer G shows zero deflection, what is the e.m.f. E_1 of the cell used?

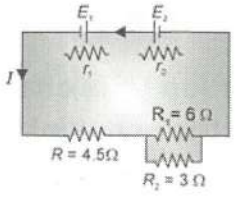
(b) If the internal resistance of the driver cell increases on some account, how will it change the balance point in the experiment?



Q29. Calculate the potential at the centre of a square $ABCD$ of each side $\sqrt{2}$ m due to charges 2, –2, –3 and 6 μC at four corners of it.

Q30. A metal wire is bent into a circle of radius 10 cm. It is given a charge of 200μC, Which spreads on it uniformly. Calculate the electric potential at its centre.

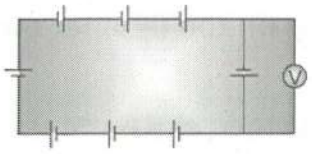
Q31. Two cells E_1 and E_2 in the circuit shown in figure below, have e.m.f. of 5 V and 9 V and internal resistance of 0.3 Ω and 1.2 Ω respectively. Calculate the value of current through the resistance of 3 Ω.



Q32. A cylindrical metallic wire is stretched to increase length by 5%. Calculate the percentage change in its resistance.

Q33. Two capacitors of capacitances 6 μF and 12 μF are connected in series with a battery. The voltage across the 6 μF capacitor is 2V. Compute the total battery voltage.

Q34. In the circuit shown in figure, each battery is of 5 V and has an internal resistance of 0.2 Ω. What will be the reading of an ideal voltmeter connected across a battery?



Q35. A battery of e.m.f. E and internal resistance r is connected to a variable external resistance R. Find the value of R so that (a) current in the circuit is maximum and (b) terminal potential across the battery is maximum.

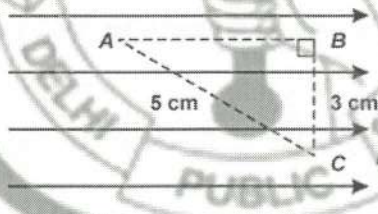
Also, find the maximum value of current in case (a) and maximum terminal potential difference in case (b).

Q36. A set of an identical resistors, each of resistance $R\,\Omega$, when connected in series have an effective resistance of $X\,\Omega$ and when the resistors are connected parallel, R, X effective resistance is $Y\,\Omega$. Find the relation between R, X and Y.

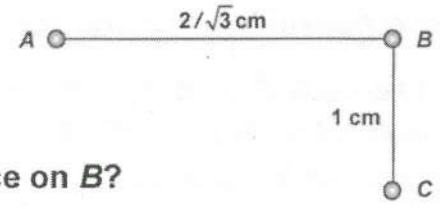
Q37. The two plates of a parallel plate capacitor are 4 mm apart. A slab of dielectric constant 3 and thickness 3 mm is introduced between the plates with its faces parallel to them. The distance between the plates is so adjusted that the capacitance of the capacitor becomes (2/3)rd of its original value. What is the new distance between the plates?

Q38. Two point electric charges values 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 acting on q and $2q$ is zero. Calculate the position of charge Q in terms of q and d.

Q39. A test charge, q is moved without acceleration from A to C along the path from A to B and then from B to C in electric field E as shown in the figure. (a) Calculate the potential difference between A and C. (b) At which point (of the tow) is the electric potential more and why?



Q40. Three small charged spheres, with equal charges on them are placed as shown in figure below.



A and C are fixed in position and B can move.

C exerts force of 4×10^{-6} N on B due to A ?

(a) What force A exerts on B? (b) What is the net force on B?

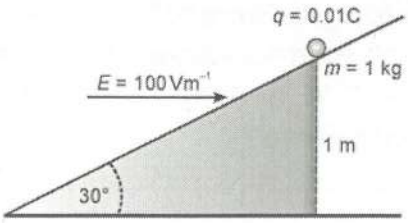
Q41. A parallel plate capacitor of plate separation 'd' is charged to a potential difference ΔV. A dielectric slab of thickness 'd' and dielectric constant 'K' is introduced between the plates while the battery remains connected to the plates.

(a) Find the ratio of energy stored in the capacitor after and before the dielectric is introduced. Given the physical explanation for this change in stored energy.

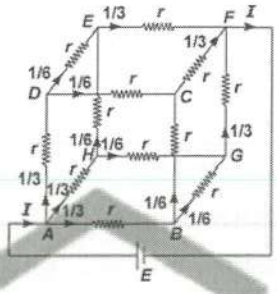
(b) What happens to the charge on the capacitor?

Q42. An inclined plane making an angle of 30° with the horizontal is placed in a uniform horizontal electric field of 100 V m^{-1} as shown in Figure.

A particle of mass 1 kg and charge 0.01 C is allowed to slide down from rest from a height of 1 m. If the coefficient of friction is 0.2, find the time it will take the particle to reach the bottom.

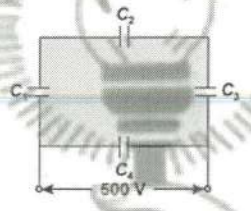


Q43. 12 wires, each of resistance *r* are connected in the form of a skeleton cube. Find the equivalent resistance of the cube, then the current enters at one corner and leaves at the diagonally opposite corner.



Q44. Three charges of equal magnitude *q* is placed at the vertices of an equilateral triangle of side *l*. Find the force on a charge *Q* placed at the centroid of the triangle is?

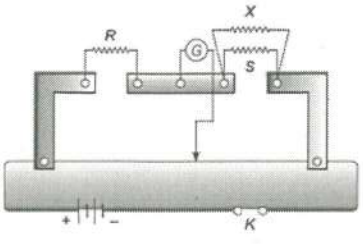
Q45. A network of four capacitors each of 12 μ*F* capacitance is connected to a 500 V supply as shown in the figure. Determine (a) equivalent capacitance of the network and (b) charge on each capacitor.



Q46. (a) Plot a graph comparing the variation of potential, *V* and electric field *E* due to a point charge *Q* as a function of distance *R* from the point charge.

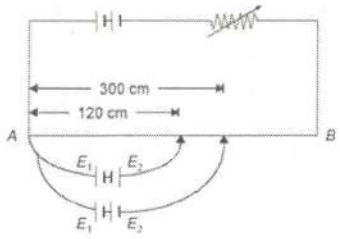
(b) Find the ratio of the potential differences that must be applied across the parallel and the series combination of two capacitors, C_1 and C_2 with their capacitances in the ratio 1 : 2 so that the energy stored, in the two cases, becomes the same.

Q47. When two known resistances *R* and *S* are connected in the left and right gaps of a metre bridge, the balance point is found at a distance l_1 from the zero end of the metre bridge wire. An unknown resistances *X* is now connected in parallel to the resistance *S* and the balance point is now found at a distance l_2 from the zero end of the metre bridge wire as shown in figure below. Obtain a formula for *X* in terms of l_1, l_2 and *S*.

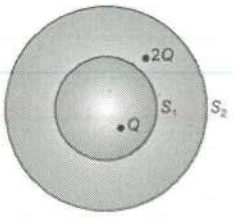


Q48. A 10 m long wire of uniform cross-section and 20 Ω resistance is used in a potentiometer. The wire is connected in series with a battery of 5 V along with an external resistance of 480 Ω. If an unknown e.m.f. *E* is balanced at 6.0 m length of the wire, calculate (a) the potential gradient of the potentiometer wire and (b) the value of unknown e.m.f.

Q49. In the figure a long uniform potentiometer wire *AB* is having a constant potential gradient along its length. The null points for the two primary cells of e.m.f.s E_1 and E_2 connected in the manner shown are obtained at a distance of 120 cm and 300 cm from the end *A*. Find (a) E_1/E_2 and (b) position of null point for the cell E_1. How is the sensitivity of a potentiometer increased?



Q50. S_1 and S_2 are two parallel concentric spheres enclosing charges Q and $2Q$ respectively as shown in Figure.



(a) What is the ratio of the electric flux through S_1 and S_2?

(b) How will the electric flux through the sphere S_1 change, if a medium of dielectric constant 5 is induced in the space inside S_1 placed of air?