PHYSICS

BOOKS - OSWAAL PUBLICATION

PHYSICS (KANNADA ENGLISH)

ELECTRIC CHARGES & FIELDS

Topic 1 Very Short Answer Type Questions

1. Define S.I unit of charge .

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2. Write the SI unit of charge .

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

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4. What is the least quantity of the magnitude of the charge that can be given to or removed from a body ?

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5. What is the value of the angle between the vectors $\vec{P}$ and $\vec{E}$ for which the potential energy of an electric dipole of dipole moment p, kept in an external electric field $\vec{E}$, has the maximum value.

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6. Two point charges q_1 and q_2 are placed at a distance 'd' apart as shwon in the figure . The electric field intensity is zero at a point 'P' on the line joining them as shown . Write two conclusions that you can draw from this.

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7. Deficiency of how many electrons will produce a positive charge of $8 \times 10^{-19} C$.?

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8. The unit of electric dipole moment is:

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9. In which oeientation a dipole placed in a uniform electric field is in (i) stable , (ii)

unstable equilibrium?

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10. Two electrically charged particles , having charges of different magnitudes , when placed at a distance 'd' from each other , experience a force of attraction 'F' . These two particles are put in contact and again placed at the same distance from each other. What is the nature of new force between them ?

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11. Figure shows the field lines on a positive charge. Is the work done by the field in moving a small positive charge from Q to P , positive or negative? Give reason.

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12. A point charge of $5 \times 10^{-6} C$ experience a force of 2×10^{-3} N when kept in a uniform electric field of intensity E. find E.

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13. Why should electrostatic field be zero inside a conductor ?

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14. Which of the following physical quantity does not represent electric field ?

(i) V/m,

(ii) J/C

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15. What is the angle between the direction of electric field at any (i) axial point , and (ii) equatorial point due to an electric dipole ?

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16. Write the formula for linear charge density .

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17. Write the dimensional formula of electric charge.

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Topic 1 Short Answer Type Questions I

1. Write Coulomb's law in vector form and explain the terms.

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2. State Coulomb's law .

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3. What is (a) electric dipole moment , (b) dielectric strength ?

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4. (a) explain the menaing of the statement electric charge of a body is quantised

(b) why can one ignore quantisation of electric charge when dealing with macrosocpic large scale charges

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6. When a galss rod is rubbed with a sild cloth charges appear on both a smilar phenomenon is observeed with many other pairs of bodies expalin how this observation is consistent with the law of conservation of charge

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7. (a) an electrostatic field line is a contiuous curve that is field line cannot have sudden breaks why not

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

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9. A small metallic sphere carrying charge $+Q$ is located at the centre of a spherical cavity in a large uncharged metallic spherical shell . Write the charges on the inner and outer surfaces of the shell . Write the expression for the electric field at the point P_1.

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10. Two point charges q_1 and q_2 are located at $\vec{r}$ and $\vec{r}_2$ respectively in an external electric

field E. Obtain the experession for the total work done in assembling this configuration .

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11. An electric dipole is placed in a uniform electric field $\vec{E}$ with its dipole moment $\vec{p}$ parallel to the field . Find

(i) the work done in turning the dipole till its dipole moment points in the direction opposite to $\vec{E}$.

(ii) The orientation of the dipole for which the torque acting on it become the maximum.

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12. An electric dipole is held in a uniform electric field .

(i) Show that the net force acting on it is zero.

(ii) The dipole is aligned parallel to the field . Find the work done in rotating it throught the angle of 180°

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13. A spherical conducting shell of inner radius r_1 and outer radius r_2 has a charge Q.

(a) A charge q is placed at the centre of the shell. What is the surface charge density on the inner and outer surfaces of the shell?

(b) Is the electric field inside a cavity (with no charge) zero, even if the shell is not spherical, but has any irregular shape? Explain.

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14. Explain quantization of charge.

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15. What are the different type of continous charge distribution ?

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16. Mention and five properties of electric field lines.

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17. Explain dielectric constant with expressions

.

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18. What do you understand by principle of superposition ?

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19. (a) A point charge $(+Q)$ is kept in the vicinity of an uncharged conducting plate . Sketch electric field lines between the charge and the plate.

Two infinitely large plane thin parallel sheets having surface charge densities σ_1 and $\sigma_2(\sigma_1 > \sigma_2)$ are shown in the figure . Write the magnitudes and directions of the fields in the regions marked II and III.

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20. Am electric dipole is placed in a uniform electric field .

(i) Show that no traslatory force acts on it .

(ii) Derive an expression for the torque acting on it.

(iii) Find work done in rotating the dipole through 180°.

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21. An electron dipole of moment $\vec{p}$ is placed in a uniform electric field $\vec{E}$. Write the

expression for the torque $\vec{\tau}$ experienced by the dipole. Identify two pairs of perpendicular vectors in the expression . Shown diagrammatically the orientation of the dipole in the field for which the torque is

(i) the maximum , (ii) Half the maximum value , (iii) Zero.

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22. Two point charges $+q$ and $-2q$ are placed at the vertices 'B' and 'C' of an

equilateral triangle ABC of side 'a' as given in the figure . Obtain the expression for (i) the magnitude and (ii) the direction of the resultant electric field at the vertex A due to these two charges .

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Topic 1 Long Answer Type Questions

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

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2. Derive an expression for electric field due to an electric dipole at a point on the axial line.

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Topic 1 Numerical Problems

1. Point charges of 10nC,20nCand10nC are kept at the corners A,B C of a square ABCD of side 3m. Calculate the magnitude of the resultant electric intensity at D.

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2. Two point charges of 6 nC and 12 nC are placed at the corners of B and C of an equilateral triangle ABC of side 0.03 m .

Calculate the magnitude of the resultant electric intensity at the vertex A of triangle.

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3. The electrostatic force on a small sphere of charge 0.4 μ c due to another small sphere of charge -0.8 μ c in air is 0.2 N (a) What is the distance between the two spheres (b) what is the force on the second sphere due to the first

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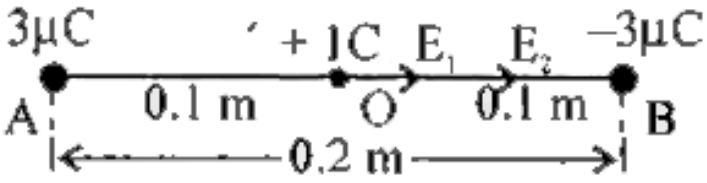
4. Two point charges $q_A = 3\mu C$ and $q_B = -3\mu C$ are located 0.2 m apart in vacuum.

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

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

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6. Two charges respectively of $+3.2 \times 10^{-19}$ coublem and -3.2×10^{-19} coulomb are separated by a distance of 2.4×10^{-10}m . This dipole is placed in a homogeneous electric field of $4.0 \times 10^{5} V/m$. Find

(i) Electric dipole moment

(ii) The maximum moment exerted on the dipole by the electric field.

(iii) The energy necessary for rotating the dipole from equilibrium position to 180°.

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7. Calculate the amount of work done to dissociate a system of three charge $1\mu C, 1\mu C$ and $-4\mu C$ placed on the vertices of an equilateral triangle of side 10 cm.

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8. Two charges of 1.0×10^{-6} coulomb are separated by a distance 10 cm . Where will the electric field be zero on the line joining the two charges ?

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9. The charges of an electric dipole are respectively 32×10^{-7} coulomb and -32×10^{-7} coulomb are separated by a distance of 10 cm . Find the field at a point situated at a distance of 8 cm from each charge.

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Topic 2 Very Short Answer Type Questions

1. Write the expression for electric flux passing through a surface in the electric field in terms of electric intensity of the field and area of the surface.

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2. Define Electric flux.

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

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

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5. Define positive electric flux.

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6. Define negative electric flux.

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Topic 2 Short Answer Type Questions I

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

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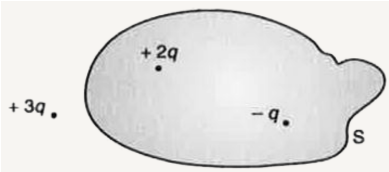
2. Figure shown three point charges , $+2q,\ -q,\ -q$ and $+3q$. Two charges +2q and -q are enclosed within a surface 'S' . What is the electric flux due to this configuration through the surface 'S'?



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3. Two charges of magnitudes $-2Q$ and $+Q$ are located at points (a,0) and (4a,0) respestively . What is the electric flux due to these charges through a sphere of radius 3a with its centre at the origin ?

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4. A sphere S_1 of radius r_1 encloses a net charge Q. If there is another concentric sphere S_2 of radius $r_2(r_2 > r_1)$ enclosing charge $2Q$,

find the ratio of the electric flux through S_1 and S_2 . How will the electric flux through sphere S_1 change, if a medium of dielectric constant K is introduced in the space inside S_2 in place of air ?

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5. Consider two hollow concentric spheres , S_1 and S_2 enlosing charges 2Q and 4Q respectively as shown in the figure . (i) Find

out the ratio of the electric flux through them

(ii) How will the flux through the sphere S_1 change if a medium of dielectric constant ε_r is introduced in the space inside S_1 in place of air ? Deduce the necessary expression.

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6. Use Gauss s law to derive the expression for the electric field between two uniformly

charged large parallel sheets with surface charge densities σ and $-\sigma$ respectively .

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7. 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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Topic 2 Long Answer Type Questions

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

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

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3. (a) Define electric flux . Write its S.I. unit.

(b) Using Gauss's law , prove that electric field at a point due to a uniformly charged infinite plane sheet is independent of the distance from it.

(c) How is the field directed if (i) the sheet is positively charged , (ii) negatively charged ?

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4. (a) Define electric flux . Write its S.I . Unit.

(b) A small metal sphere carrying charge $+Q$ is located at the centre of a spherical cavity inside a large uncharged metallic spherical shell as shown in the figure . Use Gauss 's law to find the expressions for the electric field at point P_1 and P_2.

(c) Draw the pattern of electric field lines in this arrangement .

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Topic 2 Numerical Problems

1. An atom was earlier assumed to be sphere of radius a having a positively charged point nucleus of charge $+Ze$ at its centre . This nucleus was believed to be surrounded by a uniform desity of negative charge that made the atom neutral as a whole.

Use this theorem to find the electric field of this atom at a distance $r(r > a)$ from the centre of the atom.

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2. A hollow cylindrical box of length 1 m and area of cross - section $25cm^2$ is placed in a three dimensional coordinate system as shown in the figure . The electric field in the region is given by $\vec{E} = 50x\hat{i}$, where E is NC^{-1} and x is in metres . Find .

(i) Net flux through the cylinder.

(ii) Charge enclosed by the cylinder.

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3. A point charge causes an elelctric flux of $-1.0 \times 10^3 N\frac{m^2}{C}$ to pass through a spherical gaussioan of 10.0 cm radius centred on the charge (a) if the radius of the gaussian surface wrere doubled how much flux would pas through the surface (b) what is the value of the point charge

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

a. Find the charge on the sphere.

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

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5. 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 $17.0 \times 10^{-22} Cm^{-2}$. What is the electric field

a. in the outer region of the first and the second plates?

b. between the plates?

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