PHYSICS

BOOKS - U-LIKE PHYSICS (HINGLISH)

ELECTRIC CHARGES AND FIELDS

N C E R T Textbook Exercises

1. What is the force between two small charged spheres having charges of 2×10^{-7}C and 3×10^{-7} C placed 30 cm apart in air?

View Text Solution

2. The eletrostaic force on a small sphere of charges $0.4\mu C$ due to another small sphere of charge $0.\ 8\mu C$ in air 0.2 N.

What is the distance between the two spheres?

(b) What is the force on the second sphere due to the first?

View Text Solution

3. Check that the ratio $\frac{ke^2}{Gm_em_p}$ is dimensionless. Look up a Table of Physical Constant and determine the value of this ratio. What does the ratio signify?

View Text Solution

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

Why can one ignore quantisation of electric charge when dealing with macroscopic i.e., large scale charges ?

View Text Solution

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

View Text Solution

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 centre of the square ?

` (##U_LIK_SP_PHY_XII_C01_E01_006_Q01.png" width="80%">

View Text Solution

7. An electrostatic field line is a continuous curve. That is , a field line cannot have sudden breaks. Why not?

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

View Text Solution

8. Two point charges $q_A = 3\mu C$ and $q_B = -3\mu C$ are located 20 cm apart in vacuum.

What is the electric field at the midpoint O of the line AB joining the two charges?

If a negative test charges of magnitude $1.5 \times 10^{-9} C$

` (##U_LIK_SP_PHY_XII_C01_E01_008_Q01.png" width="80%">

View Text Solution

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 points

$A:(0,0,\ -15cm)$ and $B:(0,0+15cm)$, respectively. What are the total charges and electric dipole moment of the system ?

View Text Solution

10. An electric dipole with dipole moment 4×10^{-9} C-m is aligned at 30° with the direction of a uniform electric field of magnitude $5\times10^{4}NC^{-1}$.Calculate the magnitude of the torque acting on the dipole.

View Text Solution

11. Two insulated charged copper spheres A and B have their centress separated by a distance of 50 cm . What is the mutual force of electrostatic repulsion if the charges on each is $6.5 \times 10^{-7} C$? The radii of A and B are neglible compared to the distance of separation

(b) What is the force of repulsion if each sphere is charged bouble the above amount, and the distance between them is halved?

View Text Solution

12. Suppose the sphere A and B in Question 1.12 have identical sizes.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?

View Text Solution

13. Show s tracks of three charged particles in a uniform electrostatic field.Give the signs of

the three charges. Which particle has the highest charges to mass ratio?

` (##U_LIK_SP_PHY_XII_C01_E01_014_Q01.png" width="80%">

View Text Solution

14. consider a uniform electric field $\vec{E} = 3 \times 10^3 \hat{i} N/C$

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 if the normal to its plane makes a 60° angle with the x-axis?

View Text Solution

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

` (##U_LIK_SP_PHY_XII_C01_E01_016_Q01.png" width="80%">

View Text Solution

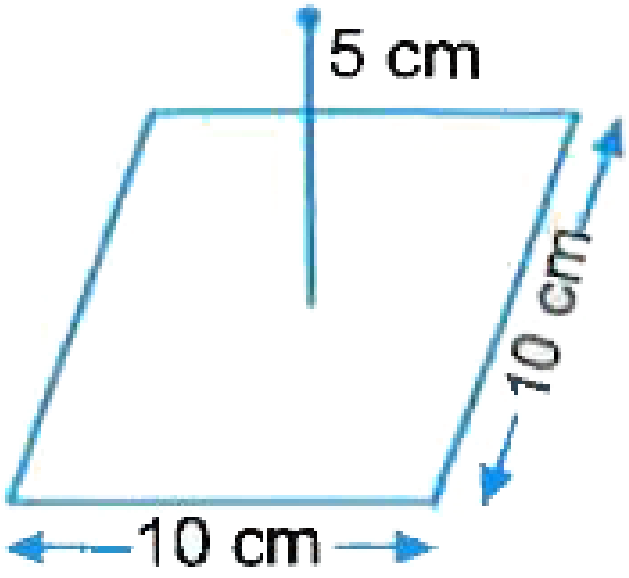
16. Carefull measurement of the electric field at the surface of a black box indicates that the net outwards flux through the surface of the box is $8.0 \times 10^3 Nm^2/C$

What is the net charges inside the box?

If the net outwards flux through the surface of the were zero ,could you concide that there were no charges inside the box? Why or why not?

View Text Solution

17. A point charges $+10\mu C$ is a distance 5 cm directly above centre of a square of side 10 cm as shown in What is the magnitude of the electric flux through the square?



View Text Solution

18. A point charges of $2.0\mu C$ is at the centre of a cubic Gaussian surface $9.0cm$ on edge . What is the net electric flux through the surface?

View Text Solution

19. A point charges 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 charges.

If the radius of the Gaussian surface were doubled , how much flux would pass through the surface?

What is the value of the point charges?

View Text Solution

20. A conducting sphere of radius 10 cm has an unknown charges. If the electric field 20 cm from the centre of the sphere is $1.5 \times 10^3 N/C$ and points radially inward, What is the net charges on the sphere?

View Text Solution

21. A uniformaly charged conducting sphere of 2.4 m diameter has a surface charge density of $80.0\mu C/m^2$

Find the charge on the sphere.

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

View Text Solution

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

View Text Solution

23. Two large, thin metal plates are parallel and close to each other , On their inner faces, the plates have surface charges densities of opposite signs and of magnitude $17.0 \times 10^{-22} C/m^2$.What is $\vec{E}$:

in the outer region of the first plate,

(b) in the outer region of the second plate,

(c) between the plates?

View Text Solution

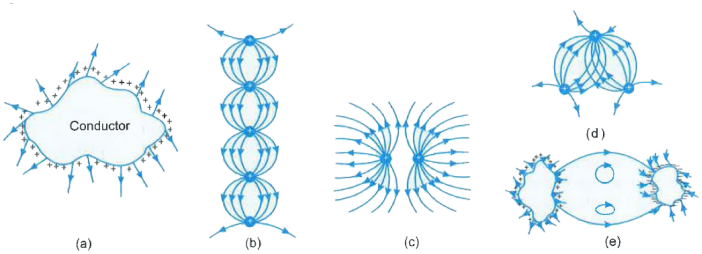
Additional Exercises

1. An oil drop of 12 excess electrons is held stationary under a constant electric field of $2.55 \times 10^4 NC^{-1}$ in Millikan's oil drop experiment. The density of the oils is 1.26

gcm^{-3} Estimate the radius of the drop $\left(g = 9.81 ms^{-2} \text{ and } e = 1.60 \times 10^{-19} C\right)$

View Text Solution

2. Which among the curve shown in cannot posibly represent electrostatic field lines?

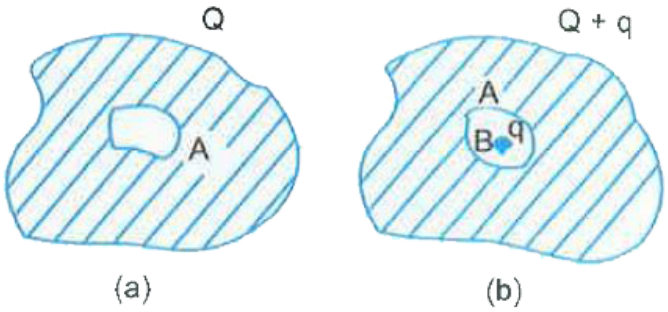


View Text Solution

3. In a certain rigion of space, electric field is along the z-direction throughout. The magnitude of electric field is , however, not constant but increases uniformaly 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 dopole moment equal to 10^{-7} C-m in the negative z-direction?

View Text Solution

4. A conductor A with a cavity as shown in is given a charge Q. show that the entire charge must appear on the outer surface of the conductor.



Another conductor B with charge q is inserted into the cavity keeping B insulated from A. Show that the total charge on the outside surface of A is Q+q

(c) A sensitive instrument is to be shielded from the strong electrostatic fields in its environment. Suggest a posible way.

View Text Solution

5. A hollow charged conductor has a tiny hole cut into its surface. Show that the electric field in the hole is $\left(\frac{\sigma}{2 \in_0}\right)\hat{n}$, where $\hat{n}$ is the unit vector in the outward normal direction, and σ is the surface charge density near the hole,

View Text Solution

6. Obtain the formula for the electric field due to a along thin wire of uniform linear charge density λ without using Gauss's law.

View Text Solution

7. It is now belived that protons and neutrons (which constitude 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 charges $+\frac{2}{3}e$, and the 'down' quark (denoted by d) of charges $\left(-\frac{1}{3}\right)$e, together with electrons build up ordinary matter. (Quarks of 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.

View Text Solution

8. Consider an arbitrary electrostatic field configuration. A small test total is placed at a null point (i.e, where $\overrightarrow{E} = 0$) of the configuration. Show that the equilibrium of the test charge is necessarily unstable.

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

View Text Solution

9. A particle of mass m and charge (-q) enters the regions between the two charged plates initially moving along x-axis with speed v_x (like particle 1 in.) The length of plate is L and an the particle at the far edge of the plate is $qEL^2 / \left(2mv_x^2\right)$.

View Text Solution

10. Suppose that the particle in Question 1.33 is an electron projected with velocity $v_x = 2.0 \times 10^6 ms^{-1}$ .If E between the plates

separated by 0.5 cm is $9.1 \times 10^2 N/C$, where will the electron strike the upper plate ? $\left(|e| = 1.6 \times 10^{-19} C, m_e = 9.1 \times 10^{-31} kg\right)$

View Text Solution

Case Based Source Based Integrated Questions

1. Answer question on the basis of your understanding of the following paragraph and the related studied concepts.

A Charges placed at a point in space produces

an electric field everywhere in the surrounding. When another charge is borught in the field of first charge, it experiences a force . The electric field at a point is space due to given charges is defind as the force that a unit positive charges would experience if placed at that point.

It we consider a system of charges $q_1, q-2, q_3 \ldots .$ with position vectors $\overrightarrow{r_1}, \overrightarrow{r_2}, \overrightarrow{r_3} \ldots .$ relative to some origin O, then electric field at a point in space due to the system of charges is determined by finding the vector sum of fields due to all individual

charges of the charges system.

State the SI unit of electric field.

View Text Solution

2. Answer question on the basis of your understanding of the following paragraph and the related studied concepts.

A Charges placed at a point in space produces an electric field everywhere in the surrounding. When another charge is borught in the field of first charge, it experiences a

force . The electric field at a point is space due to given charges is defind as the force that a unit positive charges would experience if placed at that point.

It we consider a system of charges $q_1, q-2, q_3 \ldots .$ with position vectors $\overrightarrow{r_1}, \overrightarrow{r_2}, \overrightarrow{r_3} \ldots .$ relative to some origin O, then electric field at a point in space due to the system of charges is determined by finding the vector sum of fields due to all individual charges of the charges system.

A charges $q = -2\mu C$ is placed at a point O. Find the electric field at a point P situated at a

distance 0.5 m from O along positive direction of x-axis.

` (##U_LIK_SP_PHY_XII_C01_E03_002_Q01.png" width="80%">

View Text Solution

3. Answer question on the basis of your understanding of the following paragraph and the related studied concepts.

A Charges placed at a point in space produces an electric field everywhere in the

surrounding. When another charge is borught in the field of first charge, it experiences a force . The electric field at a point is space due to given charges is defind as the force that a unit positive charges would experience if placed at that point.

It we consider a system of charges $q_1, q-2, q_3 \ldots .$ with position vectors $\overrightarrow{r_1}, \overrightarrow{r_2}, \overrightarrow{r_3} \ldots .$ relative to some origin O, then electric field at a point in space due to the system of charges is determined by finding the vector sum of fields due to all individual

charges of the charges system.

What is the direction of electric field ?

View Text Solution

4. Answer question on the basis of your understanding of the following paragraph and the related studied concepts.

A Charges placed at a point in space produces an electric field everywhere in the surrounding. When another charge is borught in the field of first charge, it experiences a

force . The electric field at a point is space due to given charges is defind as the force that a unit positive charges would experience if placed at that point.

It we consider a system of charges $q_1, q-2, q_3 \ldots .$ with position vectors $\overrightarrow{r_1}, \overrightarrow{r_2}, \overrightarrow{r_3} \ldots .$ relative to some origin O, then electric field at a point in space due to the system of charges is determined by finding the vector sum of fields due to all individual charges of the charges system.

We have a charges configuration as shown here. Without actual calculations guess the

value of net electric field at a point O, the centre of the square ABCD , Give reason for your answer.

` (##U_LIK_SP_PHY_XII_C01_E03_004_Q01.png" width="80%">

View Text Solution

5. Answer question on the basis of your understanding of the following paragraph and the related studied concepts.

A Charges placed at a point in space produces

an electric field everywhere in the surrounding. When another charge is borught in the field of first charge, it experiences a force . The electric field at a point is space due to given charges is defind as the force that a unit positive charges would experience if placed at that point.

It we consider a system of charges $q_1, q-2, q_3 \ldots .$ with position vectors $\overrightarrow{r_1}, \overrightarrow{r_2}, \overrightarrow{r_3} \ldots .$ relative to some origin O, then electric field at a point in space due to the system of charges is determined by finding the vector sum of fields due to all individual

charges of the charges system.

What will be the electric field at O if q_1 is interchanged with q_2 and q_3 interchanged with q_4?

` (##U_LIK_SP_PHY_XII_C01_E03_005_Q01.png" width="80%">

View Text Solution

6. Answer question on the basis of your understanding of the following paragraph and the related studied concepts.

Eletric field around a single charges or a charges configuration can be pictorially mapped by drawing electric field lines in space. An electric field line is, in general, a curve drawn in such a way that the tangent to it at each point is in the direction of the net. field point. An arrow on the curve is obviously necessary to specify the direction of electric field from the two possible directions indicated by a tangent to the curve. A field line is a space curve i.e., a curve in three dimensions.

Electric field lines may be taken to be

continous curve without any breaks. Relative density (i.e. closeness) of the field lines at different points indicate the relative strength of electric field at those points. The field lines crowd where the field is strong and are spaced apart where it is weak.

What is an electric field line?

View Text Solution

7. Answer question on the basis of your understanding of the following paragraph and

the related studied concepts.

Eletric field around a single charges or a charges configuration can be pictorially mapped by drawing electric field lines in space. An electric field line is, in general, a curve drawn in such a way that the tangent to it at each point is in the direction of the net. field point. An arrow on the curve is obviously necessary to specify the direction of electric field from the two possible directions indicated by a tangent to the curve. A field line is a space curve i.e., a curve in three dimensions.

Electric field lines may be taken to be continous curve without any breaks. Relative density (i.e. closeness) of the field lines at different points indicate the relative strength of electric field at those points. The field lines crowd where the field is strong and are spaced apart where it is weak.

Draw electric field lines due to an electric dipole and mark their directions.

View Text Solution

8. Answer question on the basis of your understanding of the following paragraph and the related studied concepts.

Eletric field around a single charges or a charges configuration can be pictorially mapped by drawing electric field lines in space. An electric field line is, in general, a curve drawn in such a way that the tangent to it at each point is in the direction of the net. field point. An arrow on the curve is obviously necessary to specify the direction of electric field from the two possible directions

indicated by a tangent to the curve. A field line is a space curve i.e., a curve in three dimensions.

Electric field lines may be taken to be continous curve without any breaks. Relative density (i.e. closeness) of the field lines at different points indicate the relative strength of electric field at those points. The field lines crowd where the field is strong and are spaced apart where it is weak.

In the field drawn in at what points is the electric field strongest?

View Text Solution

View Text Solution

9. Answer question on the basis of your understanding of the following paragraph and the related studied concepts.

Eletric field around a single charges or a charges configuration can be pictorially mapped by drawing electric field lines in space. An electric field line is, in general, a curve drawn in such a way that the tangent to it at each point is in the direction of the net. field point. An arrow on the curve is obviously necessary to specify the direction of electric

field from the two possible directions indicated by a tangent to the curve. A field line is a space curve i.e., a curve in three dimensions.

Electric field lines may be taken to be continous curve without any breaks. Relative density (i.e. closeness) of the field lines at different points indicate the relative strength of electric field at those points. The field lines crowd where the field is strong and are spaced apart where it is weak.

Can electrostatic field lines from closed loops? Why

View Text Solution

10. Answer question on the basis of your understanding of the following paragraph and the related studied concepts.

Eletric field around a single charges or a charges configuration can be pictorially mapped by drawing electric field lines in space. An electric field line is, in general, a curve drawn in such a way that the tangent to it at each point is in the direction of the net. field point. An arrow on the curve is obviously

necessary to specify the direction of electric field from the two possible directions indicated by a tangent to the curve. A field line is a space curve i.e., a curve in three dimensions.

Electric field lines may be taken to be continous curve without any breaks. Relative density (i.e. closeness) of the field lines at different points indicate the relative strength of electric field at those points. The field lines crowd where the field is strong and are spaced apart where it is weak.

A solid metallic sphere is placed in a uniform

electric field. The electric field lines around the sphere follow the path(s) shown in the figure as:

` (##U_LIK_SP_PHY_XII_C01_E03_010_Q01.png" width="80%">

A. 1

B. 2

C. 3

D. 4

Answer: d

View Text Solution

11. Answer questions on the basis of your understanding of the following paragraph and the related studied concept.

Electric flux, in general , through any surface is defined as per relation:

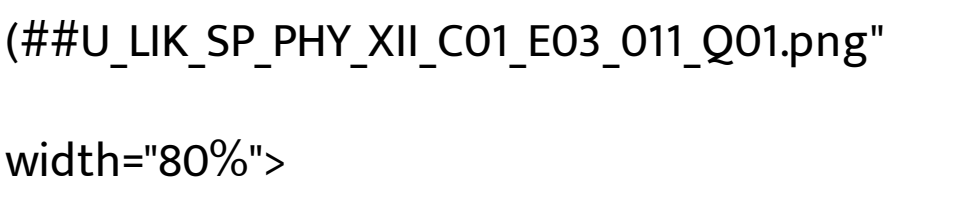
$\phi_E = \int \vec{E} . \vec{ds}$, where integration has to be performed over the entire surface through which flux is required. The surface under consideration may be a closed one or an open surface. When flux through a closed surface is

required we use a small circular sign on the integration symbol. Thus flux over a closed surface $\oint E = \oint \overrightarrow{E} . \overrightarrow{ds}$. it is customary to take the outward normal as positive in this case.

A German physicist Gauss established a fundamental law to find electric flux over a closed surface. As per Gauss' law , the flux of the net electric field through a closed surface equals the net charge enclosed by the surface divided by $\in_0$. Mathematically $\oint \overrightarrow{E} . \overrightarrow{ds} = \frac{1}{\in_0}[q_{en}]$, where q_{cn} is the net charge enclosed within the surface. It is possible to derive Gauss' law from Coulomb's

laws. Gauss' law can be applied to obtain electric field at a point due to continuous charge distribution for a number of symmetric charge configurations.

Consider a closed surface having certain charges both within and outside as shown. The total electric flux of the given closed surface is :



A. $+2.26 \times 10^5 Vm$

B. $+7.91 \times 10^5 Vm$

C. $-2.26 \times 10^{5} Vm$

D. $+1.36 \times 10^{-6} Vm$

Answer: c

View Text Solution

12. Answer questions on the basis of your understanding of the following paragraph and the related studied concept.

Electric flux, in general , through any surface is defined as per relation:

$\phi_E = \int \overrightarrow{E} . \overrightarrow{ds}$, where integration has to be performed over the entire surface through which flux is required. The surface under consideration may be a closed one or an open surface. When flux through a closed surface is required we use a small circular sign on the integration symbol. Thus flux over a closed surface $\oint E = \oint \overrightarrow{E} . \overrightarrow{ds}.$ it is customary to take the outward normal as positive in this case.

A German physicist Gauss established a fundamental law to find electric flux over a closed surface. As per Gauss' law , the flux of the net electric field through a closed surface

equals the net charge enclosed by the surface divided by $\in_0$. Mathematically $\oint \overrightarrow{E} . \overrightarrow{ds} = \frac{1}{\in_0}[q_{en}]$, where q_{cn} is the net charge enclosed within the surface. It is possible to derive Gauss' law from Coulomb's laws. Gauss' law can be applied to obtain electric field at a point due to continuous charge distribution for a number of symmetric charge configurations.

A square surface of side L m is in the plane of paper. A uniform electric field $\overrightarrow{E} Vm^{-1}$, also in the plane of the paper, is limited only to the lower half of the square surface as shown in

adjoining figure. The electric flux, in SI units, associated with the surfer is :

` (##U_LIK_SP_PHY_XII_C01_E03_012_Q01.png" width="80%">

A. zero

B. EL^2

C. $\frac{EL^2}{2\in_0}$

D. $\frac{EL^2}{2}$

Answer: a

View Text Solution

13. Answer questions on the basis of your understanding of the following paragraph and the related studied concept.

Electric flux, in general , through any surface is defined as per relation:

$\phi_E = \int \vec{E} . \vec{ds}$, where integration has to be performed over the entire surface through which flux is required. The surface under consideration may be a closed one or an open surface. When flux through a closed surface is required we use a small circular sign on the

integration symbol. Thus flux over a closed surface $\oint E = \oint \overrightarrow{E} . \overrightarrow{ds}$. it is customary to take the outward normal as positive in this case.

A German physicist Gauss established a fundamental law to find electric flux over a closed surface. As per Gauss' law , the flux of the net electric field through a closed surface equals the net charge enclosed by the surface divided by $\in_0$. Mathematically $\oint \overrightarrow{E} . \overrightarrow{ds} = \frac{1}{\in_0}[q_{en}]$, where q_{cn} is the net charge enclosed within the surface. It is possible to derive Gauss' law from Coulomb's laws. Gauss' law can be applied to obtain

electric field at a point due to continuous charge distribution for a number of symmetric charge configurations.

A charge q is enclosed by a Gaussian spherical surface of raidus R. If the radius is doubled then the electric flux will.

A. be doubled

B. increases four times

C. be reduced to half.

D. remain the same.

Answer: d

View Text Solution

14. Answer questions on the basis of your understanding of the following paragraph and the related studied concept.

Electric flux, in general , through any surface is defined as per relation:

$\phi_E = \int \vec{E} . \vec{ds}$, where integration has to be performed over the entire surface through which flux is required. The surface under consideration may be a closed one or an open surface. When flux through a closed surface is

required we use a small circular sign on the integration symbol. Thus flux over a closed surface $\oint E = \oint \overrightarrow{E} . \overrightarrow{ds}$. it is customary to take the outward normal as positive in this case.

A German physicist Gauss established a fundamental law to find electric flux over a closed surface. As per Gauss' law , the flux of the net electric field through a closed surface equals the net charge enclosed by the surface divided by $\in_0$. Mathematically $\oint \overrightarrow{E} . \overrightarrow{ds} = \frac{1}{\in_0}[q_{en}]$, where q_{cn} is the net charge enclosed within the surface. It is possible to derive Gauss' law from Coulomb's

laws. Gauss' law can be applied to obtain electric field at a point due to continuous charge distribution for a number of symmetric charge configurations.

What is the electrical flux through a cube of side 'a' if a point charge 'q' is placed at one of its vertices?

A. $\frac{q}{\in_0}$

B. $\frac{2q}{\in_0}$

C. $\frac{q}{8 \in_0}$

D. $\frac{q}{\in_0} . 6a^2$

Answer: c

View Text Solution

Multiple Choice Questions

1. When 10^{14} electrons are removed from a neutrol metal sphere, the charge on the sphere becomes

A. $16\mu C$

B. $-16\mu C$

C. $32\mu C$

D. $-32\mu C$

Answer: A

View Text Solution

2. When air is replaced by a dielectric medium of dielectric constant K, the force at attraction between two charges q_1 and q_2 separated by a finite distance 'd'

A. decreases K times

B. increases K times

C. remains uncharged

D. decreases K^2 times.

Answer: A

View Text Solution

3. An electrons is moving round the nucleus of a hydrogen atoms in a circular orbit of radius

r. The coulomg force $\vec{F}$ between the two is (where K $= \frac{1}{4\pi \in_0}$)

A. $K\frac{e^2}{r^3}\vec{r}$

B. $k\frac{e^2}{r^2}\vec{r}$

C. $-k\frac{e^2}{r^3}\vec{r}$

D. $-k\frac{e^2}{r^2}\vec{r}$

Answer: C

View Text Solution

4. Two spherical conductors B and C having equal radii and carrying equal charges in them repel each other with a force F when kept apart at some distance . A third spherical conductor having same radius as that of B but uncharged is brought in contact with B. then brought in contact with C and finaly removed away from both. The new force of repulsion between B and C is

A. $\frac{F}{4}$

B. $\frac{3F}{4}$

C. $\frac{F}{8}$

D. $\frac{3F}{8}$

Answer: D

View Text Solution

5. A charge q is placed at the centre of the line joining two equal charges Q. The system of the three charges will be in equilibrium , if q is equal to

A. $-\frac{Q}{2}$

B. $-\frac{Q}{4}$

C. $+\frac{Q}{4}$

D. $+\frac{Q}{2}$

Answer: B

View Text Solution

6. ABC is an equilateral triangle. Charged of +q are placed at each corner. The electric field at O will be

` (##U_LIK_SP_PHY_XII_C01_E04_006_Q01.png" width="80%">

A. $\frac{1}{4\pi \in_0} \cdot \frac{q}{r^2}$

B. $\frac{1}{4\pi \in_0} \cdot \frac{q}{\text{®}}$

C. 0

D. $\frac{1}{4\pi \in_0} \cdot \frac{3q}{r^2}$

Answer: C

View Text Solution

7. A hollow insulated conducting sphere is given a charges $+10\mu C$. What will be the electric field at the centre of the sphere it its radius is 2m ?

A. Zero

B. $5\mu Cm^{-2}$

C. $20\mu Cm^{-2}$

D. $8\mu Cm^{-2}$

Answer: A

View Text Solution

View Text Solution

8. The electric charges are distributed in a small volume. The flux of the electric field through a surface of radius 10 cm surrounding the total charge is 20 Vm. The flux over a concentric sphere of radius 20 cm will be

A. $20Vm$

B. $25Vm$

C. $40Vm$

D. $200Vm$

Answer: A

View Text Solution

9. A hollow cylinder has a charges q coulomb within it. If ϕ is the electric flux in units of V-m associated with the curved surface B, the flux linked with the plane surface A in units of V-m will be

A. $\frac{q}{2 \in_0}$

B. $\frac{\phi}{3}$

C. $\frac{q}{\in_0} - \phi$

D. $\frac{1}{2}\left[\frac{q}{\in_0} - \phi\right]$

Answer: D

View Text Solution

10. Two infinitely long. Parallel, thin sheets, having surface charge densities $+\sigma$ and $-\sigma$ respectively are separated. By a small distance.

The medium between the sheets is vacuum. The electric field in the region between the sheets is

A. Zero

B. $\frac{\sigma}{2 \in_0}$

C. $\frac{\sigma}{\in_0}$

D. $\frac{2\sigma}{\in_0}$

Answer: C

View Text Solution

11. An electric dipole is placed at an angle of 30° to a non-uniform electric field. The dipole will experience.

A. A translational force only in the direction of the field.

B. a translational force only in a direction normal to the direction of the field.

C. a torque as well as a translational force.

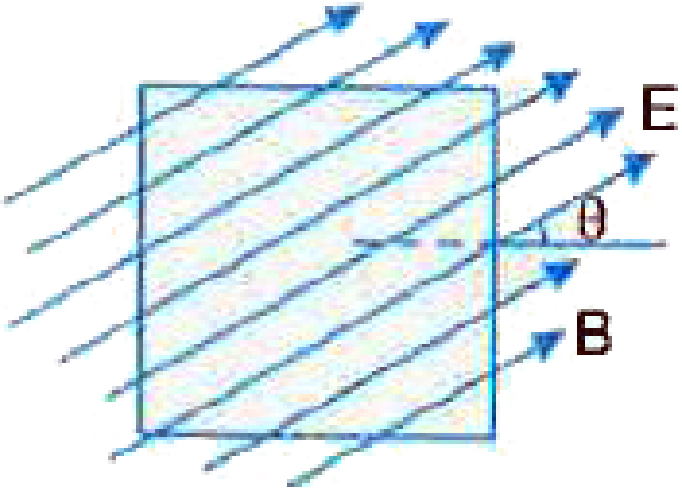
D. a torque only.

Answer: C

View Text Solution

12. A square surface of side L in the plane of the paper is placed in a uniform electric field E acting along the same. Plane at an angle θ with the horizontal side of the square as shown in. The electric flux linked to the surface

is



A. $EL^2 \sin\theta$

B. zero

C. EL^2

D. $EL^2 \cos\theta$

Answer: B

View Text Solution

13. The electric dipole moment of an electron and proton $4.3nm$apart is

A. $6.88 \times 10^{-28} Cm$

B. $2.56 \times 10^{-29} C^2 m^{-1}$

C. $3.72 \times 10^{-14} Cm^{-1}$

D. $1.1 \times 10^{-46} C^2 m$

Answer: A

View Text Solution

14. A charge Q is placed at each of the opposite corners of square. A charge q is placed at each of the other two corners. If the net electrical force on Q is zero , then Q/q equals.

A. -1

B. 1

C. $-\frac{1}{\sqrt{2}}$

D. $-2\sqrt{2}$

Answer: D

View Text Solution

15. The value of electric permittivity of free space is

A. $9 \times 10^{9} NC^{2} m^{-2}$

B. $8x85 \times 10^{-12} Nm^{2} C^{-2}$

C. $8.85 \times 10^{-12} C^{2} N^{-1} m^{-2}$

D. $9 \times 10^{9} C^{2} N^{-1} m^{-2}$

Answer: C

View Text Solution

16. Two charges q_1 and q_2 separated by a distance 'r' in air exert a force F on one another. If a copper plate of thickness $\frac{®}{2}$ is placed between the charges , the effective force will be:

A. 2F

B. 4F

C. $\frac{F}{2}$

D. 0

Answer: D

View Text Solution

17. An electron of charges e experiences a force equal to its weight 'mg' when placed in an electric field E. Value of E is

A. $m \geq$

B. $\frac{mg}{e}$

C. $\frac{e}{mg}$

D. $\frac{e^2}{m^2 g}$

Answer: B

View Text Solution

18. Which of the following is not a unit of electric field?

A. NC^{-1}

B. Vm^{-1}

C. $JC^{-1}m^{-1}$

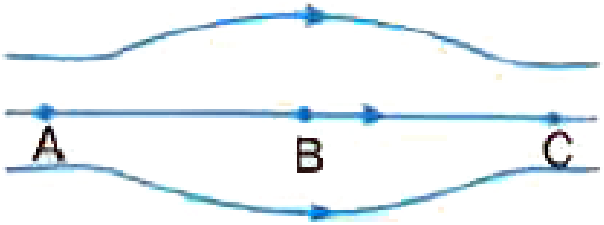
D. JC^{-1}

Answer: D

View Text Solution

19. Figure 1.24 shows electric field lines corresponding to an electric field E. Figure

suggests that.



A. $E_A < E_B ot E_C$

B. $E_A = E_B = E_C$

C. $E_A = E_C < E_B$

D. $E_A = E_C > E_B$

Answer: C

View Text Solution

20. A hexagon of side 'a' has a charge 'q' at each of its vertices. The electric field at the centre of hexagon is

A. 0

B. $\frac{1}{4\pi \in_0} \cdot \frac{q}{a^2}$

C. $\frac{1}{4\pi \in_0} \cdot \frac{6q}{a^2}$

D. $\frac{1}{4\pi \in_0} \cdot \frac{6q^2}{a^2}$

Answer: A

View Text Solution

21. Two charges of $10\mu C$ and $20\mu C$ respectively are placed at points A and B respectively separated by a distance of 60 cm . The distance of the point P from A, where the net electric field is zero, is

` (##U_LIK_SP_PHY_XII_C01_E04_021_Q01.png" width="80%">

A. 20 cm

B. 30 cm

C. 40 cm

D. 15 cm

Answer: A

View Text Solution

22. An electric and a proton are separated by a distance of $1 \overset{\rightarrow}{\circ} A$ The movement of the dipole formed in C-m will be

A. 1.6×10^{19}

B. 1.6×10^{-19}

C. 1.6×10^{-29}

D. 3.2×10^{-29}

Answer: C

View Text Solution

23. If E_a be the electric field of a short dipole at a point on its axial line and E_e that on the equatorial line at the same distance ,then

A. $E_a = 2E_e$

B. $E_e = 2E_a$

C. $E_a = E_e$

D. none of these

Answer: A

View Text Solution

24. A point P lies on the perpendicular bisector of a short electric dipole, of dipole moment p' at a distance r from the centre of dipole. The electric field at point P is proportional to

A. $\frac{P}{r^2}$

B. $\frac{1}{pr^2}$

C. $\frac{p}{r^3}$

D. $\frac{p^2}{r^3}$

Answer: C

View Text Solution

25. Ten dipoles ,each of dipole moment 'p' , are placed inside a hollow sphere . The total electric flux coming out of the sphere will be

A. 0

B. $\frac{10p}{\in_0}$

C. $\frac{p}{\in_0}$

D. $\frac{20p}{\in_0}$

Answer: A

View Text Solution

26. Electric field 'E' at a point situated at a normal distacne 'r' from an infinitely long

uniformaly charged straight were is proportional to

A. $E \infty r$

B. $E \propto \frac{1}{\circledR}$

C. $E \propto \frac{1}{r^2}$

D. $E \propto \frac{1}{r^3}$

Answer: B

View Text Solution

27. SI unit of electric flux is

A. Wb

B. NC^{-1}

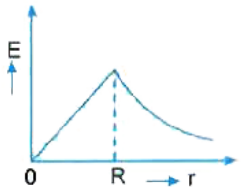
C. V m

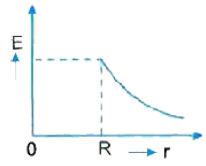
D. JC^{-1}

Answer: C

View Text Solution

28. Which of the following graph represents the variation of electric field E due to a thin charged spherical shell of radius R as a function of the distance r from the centre of the shell?

A. 

B. 

C.

Answer: B

View Text Solution

29. If the electric flux entering and leaving an enclosed surface are ϕ_1 and ϕ_2 respectively, then the electric charge present within the surface is

A. $\frac{1}{\in_0}(\phi_1 + \phi_2)$

B. $\frac{1}{\in_0}(\phi_2 - \phi_1)$

C. $\in_0 (\phi_1 + \phi_2)$

D. $\in_0 (\phi_2 - \phi_1)$

Answer: D

View Text Solution

30. Gauss' law is true only if electric force due to a given charges varies with distance 'r' as

A. r^{-2}

B. r^{-3}

C. r^2

D. r^{-1}

Answer: A

View Text Solution

Fill In The Blanks

1. As per quantisation of charge , the basic unit of charge which can exist independently _____

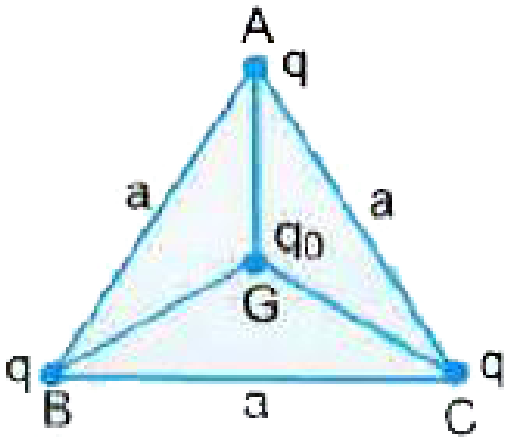
View Text Solution

2. Electric permittivity of free space is _____

View Text Solution

3. Three identical charges of q each are placed at the three verticess of an equilateral triangle ABC of side a, Electrostatic force experienced by a point charge q_0 situated at the centroid G

of triangle is _____



View Text Solution

4. A charge q is placed at the centre of a hollow sphere of radius r, Total electric flux

passing through the spherical surface is

_____

View Text Solution

5. Two electric dipoles ,each of dipole moment $\vec{p}$, are enclosed within a closed surface. Total electric flux linked with the surface is

_____

View Text Solution

6. Two charges +Q each ,are placed at the point A and B separated by a distancer r. A charge -q placed at the mid point of line AB is in a state of _____ equilibrium.

` (##U_LIK_SP_PHY_XII_C01_E05_006_Q01.png" width="80%">

View Text Solution

7. Two protons are situated at a distancer r apart in free space. The ratio of the magnitude

of electric force to the gravitational force between them is of the order of _____,

View Text Solution

8. The magnitude of electric field $\vec{E}$ due to a point charge in space around it has a _____symmetry.

View Text Solution

9. The electric field due to an electric dipole. At large distance ® from it, falls of as _____

View Text Solution

10. Net force acting on an electric dipole placed in a uniform electric field is _____but net torque acting on the dipole is _____

View Text Solution

11. Electric field at a point near a uniformaly charged infinite plane sheet having surface density of charge σ is given as E=

_____

View Text Solution

12. A silk piece, when rubbed with glass rod, acquires a charge $q = -4.8 \times 10^{-14}$ C. Charge developed on glass rod will be.

_____

View Text Solution

13. Two point charges , each of $1\mu C$,are separated from each other by a distance of 10 cm in air . Electrostatic force acting between them is _____

View Text Solution

14. Net charge on an isolated system always remains constant.This is called as the law of. _____

View Text Solution

15. A proton and an alpha particle enter into a region of uniform electric field $\vec{E}$. The ratio of the electric force experienced by the proton to that by the alpha particle is _____

View Text Solution

True Or False

1. Charged of $+6nC$ and $-15nC$,when separated by a certain distance , attract each other by a force F. If an additional charges of + $9\mu C$ is given to each of the two charges and separation between them is kept unchanged, the force between them will still be an attractive force of magnitude F.

View Text Solution

2. A charged particle free to move in an electric field always moves along the electric field line.

View Text Solution

3. A stationary charges produce an electrostatic field as wlell as a gravitational field but does not produce a magnitude field.

View Text Solution

4. Electric field lines cannot form closed loops and thus are discontinuous in nature.

View Text Solution

5. A ring of radius R carries a charge +Q, which is uniformally distributed on the surface of the ring. The electrostatic force acting on a charge $+q$ situated at the centre of ring is zero.

View Text Solution

Assertion Reason Type Questions

1. Assertion (A) : Electric charges is quantised.

Reason ® : charges less than n C is not possible in nature.

View Text Solution

2. Assertion (A) : If a proton and an electron are placed in the same uniform electric field ,they experience force of equal magnitude.

Reason ® : Electric force on a test charges is independent of its mass.

View Text Solution

3. Assertion (A) : The electric field at any point inside a uniformally charged thin spherical shell is zero.

Reason ® : Entire charge given to a thin spherical shll lies only on its outer surface and there is no charge present inside the shell.

View Text Solution

4. Assertion (A) : Electric field lines can never cross other .

Reason ® : Electric fields due to a number of point charges at a given point superimpose and give one resultant electric field.

View Text Solution

5. Assertion (A) : Force between two point charges is directly proportional to the magnitude of the two charges and inversely

proportional to the distance between them.

Reason ® : Like charges repel but unlike charges attract each other.

View Text Solution

Very Short Answer Questions

1. What does $q_1 + q_2 = 0$, signify in electrostatics?

View Text Solution

2. A glass rod rubbed with silk acquires a charge $+1.6 \times 10^{-12}$ C . What is the charges on the silk?

View Text Solution

3. State the unit of dielectric constant of a medium.

View Text Solution

4. Two point charges having equal charges separated by 1 m distance experience a force of 8 N. what will be the force experienced by them . If they are held in water at the same distance?

(Given : $K_{\text{water}} = 80$)

View Text Solution

5. What is quantisation of electric charges?

View Text Solution

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

View Text Solution

7. Which physical quantity has unit newton (coulomb) $\hat{}$ (-1) ? Is it vector or scalar quantity?

View Text Solution

8. Write the SI units of (i) electric field, and (ii) electric dipole moment.

View Text Solution

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

View Text Solution

10. What is direction of dipole moment? Is it a vector?

View Text Solution

11. Define relative permittivity of a medium.

View Text Solution

12. Consider the situation shown in the given below. What are the sign of q_1 and q_2 ?

View Text Solution

13. Draw electrostatic field lines due to a small conducting sphere having negative charges on it.

View Text Solution

14. Does the charges given to a metallic sphere depend on whether it is hollow or solid? Give reason for your answer.

View Text Solution

15. Sketch the electric field lines for a uniformaly charged hollow cylinder shown in figure.

View Text Solution

16. Sketch the pattern of electric field lines due to an electric dipole.

View Text Solution

17. Why do the electrostatic field lines not form closed loops?

View Text Solution

18. A point charges + Q is placed in the vicinity of a conducting surface Draw. The electric field lines between the surface and the charges.

View Text Solution

19. A proton is placed in a uniform electric field directed along the positive x-axis . In which direction will it tend to move?

View Text Solution

20. Which orientation of an electric dipole in a uniform electric field corresponds to stable equilibrium ?

View Text Solution

21. Is the electric field due to a charge configuration with total charge zero necessarily zero?

View Text Solution

22. What is the net force on a dipole placed in a uniform electric field?

View Text Solution

23. A dipole of dipole moment $\vec{p}$, is present in a uniform electric field $\vec{E}$. Write the value of the a between $\vec{p}$ and $\vec{E}$ for which the torque experienced by the dipole is minimum.

View Text Solution

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

View Text Solution

25. In which case are the electric field lines parallel to one another?

View Text Solution

26. When is the torque acting on an electric dipole placed in a uniform electric field maximum?

View Text Solution

27. Define electric flux. Write its SI unit. It a scalar or a vector quantity?

View Text Solution

28. State Gauss' law in electrostatic.

View Text Solution

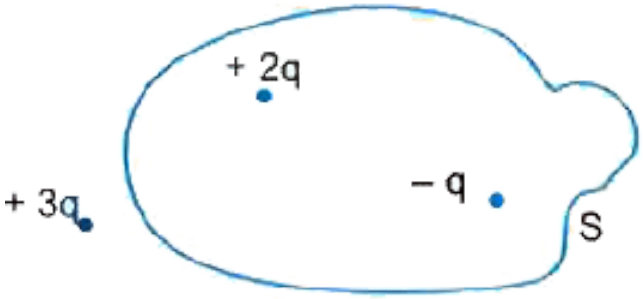
29. A chrage 'q' is placed at the centre of a cube of side 'l' . What is the electric flux passing through each face of the cube?

View Text Solution

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

View Text Solution

31. Show three points charges +2q. -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' ?



View Text Solution

32. An arbitary surface enclose an electric dipole of dipole moment 20×10^{-6} C-m, What

is the electric flux through this surface?

View Text Solution

33. How does the electric flux due to a point charge enclosed by a spherical Gaussian surface altered when its radius is increased?

View Text Solution

34. Two metallic sphere A and B kept on insulating stand are in contact with each

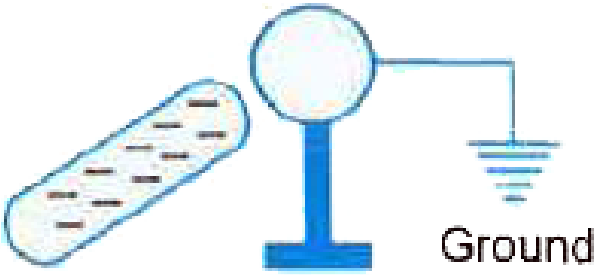
other. A positively charged rod P is brought near the sphere A as shown in the figure. The two spheres are separated from each other , and the rod p is removed. What will be the nature of charges on sphere A and B ?

` (##U_LIK_SP_PHY_XII_C01_E08_035_Q01.png" width="80%">

View Text Solution

35. A metal sphere is kept on an insulating stand. A negatively charged rod is brought

near it , then the sphere is earthed as shown. On removing the earthing, and taking the negatively charges rod away , what will be the nature of charges on the sphere? Give reason for your answer.



View Text Solution

36. Draw a plot showing variation of electric field with distance from the centre of a solid conducting sphere of radius R having a charge Q on its surface.

View Text Solution

37. A metalic spherical shell has an inner radius R_1 and outer radius R_2 . A charge Q is placed at the centre of the spherical cavity.

What will be surface charge density on (i) the inner surface and (ii) the outer surface?

View Text Solution

38. Two identical conducting balls A and B have charges -Q and +3Q respectively . They are brought in contact with each other and then separated by a distance d apart. Find the nature of the coulumb force between them.

View Text Solution

39. A sphere S_1 of radius r enclose a total charge Q. If there is another concentric sphere S_2 of radius $r_2(>r_1)$ and there be no additioanl charges between S_1 and S_2 find the ratio of electric flux through S_1 and S_2

View Text Solution

Short Answer Questions

1. Two charged spherical conductors, each of radius R, are distant $d(d<2R)$. They carry

charges +qand -q will the force of attraction between them be exactly $\frac{q^2}{4\pi \in_0 d^2}$? Give reasons of your answer.

View Text Solution

2. Two identical metallic sphere's having unequal opposite charges are placed at a distance 0.9 m apart in air. After bringing them in contact with each other they are again placed at the same distance apart. Now the

force of repulsion between them is 0.025 N. calculate the final charges on each of them.

View Text Solution

3. Two similarly and equally charged idential 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 mid - point between A and B. Calculate the net electric force on C.

View Text Solution

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

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

Draw the electric field lines of a point charge Q when (i) $Q > 0,$ and $(ii) Q < 0.$

View Text Solution

5. Shows the electric field lines around three point charges A,B and C.

(a) Which charges are positive ?

(b) Which charge has the largest magnitude? Why?

` (##U_LIK_SP_PHY_XII_C01_E09_005_Q01.png" width="80%">

View Text Solution

6. Plot a graph showing the variation of coulomb force (F) versus $\left(\frac{1}{r^2}\right)$ where r is the distance between the two charges of each pair of charges

$: (1\mu C, 2\mu C)$ and $(2\mu C, -3\mu C)$. Interpret the graphs obtained.

View Text Solution

7. Two charges +q and -q are kept at $(-x_1, 0)$ and $(x_1, 0)$ respectively in the x-y plane. Find the magnitude and direction of the net electric field at the origin (0,0)

View Text Solution

8. Two charges Q and -3Q are placed fixed on x-axis separated by a distance 'd' Where should a third charge 2Q be placed such that it will not experience any force?

View Text Solution

9. Two point charges $+4\mu C$ and $+1\mu C$ are separated by a distance of 2 m in air. Find the point on the line joining the two charges at

which the net electric field of the system is zero.

View Text Solution

10. A particle of mass 10^{-3} kg and charge $5\mu C$ centers into a uniform electric field of $2 \times 10^5 NC^{-1}$ moving with a velocity of $20ms^{-1}$ in a direction opposite to that of the field. Calculate the distance it would travel before coming to rest.

View Text Solution

11. Define electric field. Write its SI units. Write the magnitude and direction of electric field due to an electric dipole of length '2a' at the mid-point of the line joining the two charges.

View Text Solution

12. Deduce the expression for the electric filed $\overrightarrow{E}$ due to a system of two charges q_1 and q_2 with position vectors $\overrightarrow{r_1}$ and $\overrightarrow{r_2}$ at a point P having position vector $\overrightarrow{\mathrm{R}}$.

View Text Solution

13. A charge q is placed at the centre of the line joining two equal charges Q. Show that the system of three charges will be in equilibrium if $q = -\frac{Q}{4}$.

View Text Solution

14. Two identical point charges ,q each , are kept 2 m apart in air. A third pint charges Q of

unknown magnitude and sign is placed on the line joining the charges such that the system remains in equilibrium. Find the position and nature of Q.

View Text Solution

15. Derive an expression for the electric field at any point along the axial line of an electrical dipole.

View Text Solution

16. An electric dipole is free to move in a uniform electric field. Explain its motion when it is placed.

parallel to the field

perpendicular to the field.

View Text Solution

17. Three point charges of $+2\mu C, -3\mu C$ and $-3\mu C$ are kept at the vertices A,B and C , respectively of an

equilateral triangle of side 20 cm as shown in What should be the sign and magnitude of the charge to be placed at the mid-point (M) of side BC so that the charge at A remains in equilibrium?

` (##U_LIK_SP_PHY_XII_C01_E09_017_Q01.png" width="80%">

View Text Solution

18. Five point charges each of charges +q are placed of five vertices of a regular hexagon of

side 'l'. Find the magnitude of the resultant force on a charge -q placed at the centre of the hexagon.

` (##U_LIK_SP_PHY_XII_C01_E09_018_Q01.png" width="80%">

View Text Solution

19. Three small charges of equal magnitude and same sign lie on the circumference of a circle forming an equilateral triangle. What is the value of electric field at the centre of circle

?

` (##U_LIK_SP_PHY_XII_C01_E09_019_Q01.png" width="80%">

View Text Solution

20. 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 downwards. Finds the period of oscillation of

the pendulum due to the electrostatic force acting on the sphere, neglecting the effect of the gravitational force.

View Text Solution

21. Define electric flux. Write its SI units. A spherical rubber ballon carries a charge that is uniformly distrubuted over its surface. As the balloon is blown up and increases its size, how does the total electric flux coming out of the surface change? Give reason.

View Text Solution

22. A thin straight infinitely long conducting wire having charge density λ is enclosed by a cylinder surface of radius r and length l, its axis coinciding with the length of the wire. Find the expression for the electric flux through the surface of the cylinder.

View Text Solution

23. Given a uniform electric field $\overrightarrow{E} = 5 \times 10^3 \hat{i} NC^{-1}$. Find the flux of this field through square of 10 cm on a side whose plane is parallel to the y-Z plane.

What would be the flux through the same square if the plane makes a 30° angle with the x-axis?

View Text Solution

24. S_1 and S_2 are two hollow concentric thin spherical shells enclosing charges Q and 2Q respectively as shown in

What is the ratio of the electric flus through S_1 and S_2 ?

(ii) How will the eletric flux through the shell S_1 change, If a medium of dielectric constant 5 is introduced in the space inside S_1 in place of air ?

` (##U_LIK_SP_PHY_XII_C01_E09_024_Q01.png" width="80%">

View Text Solution

25. A thin metallic spherical shell of radius R carries a charge Q on its surface. A point charge $\frac{Q}{2}$ is placed at its centre C and another charge +2Q is placed outside the shell at point A at a distance x from the centre $(x > R)$

Find the force on the charge at the centre of the shell and at the point A

Find the electric flux through the shell.

View Text Solution

26. A spherical conducting shell of inner radius r_1 and outer radius r_2 has a charges 'Q' A charges 'q' is placed at the centre of the shell. What is the surface charges density on the (i) inner surface (ii) outer surface of the shell?

(b) A spherical conducting shell of inner radius r_1 and outer radius r_2 has a charges 'Q' A charges 'q' is placed at the centre of the shell. Write the expression for the electric field at a point $x > r_2$ from the centre of the shell.

View Text Solution

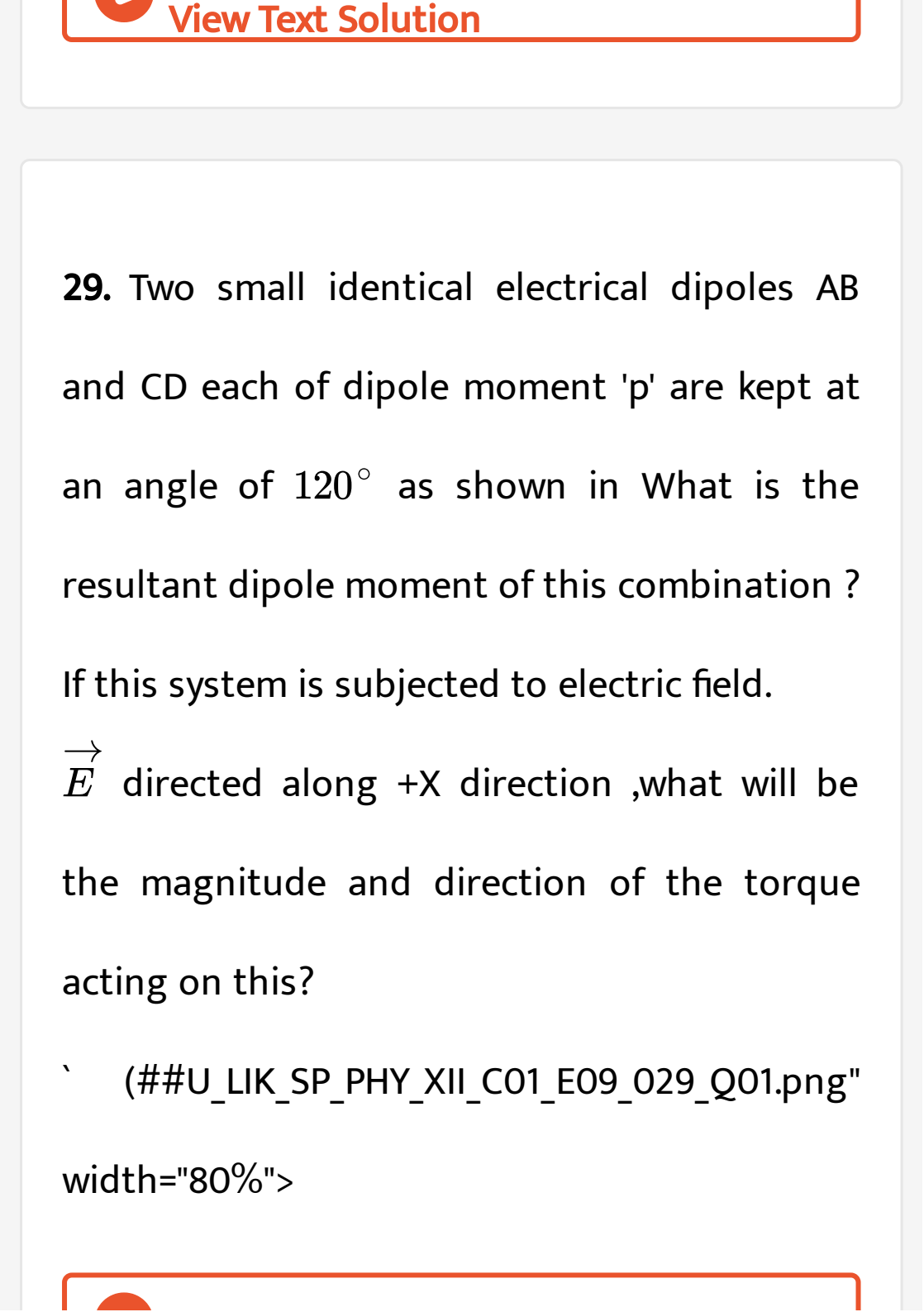
27. A small metallic sphere carrying charge +Q is located at the centre of a spherical cavity in a large uncharged metallic spherical shell. Write the charge on the inner and outer surface of the shell. Write the expression for the electric field at the point?

View Text Solution

28. Show that net force acting on an electric dipole held in a uniform electric field is zero.

View Text Solution

29. Two small identical electrical dipoles AB and CD each of dipole moment 'p' are kept at an angle of 120° as shown in What is the resultant dipole moment of this combination ? If this system is subjected to electric field. $\vec{E}$ directed along +X direction ,what will be the magnitude and direction of the torque acting on this?


` (##U_LIK_SP_PHY_XII_C01_E09_029_Q01.png" width="80%">

View Text Solution

Long Answer Questions I

1. A charge is distributed uniformaly over is ring of radius 'a' .Obtain an expression for the electric intensity E at a point on the axis of the ring. Hence show that for points at large distances from the ring, it behaves like a point charge.

View Text Solution

2. Define electric dipole moment. Is it a scalar or a vector ? Derive the expression for the electric field of a dipole at a point on the equatorial line of the dipole.

View Text Solution

3. Derive the expression for electric field at a point on the equatorial line of an electric dipole.

(b) Depict the orientation of the dipole in (i)

Stable (ii) unstable equilibrium in a uniform magnetic field

View Text Solution

4. Derive an expression for torque $\vec{\tau}$ experienced by an electric dipole of dipole moment $\vec{p}$ kept in uniform electric $\vec{E}$. What will happen if the field were not uniform?

View Text Solution

5. An electric dipole of dipole moment $\vec{P}$ is placed in a uniform electric field $\vec{E}$. Obtain the expression for the torque $\vec{\tau}$ experienced by the dipole. Identify two pairs of perpendicular vectors in the expression.

View Text Solution

6. Show mathematically that the electric field due to a short dipole at a distance 'd' along its

axis is twice the value of field at the same distance along the equatorial line.

View Text Solution

7. Two idential pith balls , each of mass m and charge +q. are suspended from a point with threads of length l each. If in equiilbrium state θ be the angle which each thread makes with vertical in equilibrium , find value of charge on each ball.

View Text Solution

8. State Gauss' law in electrostatic. Using it derive an expression for the electric field due to an infinitely long straight wire of linear charge density λ C/m.

View Text Solution

9. State Gauss' law in electrostatic.. A thin straight infinitely long conducting wire of linear charge density λ is enclosed by a cylinder surface of radius 'r' and length "l' ,its

axis coinciding with the length of the wire . Qbtain the expressionn for the electric field, indicating its direction at a point on the surface of the cylinder.

View Text Solution

10. State Gauss's theoram in electric field at a point due to a uniformaly charged infinite plane thin sheet.

View Text Solution

11. Using Gauss' law porve that the electric field at a point due to a uniformaly charged infinite plane sheet is independent of the distance form it. How is the field directed if the sheet is

(i) positively charged, (ii) negatively charged.

View Text Solution

12. Two large charged plane sheets of charge densities σ and $-2\sigma C/m^2$ are arranged vertically a separation of d between them.

Deduce expressions for the electric field at points

to the left of the first sheet ,

(ii) To right of the second sheet,

between the two sheets.

View Text Solution

13. Using Gauss's theorem derive an expression for the electric field at any point outside a charged spherical shell of radius R and of charge density $\sigma C / m^2$

View Text Solution

14. State Gauss theorem in electrostatics. Prove that no electric field exists inside a hollow charged sphere.

View Text Solution

15. Using Gauss's theorem show mathematically that for any point outside the shell , the field due to a uniformaly charged thin spherical shell is the same as if the entire

charge of the shell is concentrated at the centre? Why do you expect the electric field inside the shell to be zero according to this theorem?

View Text Solution

16. Using Gauss' law deduce the expression for the electric field due to uniformaly charged spherical conducting shell of radius R at point (i) outside ,and (ii) inside the shell.

Plot a graph showing variation of electric field

as a functions or r for $r <$ R and .(r being the distance from the centre of the shell).

View Text Solution

17. Show that the electric field at the surface of a charged conductor is given by $\vec{E} = \frac{\sigma}{60}\hat{n}$, where σ is the surface charge density and $\hat{n}$ is a unit vector normal to the surface in the outward direction.

View Text Solution

18. An electron falls through a distance 1.5 cm in a uniform electric field of magnitude $2.0 \times 10^4 NC^{-1}$ .Calculate the time it takes to fall through this distance starting from rest. If the direction of the field is reversed keeping its magnitude uncharged , calculate the time taken by a proton to fall through this distance starting from rest.

View Text Solution

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

(i) Net flux through the cylinder.

(ii) charge enclosed by the cylinder.

` (##U_LIK_SP_PHY_XII_C01_E10_019_Q01.png" width="80%">

View Text Solution

20. Two point charges +q and -2qare placed at the vertices B and C of an equilateral triangle ABC of side 'a' as shown in Obtain the expression for

The magnitude ,

(b)

The direction of the resultant electric field at the vertex A due to these two charges.

(c)

View Text Solution

21. 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 at point B ,C and A

` (##U_LIK_SP_PHY_XII_C01_E10_021_Q01.png" width="80%">

View Text Solution

22. Charges of +2 +2, and $-2\mu C$ respectively are placed at the vertices of an equilateral

triangle of side $0.3m$ each in Find the net forces experienced by each charges.

View Text Solution

23. Two large metal plates of area $6.0m^2$ face each other . The plates are 3 cm apart and carry equal and opposite charges on their inner surfaces. If electric field at a point between the plates is $5 \times 10^4 NC^{-1}$, then calculate the magnitude of charge on each plates.

View Text Solution

24. A tiny particle of mass $4\mu g$ is kept over a large horizontal sheet of charge density $4 \times 10^{-6} Cm^{-1}$ What charge should be given to the particle so that if released it does not fall down?

View Text Solution

25. A small metal sphere carrying charge +Q is located at the centre of a sphereical cavity

inside a large uncharged metallic spherical shell. Use Gauss' law to find the expression for the electric field

At a point P_1 situated inside the cavity at a distance x_1 from centre.

(ii) At a point P_2 situated in the metalic spherical shell at a distance x_2 from the centre.

View Text Solution

26. 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. Find out the surface charge density on the inner and outer surface of the shell.

Is the electric field inside a cavity (with no charge) zero. Independent of the fact wheather the shell is spherical or not ? Explain.

View Text Solution

27. Two thin cocentric and coplanar spherical shells , of radii 'a' and 'b' $(b > a)$, carry charges q and Q respectively. Find the magnitude of the electric at a point distant x from their common centre for

$0 < x < a,$

(b) $a \leq x \leq b,$

(c) $b \leq x < \infty$

View Text Solution

28. A spherical conductor of radius 12 cm has a charge of 1.6×10^7 C distributed uniformly on its surface. What is the electric field

inside the sphere

(ii) just outside the sphere

© At a point 18 cm from the centre of the sphere?

View Text Solution

29. An early model for an atom considered it to have a positivelly charged point nucleus of charge +Ze surrounded by a uniform density of negative charge up to a radius R. The atom as whole is neutral. For this model , what is the electric field at a distance r from the nucleus when

$r < R$

$r = R$?Use Gauss's theorem

View Text Solution

30. Two identical metallic sphere's A and B having charges $+4Q$ and $-10Q$ are kept a certain distance apart. A third identical uncharged sphere C is first placed in contact with sphere A and then with sphere B. Spheres A and B are then brought in contact and then separated. Find the charges on the spheres A and B.

View Text Solution

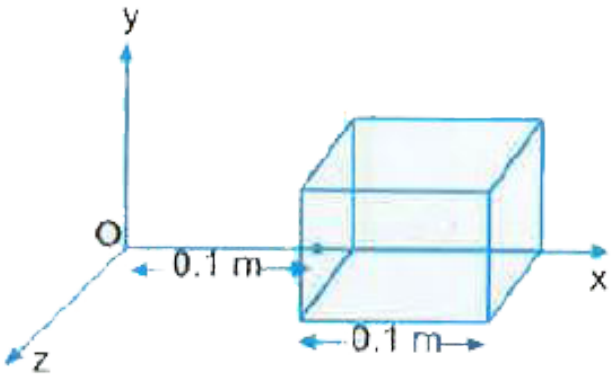
Long Answer Questions Ii

1. Define electric flux. Write its SI units.

(b) The electric field components due to a charge inside the cube of side $0.1m$ area as shown in $E_x = \alpha x$, where $\alpha = 500N/Cm$, $E_Y = 0$ and $E_Z = 0$.

Calculate (i) the flux through the cube , and

(ii) the charges inside the cube.



View Text Solution

2. An electric dipole of dipole moment $\vec{p}$ consists of point charges +q and -q separated by a distance '2a' apart. Deduce the expression for the electric field $\vec{E}$ due to the dipole on its axial line in term of the dipole moment $\vec{p}$. Hence show that in the limit $r > > a, \vec{E} = \frac{2\vec{p}}{4\pi \in_0 r^3}$

(b) Given the electric field in the region $\vec{E} = 2x\hat{i}$ Find the net electric flux through the cube and the charge enclosed by it.

View Text Solution

3. Deduce an expression for the electric field E due to a dipole of length '2a' at a point distant 'r' from the centre of the dipole on the axial line.

(b) Draw a graph of E versus r for $r > > a$.

©

View Text Solution

4. Define electric flux, Is it a scalar or a vector quantity? A point charg q is at a distance of $\frac{d}{2}$ directly above the centre of a square of side 'd' Use Gauss' law to obtain the expression for the electric flux through the square.

(b) If the point charge is now moved to a distance 'd' from the centre of the square and the side of the square is doubled , explain how the electric flux will be affected.

View Text Solution

5. Using Gauss's law derive an expression for the electric field at any point outside a uniformaly charged thin spherical shell of radius R and charge density $\sigma C/m^2$. Draw the field lines when the charges density of the sphere is (i) positive (ii) negative.

(b) A uniformly charged conducting sphere of 2.5 m in diameter has a surface charge density of $100\mu C/m^2$ Calculate the

(i) charge on the sphere (ii) total electric flux passing through the sphere.

View Text Solution

6. Use Gauss'law to derive the expression for the electric field $\left(\vec{E}\right)$ due to a straight uniformaly charged infinite line of charge density λCm^{-1}

(b) Draw a graph to show the variation of E with perpendicular distance r from the line of charge.

(c) Find the work done is bringing a charge q from perpendicular distance $r_1 \to r_2 (r_2 < r_1)$

View Text Solution

7. State Gauss 'law in electrostatics.

Consider an overall neutral sphere of radius R. This sphere has a point charge +Q at its centre and this positive charge is surrounded by a uniform density ρ of negative charges up to a radius R.

Use Gauss, law to obtain expression for the electric field , of this sphere , at a point distant r, from its centre ,where

$r < R,$

$r > R$

Show that these two expressions give identical results, for the electric field, at r= R.

View Text Solution

8. State Gauss' law.Using this law obtain the expression for the electric field due to an infinitely long straight conductor of linear charge density λ

(ii) A wire AB of length L has linear charge $\lambda = kx,$ where x is measured from the end A of the wire. The wire is enclosed by a Gaussian

hollow surface.Find the expression for the electric flux through the surface.

View Text Solution

9. Define electric flux. Write its SI unit.

"Gauss 'law in electrostatic is true for any closed surface, no matter what its shape or size is" Justify this statement with the help of a suitable example.

View Text Solution

Self Assessment Test Section A

1. Two point charges +8q and -2q located at x =0 and x=L respectively . The location of a point on the x-axis at which the net electric field due to these two point charges is zero is.

A. $8L$

B. $4L$

C. $2L$

D. $\frac{L}{4}$

Answer: C

View Text Solution

2. Two infinitely long parallel sheets having surface charge densities $+\sigma$ and $-\sigma$ respectively are separated by a small distance. The electric field in the region between the plates is

A. 0

B. $\frac{\sigma}{2 \in_0}$

C. $\frac{\sigma}{\in_0}$

D. $\frac{2\sigma}{\in_0}$

Answer: C

View Text Solution

3. The charges given to a hollow sphere of radius 10 cm is 10 n C . Electric field at a point situated at a distance of 4 cm from its centre is

A. $2250NC^{-1}$

B. $56250NC^{-1}$

C. $9000NC^{-1}$

D. zero

Answer: D

View Text Solution

4. Total electric flux coming out of a unit positive charge put in air is

A. $\in_0$

B. $\in_0^{-1}$

C. $4\pi \in_0$

D. $\frac{1}{4\pi \in_0}$

Answer: B

View Text Solution

5. A charge q is located at centre of a cube of edge length 'a' The electric flux through any force

A. $\frac{q}{\in_0}$

B. $\frac{q}{6 \in_0}$

C. $\frac{q}{6a^2 \in_0}$

D. $\frac{4\pi \in_0 q}{6a^2}$

Answer: B

View Text Solution

Self Assessment Test Section A Fill In The Blanks

1. A charge Q is divided into two parts of q and (Q-q) . If the Coulombian repulsion between them, when they are separated by a finite distance, is maximum the ratio $\frac{q}{Q}$ should be _____

View Text Solution

2. Charge on an alpha particle is _____

View Text Solution

3. The number of electrons in $-1C$ charge is

_____

View Text Solution

Self Assessment Test Section B Very Short Answer Questions

1. Three small , identical point charges lie on the circumference of a circle forming an equilateral triangle.Calculate the value of electric field at the centre of circle.

View Text Solution

2. A spherical conducting shell of inner radius r_1 and outer radius r_2 ahs a charges 'Q' A charges 'q' is placed at the centre of the shell.

(a) What is the surface charges density on the

(i) inner surface (ii) outer surface of the shell?

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

View Text Solution

3. Two point charges +q and -2q are placed at the vertices B and C of an equilateral triangle ABC of side 'a' as shown Obtain the expession for (i) the magnitude ,and (ii) the direction of the resultant electric field at the vertex A due to these two charges .

View Text Solution

4. Deive an expression for the electric field at any point on the equatorial line of an electric dipole.

View Text Solution