MULTIPLE CHOICE QUESTIONS (One mark each)

1. A charge Q_1 exerts 20 N force on another charge Q_2. If the distance between the charges is doubled what is the magnitude of the force exerted on Q_1 by Q_2?

(a) 10 N (b) 5 N

(c) 20 N (d) 25 N

2. A $-6\ \mu C$ charge is located 0.20 m to the left of a $+4\ \mu C$ charge. What is the magnitude and direction of the electrostatic force on the positive charge ?

(a) 5.4 N to the right (b) 5.4 N to the left

(c) 4.8 N to the right (d) 4.8 N to the left

3. Two positive point charges Q and 2Q are separated by distance r. If the charge Q experiences a force of magnitude F when separation is r, what is the magnitude of force on the charge 2Q when the separation is $2r$?

(a) F/2 (b) F

(c) 2F (d) F/4

4. Two identical conducting spheres carry charges of $+5\ \mu C$ and $-1\ \mu C$ respectively. The centres of the spheres are initially separated by a distance r. Then two spheres are placed in contact with each other and then separated and returned to their original separation. The ratio of magnitude of the force on either charge before and after touching of each other.

(a) 9/5 (b) 4/9

(c) 5/4 (d) 4/5

5. Electrostatic Force between two charges placed in vacuum is F. If the charges are placed at the same distance in a medium of dielectric constant K, the force between them will be

(a) F (b) F/K

(c) KF (d) K^2F

6. Three equal charges q are placed at the corners of an equilateral triangle of side a. A charge Q is placed such that its distance from each charge is r. The force experienced by Q will be

(a) $\frac{qQ}{4\pi\varepsilon_0 r^2}$ (b) $\frac{qQ}{4\pi\varepsilon_0 (r+a)^2}$

(c) $\frac{qQ}{4\pi\varepsilon_0 (r-a)^2}$ (d) zero

7. Two charges are placed at a certain distance apart in air. When a metallic sheet is placed between them, the electrostatic force between them will

(a) decrease (b) increase

(c) remain unchanged (d) none.

8. A charge having magnitude Q is divided into two parts q and $(Q - q)$, which are held at certain distance apart. The force of Repulsion between two parts will be maximum if the ratio q/Q is

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$

(c) $\frac{1}{4}$ (d) $\frac{1}{5}$.

9. Two equal point charges of $1\ \mu C$ each are located at points $(\hat{i} + \hat{j} - \hat{k})\ m$ and $(2\hat{i} + 3\hat{j} + \hat{k})\ m$. What is the magnitude of electrostatic force between them ?

(a) $10^{-3}\ N$ (b) $10^{-6}\ N$

(c) $10^{-9}\ N$ (d) $10^{-12}\ N$

10. Three equal point charges q are placed at the corners of an equilateral triangle. Another charge Q is placed at the centroid of the triangle. The system of charges will be in equilibrium if Q equals

(a) $\frac{q}{\sqrt{3}}$ (b) $-q/\sqrt{3}$

(c) $\frac{q}{3}$ (d) $-\frac{q}{3}$

11. Two charges q_1 and q_2 separated by some distance in air exert Force F on each other. But if another charge q_3 is brought near q_1 then the force between q_1 and q_2 will be

(a) F (b) greater than F

(c) smaller than F (d) may be greater or smaller than F

12. Two charges of $-10\ \mu C$ and $20\ \mu C$ are separated by distance $20\ cm$. The ratio of the forces acting on them will be

(a) 1 : 2 (b) 2 : 1

(c) 1 : 4 (d) 1 : 1.

13. Three equal charges $3\ \mu C$ each are placed at the three corners of an equilateral triangle of side $3\ cm$ each. The force exerted on any charge due to the other two charges is

(a) $30\sqrt{3}\ N$ (b) $90\sqrt{3}\ N$

(c) $60\sqrt{3}\ N$ (d) $50\sqrt{3}\ N$

14. A charged oil drop of m and charge q is suspended in air above another charge Q at rest. The distance between the two charges is

(a) $\sqrt{\frac{Qq}{4\pi\varepsilon_0 mg}}$ (b) $\sqrt{\frac{Qq}{2\pi\varepsilon_0 mg}}$

(c) $\sqrt{\frac{Qq}{\pi\varepsilon_0 mg}}$ (d) $\sqrt{\frac{Qq}{3\pi\varepsilon_0 mg}}$

15. Four point charges Q, q, Q and q are kept respectively at the vertices A, B, C and D of a square of side l. If the net force on q is zero then Q is equal to

(a) $\frac{-q}{2\sqrt{2}}$ (b) $\frac{-q}{\sqrt{2}}$

(c) $\frac{q}{2\sqrt{2}}$ (d) $\frac{q}{\sqrt{2}}$

16. Two point charges placed at a certain distance r in air exert a force F on each other. The distance r at which these charges will exert the same force is a medium of dielectric constant K is given by

(a) r (b) r/K

(c) $r/\sqrt{\mathrm{K}}$ (d) none

17. Infinite number of identical charges $5\ \mu C$ each are placed along X axis at $x = 0$, $1\ m$, $2\ m$, $4\ m$, $8\ m$, $16\ m$ and so on. The net force on the charge at $x = 0$ due to other charges is

(a) $0.3\ N$ (b) $3\ N$

(c) $0.03\ N$ (d) $30\ N$

18. Two point charges $+8\ \mu C$ and $-10\ \mu C$ are placed at $10\ cm$ in air. A dielectric slab of thickness $5\ cm$ is placed between them. If the dielectric constant of the slab is 9 then the force of attraction between the charges is

(a) $10\ N$ (b) $18\ N$

(c) $8\ N$ (d) $10\sqrt{3}\ N$

Practice Questions

MULTIPLE CHOICE QUESTIONS (One mark each)

Choose the correct answer out of the four probables given at the end of each bit.

1. If $\vec{r}_1$ and $\vec{r}_2$ are position vectors of q_1 and q_2 respectively the $\vec{F}_{12}$ is given as

(a) $\frac{q_1 q_2}{4\pi\varepsilon_0} \frac{(\vec{r}_1 - \vec{r}_2)}{|\vec{r}_1 - \vec{r}_2|^2}$ (b) $\frac{q_1 q_2}{4\pi\varepsilon_0} \frac{(\vec{r}_1 - \vec{r}_2)}{|\vec{r}_1 - \vec{r}_2|^3}$

(c) $\frac{q_1 q_2}{4\pi\varepsilon_0} \frac{(\vec{r}_1 - \vec{r}_2)}{|(\vec{r}_1 - \vec{r}_2)|}$ (d) None of the above

2. The principle of superposition cf Coulomb's forces leads to the concept that

(a) The individual forces are affected due to the presence of other charges.

(b) The individual forces are unaffected due to the presence of other charges.

(c) The individual forces are sometimes affected and sometimes not affected due to the presence of other charges.

(d) None of the above

3. A regular polygon has 20 sides. Equal charges each Q are placed at 19 vertices of the polygon and charge q is placed at the centre of polygon. If the distance of each vertex from the centre is a, the net force on q is

(a) $\frac{20Qq}{4\pi\varepsilon_0 a^2}$ (b) $\frac{Qq}{4\pi\varepsilon_0 a^2}$

(c) $\frac{19Qq}{4\pi\varepsilon_0 a^2}$ (d) Zero

4. An infinite number of charges each of magnitude Q are placed along X axis at $x = 1\ m$, $2\ m$, $4\ m$, $8\ m$, $16\ m$ and so on, but the consecutive charges are of opposite sign starting with +Q at $x = 1\ m$. A point charge q_0 is at origin which will experience a force of magnitude

(a) $\frac{Qq_0}{4\pi\varepsilon_0}$ (b) $\frac{Qq_0}{5\pi\varepsilon_0}$

(c) $\frac{Qq_0}{3\pi\varepsilon_0}$ (d) $\frac{Qq_0}{2\pi\varepsilon_0}$

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

(a) $100\ N$ (b) $200\ N$

(c) $180\ N$ (d) $150\ N$

6. Three charges $-q_1$, $+q_2$ and $-q_3$ are placed as shown. The x component of the force on $-q_1$ is proportional to

(a) $\frac{q_2}{b^2} - \frac{q_3}{a^2}\sin$ (b) $\frac{q_2}{b^2} - \frac{q_3}{a^2}\cos\theta$

(c) $\frac{q_2}{b^2} + \frac{q_3}{a^2}\sin\theta$ (d) $\frac{q_2}{b^2} + \frac{q_3}{a^2}\cos\theta$

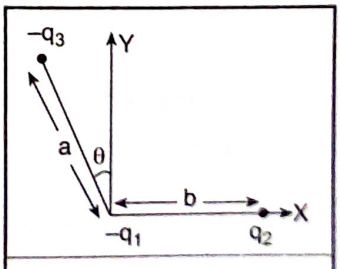


Fig. 1.49

Answers

cup of radius 0.1 *m*. Calculate the electric field strength at the centre of hemisphere.

[**Ans.** $9 \times 10^5\ NC^{-1}$]

Practice Questions

MULTIPLE CHOICE QUESTIONS (Each question is of 1 mark)

1. SI Unit of Electric Field is expressed in

(*a*) NC (*b*) N/C

(*c*) N/*m* (*d*) $\frac{Nm}{C}$

2. A cube of side L has charge *q* at each of its vertices. The electric field at the centre of the cube will be

(*a*) $\frac{1}{4\pi\varepsilon_0}\frac{q}{L^2}$ (*b*) $\frac{q}{4\pi\varepsilon_0 (2L^2)}$

(*c*) $\frac{8q}{4\pi\varepsilon_0 L^2}$ (*d*) Zero

3. The magnitude of Electric Field Intensity (E) such that an electron placed in it would experience an electrical force equal to its weight (Mg) is equal to

(*a*) *mge* (*b*) $\frac{mg}{e}$

(*c*) 2*mge* (*d*) $\frac{2mg}{e}$

4. The angle between the surface of a conductor and the electric line of force leaving the conductor is

(a) 90° (b) 0°

(c) 30° (d) 45°

5. A point charge produces an electric field of $2NC^{-1}$ at a distance 60 cm from it. The charge is

(a) $2 \times 10^{-12}\,C$ (b) $3 \times 10^{-11}\,C$

(c) $8 \times 10^{-11}\,C$ (d) $6 \times 10^{-10}\,C$

6. An electron moves with velocity $\vec{v}$ along Y axis. An electric Field $\vec{E}$ acts on it in X direction. The force on the electron will be

(a) +ve direction of Z axis (b) –ve direction of Z axis

(c) +ve direction of X axis (d) –ve direction of X axis.

7. A point charge is placed on the X axis at $x = 20\ cm$. If the electric field at the point $x = 50\ cm$ is $16 \times 10^{-3}\frac{V}{m}$ then the electric field at $x = 80\ cm$ is

(a) $16 \times 10^{-3}\frac{V}{m}$ (b) $4 \times 10^{-3}\frac{V}{m}$

(c) $32 \times 10^{-3}\frac{V}{m}$ (d) $64 \times 10^{-3}\frac{V}{m}$

8. A charge of Q has displacement $(3\hat{i} - 4\hat{j})\ m$ under uniform electric field $\vec{E} = (3\hat{i} - 4\hat{j})\ N/C$. Work done by the electric field is

(a) 25Q (b) –25Q

(c) 50Q (d) –50Q

9. An oil drop of charge $2e$ falls freely with a terminal speed. The mass oil drop so that it can move upward with same terminal speed if an electric field of $2 \times 10^3\frac{V}{m}$ is applied is

(a) $1.6 \times 10^{-12}\,kg$ (b) $9.1 \times 10^{-12}\,kg$

(c) $3.2 \times 10^{-12}\,kg$ (d) $6.4 \times 10^{-12}\,kg$

10. Find $\frac{Q_1}{Q_2}$ in the figure shown

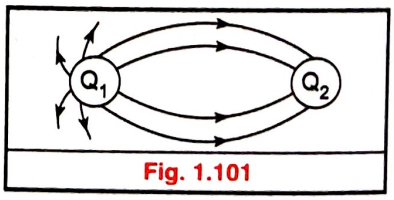


Fig. 1.101

(a) 1 : 2 (b) 2 : 1

(c) 1 : 3 (d) 3 : 1

11. A point charge +Q is placed at the centre of thick insulated metallic spherical shell which has internal and external radii r_1 and r_2. The electric field at a distance d $(r_1 < d < r_2)$ from the centre is

(a) $\frac{Q}{4\pi\varepsilon_0 r_1^2}$ (b) $\frac{Q}{4\pi\varepsilon_0 r_2^2}$

(c) $\frac{Q}{4\pi\varepsilon_0 d^2}$ (d) Zero.

12. A point charge 50 μC is placed in XY plane at position vector $(3\hat{i} + 2\hat{j})\ m$. The value of E at the point of position vector $(9\hat{i} - 6\hat{j})\ m$ is

(a) $5000\frac{V}{m}$ (b) $6000\frac{V}{m}$

(c) $4500\frac{V}{m}$ (d) $3600\frac{V}{m}$.

13. If the work done in moving a charge of 0.2C through a distance of 2*m* along a line making angle of 60° with X axis is –4J, then the value of E (along X axis) is

(*a*) 20 *N*/*C* (*b*) –20 *N*/*C*

(*c*) 10 *N*/*C* (*d*) –10 *N*/*C*

14. Identical charges of magnitude Q are placed at (*n* – 1) corners of a regular polygon of *n* sides. Each corner of the polygon is at a distance *r* from the centre. Then the net electric field at the centre is

(*a*) Zero (*b*) $\left(\frac{KQ}{r^2}\right)$

(*c*) $(n-1)\frac{KQ}{r^2}$ (*d*) $\left(\frac{n}{n-1}\right)\frac{KQ}{r^2}$

15. Two charges +5 μC and –5 μC are separated by a distance 2 *m* from each other. The electric field at the mid point of the line joining them is

(*a*) zero (*b*) 45000 NC^{-1}

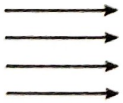
(*c*) 90000 NC^{-1} (*d*) 30000 NC^{-1}

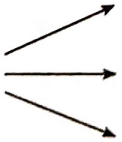
16. An electrostatic Field $\vec{E} = 20\frac{N}{C}$ is directed along +ve X axis. A point charge of 5 μC is taken from (2, 0, 0) to (3, 0, 2) and then to (0, 0, 0). The work done by the electrostatic force is

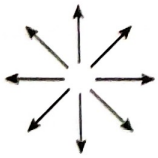
(*a*) $20 \times 10^{-4} J$ (*b*) $4 \times 10^{-4} J$

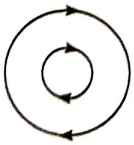
(*c*) $-2 \times 10^{-4} J$ (*d*) $-10^{-4} J$

17. Which of the following is not electrostatic Field ?

(*a*) 

(*b*) 

(*c*) 

(*d*) 

18. The field pattern is shown due to two point charges 1 and 2. The point where the net electric field is zero (null point) is at a distance *x* whose value is

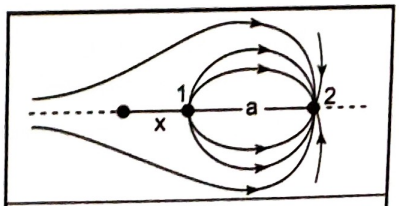


Fig. 1.102

(*a*) 0.414 *a* (*b*) $\frac{a}{\sqrt{2}}$

(*c*) 2.414*a* (*d*) 1.414*a*

19. Electrostatic lines of force

(*a*) can be closed (*b*) never intersect

(*c*) start from –ve charge (*d*) can be circular

20. The electric field inside a uniformly charged spherical shell is

(*a*) zero (*b*) finite

(*c*) undefined (*d*) depends on charge on shell

Answers

of mass 1 kg and charge ... 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. [Ans. 1.31 *sec.*]

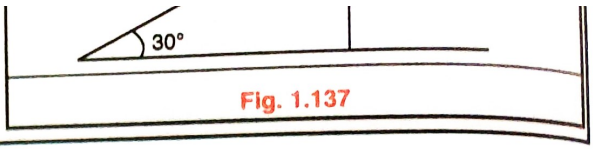


Fig. 1.137

Practice Questions

MULTIPLE CHOICE QUESTIONS (Each question is of 1 mark)

1. An electric dipole consists of
   (*a*) two equal and similar charges separated by small distance
   (*b*) two equal and opposite charges separated by small distance
   (*c*) two unequal and opposite charges separated by small distance
   (*d*) None of these
2. The direction of electric dipole moment is from
   (*a*) positive charge to negative charge
   (*b*) negative charge to positive charge
   (*c*) positive charge to negative charge in some cases and from negative charge to positive charge in some other cases.
   (*d*) It has no direction.
3. The electric Field Intensity due to an electric dipole at an axial point (End-on position)
   (*a*) is parallel to direction of electric dipole moment.
   (*b*) is antiparallel to direction of electric dipole moment.
   (*c*) is at right angles to direction of electric dipole moment.
   (*d*) is inclined at some angle with the direction of electric dipole moment.
4. The angle between the electric dipole moment and the Electric Field Intensity due to electric dipole at an equatorial point is
   (*a*) 0° (*b*) 90°
   (*c*) 180° (*d*) 45°
5. For a short electric dipole, the ratio of Electric Field Intensity (for same distance from the centre) at axial and equatorial point *i.e.* $\frac{E_{axial}}{E_{equatorial}} =$
   (*a*) 1 : 2 (*b*) 1 : 1
   (*c*) 1 : 3 (*d*) 2 : 1
6. The net force on an electric dipole in a uniform electric field is
   (*a*) zero (*b*) $-2qE$
   (*c*) qE (*d*) $2qE$

7. The Torque acting on an electric dipole in a uniform electric field is given by
   (a) $\vec{p}.\vec{E}$ (b) $\vec{p} \times \vec{E}$
   (c) $-\vec{p}.\vec{E}$ (d) $-\vec{p} \times \vec{E}$
8. Electric field Intensity due to an electric dipole at a point of distance r from its centre varies as
   (a) r^2 (b) r^{-2}
   (c) r^3 (d) r^{-3}
9. An electric dipole is placed in a uniform electric field. The dipole will experience maximum torque when
   (a) dipole is placed perpendicular to electric field
   (b) dipole is placed parallel to electric field
   (c) dipole is placed in any other position in the electric field
   (d) none
10. In a non uniform electric field, the electric dipole experiences
   (a) torque only (b) torque as well as net force
   (c) force only (d) none of above
11. An electric dipole of dipole moment p is placed in uniform electric field $\vec{E}$ If its dipole moment is along the direction of field, the force on it and its potential energy are respectively
   (a) $2q\vec{E}$ and minimum (b) $q\vec{E}$ and pE
   (c) Zero and minimum (d) $q\vec{E}$ and maximum
12. Electric Field Intensity due to an electric dipole of dipole moment p at a distance r along the axis of dipole is
   (a) $E = \frac{1}{E\pi\varepsilon_0}\frac{2p}{r^3}$ (b) $E = \frac{1}{4\pi\varepsilon_0}\frac{2p}{r^2}$
   (c) $E = \frac{p}{4\pi\varepsilon_0 r^2}$ (d) $E = \frac{p}{4\pi\varepsilon_0 r^3}$
13. Electric Field Intensity due to an electric dipole of dipole moment p at a distance r along the equatorial line of dipole is
   (a) $E = \frac{1}{4\pi\varepsilon_0}\frac{2p}{r^3}$ (b) $E = \frac{1}{4\pi\varepsilon_0}\frac{2p}{r^2}$
   (c) $E = \frac{1}{4\pi\varepsilon_0}\frac{p}{r^2}$ (d) $E = \frac{1}{4\pi\varepsilon_0}\frac{p}{r^3}$
14. An electric dipole is placed at an angle of 30° with an electric field intensity $2 \times 10^5 \frac{N}{C}$. It experiences a torque equal to 4 Nm. The charge on the dipole, if the dipole length is 2 cm is
   (a) 7 μC (b) 8 mC
   (c) 2 mC (d) 5 mC
15. In polar molecules
   (a) Centre of positive charges does not coincide with centre of negative charges and the substance has permanent dipole moment.
   (b) Centre of positive charges coincides with centre of negative charges and the substance has no dipole moment.
   (c) Centre of positive charges does not coincide with centre of negative charges and the substance has zero dipole moment.
   (d) None of above.

16. Which of the following molecule is not a dipole ?

(a) NH_3 (b) H_2O

(c) HCl (d) CH_4

17. Charges q, q and $-2q$ are placed at the corners of equilateral triangle of side l each. The magnitude of electric dipole moment of the system is

(a) ql (b) $2\,ql$

(c) $\sqrt{3}\,ql$ (d) $4\,ql$

18. A given charge situated at a certain distance from an electric dipole in the end on position experience a force F. If the distance of the charge is doubled the force acting on the charge will be

(a) 2F (b) F/2

(c) F/4 (d) F/8

19. An electric dipole consists of two opposite charges each of magnitude 1 μC separated by a distance of 2 cm. The dipole is placed in an external field of 10^5 N/C. The maximum torque on the dipole is

(a) $0.2 \times 10^{-3}\,Nm$ (b) $2 \times 10^{-3}\,Nm$

(c) $4 \times 10^{-3}\,Nm$ (d) $10^{-3}\,Nm$

20. The electric field due to an electric dipole at a distance r from its centre in axial position is E. If the dipole is rotated through angle of 90°, about its perpendicular axis, the electric field at the same point will be

(a) E (b) E/4

(c) 2E (d) $\frac{E}{2}$

Answers

Practice Questions

MULTIPLE CHOICE QUESTIONS (Each question is of 1 mark)

1. Electric Flux through an area is
   (a) the product of magnitude of area and the component of electric field vector normal to it.
   (b) the product of magnitude of area and component of electric field vector parallel to it.
   (c) the product of magnitude of area and any component of electric field.
   (d) None.

2. Electric flux through an area will be maximum when
   (a) Electric field is parallel to the surface or area.
   (b) Electric field is perpendicular to the surface area.
   (c) Electric field is inclined to the surface or area at angle 60°.
   (d) None

3. If a closed body not enclosing any charge is placed in an electric field then the total Electric Flux linked with it will be
   (a) positive
   (b) negative
   (c) zero
   (d) none

4. According to Gauss law (q is net charge enclosed by the surface)
   (a) $\oint_S \vec{E} \cdot \vec{dS} = \varepsilon_0 q$
   (b) $\oint_S \vec{E} \cdot \vec{dS} = \varepsilon_0 / q$
   (c) $\oint_S \vec{E} \cdot \vec{dS} = q / \varepsilon_0$
   (d) $\oint_S \vec{E} \cdot \vec{dS} = 0$

5. Electric Flux over a closed surface
   (a) depends on the shape and size of the surface
   (b) does not depend on the shape and size of the surface
   (c) depends on the shape and size of the surface in certain situations and does not depend on shape and size in some other situations.
   (d) None.

6. A cube of side 'a' encloses charge $+q$ at its centre. The electric flux through the cube is
   (a) $q/6\varepsilon_0$
   (b) $q/2\varepsilon_0$
   (c) $q/8\varepsilon_0$
   (d) q/ε_0

7. The electric Field $\vec{E}$ in the expression $\oint_S \vec{E}.\vec{dS} = \frac{q}{\varepsilon_0}$ is due to
   (a) all the charges lying outside the surface
   (b) all the charges lying inside the surface.
   (c) all the charges lying inside and outside the surface.
   (d) None.

8. Figure shows a Gaussian surface (spherical) which encloses charge q and $-q$, but charge Q is outside the surface. Then the net electric flux passing through S is
   (a) q/ε_0
   (b) $\frac{2q}{\varepsilon_0}$
   (c) $\frac{q}{2\varepsilon_0}$
   (d) zero

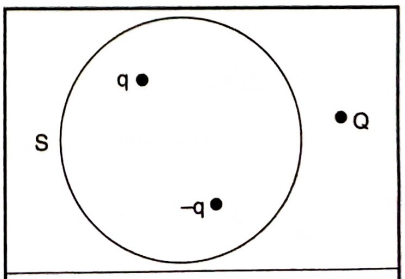


Fig. 1.182

9. Find the ratio of Electric Flux through the surface S_1 and S_2 with reference to the following figure.

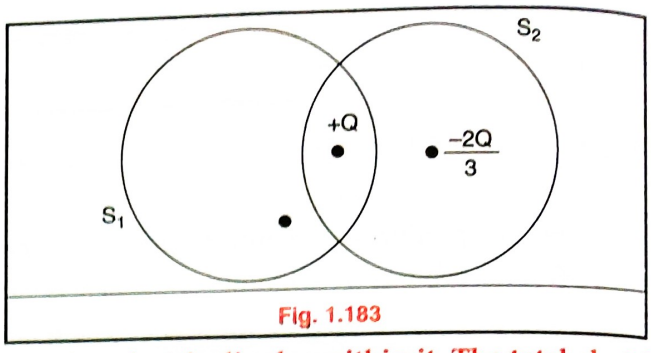


Fig. 1.183

(a) 1 : 1
(b) 1 : 3
(c) 3 : 1
(d) –1 : 3

10. A spherical surface of radius 5 *cm* encloses twelve electric dipoles within it. The total electric flux linked with this surface is
(a) zero
(b) +ve
(c) –ve
(d) None

11. Total Electric Flux coming out of a unit positive charge kept in air is
(a) ε_0
(b) ε_0^{-1}
(c) $(4\pi\varepsilon_0)^{-1}$
(d) $4\pi\varepsilon_0$

12. A point charge Q is placed at a distance $a/2$ directly above the centre of a square of side a. The electric flux through the square
(a) q/ε_0
(b) $q/\pi\varepsilon_0$
(c) $q/4\varepsilon_0$
(d) $q/6\varepsilon_0$

13. The Electric Field in a region is given as $\vec{E} = \frac{1}{5} E_0 \hat{i} + \frac{2}{5} E_0 \hat{j}$. The Electric Flux of this field through a rectangular surface of area $0.4m^2$ parallel to Y-Z plane is ($E_0 = 3 \times 10^3 NC^{-1}$)
(a) 240 Nm^2C^{-1}
(b) 300 Nm^2C^{-1}
(c) 180 Nm^2C^{-1}
(d) Zero

14. An area of 0.4 m^2 is oriented so that its normal makes an angle of 60° with uniform electric field of 2×10^5 N/C. The Electric Flux through this area is
(a) $4 \times 10^3 Nm^2C^{-1}$
(b) $4\sqrt{3} \times 10^3 Nm^2C^{-1}$
(c) Zero
(d) None

15. The Resultant Electric Field at point P due to two thin infinite planes of surface charge densities σ and –σ at the point P is

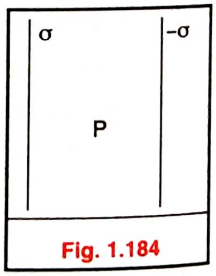


Fig. 1.184

(a) Zero
(b) $\frac{\sigma}{\varepsilon_0}$
(c) $\frac{2\sigma}{\varepsilon_0}$
(d) $\frac{-\sigma}{2\varepsilon_0}$

16. Electric Field at the surface of a conductor is given by
(a) $\frac{\sigma}{2\varepsilon_0}$
(b) $\frac{\sigma}{\varepsilon_0}$
(c) Zero
(d) $\frac{2\sigma}{\varepsilon_0}$

17. Two charges –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 center at origin ?
(a) $\frac{2Q}{\varepsilon_0}$
(b) $\frac{-2Q}{\varepsilon_0}$
(c) $\frac{-Q}{2\varepsilon_0}$
(d) $\frac{Q}{2\varepsilon_0}$