INDIAN SCHOOL MUSCAT

DEPARTMENT OF PHYSICS

STUDY MATERIAL FOR NEET AND JEE EXAMS

ELECTROSTATICS

1 When a Piece of Polythene is rubbed with wool, a charge of -2×10^{-7}C is developed on polythene. The mass transferred to polythene is ..... kg.

(A) 11.38×10^{-19} (B) 5.69×10^{-19} (C) 2.25×10^{-19} (D) 9.63×10^{-19}

2 A Semicircular rod is charged uniformly with a total charge Q coulomb. The electric field intensity at the centre of curvature is ....

(A) $\frac{2KQ}{\pi r^2}$ (B) $\frac{3KQ}{\pi r^2}$ (C) $\frac{KQ}{\pi r^2}$ (D) $\frac{4KQ}{\pi r^2}$

3 Four charges, each equal to –Q, are placed at the corners of a square and a charge +q is placed at its centre. If the system is in equilibrium, the value of q is ....

(A) $\frac{Q}{4}\left(1+2\sqrt{2}\right)$ (B) $-\frac{Q}{4}\left(1+2\sqrt{2}\right)$

(C) $-\frac{Q}{2}\left(1+2\sqrt{2}\right)$ (D) $\frac{Q}{2}\left(1+2\sqrt{2}\right)$

4 Two equal negative charges –q are fixed at points (o, a) and (o, –a). A positive charge Q is released from rest at the point (2a, o) on the X - axis. The charge Q will ....

(A) move to the origin and remain at rest there

(B) execute simple harmonic motion about the origin

(C) move to infinity

(D) execute oscillations but not simple harmonic motion

5 Two small conducting sphere of equal radius have charges +1μc and – 2μc respectively and placed at a distance d from each other experience force F_1. If they

are brought in contact and separated to the same distance, they experience force F_2. The ratio of F_1 to F_2 is ....

(A) –8 : 1 (B) 1 : 2 (C) 1 : 8 (D) –2 : 1

6 Three charges, each of value Q, are placed at the vertex of an equilateral triangle. A fourth charge q is placed at the centre of the triangle. If the charges remains stationery then, q = ...

(A) $\frac{Q}{\sqrt{2}}$ (B) $-\frac{Q}{\sqrt{3}}$ (C) $-\frac{Q}{\sqrt{2}}$ (D) $\frac{Q}{\sqrt{3}}$

7 Two point charges repel each other with a force of 100 N. One of the charges is increased by 10% and other is reduced by 10%. The new force of repulsion at the same distance would be .... N.

(A) 121 (B) 100 (C) 99 (D) 89

8 A charge Q is divided into two parts and then they are placed at a fixed distance. The force between the two charges is always maximum when the charges are ....

(A) $\frac{Q}{3}, \frac{Q}{3}$ (B) $\frac{Q}{2}, \frac{Q}{2}$ (C) $\frac{Q}{4}, \frac{3Q}{4}$ (D) $\frac{Q}{5}, \frac{4Q}{5}$

9 A copper sphere of mass 2 gm contains about 2×10^{22} atoms. The charge on the nucleus of each atom is 29e. The fraction of electrons removed.

(A) 2×10^{-10} (B) 1.19×10^{-12} (C) 1.25×10^{-11} (D) 2.16×10^{-11}

10 The rate of alpha particle falls on neutral sphere is 10^{12} per second. The time in which

sphere gets charged by 2μc is .... sec.

(A) 2.25 (B) 3.15 (C) 6.25 (D) 1.66

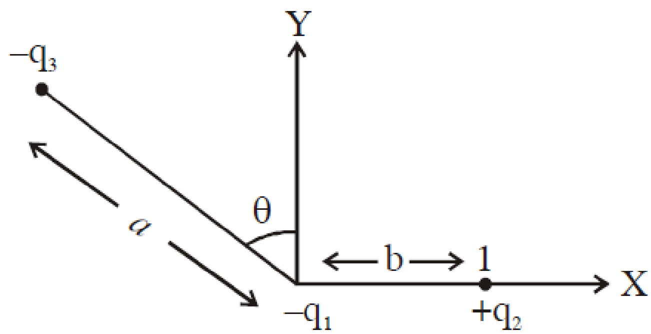
11 Two small charged spheres repel each other with a force 2×10^{-3}N. The charge on one sphere is twice that of the other. When these two spheres displaced 10 cm

further apart the force is 5×10^{-4}N, then the charges on both the spheres are ....

(A) $1.6\times10^{-19}C, 3.2\times10^{-19}C$ (B) $3.4\times10^{-19}C, 11.56\times10^{-19}C$

(C) $33.33\times10^{-19}C, 66.66\times10^{-19}C$ (D) $2.1\times10^{-19}C, 4.41\times10^{-19}C$

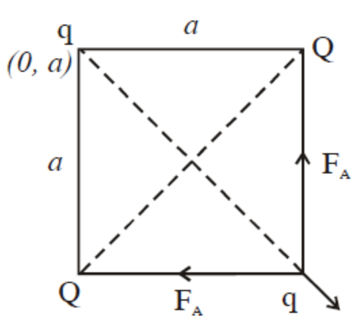
12 Three charges $-q_1$, $+q_2$ and $-q_3$ are placed as shown in figure. The *x* component of the force on $-q_1$ is proportional to ....



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

13 For the system shown in figure, if the resultant force on q is zero, then Q = ...



(A) $-2\sqrt{2}Q$ (B) $2\sqrt{2}Q$

(C) $2\sqrt{3}Q$ (D) $-3\sqrt{2}Q$

14 Two point positive charges q each are placed at (–a, o) and (a, o). A third positive charge q_o is placed at (o, y). For which value of y the force at q_o is maximum ....

(A) a (B) 2a (C) $\frac{a}{\sqrt{2}}$ (D) $\frac{a}{\sqrt{3}}$

15 Two identical charged spheres suspended from a common point by two massless strings of length l are initially a distance d (d << l) apart because of their mutual repulsion. The charge begins to leak from both the spheres at a constant rate. As a result the spheres approach each other with a velocity υ . Then function of distance x between them

Becomes ....

(A) $v \alpha x$ (B) $v \alpha x^{\frac{-1}{2}}$ (C) $v \alpha x^{-1}$ (D) $v \alpha x^{\frac{1}{2}}$

16 Three identical spheres each having a charge q and radius R, are kept in such a way that each touches the other two spheres. The magnitude of the electric force on any sphere due to other two is ....

(A) $\frac{R}{2}\frac{1}{4\pi\in_0}\frac{\sqrt{5}}{4}\left(\frac{q}{R}\right)^2$ (B) $\frac{1}{8\pi\in_0}\sqrt{\frac{2}{3}}\left(\frac{q}{R}\right)^2$ (C) $\frac{1}{4\pi\in_0}\frac{\sqrt{3}}{4}\left(\frac{q}{R}\right)^2$ (D) $-\frac{1}{8\pi\in_0}\sqrt{\frac{3}{2}}\left(\frac{q}{R}\right)^2$

17 Two equal negative charges –q are fixed at points (o, a) and (o, –a) on the Y axis. A positive charge q is released from rest at the point x (x < < a) on the X-axis, then the frequency of motion is ....

(A) $\sqrt{\frac{q^2}{\pi\in_0 ma^3}}$ (B) $\sqrt{\frac{2q^2}{4\pi\in_0 ma^3}}$ (C) $\sqrt{\frac{4q^2}{2\pi\in_0 ma^3}}$ (D) $\sqrt{\frac{q^2}{2\pi\in_0 ma^3}}$

18 Two identical balls having like charges and placed at a certain distance apart repel each other with a certain force. They are brought in contact and then moved apart to a distance equal to half their initial separation. The force of repulsion between them increases 4.5 times in comparison with the initial value. The ratio of the initial charges of the balls is ....

(A) 4 : 1 (B) 6 : 1 (C) 3 : 1 (D) 2 : 1

19 A point charge q is situated at a distance r from one end of a thin conducting rod of length L having a charge Q (uniformly distributed along its length). The magnitude of electric force between the two, is ....

(A) $\frac{2kqQ}{r(r+L)}$ (B) $\frac{kqQ}{r(r+L)}$ (C) $\frac{kqQ}{r(r-L)}$ (D) $\frac{kQ}{r(r+L)}$

20 Two point charges of +16μc and –9μc are placed 8 cm apart in air. .... distance of a point from –9μc charge at which the resultant electric field is zero.

(A) 24 cm (B) 9 cm (C) 16 cm (D) 35 cm

21 Point charges 4μc and 2μc are placed at the vertices P and Q of a right angle triangle PQR respectively. Q is the right angle, PR = 2×10^{-2}m and QR = 10^{-2}m . The magnitude and direction of the resultant electric field at R is ....

(A) $4.28\times10^{9}\ NC^{-1}, 45^{0}$ (B) $2.38\times10^{8}\ NC^{-1}, 40.9^{0}$

(C) $1.73\times10^{4}\ NC^{-1}, 34.7^{0}$ (D) $4.9\times10^{10}\ NC^{-1}, 34.7^{0}$

22 An inclined plane making an angle of 30^{o} with the horizontal is placed in an uniform electric field E = 100 Vm^{-1}. A particle of mass 1 kg and charge 0.01 C is allowed to slide down from rest from a height of 1m. If the coefficient of friction is 0.2 the time taken by the particle to reach the bottom is .... sec.

(A) 2.337 (B) 4.337 (C) 5 (D) 1.337

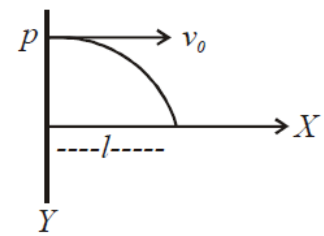
23 A small sphere whose mass is 0.1 gm carries a charge of 3×10^{-10}C and is tie up to one end of a silk fibre 5 cm long. The other end of the fibre is attached to a large vertical conducting plate which has a surface charge of $25\times10^{-6}Cm^{-2}$, on each side. When system is freely hanging the angle fibre makes with vertical is ....

(A) 41.8^{0} (B) 45^{0} (C) 40.8^{0} (D) 45.8^{0}

24 A Semicircular rod is charged uniformly with a total charge Q coulomb. The electric field intensity at the centre of curvature is ....

(A) $\frac{2KQ}{\pi r^2}$ (B) $\frac{3KQ}{\pi r^2}$ (C) $\frac{KQ}{\pi r^2}$ (D) $\frac{4KQ}{\pi r^2}$

25 The electron is projected from a distance d and with initial velocity υ_0 parallel to a uniformly charged flat conducting plate as shown in figure. It strikes the plate after travelling a distance l along the direction. The surface charge density of conducting plate is equal to



(A) $\frac{2d \in_0 m\upsilon_0}{el}$ (B) $\frac{d \in_0 m\upsilon^2_0}{el}$ (C) $\frac{d \in_0 m\upsilon_0}{el}$ (D) $\frac{2d \in_0 m\upsilon^2_0}{el^2}$

26 Two point masses m each carrying charge –q and +q are attached to the ends of a massless rigid non-conducting rod of length l. The arrangement is placed in a uniform electric field E such that the rod makes a small angle 5^0 with the field direction. The minimum time needed by the rod to align itself along the field is ....

(A) $t = \pi\sqrt{\frac{2ml}{3qE}}$ (B) $t = \frac{\pi}{2}\sqrt{\frac{ml}{2qE}}$ (C) $t = \sqrt{\frac{ml}{qE}}$ (D) $t = 2\pi\sqrt{\frac{ml}{E}}$

27 Two uniformaly charged spherical conductors A and B having radius 1mm and 2mm are separated by a distance of 5 cm. If the spheres are connected by a conducting wire then in equilibrium condition, the ratio of the magnitude of the electric fields at the surfaces of spheres A and B is ....

(A) 4 : 1 (B) 1 : 2 (C) 2 : 1 (D) 1 : 4

28 Let $P(r) = \frac{Q}{\pi R^4} r$ be the charge density distribution for a solid sphere of radius R and total charge Q. For a point 'P' inside the sphere at distance r_1 from the centre of the sphere the magnitude of electric field is

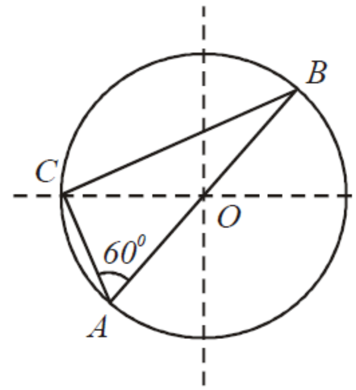
(A) $\frac{Q}{4\pi \in_0 r_1^2}$ (B) $\frac{Qr_1^2}{4\pi \in_0 R^4}$ (C) $\frac{Qr_1^2}{3\pi \in_0 R^4}$ (D) 0

29 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 upwards. If the electrostatic force acting on the sphere is less than gravitational force the period of pendulum is

A

(A) $T = 2\pi\left[\dfrac{l}{g - \frac{qE}{m}}\right]^{\frac{1}{2}}$ (B) $T = 2\pi\left(\dfrac{l}{g}\right)^{\frac{1}{2}}$ (C) $T = 2\pi\left[\dfrac{l}{g + \frac{qE}{m}}\right]^{\frac{1}{2}}$ (D) $T = 2\pi\left[\dfrac{ml}{qE}\right]^{\frac{1}{2}}$

30 Consider a system of three charges q/3, q/3 and –2a/3 placed at points A, B and C respectively as shown in the figure. It the radius of the circle is R and $\angle CAB = 60^0$ then the electric field at centre 0 is ....



(A) $\dfrac{q}{8\pi \in_0 R^2}$ (B) $\dfrac{q^2}{54\pi \in_0 R^2}$

(C) $\dfrac{q}{6\pi \in_0 R^2}$ (D) 0

31 In Millikan's oil drop experiment an oil drop carrying a charge Q is held stationary by a p.d. 2400 v between the plates. To keep a drop of half the radius stationary the potential difference had to be made 600 v. What is the charge on the second drop ?

(A) $\dfrac{3Q}{2}$ (B) $\dfrac{Q}{4}$ (C) Q (D) $\dfrac{Q}{2}$

32 Equal charges q are placed at the vertices A and B of an equilateral triangle ABC of side a. The magnitude of electric field at the point c is ....

(A) $\dfrac{Kq}{a^2}$ (B) $\dfrac{\sqrt{3}Kq}{a^2}$ (C) $\dfrac{\sqrt{2}Kq}{a^2}$ (D) $\dfrac{q}{2\pi t\varepsilon_0 a^2}$

33 An electric dipole is placed along the x-axis at the origin o. A point P is at a distance of 20 cm from this origin such that OP makes an angle $\dfrac{\pi}{3}$ with the x-axis. If the electric field at P makes an angle θ with the x-axis, the value of θ would be ....

(A) $\dfrac{\pi}{3} + \tan^{-1}\left(\dfrac{\sqrt{3}}{2}\right)$ (B) $\dfrac{\pi}{3}$ (C) $\dfrac{2\pi}{3}$ (D) $\tan^{-1}\left(\dfrac{\sqrt{3}}{2}\right)$

34 A particle having a charge of 1.6×10^{-19}C enters between the plates of a parallel plate capaciter. The initial velocity of the particle is parallel to the plates. A potential difference of 300v is applied to the capacitor plates. If the length of the capacitor plates is 10cm and they are separated by 2cm, Calculate the greatest initial velocity for which the particle will not be able to come out of the plates. The mass of the particle is 12×10^{-24}kg .

(A) $10^4 \frac{m}{s}$ (B) $10^2 \frac{m}{s}$ (C) $10^{-1} \frac{m}{s}$ (D) $10^3 \frac{m}{s}$

35 A charged particle of mass 1 kg and charge $2\ c$ is thrown from a horizontal ground at an angle $\theta = 45°$ with speed 20m/s. In space a horizontal electric field $E = 2 \times 10^7 V/m$ exist. The range on horizontal ground of the projectile thrown is ....

(A) 100 m (B) 50 m (C) 200 m (D) 0 m

36 If electron in ground state of H-atom is assumed in rest then dipole moment of electron proton system of H-atom is ....

Orbit radius of H atom in ground state is $0.56 \overset{0}{A}$.

(A) 0.253×10^{-29} cm (B) 0.848×10^{-29} cm (C) 0.305×10^{-29} cm (D) 1.205×10^{-28} cm

37 At what angle θ a point P must be located from dipole axis so that the electric field intensity at the point is perpendicular to the dipole axis ?

(A) 53^0 to 54^0 (B) 50^0 to 51^0 (C) 45^0 to 46^0 (D) 52^0 to 53^0

38 A Charge q is placed at the centre of the open end of cylindrical vessel. The flux of the electric field through the surface of the vessel is ....

(A) $\frac{q}{\epsilon_0}$ (B) $\frac{q}{2\epsilon_0}$ (C) $\frac{2q}{\epsilon_0}$ (D) Zero

39 The inward and outward electric flux for a closed surface in units of Nm^2/C are respectively 8×10^3 and 4×10^3. Then the total charge inside the surface is .... c.

(A) $\frac{-4 \times 10^3}{\epsilon_0}$ (B) -4×10^3 (C) 4×10^3 (D) $-4 \times 10^3 \epsilon_0$

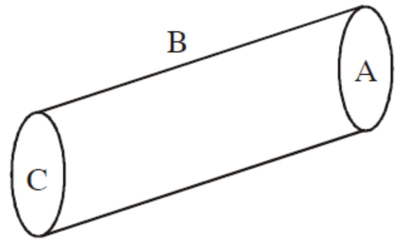
40 An electric dipole is placed at an angle of 60° with an electric field of intensity $10^5 NC^{-1}$. It experiences a torque equal to $8\sqrt{3}Nm$. If the dipole length is 2cm then the charge on the dipole is .... c.

(A) -8×10^3 (B) 8.54×10^{-4} (C) 8×10^{-3} (D) 0.85×10^{-6}

41 A sphere of radius R has a uniform distribution of electric charge in its volume. At a distance x from its centre, (for $x < R$), the electric field is directly proportional to ....

(A) x (B) x^{-1} (C) x^{-2} (D) x^2

42 A hollow cylinder has a charge q coulomb within it. If ϕ is the electric flux in units of volt-meter associated with the curved surface B, the flux linked with the plane surface A in units of volt-meter will be ....



(A) $\frac{1}{2}\left(\frac{q}{\epsilon_0}-\phi\right)$ (B) $\frac{q}{2\epsilon_0}$

(C) $\frac{\phi}{3}$ (D) $\frac{q}{\epsilon_0}-\phi$

43 An infinitly long thin straight wire has uniform linear charge density of $\frac{1}{3}$ c/m. Then, the magnitude of the electric intiensity at a point 18 cm away is .... NC^{-1}.

(A) 0.66×10^{11} (B) 1.32×10^{11} (C) 0.33×10^{11} (D) 3×10^{11}

44 Two points are at distances a and b (a < b) from a long string of charge per unit length λ. The potential difference between the points in proportional to ....

(A) $ln\left(\frac{b}{a}\right)$ (B) $\frac{\lambda}{\pi\epsilon_0}ln\left(\frac{b^2}{a^2}\right)$ (C) $\frac{\lambda}{2\pi\epsilon_0}ln\sqrt{\frac{b}{a}}$ (D) $\frac{\lambda}{2\pi\epsilon_0}ln\left(\frac{b}{a}\right)$

45 Two Points P and Q are maintained at the Potentials of 10 v and –4 v, respectively. The work done in moving 100 electrons from P to Q is ....

(A) 2.24×10^{-16} J (B) -9.60×10^{-17} J (C) -2.24×10^{-16} J (D) 9.60×10^{-17} J

46 The electric Potential V at any Point o (x, y, z all in metres) in space is given by $V = 4x^2$ volt. The electric field at the point (1m, 0.2m) in volt/metre is ......

(A) 8, along negative x - axis (B) 8, along positives x - axis

(C) 16, along negative x - axis (D) 16, along positives x - axis

47 Charges of $+\frac{10}{3}\times10^{-9}$ C are placed at each of the four corners of a square of side 8cm. The potential at the intersection of the diagonals is ....

(A) $150\sqrt{2}$ Volt (B) $900\sqrt{2}$ Volt (C) $1500\sqrt{2}$ Volt (D) $900\sqrt{2}\cdot\sqrt{2}$ Volt

48 Three charges 2q, –q, –q are located at the vertices of an equilateral triangle. At the centre of the triangle.

(A) The Field is Zero but Potential is non - zero

(B) The Field is non - Zero but Potential is zero

(C) Both field and Potential are Zero

(D) Both field and Potential are non- Zero

49 Three concentric spherical shells have radii a, b and c (a < b < c) and have surface charge densities σ, $-\sigma$ and σ respectively. If V_A, V_B and V_C denote the Potentials of the three shells, then for c = a + b, we have

(A) $V_C = V_B = V_A$ (B) $V_c = V_B \neq V_A$ (C) $V_c \neq V_B \neq V_A$ (D) $V_c = V_A \neq V_B$

50 Four equal charges Q are placed at the four corners of a square of each side is 'a'. Work done in removing a charge - Q from its centre to infinity is ...

(A) 0 (B) $\frac{\sqrt{2}Q^2}{\pi \epsilon_0 a}$ (C) $\frac{\sqrt{2}Q^2}{4\pi \epsilon_0 a}$ (D) $\frac{Q^2}{2\pi \epsilon_0 a}$

ANSWER KEY

1(A)	11(C)	21(B)	31(D)	41(A)
2(A)	12(C)	22(D)	32(C)	42(A)
3(B)	13(A)	23(C)	33(A)	43(C)
4(D)	14(C)	24(A)	34(A)	44(D)
5(A)	15(B)	25(D)	35(C)	45(A)
6(B)	16(C)	26(B)	36(B)	46(A)
7(C)	17(A)	27(C)	37(D)	47(C)
8(B)	18(D)	28(B)	38(D)	48(B)
9(D)	19(B)	29(A)	39(D)	49(D)
10(C)	20(A)	30(C)	40(C)	50(B)

Answer Key for current electricity

1) 3	2) 3	3) 3	4) 2	5) 2	6) 2	7) 1	8) 1	9) 3	10) 3
11) 1	12) 2	13) 3	14) 4	15) 3	16) 2	17) 3	18) 1	19) 4	20) 3
21) 4	22) 3	23) 2	24) 3	25) 3	26) 3	27) 2	28) 4	29) 1	30) 3
31) 3	32) 1	33) 3	34) 2	35) 3	36) 3	37) 2	38) 4	39) 3	40) 4
41) 4	42) 1	43) 3	44) 3	45) 1	46) 4	47) 1	48) 2	49) 1	50) 3