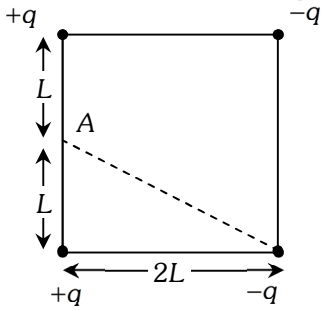
BALUNI CLASSES

(CHOICE OF THE GENIUS)
(For IIT-JEE, NEET)

Topic : Electrostatics ***D.P.P.*** ***Batch : NEET***

Electric Charge and Coulomb's Law

1. Four electric charges +q, +q, –q and –q are placed at the corners of a square of side $2L$ (see figure). The electric potential at point A, mid–way between the two charges +q and +q, is



(a) $\frac{1}{4\pi\varepsilon_0}\frac{2q}{L}\left(1+\frac{1}{\sqrt{5}}\right)$

(b) $\frac{1}{4\pi\varepsilon_0}\frac{2q}{L}\left(1-\frac{1}{\sqrt{5}}\right)$

(c) zero

(d) $\frac{1}{4\pi\varepsilon_0}\frac{2q}{L}\ 1+\sqrt{5}$

2. The unit of physical quantity obtained by the line integral of electric field is

(a) NC^{-1} (b) Vm^{-1}

(c) JC^{-1} (d) $C^2N^{-1}m^{-2}$

3. Charge q_2 of mass m revolves around a stationary charge q_1 in a circular orbit of radius r. The orbital periodic time of q_2 would be

(a) $\left[\frac{4\pi^2mr^3}{kq_1q_2}\right]^{1/2}$ (b) $\left[\frac{kq_1q_2}{4\pi^2mr^3}\right]^{1/2}$

(c) $\left[\frac{4\pi^2mr^4}{kq_1q_2}\right]^{1/2}$ (d) $\left[\frac{4\pi^2mr^2}{kq_1q_2}\right]^{1/2}$

4. The work done in carrying a charge q once round a circle of radius a with a charge Q at its centre is

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

(c) $\frac{q}{4\pi\varepsilon_0 a}$ (d) $\frac{q}{4\pi\varepsilon_0 a^2}$

5. A charge Q is placed at the origin. The electric potential due to this charge at a given point in space is v. The work done by an external force in bringing another charge q from infinity up to the point is

(a) $\frac{V}{q}$ (b) Vq (c) $V+q$ (d) V

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

(a) $\frac{-Q}{4}(1+2\sqrt{2})$ (b) $\frac{Q}{4}(1+2\sqrt{2})$

(c) $\frac{-Q}{2}(1+2\sqrt{2})$ (d) $\frac{Q}{2}(1+2\sqrt{2})$

7. Domestic electrical wiring has three wires

(a) positive, negative and neutral
(b) positive, negative and earth
(c) live, neutral and earth
(d) positive, negative and live

8. Which of the following is not true?

(a) For a point charge, the electrostatic potential varies as 1/r
(b) For a dipole, the potential depends on the position vector and dipole moment vector
(c) The electric dipole potential varies as $1/r$ at large distance
(d) For a point charge, the electrostatic field varies as $1/r^2$

9. The mobility of charge carriers increases will

(a) increase in the average collision time
(b) increase in the electric field
(c) increase in the mass of the charge carriers
(d) decrease in the charge of the mobile carriers

10. Two positive ions, each carrying a charge q, are separated by a distance d. If F is the force of repulsion between the ions, the number of electrons missing from each ion will bn (e being the charge on an electron)

(a) $\frac{4\pi\varepsilon_0 Fd^2}{e}$ (b) $\sqrt{\frac{4\pi\varepsilon_0 Fd^2}{e}}$

(c) $\sqrt{\frac{4\pi\varepsilon_0 Fd^2}{e^2}}$ (d) $\frac{4\pi\varepsilon_0 Fd^2}{e^2}$

11. 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) $+\frac{Q}{2}$

12. Two copper balls, each weighing 10g, are kept in air 10 apart. If one electron from every 10^6 atoms is transferred from one bal to the other, the coulomb force between them is (atomic weight of copper is 63.5)

(a) $2.0\times10^{10}N$ (b) $2.0\times10^{4}N$

(c) $2.0\times10^{8}N$ (d) $2.0\times10^{6}N$

13. If 10^{10} electrons are acquired by a body every second, the time required for the body to get a total charge of *C* will be

(a) 2h (b) 2 days (c) 2 yr (d) 20 yr

14. A ball with charge –50 *e* is placed at the centre of a hollow spherical shell has a net charge of –50*e*. What is the charge on the shell's outer surface?

(a) –50 *e* (b) zero

(c) –100 *e* (d) +100 *e*

15. Two identical conducting balls A and *B* have positive charge q_1 and q_2 respectively but $q_1 \neq q_2$. The balls are brought together so that they touch each other and then kept in their original position, the force between them is

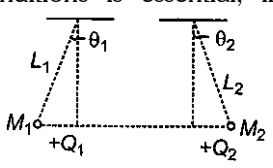
(a) less than that before the balls touched

(b) greater than that before the balls touched

(c) same as that before the balls toucher

(d) zero

16. Two small spheres of masses M_1 and M_2 are suspended by weightless insulating threads of lengths L_1 and L_2. The spheres carry charges Q_1 and Q_2 respectively. The spheres are suspended such that they are in level with one another and the threads are inclined to the vertical at angles of θ_1 and θ_2 as shown. Which one of the following conditions is essential, if $\theta_1 = \theta_2$?



(a) $M_1 \neq M_2$, but $Q_1 = Q_2$ (b) $M_1 = M_2$

(c) $Q_1 = Q_2$ (d) $L_1 = L_2$

17. A charged particle of mass 0.003 g is held stationary is space by placing it in a downward direction of electric field of 6×10^4 N/C. Then the magnitude of charge is

(a) 5×10^{-4}C (b) 5×10^{-10} C

(c) 5×10^{-6} C (d) 5×10^{-9} C

18. When 10^{19} electrons are removed from a neutral metal plate, the electric charge on it is

(a) –1.6C (b) +1.6C

(c) 10^{+19}C (d) 10^{-19}C

19. Mark the correct option

(a) In electrostatics, there is no motion of charge at all in conductor's bulk

(b) In electrostatic, there is motion of charged particle in conductor's bulk

(c) In electrostatic and current electricity them is a net motion of charged particle in the bulk of the material of the conductor

(d) In electrostatics and current electricity them is no net motion of charged particles in the bulk of the material of the conductor

20. Among two discs A and *B*, first has radius 10 *cm* and charged 10^{-6} *C* and second has radius 30 *cm* and charge 10^{-5} C. When they are touched, charges on both are, q_A and q_B respectively, will be

(a) $q_A = 2.75\ \mu C$, $q_B = 3.15\ \mu C$

(b) $q_A = 1.09\ \mu C$, $q_B = 1.53\ \mu C$

(c) $q_A = q_B = 5.5\ \mu C$

(d) None of the above

21. Two charges are at a distance d apart. If a copper plate of thickness $\frac{d}{2}$ is kept between them, the effective force will be

(a) $\frac{F}{2}$ (b) zero (c) 2 F (d) $\sqrt{2F}$

22. The charge given to any conductor resides on its outer surface, because

(a) the free charge tends to be in its minimum potential energy state

(b) the free charge tends to be in its minimum kinetic energy state

(c) the free charge tends to be in its maximum potential energy state

(d) the free charge tends to be in its maximum kinetic energy state

23. 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 finally 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) $\frac{3F}{8}$

24. A pendulum bob of mass *m* carrying a charge q is at rest with its string making an angle θ with the vertical in a uniform horizontal electric field *E*. The tension in the string is

(a) $\frac{mg}{\sin\theta}$ and $\frac{qE}{\cos\theta}$

(b) $\frac{mg}{\cos\theta}$ and $\frac{qE}{\sin\theta}$

(c) $\frac{qE}{mg}$

(d) $\frac{mg}{qE}$

25. The specific charge of a proton is 9.6×10^{-7} *C* kg^{-1}. The specific charge of an alpha particle will be

(a) 9.6×10^{7} Ckg^{-1} (b) 9.6×10^{11} Ckg^{-1}
(c) 4.8×10^{7} Ckg^{-1} (d) 2.4×10^{7} Ckg^{-1}

26. The distance between charges 5×10^{-11} *C* and -2.7×10^{-11} *C* is 0.2 m. The distance at which is third charged should be placed from second charge in order that it will not experience any force along the line joining the two charges is

(a) 0.44 *m* (b) 0.65 *m*
(c) 0.556 *m* (d) 0.350 *m*

27. The number of electrons in 2 *C* of charge is

(a) 5×10^{29} (b) 12.5×10^{18}
(c) 1.6×10^{19} (d) 9×10^{11}

28. When air medium in which two charges kept apart at a distance *r* is replaced by a dielectric medium of dielectric constant *K*, the force between the charges

(a) remains unchanged
(b) decreases *K* times
(c) increases *K* times
(d) increases K^2 times

29. A comb run through one's dry hair attracts small bits of paper. This is due to

(a) comb is a good conductor
(b) paper is good conductor
(c) the atoms is the paper get polarized by the charged comb
(d) the comb posses magnetic properties

30. Each of the two point charges are doubled and their distance is halved. Force of interaction becomes *n* times, where *n* is

(a) 4 (b) 1 (c) 1/16 (d) 16

31. A cylindrical conductor is placed near another positively charged conductor. The net charge acquired by the cylindrical conductor will be

(a) positive only
(b) negative only
(c) zero
(d) either positive or negative

32. A table tennis which has been covered with a conducting paint is suspended by a silk thread so that it hangs between two metal plates. One plate is earthed. When then other plate is connected to a high voltage generator, the ball

(a) is attracted to the high voltage plate and stays there
(b) hangs without moving
(c) swings backward and forward hitting each plate in turn
(d) is repelled to the earthed plate and stays there

33. Three charges 1μ*C*, 1μ*C* and 2μ*C* are kept at the vertices A, *B* and *C* of an equilateral triangle ABC of 10 *cm* side, respectively. The resultant force on the charge at *C* is

(a) 0.9 N (b) 1.8 N (c) 2.72 N (d) 3.6 N

34. What is charge on 90 kg of electrons?

(a) 1.58×10^{13} (b) 2.3×10^{12}
(c) 2.53×10^{12} (d) None of these

35. If charge and distance between two charges are reduced to half. Force between them

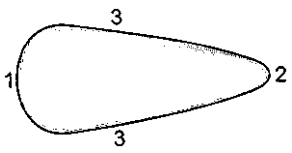
(a) remains same
(b) increases four times
(c) reduce four times
(d) none of the above

36. Two identical metal spheres charged with +12μF and –8μF are kept at certain distance in air. They are brought into contact and then kept at the same distance. The ratio of the magnitudes of electrostatic forces between them before and after contact is

(a) 12 : 1 (b) 8 : 1 (c) 24 : 1 (d) 4 : 1

37. Consider a non spherical conductor shown in the figure which is given a certain amount of positive charge. The charge distributes itself on the surface such that the charge densities are σ_1, σ_2

and σ_3 at the region 1, 2 and 3 respectively. Then



(a) $\sigma_1 > \sigma_2 > \sigma_3$ (b) $\sigma_2 > \sigma_3 > \sigma_1$
(c) $\sigma_1 > \sigma_3 > \sigma_2$ (d) $\sigma_2 > \sigma_1 > \sigma_3$

38. A charge q is placed at the mid-point of the line joining two equal charges of Q. If the whole system is in equilibrium, then the value of q is

(a) $-\frac{Q}{2}$ (b) $+\frac{Q}{2}$ (c) $-\frac{Q}{4}$ (d) $+\frac{Q}{4}$

39. A circle of radius a has charge density given by $\lambda = \lambda_0\cos^2\theta$ on its circumference. What will be the total charge on the circle?

(a) $2\pi a$ (b) zero
(c) $\pi a\lambda_0$ (d) none of these

40. Electrical force between two point charges is 200 *N*. If we increase 10% charge on one of the charges and decrease 10% charge on the other, then electrical force between them for the same distance becomes

(a) 198 *N* (b) 100 *N* (c) 200 *N* (d) 99 *N*

41. 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 finally 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) $\frac{3F}{8}$

42. When air is replaced by a dielectric medium of constant K. The maximum force of attraction between two charges separated by a distance

(a) increases K^{-1} times (b) increases *K* times
(c) decreases *K* times (d) remains constant

43. **Assertion** The lightning conductor at the top of high building has sharp pointed ends.

Reason The surface density of charge at sharp points is very high resulting in setting up of electric wind.

(a) Both assertion and reason are true and the reason is the correct explanation of the assertion
(b) Both assertion and reason are true but the reason is not the correct explanation of the assertion
(c) Assertion is true but reason is false
(d) Both assertion and reason are false

44. Two point charges $+2C$ and $+6C$ repel each other with a force of 12 N. If a charge of $-2C$ is given to each of these charges the force will now be

(a) zero (b) 8 *N* (attractive)
(c) 8 *N* (repulsive) (d) None of these

45. An electron is moving round the nucleus of a hydrogen atom in a circular orbit of radius r. The Coulomb force F between the two is

(a) $k\frac{e^2}{r^3}r$ (b) $-k\frac{e^2}{r^3}r$
(c) $k\frac{e^2}{r}r$ (d) $-k\frac{e^2}{r}r$

$\left(\text{where } k = \frac{1}{4\pi\varepsilon_0}\right)$

46. Two identical charges repel each other with a force equal to 10 mg wt when they are 0.6 *m* a part in air ($g = 10\ ms^{-2}$). The value of each charge is

(a) 2 mC (b) 2×10^{-7} *C* (c) 2 nC (d) 2 μC

47. Two identical spheres carrying charges $-9\mu C$ and 5 μC respectively are kept in contact and then separated from each other. Point out true statement from the following. In each sphere

(a) 1.25×10^{13} electrons are in deficit
(b) 1.25×10^{13} electrons are in excess
(c) 2.15×10^{13} electrons are in excess
(d) 2.15×10^{13} electrons are in deficit
(e) 1.52×10^{13} electrons are in excess

48. The voltage of clouds is 4×10^6 *V* with respect to ground. In a lightning strike lasting 100 ms, a charge of 4 *C* is delivered to the ground. The power of lightning strike is

(a) 160 MW (b) 80 MW
(c) 20 MW (d) 500 kW

49. The top of the atmosphere is about 400 kV with respect to the surface of the earth, corresponding to an electric field that decreases with altitude. Near the surface of the earth, the field is about 100 Vm^{-1}. Still, we do not get an electric shock as we step out of our house into the open house because (assume the house to be a steel cage so that there is no field inside)

(a) there is a potential difference between our body and the ground
(b) 100 Vm^{-1} is not a high electric field so that

we do not feel the shock
(c) our body and the ground forms an equipotential surface
(d) the dry atmosphere is not a conductor

50. Two unit negative charges are placed on a straight line. A positive charge q is placed exactly at the mid-point between these unit charges. If the system of three charges is in equilibrium the value of 'q (in *C*) is
(a) 1.0 (b) 0.75 (c) 0.5 (d) 0.25

51. A pendulum bob carriers a negative charge –q. A positive charge +q is held at the point of support. Then, the time period of the bob is
(a) greater than $2\pi\sqrt{\frac{L}{g}}$
(b) less than $2\pi\sqrt{\frac{L}{g}}$
(c) equal to $2\pi\sqrt{\frac{L}{g}}$
(d) equal to $2\pi\sqrt{\frac{2L}{g}}$

52. Two identical spheres with charges 4q, –2q kept some distance apart exert a force F on each other. If they are made to touch each other and replaced at their old positions, the force between them will be
(a) $\frac{1}{9}F$ (b) $\frac{1}{8}F$ (c) $\frac{9}{8}F$ (d) $\frac{8}{9}F$

53. Two equal –ve charge –q are fixed at the point (0, a) and (0, –a) on the *y*–axis. A positive charge Q is released from rest at the point (2a, 0) on the x–axis. The charge will
(a) execute SHM about the origin
(b) move to the origin and remain at rest
(c) move to infinity
(d) execute oscillatory but not SHM

54. Charges 4Q, q and Q are placed along x–axis at position x = 0, x = l/2 and x = l, respectively. Find the value of q, so that force on charge Q is zero.
(a) *Q* (b) $\frac{Q}{2}$ (c) $-\frac{Q}{2}$ (d) –Q

55. Four metal conductors having different shapes
1. a sphere 2. cylinder
3. pear 4.lightning conductor
are mounted on insulating stands and charged. The one which is best suited to retain the charges for a longer time is
(a) 1 (b) 2 (c) 3 (d) 4

Answer Key

1. (b)	11. (b)	21. (b)	31. (c)	41. (d)	51. (c)
2. (c)	12. (c)	22. (a)	32. (c)	42. (d)	52. (b)
3. (a)	13. (d)	23. (d)	33. (*)	43. (a)	53. (d)
4. (e)	14. (d)	24. (b)	34. (a)	44. (a)	54. (d)
5. (b)	15. (b)	25. (c)	35. (a)	45. (b)	55. (a)
6. (b)	16. (b)	26. (c)	36. (c)	46. (d)	
7. (c)	17. (b)	27. (b)	37. (d)	47. (b)	
8. (c)	18. (b)	28. (b)	38. (c)	48. (a)	
9. (a)	19. (a)	29. (c)	39. (c)	49. (d)	
10. (c)	20. (c)	30. (d)	40. (a)	50. (d)	