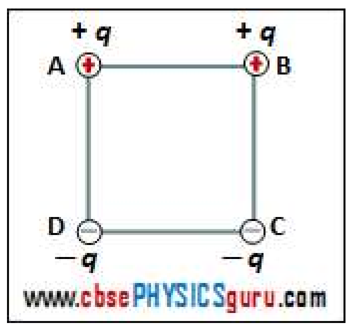
COULOMB'S LAW AND ELECTRIC FIELD

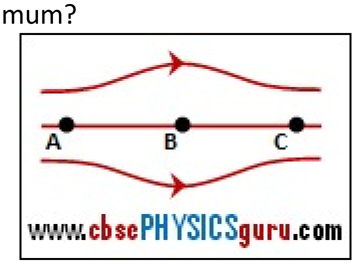
1. If a charge –200 nC is given to a concentric spherical shell and a charge +100 nC is placed at its centre then the charge on inner and outer surface of the shell is:
   (a) –100 nC, –100 nC (b) +100 nC, –100 nC (c) –100 nC, –200 nC (d) –100 nC, 100 nC
2. A conductor has been given a charge +3 x 10^{-7} C by transferring electrons. Mass decrease (in kg) of the conductor and the number of electrons removed from the conductor are respectively:
   (a) 1 x 10^{-16} and 3 x 10^{30} (b) 6 x 10^{-31} and 2 x 10^{19} (c) 4 x 10^{-18} and 6 x 10^{16} **(d)** 2 x 10^{-18} and 2 x 10^{12}
3. Two point charges exert on each other a force F when they are placed r distance apart in air. When they are placed R distance apart in medium of dielectric constant K, they exert the same force. The distance R equals:
   (a) rK (b) $\frac{r}{K}$ **(c)** $\frac{r}{\sqrt{K}}$ (d) $r\sqrt{K}$
4. Force between two identical charges placed at a distance r in vacuum is F. Now a slab of dielectric constant K = 4 is inserted between these two charges. The thickness of the slab is r/2. The force between the charges will now become:
   (a) 3F/4 **(b)** 4F/9 (c) 3F/7 (d) 2F/7
5. Two particles, each of mass m and carrying charges Q, are separated by some distance. If they are in equilibrium under mutual gravitational and electrostatic forces, then Q/m (in C/kg) is of the order of:
   (a) 10^{-4} (b) 10^{-6} (c) 10^{-8} **(d)** 10^{-10}
6. Two identical spherical conductors A and B carrying equal charges in them repel each other with a force F when kept apart at some distance. A third identical spherical conductor C but uncharged, is brought in contact with A, then brought in contact with B and finally removed away from both. The new force of repulsion between A and B is:
   (a) 3F/5 (b) F/4 **(c)** 3F/8 (d) F/2
7. Four charges are arranged at the corners of a square ABCD as shown in the figure. The force on the charge kept at the centre 0 is:
   (a) along the diagonal BD (b) along the diagonal AC (c) zero **(d)** perpendicular to side AB



8. Two equally charged identical metal spheres A and B repel each other with a force 3 x 10^{-5} N. Another identical uncharged sphere C is touched with A and then placed at the midpoint between A and B. Net force on C is:
   (a) 3 x 10^{-5} N (b) 2 x 10^{-5} N (c) 1 x 10^{-5} N (d) 2.5 x 10^{-5} N
9. A charge Q is fixed at each of two opposite corners of a square. A charge q is placed at each of the other two corners. If the resultant electric force on Q is zero, then Q and q are related as:
   (a) Q = $2\sqrt{2}$q **(b)** Q = $-2\sqrt{2}$q (c) Q = $\sqrt{2}$q (d) Q = $-\sqrt{2}$q
10. Three concentric metallic spherical shells of radii R, 2R, 3R, are given charges q_1, q_2, q_3, respectively. It is found that the surface charge densities on the outer surfaces of the shells are equal. Then, the ratio of the charges given to the shells, q_1, q_2, q_3, is:

(a) 1 : 2 : 3 **(b)** 1 : 3 : 5 (c) 1 : 5 : 9 (d) 1 : 8 : 27

11. 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. The surface charge density on the inner and outer surfaces of the shell will be:
(a) $\frac{q}{4\pi R_1^2}$ and $\frac{Q}{4\pi R_2^2}$ (b) $\frac{-q}{4\pi R_1^2}$ and $\frac{Q+q}{4\pi R_2^2}$ (c) $\frac{Q+q}{4\pi R_1^2}$ and $\frac{Q-q}{4\pi R_2^2}$ **(d)** $\frac{q}{4\pi R_1^2}$ and $\frac{Q-q}{4\pi R_2^2}$
12. In the uniform electric field of E = 1 x 10^4 N/C an electron is accelerated from rest. The velocity of the electron when it has travelled a distance of 2 cm nearly (e/m of electron = 1.8 x 10^{11} C/kg):
(a) 1.85 x 10^6 m/s (b) 0.55 x 10^6 m/s (c) 4.25 x 10^6 m/s **(d)** 8.5 x 10^6 m/s
13. A charged oil drop is suspended in a uniform electric field of 3 x 10^4 V/m. The charge on the drop will be (Take the mass of the drop is 9.9 x 10^{-15} kg and g = 10 m/s^2):
(a) 3.3 x 10^{-18} C (b) 2.3 x 10^{-18} C (c) 3.6 x 10^{-18} C (d) 4.8 x 10^{-18} C
14. There is a uniform electric field of strength 10^3 V/m along the y-axis. A body of mass 1 g and charge 10^{-6} C projected into the field from the origin along the positive x-axis with a velocity of 10 m/s. Its speed (in m/s) of 10 s will be (neglect gravitation):
(a) 10 (b) $4\sqrt{2}$ **(c)** $10\sqrt{2}$ (d) $15\sqrt{2}$
15. A charged particle of mass m and charge q is released from rest in an electric field of constant magnitude E. The kinetic energy of the particle after time t is:
(a) $\frac{E^2q^2t^2}{2m}$(b) $\frac{E^2q^2t}{m}$ (c) $\frac{E^2qt}{2m}$ (d) $\frac{Eq^2t^2}{2m}$
16. A negatively charged oil drop is prevented from falling under gravity by applying a vertical electric field 100 V/m. If the mass of the drop is 1.6 x 10^{-3} g, the number of electrons carried by the drop is (g = 10 m/s^2):
(a) 10^{16} (b) 10^{18} (c) 10^{10} **(d)** 10^{12}
17. An electron initially at rest falls a distance of 1.5 cm in a uniform electric field of magnitude 2 x 10^4 N/C. The time taken by the electron to fall to this distance is:
(a) 1.3 x 10^{-2} s (b) 2.2 x 10^{-5} s **(c)** 2.9 x 10^{-9} s (d) 1.3 x 10^{-12} s
18. At which point A, B or C shown in the figure is the electric field minimum?
(a) A **(b)** B (c) C (d) Same at all points



19. The direction of electric field intensity at a point on the equatorial line of an electric dipole is:
(a) along the equatorial line towards the dipole (b) along the equatorial line away from the dipole **(c)** perpendicular to the equatorial line and opposite to dipole moment (d) perpendicular to the equatorial line and parallel to dipole moment
20. The force experienced by a point charge on the axis of a short electric dipole is F. What will be the force experienced by the point charge if its distance is doubled from the dipole?
(a) F (b) F/4 **(c)** F/8 (d) 2F