JEE MAIN : CHAPTER WISE TEST PAPER-1

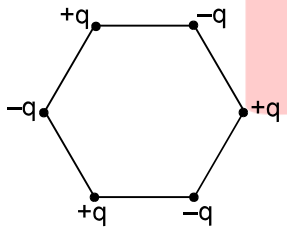
SUBJECT :- PHYSICS **DATE.....**
CLASS :- 12th **NAME.....**
CHAPTER :- ELECTROSTATICS **SECTION.....**

(SECTION-A)

1. A flat circular fixed disc has a charge +Q uniformly distributed on the disc. A charge +q is thrown with kinetic energy K, towards the disc along its axis. The charge q :
(A) may hit the disc at the centre
(B) may return back along its path after touching the disc
(C) may return back along its path without touching the disc
(D) any of the above three situations is possible depending on the magnitude of K

2. A 5 coulomb charge experiences a constant force of 2000 N when moved between two points separated by a distance of 2 cm in a uniform electric field. The potential difference between these two points is:
(A) 8 V (B) 200 V
(C) 800 V (D) 20,000 V

3. Six charges of magnitude + q and –q are fixed at the corners of a regular hexagon of edge length a as shown in the figure. The electrostatic potential energy of the system of charged particles is :



(A) $\frac{q^2}{\pi \in_0 a}\left[\frac{\sqrt{3}}{8}-\frac{15}{4}\right]$

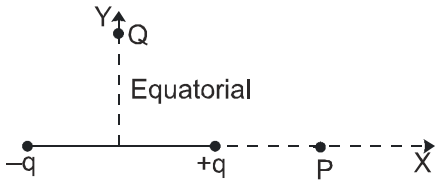
(B) $\frac{q^2}{\pi \in_0 a}\left[\frac{\sqrt{3}}{2}-\frac{9}{4}\right]$

(C) $\frac{q^2}{\pi \in_0 a}\left[\frac{\sqrt{3}}{4}-\frac{15}{2}\right]$

(D) $\frac{q^2}{\pi \in_0 a}\left[\frac{\sqrt{3}}{2}-\frac{15}{8}\right]$

4. A sphere of radius 1 cm has potential of 8000 V. The energy density near the surface of sphere will be:
(A) 64×10^5 J/m^3 (B) 8×10^3 J/m^3
(C) 32 J/m^3 (D) 2.83 J/m^3

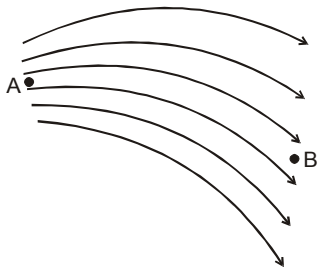
5. Due to an electric dipole shown in fig., the electric field intensity is parallel to dipole axis :



(A) at P only
(B) at Q only
(C) both at P and at Q
(D) neither at P nor at Q

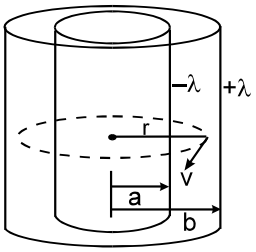
6. At a point on the axis (but not inside the dipole and not at infinity) of an electric dipole
(A) The electric field is zero
(B) The electric potential is zero
(C) Neither the electric field nor the electric potential is zero
(D) The electric field is directed perpendicular to the axis of the dipole

7. The figure shows the electric lines of force emerging from a charged body. If the electric fields at A and B are E_A and E_B respectively and if the distance between A and B is r, then



(A) $E_A < E_B$ (B) $E_A > E_B$
(C) $E_A = \frac{E_B}{r}$ (D) $E_A = \frac{E_B}{r^2}$

8. Figure shows two large cylindrical shells having uniform linear charge densities + λ and – λ. Radius of inner cylinder is 'a' and that of outer cylinder is 'b'. A charged particle of mass m, charge q revolves in a circle of radius r. Then, its speed 'v' is : (Neglect gravity and assume the radii of both the cylinders to be very small in comparison to their length.)



(A) $\sqrt{\frac{\lambda q}{2\pi \in_0 m}}$ (B) $\sqrt{\frac{2\lambda q}{\pi \in_0 m}}$

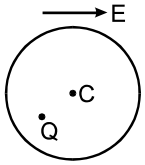
(C) $\sqrt{\frac{\lambda q}{\pi \in_0 m}}$ (D) $\sqrt{\frac{\lambda q}{4\pi\varepsilon_0 m}}$

9. A positive point charge q is brought near a neutral metal sphere.
(A) The sphere becomes negatively charged.
(B) The sphere becomes positively charged.
(C) The interior remains neutral and the surface gets non-uniform charge distribution.
(D) The interior becomes positively charged and the surface becomes negatively charged.

10. A charge q is uniformly distributed over a large plastic plate. The electric field at a point P close to the centre and just above the surface of the plate is 50 V/m. If the plastic plate is replaced by a copper plate of the same geometrical dimensions and carrying the same uniform charge q, the electric field at the point P will become:
(A) zero (B) 25 V/m
(C) 50 V/m (D) 100 V/m

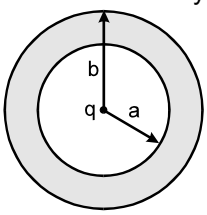
11. Two uniformly charged non-conducting hemispherical shells each having uniform charge density σ and radius R form a complete sphere (not stuck together) and surround a concentric spherical conducting shell of radius R/2. If hemispherical parts are in equilibrium then minimum surface charge density of inner conducting shell is:
(A) -2σ (B) $-\sigma/2$ (C) $-\sigma$ (D) 2σ

12. A positive point charge Q is kept (as shown in the figure) inside a neutral conducting shell whose centre is at C. An external uniform electric field E is applied. Then :



(A) Force on Q due to E is zero
(B) Net force on Q is zero
(C) Net force acting on Q and conducting shell considered as a system is zero
(D) Net force acting on the shell due to E is zero.

13. A point charge q is brought from infinity (slowly so that heat developed in the shell is negligible) and is placed at the centre of a conducting neutral spherical shell of inner radius a and outer radius b, then work done by external agent is:



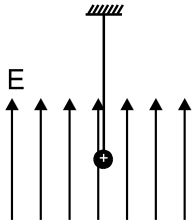
(A) 0 (B) $\frac{k q^2}{2 b}$

(C) $\frac{k q^2}{2 b} - \frac{k q^2}{2 a}$ (D) $\frac{k q^2}{2 a} - \frac{k q^2}{2 b}$

14. A solid sphere of radius R has a volume charge density $\rho = \rho_0 r^2$ (Where ρ_0 is a constant and r is the distance from centre). At a distance x from its centre (for x < R), the electric field is directly proportional to :
(A) $1/x^2$ (B) $1/x$ (C) x^3 (D) x^2

15. A charge Q is kept at the centre of a conducting sphere of inner radius R_1 and outer radius R_2. A point charge q is kept at a distance r (> R_2) from the centre. If q experiences an electrostatic force 10 N then assuming that no other charges are present, electrostatic force experienced by Q will be:
(A) – 10 N (B) 0
(C) 20 N (D) none of these

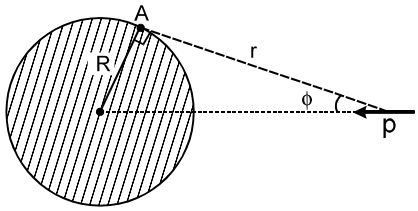
16. A positively charged pendulum is oscillating in a uniform electric field as shown in Figure. Its time period of SHM as compared to that when it was uncharged. (mg > qE)



(A) Will increase
(B) Will decrease
(C) Will not change
(D) Will first increase then decrease

17. A solid conducting sphere having a charge Q is surrounded by an uncharged concentric conducting hollow spherical shell. Let the potential difference between the surface of the solid sphere and that of the outer surface of the hollow shell be V. If the shell is now given a charge –3Q, the new potential difference between the same two surfaces is :
(A) V (B) 2V (C) 4V (D) –2V

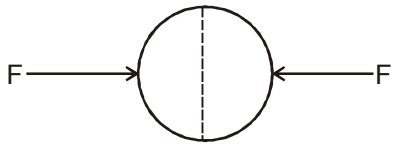
18. A dipole having dipole moment p is placed in front of a solid uncharged conducting sphere as shown in the diagram. The net potential at point A lying on the surface of the sphere is :



(A) $\frac{kp\cos\phi}{r^2}$ (B) $\frac{kp\cos^2\phi}{r^2}$

(C) zero (D) $\frac{2kp\cos^2\phi}{r^2}$

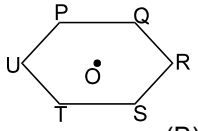
19. A uniformly charged thin spherical shell of radius R carries uniform surface charge density of σ per unit area. It is made of two hemispherical shells, held together by pressing them with force F (see figure). F is proportional to



(A) $\frac{1}{\varepsilon_0}\sigma^2R^2$ (B) $\frac{1}{\varepsilon_0}\sigma^2R$

(C) $\frac{1}{\varepsilon_0}\frac{\sigma^2}{R}$ (D) $\frac{1}{\varepsilon_0}\frac{\sigma^2}{R^2}$

20. Six charges q,q,q, – q, –q and –q are to be arranged on the vertices of a regular hexagon PQRSTU such that the electric field at centre is double the field produced when only charge 'q' is placed at vertex R. The sequence of the charges from P to U is :



(A) q, –q, q, q, –q, –q (B) q, q, q, –q, –q, –q

(C) –q, q, q, –q, –q, q (D) –q, q, q, q, –q, –q

(SECTION-B)

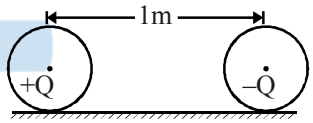
21. There is a uniform electric field in x-direction. If the work done by external agent in moving a charge of 0.2 C through a distance of 2 metre slowly along the line making an angle of 60º with x-direction is 4 joule, then the magnitude of E is:

22. A force of 3000 N is acting on a charge of 3 coloumb moving in a uniform electric field. The potential difference between two point at a distance of 1 cm in this field is :

23. In H atom, an electron is rotating around the proton in an orbit of radius r. Work done by an electron in moving once around the proton along the orbit will be -

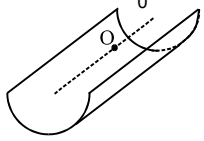
24. If 'n' identical water drops assumed spherical each charged to a potential energy U coalesce to a single drop, the potential energy of the single drop is $n^{a/b}$ U. Calculate the value of a + b.(Assume that drops are uniformly charged):

25. Two point charges are embedded inside two identical insulated smooth balls kept on horizontal ground as shown. The balls have radius of 10 cm each and are initially kept at a distance of 1m as shown. They move under the influence of mutual attraction collide with e = $\frac{1}{2}$. What is the maximum distance between their centers (in cm) after 1st collision?



26. Two large parallel conducting plates are 10 cm apart and carry equal but opposite charges on their facing surfaces. An electron placed midway between the plates experiences aforce of 3.2×10^{-17} N. What is the potential difference (in volts) between the plates ?

27. A thin long strip whose cross-section is a semicircle carries a uniform surface charge of density 'σ'on its inner surface. Find the electric field in SI unit at a point 'O' located midway on its axis. Take $\sigma = 4\pi\in_0$ .SI unit.



28. An electron is released from rest on the axis of an electric dipole that has charge e and –e on its two parts, charge separation d = 20 cm and that is fixed in place. The release point is on the positive side of the dipole, at distance 7.0d from the dipole center. What is the electron's speed (in m/s) when it reaches a point 5.0d from the dipole center? Round off the answer to nearest integer. Take the mass of the electron as 9.1×10^{-31} kg.

29. A non-conducting spherical ball of radius R contains a spherically symmetric charge with volume charge density $\rho = kr^n$, where r is the distance from the center of the ball and n is a constant. What should be n such that the electric field inside the ball is directly proportional to square of distance from the centre.

30. Two identical point charges $q(=2C)$ are placed such that one lies at centre of a sphere of radius 2cm and other at a distance $2\sqrt{2}$ cm from the centre of sphere as shown in figure. Find the flux through the surface of sphere enclosed by all the tangents to the sphere passing through the outer charge as shown in figure.