DPP No: 24

Maximum Time
50 Min

PHYSICS

TARGET
JEE-MAINS

SYLLABUS : ELECTROSTATICS

1. A charged particle q_1 is at position (2, - 1, 3). The electrostatic force on another charged particle q_2 at (0, 0, 0) is :

(A) $\frac{q_1 q_2}{56\pi\epsilon_0}(2\hat{i} - \hat{j} + 3\hat{k})$

(B) $\frac{q_1 q_2}{56\sqrt{14}\pi\epsilon_0}(2\hat{i} - \hat{j} + 3\hat{k})$

(C) $\frac{q_1 q_2}{56\pi\epsilon_0}(\hat{j} - 2\hat{i} - 3\hat{k})$

(D) $\frac{q_1 q_2}{56\sqrt{14}\pi\epsilon_0}(\hat{j} - 2\hat{i} - 3\hat{k})$

2. Three charges +4q, Q and q are placed in a straight line of length ℓ at points at distance 0, $\ell/2$ and ℓ respectively from one end of line. What should be the value of Q in order to make the net force on q to be zero?

(A) –q (B) –2q (C) –q/2 (D) 4q

3. Two point charges placed at a distance r in air exert a force F on each other. The value of distance R at which they experience force 4F when placed in a medium of dielectric constant K = 16 is :

(A) r (B) r/4 (C) r/8 (D) 2r

4. Two point charges $q_1 = 2 \times 10^{-3}$ C and $q_2 = -3 \times 10^{-6}$C are separated by a distance x = 10cm. Find the magnitude and nature of the force between the two charges.

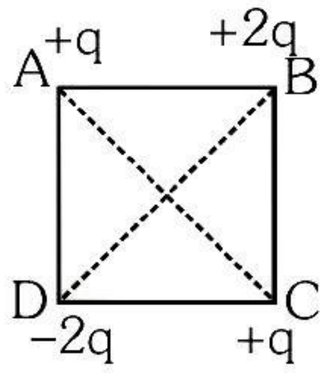
(A) 2500 N, attractive.

(B) 3500 N, attractive.

(C) 4500 N, attractive.

(D) 5400 N, attractive.

5. 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 O will be :



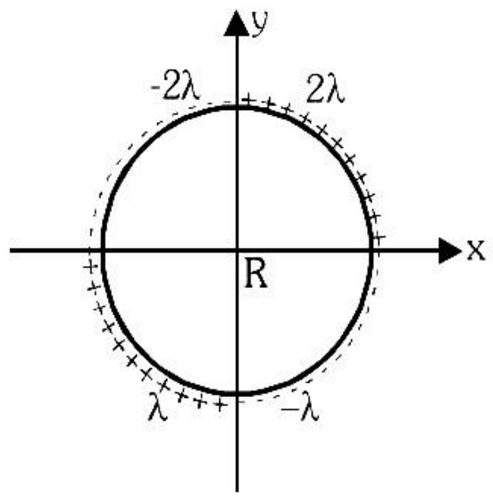
(A) perpendicular to side AB

(B) along the diagonal BD

(C) along the diagonal AC

(D) zero

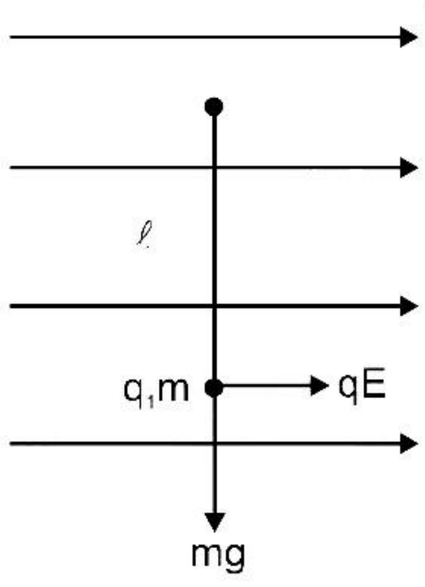
6. The charge per unit length of the four quadrant of the ring is 2λ, -2λ, λ and $-\lambda$ respectively. The electric field at the centre is :



(A) $\frac{-\lambda}{2\pi\varepsilon_0 R}\hat{i}$ (B) $\frac{\lambda}{2\pi\varepsilon_0 R}\hat{j}$

(C) $\frac{\sqrt{2}\lambda}{4\pi\varepsilon_0 R}\hat{i}$ (D) None

7. A simple pendulum has a length ℓ & mass of bob m. The bob is given a charge q coulomb. The pendulum is suspended in a uniform horizontal electric field of strength E as shown in figure, then calculate the time period of oscillation when the bob is slightly displaced from its mean position.



(A) $2\pi\sqrt{\frac{\ell}{g}}$ (B) $2\pi\sqrt{\left\{\frac{\ell}{g+\frac{qE}{m}}\right\}}$ (C) $2\pi\sqrt{\left\{\frac{\ell}{g-\frac{qE}{m}}\right\}}$ (D) $2\pi\sqrt{\frac{\ell}{\sqrt{g^2+\left(\frac{qE}{m}\right)^2}}}$

8. The maximum electric field intensity on the axis of a uniformly charged ring of charge q and radius R will be :

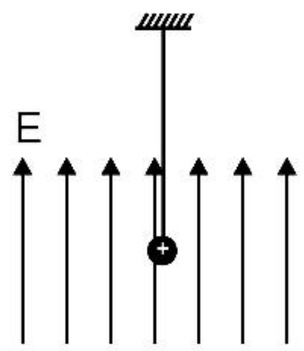
(A) $\frac{1}{4\pi\varepsilon_0}\frac{q}{3\sqrt{3}R^2}$ (B) $\frac{1}{4\pi\varepsilon_0}\frac{2q}{3R^2}$ (C) $\frac{1}{4\pi\varepsilon_0}\frac{2q}{3\sqrt{3}R^2}$ (D) $\frac{1}{4\pi\varepsilon_0}\frac{3q}{2\sqrt{3}R^2}$

9. A non-conducting solid sphere of radius R is uniformly charged. The magnitude of the electric field due to the sphere at a distance r from its centre.

(A) increases as r increases, for $r \le R$ (B) decreases as r increases, for $0 < r < \infty$.

(C) is discontinuous at $r = R$ (D) None of these

10. 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)



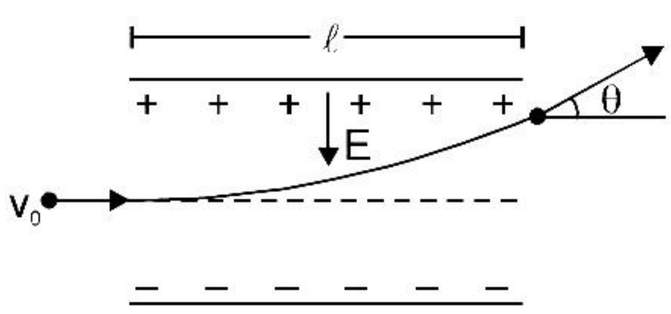
(A) Will increase

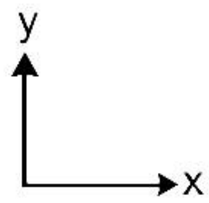
(B) Will decrease

(C) Will not change

(D) Will first increase then decrease

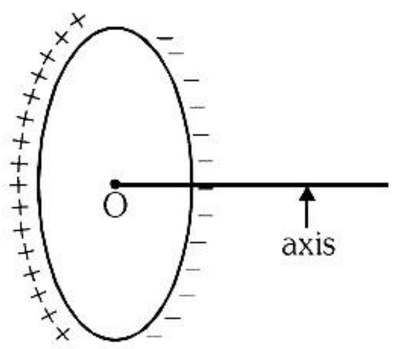
11. A uniform electric field $E = 91 \times 10^{-6}$ V/m is created between two parallel, charged plates as shown in figure. An electron enters the field symmetrically between the plates with a speed $v_0 = 4 \times 10^3$ m/s. The length of each plate is $\ell = 1$m. Find the angle of deviation of the path of the electron as it comes out of the field. (Mass of the electron is $m = 9.1 \times 10^{-31}$ kg and its charge is $e = -1.6 \times 10^{-19}$ C).





(A) 25° (B) 35° (C) 45° (D) 55°

12. The figure shows a nonconducting ring which has positive and negative charge non uniformly distributed on it such that the total charge is zero. Which of the following statements is true?



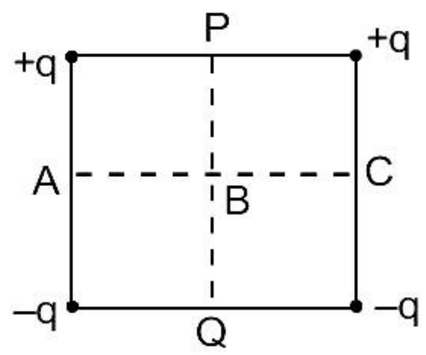
(A) The potential at all the points on the axis will be zero.

(B) The electric field at all the points on the axis will be zero.

(C) The direction of electric field at all points on the axis will be along the axis.

(D) If the ring is placed inside a uniform external electric field then net torque and force acting on the ring would be zero.

13. Figure represents a square carrying charges +q, +q, –q, –q at its four corners as shown. Then the potential will be zero at points : (A, C, P and Q are mid points of sides)



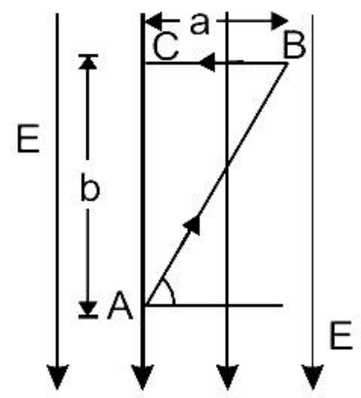
(A) A, B, C, P and Q (B) A, B and C (C) A, P, C and Q (D) P, B and Q

14. Two equal positive charges are kept at points A and B. The electric potential, while moving from A to B along straight line :

(A) continuously increases (B) remains constant

(C) decreases then increases (D) increases then decreases

15. The potential difference between points A and B in the given uniform electric field is :



(A) Ea (B) $E\sqrt{(a^2+b^2)}$ (C) Eb (D) $(Eb/\sqrt{2})$

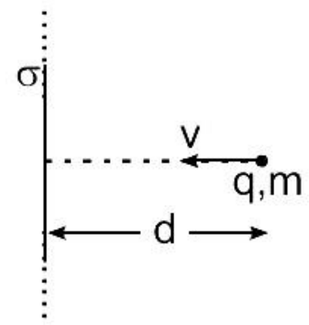
16. If a uniformly charged spherical shell of radius 10 cm has a potential V at a point distant 5 cm from its centre, then the potential at a point distant 15 cm from the centre will be :

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

17. A hollow uniformly charged sphere has radius r. If the potential difference between its surface and a point at distance 3r from the centre is V, then the electric field intensity at a distance 3r from the centre is:

(A) V/6r (B) V/4r (C) V/3r (D) V/2r

18. The particle of mass m and charge q will touch the infinitely large plate of uniform charge density σ if its velocity v is more than: {Given that $\sigma q > 0$}



(A) 0 (B) $\sqrt{\frac{2\sigma qd}{m\epsilon_0}}$ (C) $\sqrt{\frac{\sigma qd}{m\epsilon_0}}$ (D) none of these

19. A charge +q is fixed at each of the points $x = x_0$, $x = 3x_0$, $x = 5x_0$, ... upto infinity on the x-axis and a charge -q is fixed at each of the points $x = 2x_0$, $x = 4x_0$, $x = 6x_0$, ... upto infinity. Here x_0 is a positive constant. Take the electric potential at a point due to a charge Q at a distance r from it to be $\frac{Q}{4\pi\epsilon_0 r}$. Then the potential at the origin due to the above system of charges is:

(A) 0 (B) $\frac{q}{8\pi\epsilon_0 x_0 \ell n 2}$ (C) ∞ (D) $\frac{q\,\ell n 2}{4\pi\epsilon_0 x_0}$

20. If a charge is shifted from a high potential region to low potential region, the electrical potential energy:

(A) Increases (B) Decreases

(C) May increase or decrease. (D) Remains constant

21. A particle of mass 2 g and charge 1μC is held at rest on a frictionless horizontal surface at a distance of 1 m from a fixed charge of 1 mC. If the particle is released it will be repelled. The speed of the particle when it is at distance of 10 m from the fixed charge is:

(A) 100 m/s (B) 90 m/s (C) 60 m/s (D) 45 m/s

22. An α particle is placed in an electric field at a point having electric potential 5V. Find its potential energy ?

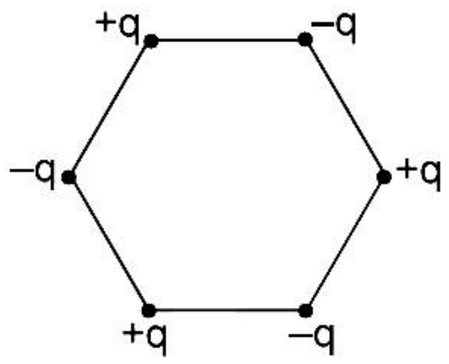
(A) 2 eV (B) 5 eV (C) 10 eV (D) 12 eV

23. When the separation between two charges is decreased, the electric potential energy of the charges

(A) increases (B) decreases

(C) may increase or decrease (D) remains the same

24. 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 electro static 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) $\frac{q^2}{\pi \in_0 a}\left[\frac{\sqrt{3}}{2}-\frac{15}{8}\right]$

25. Two positive point charges 15 μC and 10 μC are 30 cm apart. Calculate the work done in bringing them closer to each other by 15 cm.

(A) 1.5J (B) 2.5 J (C) 3.5 J (D) 4.5 J

ANSWER KEY

1.	(D)	**2.**	(A)	**3.**	(C)	**4.**	(D)	**5.**	(B)
6.	(A)	**7.**	(D)	**8.**	(C)	**9.**	(A)	**10.**	(A)
11.	(C)	**12.**	(A)	**13.**	(B)	**14.**	(C)	**15.**	(C)
16.	(B)	**17.**	(A)	**18.**	(C)	**19.**	(D)	**20.**	(C)
21.	(B)	**22.**	(C)	**23.**	(C)	**24.**	(D)	**25.**	(D)