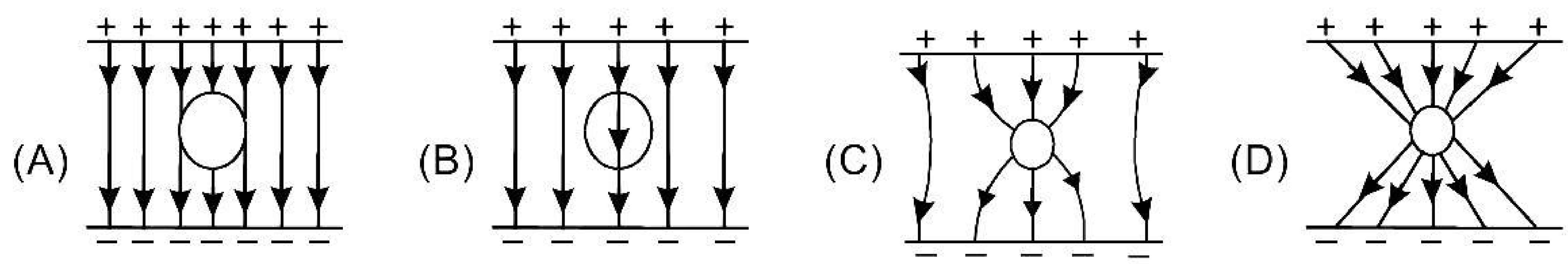
DPP No: 26 | **PHYSICS**

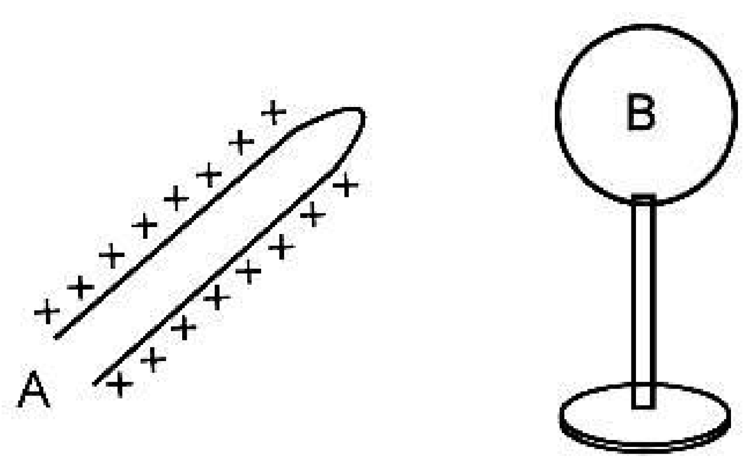
Maximum Time 50 Min | **TARGET JEE-MAINS**

SYLLABUS : ELECTROSTATICS

1. An uncharged sphere of metal is placed in a uniform electric field produced by two large conducting parallel plates having equal and opposite charges, then lines of force look like:

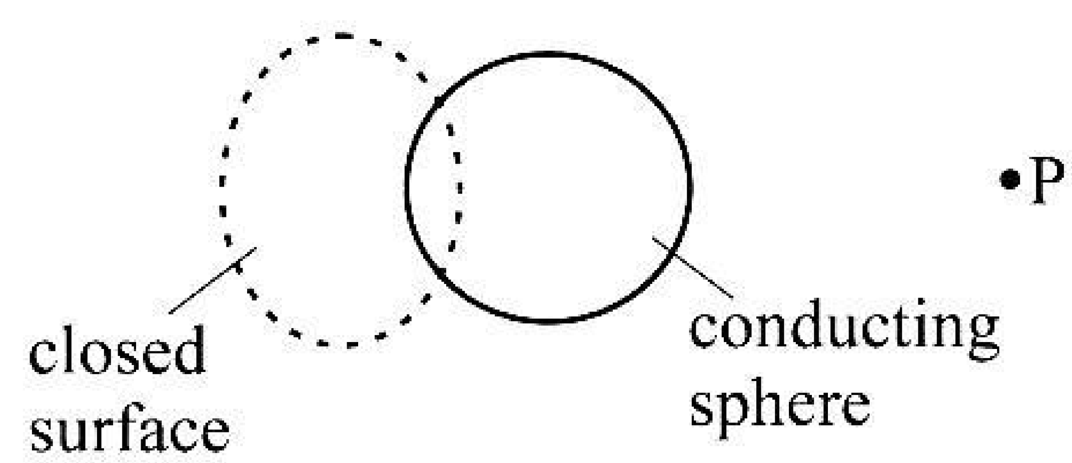


2. A positively charged body 'A' has been brought near a neutral brass sphere B mounted on a glass stand as shown in the figure. The potential of B will be:



(A) Zero (B) Negative (C) Positive (D) Infinite

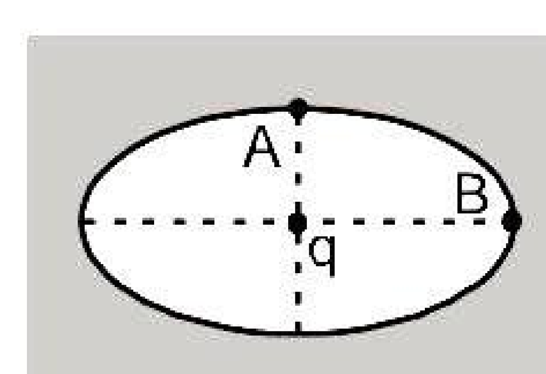
3. Figure shows a closed surface which intersects a conducting sphere. If a positive charge is placed at the point P, the flux of the electric field through the closed surface:



(A) will become positive (B) will remain zero

(C) will become undefined (D) will become negative

4. An ellipsoidal cavity is carved within a perfect conductor. A positive charge q is placed at the center of the cavity. The points A and B are on the cavity surface as shown in the figure



. Then :

(A) Electric field near A in the cavity = electric field near B in the cavity

(B) Charge density at A = Charge density at B

(C) Potential at A = Potential at B

(D) Total electric field flux through the surface of the cavity is q/ε_0 .

5. If the electric flux entering and leaving an enclosed surface respectively is ϕ_1 and ϕ_2, the electric charge inside the surface will be :

(A) $(\phi_2 - \phi_1)\varepsilon_0$ (B) $(\phi_1 + \phi_2)/\varepsilon_0$ (C) $(\phi_2 - \phi_1)/\varepsilon_0$ (D) $(\phi_1 + \phi_2)\,\varepsilon_0$

6. 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) 9.60×10^{-17} J (B) -2.24×10^{-16} J (C) 2.24×10^{-16} J (D) -9.60×10^{-17} J

7. Five balls, numbered 1 to 5, are suspended using separate threads. Pairs (1, 2), (2, 4), (4, 1) show electrostatic attraction, while pairs (2, 3) and (4, 5) show repulsion. Therefore ball 1 :

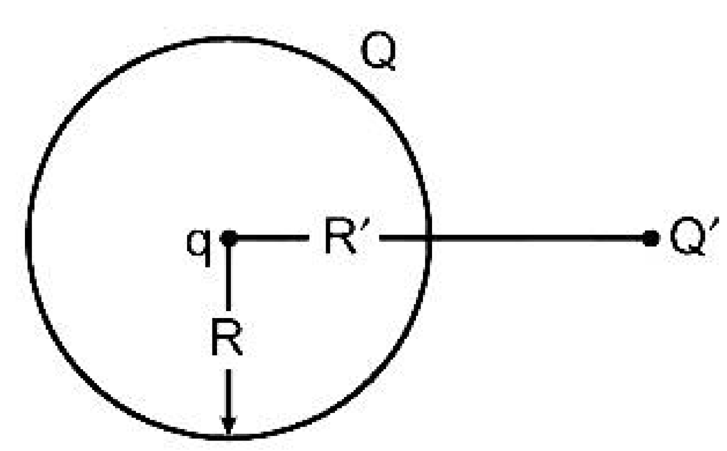
(A) Must be positively charged (B) Must be negatively charged

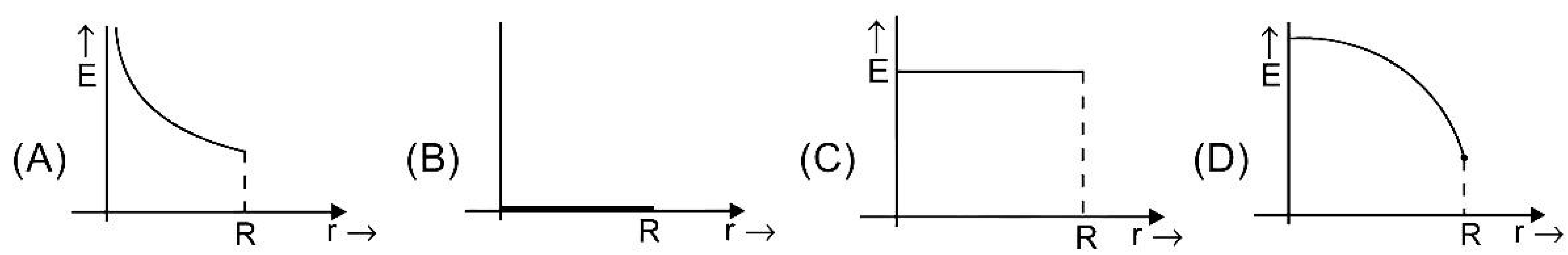
(C) May be neutral (D) Must be made of metal

8. A particle A has charge +q and particle B has charge + 4q with each of them having the same mass m. When allowed to fall from rest through same electrical potential difference, the ratio of their speed $v_A : v_B$ will be :

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

9. A charge 'q' is placed at the centre of a conducting spherical shell of radius R, which is given a charge Q. An external charge Q′ is also present at distance R′ (R′ > R) from 'q'. Then the resultant field will be best represented for region r < R by: [where r is the distance of the point from q]





10. The net charge given to a solid insulating sphere:

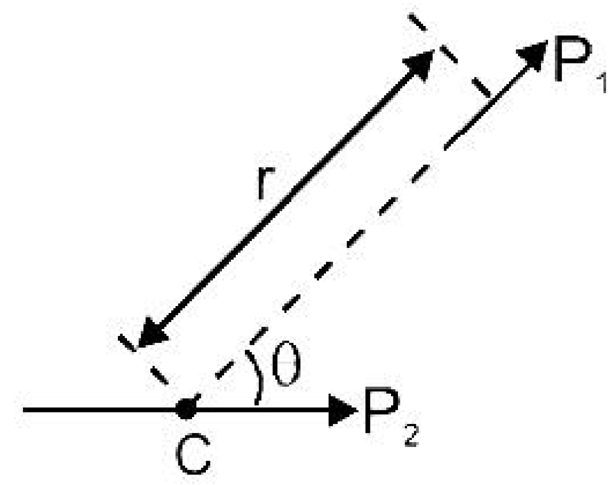
(A) must be distributed uniformly in its volume

(B) may be distributed uniformly in its volume

(C) must be distributed uniformly on its surface

(D) the distribution will depend upon whether other charges are present or not.

11. Two short electric dipoles are placed as shown (r is the distance between their centres). The energy of electric interaction between these dipoles will be: (C is centre of dipole of moment P_2)



(A) $\frac{2k\ P_1P_2\cos\theta}{r^3}$ (B) $\frac{-2k\ P_1P_2\cos\theta}{r^3}$ (C) $\frac{-2kP_1P_2\sin\theta}{r^3}$ (D) $\frac{-4kP_1P_2\cos\theta}{r^3}$

12. A solid conductor 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

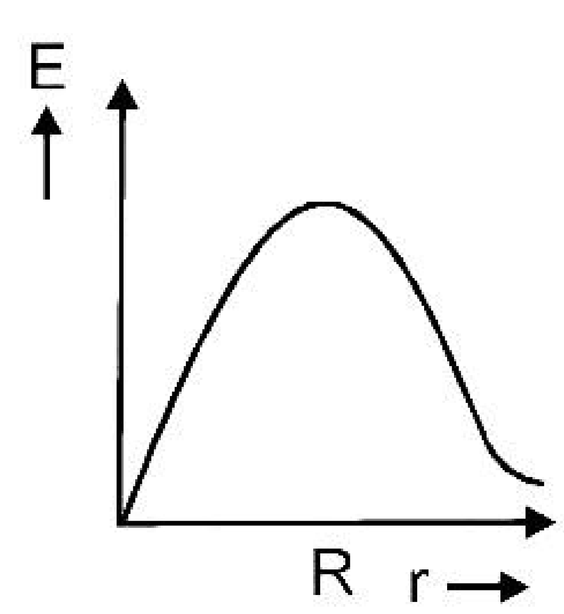
13. In an electron gun, electrons are accelerated through a potential difference of V volt. Taking electronic charge and mass to be respectively e and m, the maximum velocity attained by them is :

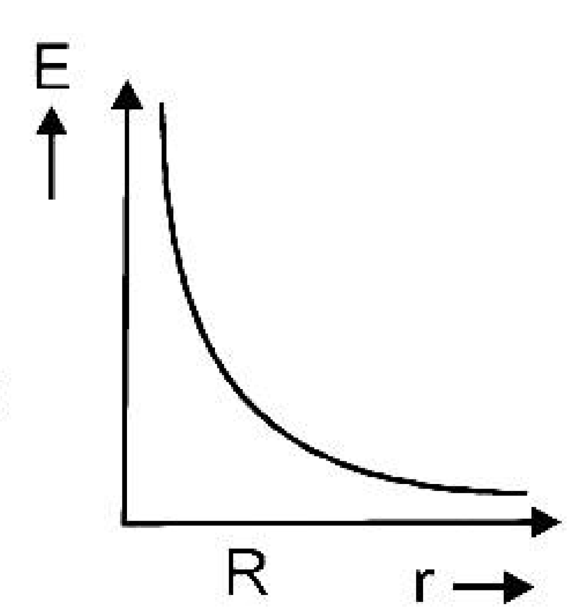
(A) $\frac{2eV}{m}$ (B) $\sqrt{\frac{2eV}{m}}$ (C) 2 m/eV (D) (V^2 /2em)

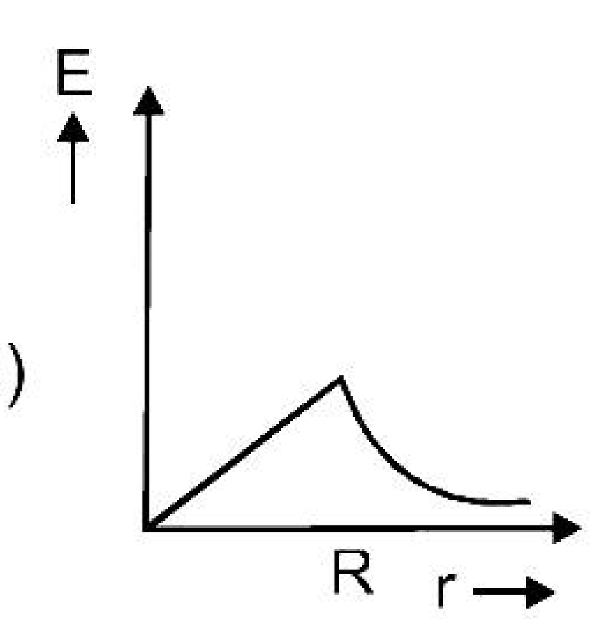
14. Two positive charges of magnitude 'q' are placed at the ends of a side (side 1) of a square of side '2a'. Two negative charges of the same magnitude are kept at the other corners. Starting from rest, if a charge Q moves from the middle of side 1 to the centre of square, its kinetic energy at the centre of square is :

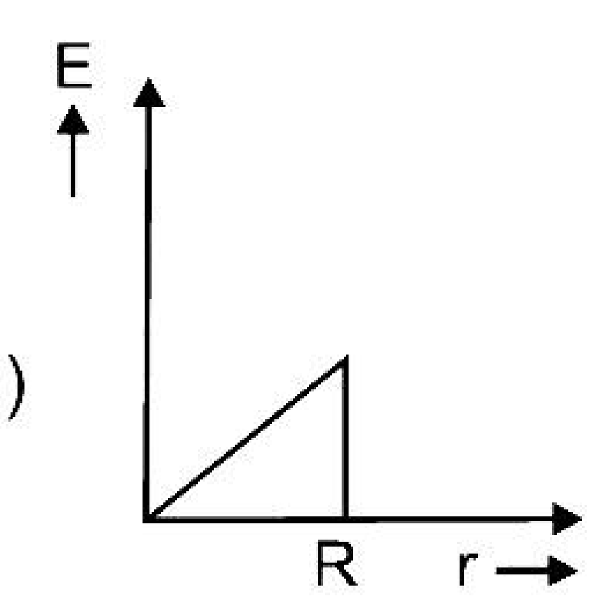
(A) zero (B) $\frac{1}{4\pi\varepsilon_0}\frac{2qQ}{a}\left(1+\frac{1}{\sqrt{5}}\right)$ (C) $\frac{1}{4\pi\varepsilon_0}\frac{2qQ}{a}\left(1-\frac{2}{\sqrt{5}}\right)$ (D) $\frac{1}{4\pi\varepsilon_0}\frac{2qQ}{a}\left(1-\frac{1}{\sqrt{5}}\right)$

15. In a uniformly charged sphere of total charge Q and radius R, the electric field E is plotted as function of distance from the centre. The graph which would correspond to the above will be :

(A) 

(B) 

(C) 

(D) 

16. This question has statement-1 and statement-2. Of the four choices given after the statements, choose the one that best describes the two statements.

An insulating solid sphere of radius R has a unioformly positive charge density ρ. As a result of this uniform charge distribution there is a finite value of electric potential at the centre of the sphere, at the surface of the sphere and also at a point out side the sphere. The electric potential at infinite is zero.

Statement-1 : When a charge 'q' is taken from the centre to the surface of the sphere its potential energy changes by $\frac{q\rho}{3\varepsilon_0}$.

Statement-2 : The electric field at a distance r (r < R) from the centre of the sphere is $\frac{\rho r}{3\varepsilon_0}$

(A) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation of statement-1.

(B) Statement 1 is true Statement 2 is false.

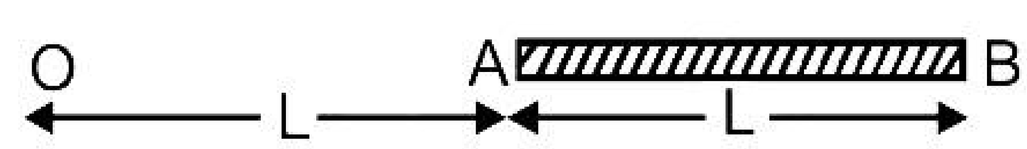
(C) Statement 1 is false Statement 2 is true.

(D) Statement 1 is true, Statement 2 is true, Statement 2 is the correct explanation of Statement 1.

17. Two charges, each equal to q, are kept at x = – a and x = a on the x-axis. A particle of mass m and charge $q_0 = \frac{q}{2}$ is placed at the origin. If charge q_0 is given a small displacement (y <<a) along the y-axis, the net force acting on the particle is proportional to :

(A) y (B) –y (C) $\frac{1}{y}$ (D) $-\frac{1}{y}$

18. A charge Q is uniformly distributed over a long rod AB of length L as shown in the figure. The electric potential at the point O lying at distance L from the end A is :



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

19. Assume that an electric field $\vec{E} = 30x^2\,\hat{i}$ exists in space. Then the potential difference $V_A - V_O$, where V_0 is the potential at the origin and V_A the potential at x = 2 m is :

(A) –120 J (B) –80 J (C) 80 J (D) 120 J

20. A uniformly charged solid sphere of radius R has potential V_0 (measured with respect to ∞) on its surface. For this sphere the equipotential surfaces with potentials $\frac{3V_0}{2}$, $\frac{5V_0}{4}$, $\frac{3V_0}{4}$ and $\frac{V_0}{4}$ have radius R_1, R_2, R_3 and R_4 respectively. Then

(A) $R_1 = 0$ and $R_2 < (R_4 - R_3)$ (B) $2R < R_4$

(C) $R_1 = 0$ and $R_2 > (R_4 - R_3)$ (D) $R_1 \neq 0$ and $(R_2 - R_1) > (R_4 - R_3)$

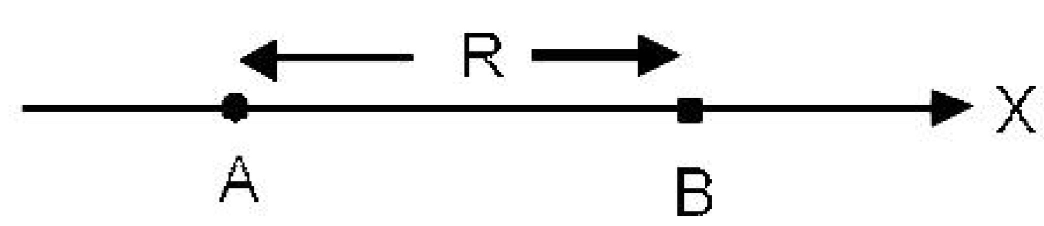
21. Three concentric metal shells A, B and C of respective radii a,b and c (a < b < c) have surface charge densities $+\sigma$, $-\sigma$ and $+\sigma$ respectively. The potential of shell B is :

(A) $\frac{\sigma}{\varepsilon_0}\left[\frac{b^2-c^2}{b}+a\right]$ (B) $\frac{\sigma}{\varepsilon_0}\left[\frac{b^2-c^2}{c}+a\right]$ (C) $\frac{\sigma}{\varepsilon_0}\left[\frac{a^2-b^2}{a}+c\right]$ (D) $\frac{\sigma}{\varepsilon_0}\left[\frac{a^2-b^2}{b}+c\right]$

22. Charge is distributed within a sphere of radius R with a volume charge density $\rho(r)=\frac{A}{r^2}e^{-2r/a}$, where A and a are constant. If Q is the total charge of this charge distribution, the radius R is :

(A) $a\log\left(\frac{1}{1-\frac{Q}{2\pi aA}}\right)$ (B) $\frac{a}{2}\log\left(\frac{1}{1-\frac{Q}{2\pi aA}}\right)$ (C) $\frac{a}{2}\log\left(1-\frac{Q}{2\pi aA}\right)$ (D) $a\log\left(1-\frac{Q}{2\pi aA}\right)$

23. Two electric dipoles, A, B with respective dipole moments $\vec{d}_A=-4qa\hat{i}$ and $\vec{d}_B=-2qa\hat{i}$ are placed on the x–axis with a separation R, as shown in the figure.

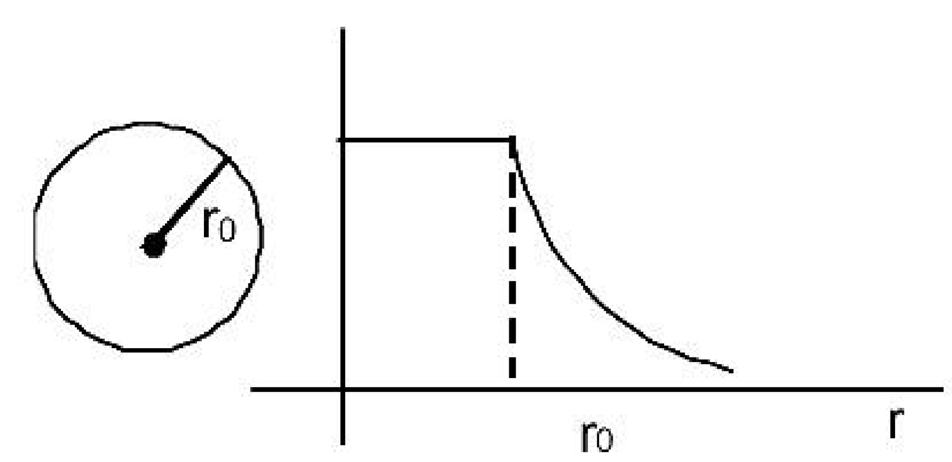


The distance from A at which both of them produce the same potential is :

(A) $\frac{R}{\sqrt{2}-1}$ (B) $\frac{\sqrt{2}R}{\sqrt{2}+1}$ (C) $\frac{\sqrt{2}R}{\sqrt{2}-1}$ (D) $\frac{R}{\sqrt{2}+1}$

24. The given graph shown variation

(with distance r from centre) of :



(A) Electric field of a uniformly charged sphere

(B) Potential of a uniformly charged spherical shell

(C) Potential of a uniformly charged sphere

(D) Electric field of a uniformly charged spherical shell

25. Concentric metallic hollow spheres of radii R and 4R hold charges Q_1 and Q_2 respectively. Given that surface charge densities of the concentric spheres are equal, the potential difference V(R) – V(4R) is

(A) $\frac{3Q_2}{4\pi\varepsilon_0 R}$ (B) $\frac{3Q_1}{16\pi\varepsilon_0 R}$ (C) $\frac{Q_2}{4\pi\varepsilon_0 R}$ (D) $\frac{3Q_1}{4\pi\varepsilon_0 R}$

ANSWER KEY

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