1. Two point charge of 100 μC and –4 μC are positioned at points $(-2\sqrt{3}, 3\sqrt{3}, -4)$ and $(4\sqrt{3}, -5\sqrt{3}, 6)$ respectively of a Cartesian coordinate system. Find the force vector on the –4 μC charge? All the coordinates are in meters.

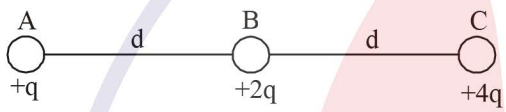
(1) $9\times10^{-4}\left(3\sqrt{3}\hat{i}-4\sqrt{3}\hat{j}+5\hat{k}\right)$

(2) $9\times10^{-4}\left(-3\sqrt{3}\hat{i}+4\sqrt{3}\hat{j}-5\hat{k}\right)$

(3) $2.25\times10^{-4}\left(-3\sqrt{3}\hat{i}+4\sqrt{3}\hat{j}-5\hat{k}\right)$

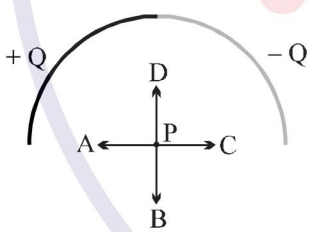
(4) $2.25\times10^{-4}\left(3\sqrt{3}\hat{i}-4\sqrt{3}\hat{j}+5\hat{k}\right)$

2. Three charges +q, +2q and +4q are connected by strings as shown in the figure. What is ratio of tensions in the strings AB and BC.



(1) 1 : 2 (2) 1 : 3 (3) 2 : 1 (4) 3 : 1

3. As shown in the figure to the right, an insulating rod is set into the shape of a semicircle. The left half of the rod has a charge of + Q uniformly distributed along its length, and the right half of the rod has a charge of –Q uniformly distributed along its length. What vector shows the correct direction of the electric field at point P, the centre of the semicircle?



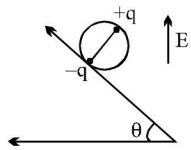
(1) A (2) B
(3) C (4) D

4. A particle of mass m, charge –Q is constrained to move along the axis of a ring of radius a. The ring carries a uniform charge density + λ along its circumference. Initially, the particle lies in the plane of the ring at a point where no net force acts on it. The period of oscillation of the particle when it is displaced slightly from its equilibrium position is:-

(1) $T = 4\pi\sqrt{\frac{\varepsilon_0 ma^2}{\lambda Q}}$ (2) $T = 2\pi\sqrt{\frac{2\varepsilon_0 ma^2}{\lambda Q}}$

(3) $T = 2\pi\sqrt{\frac{4\varepsilon_0 ma^2}{\lambda Q}}$ (4) $T = 2\pi\sqrt{\frac{\varepsilon_0 ma^2}{2\lambda Q}}$

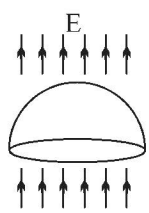
5. A wheel having mass m has charges +q and –q on diametrically opposite points. It remains in equilibrium on a rough inclined plane in the presence of uniform vertical electric field E =



(1) $\frac{mg}{q}$ (2) $\frac{mg}{2q}$

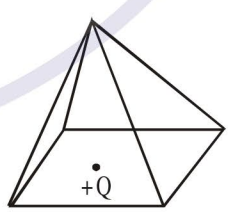
(3) $\frac{mg\tan\theta}{2q}$ (4) none

6. A hemispherical surface (half of a spherical surface) of radius R is located in a uniform electric field E that is parallel to the axis of the hemisphere. What is the magnitude of the electric flux through the hemisphere surface?



(1) 0 (2) $4\pi R^2E/3$
(3) $2\pi R^2E$ (4) πR^2E

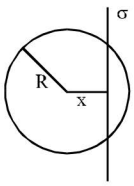
7. A point charge +Q is positioned at the center of the base of a square pyramid as shown. The flux through one of the four identical upper faces of the pyramid is



(1) $\frac{Q}{16\varepsilon_0}$ (2) $\frac{Q}{4\varepsilon_0}$

(3) $\frac{Q}{8\varepsilon_0}$ (4) None of these

8. An infinite, uniformly charged sheet with surface charge density σ cuts through a spherical Gaussian surface of radius R at a distance x from its center, as shown in the figure. The electric flux Φ through the Gaussian surface is :-



(1) $\frac{\pi R^2 \sigma}{\varepsilon_0}$ (2) $\frac{2\pi\left(R^2 - x^2\right)\sigma}{\varepsilon_0}$

(3) $\frac{\pi(R-x)^2\sigma}{\varepsilon_0}$ (4) $\frac{\pi\left(R^2 - x^2\right)\sigma}{\varepsilon_0}$

9. Potential energy of a system comprising of point charges is U_1.When a charge q is added in the system without disturbing other charges, the potential energy becomes U_2.The potential of the point where the charge q is placed in the system is

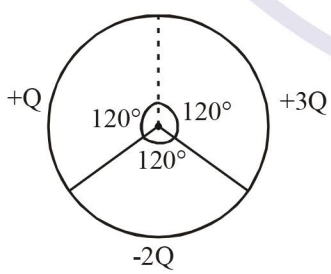
(1) $\frac{U_2 - U_1}{q}$ (2) $\frac{U_1 - U_2}{q}$

(3) $\frac{U_1 + U_2}{2q}$ (4) $\frac{U_2 - U_1}{2q}$

10. Two fixed charges A and B of 5 μC each are separated by a distance of 6m. C is the mid point of the line joining A and B. A charge 'Q' of –5μC is shot perpendicular to the line joining A and B through C with a kinetic energy of 0.06J. The charge 'Q' comes to rest at a point D. The distance CD is:-

(1) 3 m (2) $\sqrt{3}$ m (3) $3\sqrt{3}$ m (4) 4 m

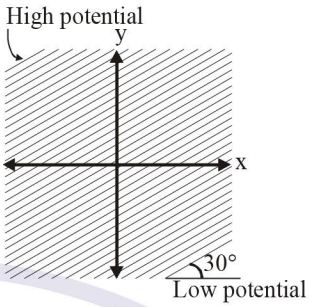
11. Figure shows three circular arcs, each of radius R and total charge as indicated. The net electric potential at the centre of curvature is :-

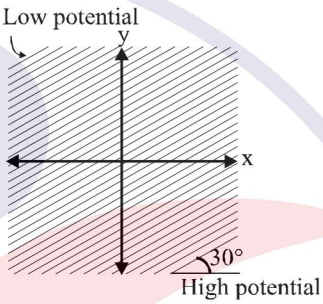


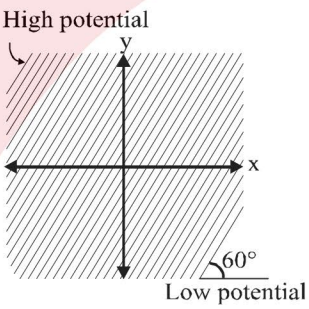
(1) $\frac{Q}{4\pi \in_0 R}$ (2) $\frac{Q}{2\pi \in_0 R}$

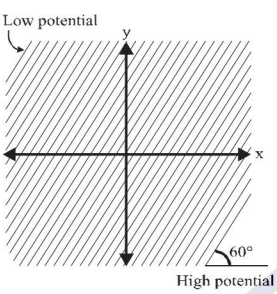
(3) $\frac{2Q}{\pi \in_0 R}$ (4) $\frac{Q}{\pi \in_0 R}$

12. The electric field intensity at all points in space is given by $\vec{E} = \sqrt{3}\hat{i} - \hat{j}$ volts/metre. The nature of equipotential lines in x-y plane is given by :-

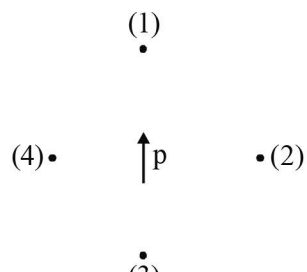
(1)


(2)


(3)


(4)


13. The drawing shows four points surrounding an electric dipole. Which one of the following expressions best ranks the electric potential at these four locations?



(1) 1 > 2 = 4 > 3 (2) 3 > 2 > 4 > 1

(3) 3 > 2 = 4 > 1 (4) 2 = 4 > 1 = 3

14. In an electric field the potential at a point is given by the following relation $V = \frac{343}{r}$. The electric field at $\vec{r} = 3\hat{i} + 2\hat{j} + 6\hat{k}$ is :

(1) $21\hat{i} + 14\hat{j} + 42\hat{k}$ (2) $3\hat{i} + 2\hat{j} + 6\hat{k}$

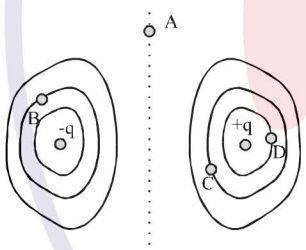
(3) $\frac{1}{7}\left(3\hat{i} + 2\hat{j} + 6\hat{k}\right)$ (4) $-\left(3\hat{i} + 2\hat{j} + 6\hat{k}\right)$

15. From a point if we move in a direction making an angle θ measured from +ve x-axis , the potential gradient is given as $\frac{dv}{dr} = 2\cos\theta$. Find the direction and magnitude of electric field at that point.

(1) $2\hat{i}$ (2) $-2\hat{i}$

(3) $\hat{i} + \hat{j}$ (4) $-\hat{i} + \hat{j}$

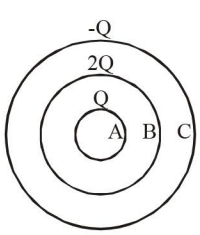
16. Figure shows equi-potential surfaces for a two charges system. At which of the labeled points point will an electron have the highest potential energy?



(1) Point A (2) Point B

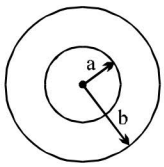
(3) Point C (4) Point D

17. Charge Q, 2Q and –Q are given to three concentric conducting spherical shells A, B and C respectively. The ratio of charges on the inner and the outer surfaces of the shell 'C' will be



(1) $\frac{3}{4}$ (2) $-\frac{3}{4}$ (3) $\frac{3}{2}$ (4) $-\frac{3}{2}$

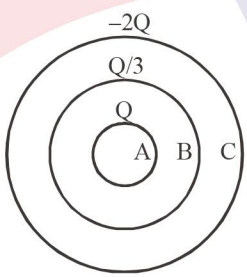
18. If the electric potential of the inner metal sphere is 10 volt & that of the outer shell is 5 volt, then the potential at the centre will be :



(1) 10 volt (2) 5 volt

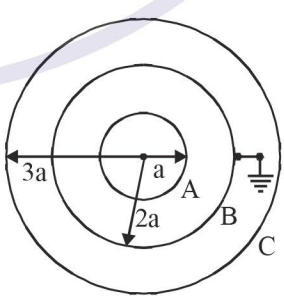
(3) 15 volt (4) 0

19. Three conducting concentric spherical shells of radius R, 2R and 3R have charges Q, $\frac{Q}{3}$ and – 2Q respectively. The intermediate shell is now grounded. Find the charge flow into the earth.



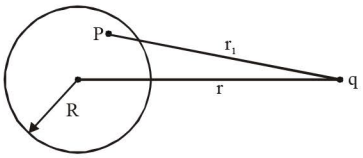
(1) $\frac{Q}{3}$ (2) $\frac{2Q}{3}$ (3) Q (4) 0

20. Figure shows a system of three concentric metal shells A, B and C with radii a, 2a and 3a respectively. Shell B is earthed and shell C is given a charge Q. Now if shell C is connected to shell A, then the final charge on the shell B, is equal to :



(1) $-\frac{4Q}{13}$ (2) $-\frac{8Q}{11}$ (3) $-\frac{5Q}{3}$ (4) $-\frac{3Q}{7}$

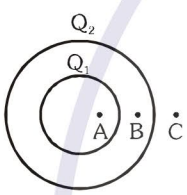
21. A point charge q is placed at a distance r from center of a conducting neutral sphere of radius R (r>R). The potential at any point P inside the sphere at a distance r_1 from point charge due to induced charge of the sphere is given by



(1) $\frac{Kq}{r_1}-\frac{Kq}{R}$ (2) $\frac{Kq}{r_1}-\frac{Kq}{R}$

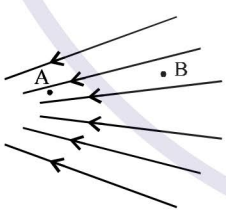
(3) $\frac{Kq}{r}-\frac{Kq}{r_1}$ (4) $-\frac{Kq}{r_1}+\frac{Kq}{R}$

22. Figure shows two uniform charged concentric spherical shell. Both charges are positive, Select correct statement :-



(1) Electric field intensity at B may be greater than electric field intensity at C.
(2) Electric field intensity at B must be greater than electric field intensity at C.
(3) Potential at A greater than potential at B
(4) If a charge moves from B to C work done by electric force must be positive.

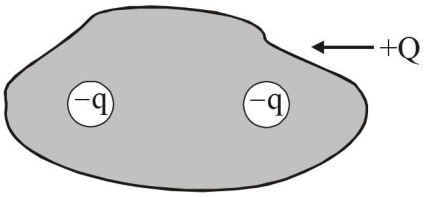
23. Which of the following is true for the figure showing electric lines of force? (E is electrical field, V is potential)



(1) $E_A > E_B$ (2) $E_B > E_A$
(3) $V_A > V_B$ (4) $V_B > V_A$

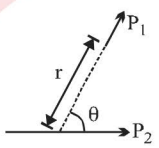
24. A hollow closed conductor of irregular shape is given some charge. Which of the following statements are correct ?
(1) The entire charge will appear on its outer surface.
(2) All points on the conductor will have the same potential.
(3) All points on its surface will have the same charge density.
(4) All points just outside it will have the same electric intensity.

25. A conducting body is given charge Q and charge –q has been placed in each of the cavity, which of the following statements is/are true?



(1) If Q = 2q, then conducting body will be at zero potential.
(2) If an external electric field is applied then the charge distribution on the outer surface of conductor would change.
(3) The potential of any point inside the cavity is less than that of conducting body.
(4) None of these

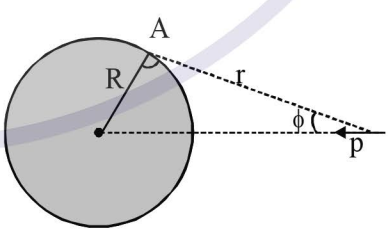
26. Two short electric dipoles are placed as shown. The energy of electric interaction between these dipoles will be :-



(1) $\frac{2kP_1P_2\cos\theta}{r^3}$ (2) $\frac{-2kP_1P_2\cos\theta}{r^3}$

(3) $\frac{-2kP_1P_2\sin\theta}{r^3}$ (4) $\frac{-4kP_1P_2\cos\theta}{r^3}$

27. 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 :-



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

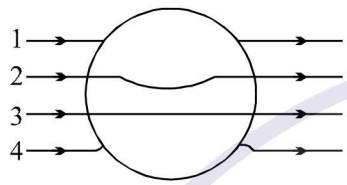
(3) 0 (4) $\frac{2kp\cos^2\phi}{r^2}$

28. n small drops of same size are charged to V volts each. If they coalesce to form a signal large drop, then its potential will be :-

(1) V/n (2) Vn

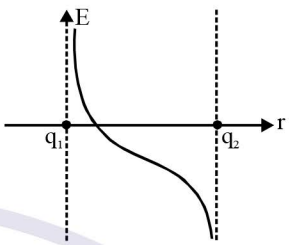
(3) $Vn^{1/3}$ (4) $Vn^{2/3}$

29. A metallic solid sphere is placed in a uniform electric field. The lines of force follow the path (s) shown in figure as :



(1) 1 (2) 2 (3) 3 (4) 4

30. The variation of electric field between the two charges q_1 and q_2 along the line joining the charges is plotted against distance from q_1 (taking rightward direction of electric field as positive) as shown in the figure. Then the correct statement is :-



(1) q_1 and q_2 are positive and $q_1 < q_2$

(2) q_1 and q_2 are positive and $q_1 > q_2$

(3) q_1 is positive and q_2 is negative and $q_1 < q_2$

(4) q_1 and q_2 are negative and $q_1 < q_2$

ANSWER KEY — Exercise-I

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	**2**	**2**	**3**	**2**	**2**	**4**	**3**	**4**	**1**	**4**
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	**2**	**3**	**1**	**2**	**2**	**2**	**4**	**1**	**4**	**2**
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	**3**	**1,3**	**1,4**	**1,2**	**1,2,3**	**2**	**2**	**4**	**4**	**1**