1. Inside a hollow charged spherical conductor, the potential

(a) Is constant

(b) Varies directly as the distance from the centre

(c) Varies inversely as the distance from the centre

(d) Varies inversely as the square of the distance from the centre

2. Two small spheres each carrying a charge q are placed r metre apart. If one of the spheres is taken around the other one in a circular path of radius r, the work done will be equal to

(a) Force between them $\times r$

(b) Force between them $\times 2\pi r$

(c) Force between them $/ 2\pi r$

(d) Zero

3. Two charged spheres of radii 10 *cm* and 15 *cm* are connected by a thin wire. No current will flow, if they have

(a) The same charge on each

(b) The same potential

(c) The same energy

(d) The same field on their surfaces

4. The electric potential V at any point O (x, y, z all in metres) in space is given by $V = 4x^2\ volt$. The electric field at the point $(1m, 0, 2m)$ in $volt/metre$ is

(a) 8 along negative $X-$axis

(b) 8 along positive $X-$axis

(c) 16 along negative $X-$axis

(d) 16 along positive $Z-$axis

5. A hollow metal sphere of radius 5 cm is charged so that the potential on its surface is 10 V. The potential at the centre of the sphere is

(a) 0 V (b) 10 V

(c) Same as at point 5 cm away from the surface

(d) Same as at point 25 cm away from the surface

6. If a unit positive charge is taken from one point to another over an equipotential surface, then

(a) Work is done on the charge

(b) Work is done by the charge

(c) Work done is constant

(d) No work is done

7. Electric lines of force about negative point charge are

(a) Circular, anticlockwise (b) Circular, clockwise

(c) Radial, inward (d) Radial, outward

8. Charges of $+\frac{10}{3}\times 10^{-9} C$ are placed at each of the four corners of a square of side $8\,cm$. The potential at the intersection of the diagonals is

(a) $150\sqrt{2}\ volt$ (b) $1500\sqrt{2}\ volt$

(c) $900\sqrt{2}\ volt$ (d) $900\ volt$

9. A uniform electric field having a magnitude E_0 and direction along the positive $X-$axis exists. If the potential V is zero at $x = 0$, then its value at $X = +x$ will be

(a) $V_{(x)} = +xE_0$ (b) $V_x = -xE_0$

(c) $V_x = +x^2E_0$ (d) $V_x = -x^2E_0$

10. Three charges $2q, -q, -q$ are located at the vertices of an equilateral triangle. At the centre of the triangle

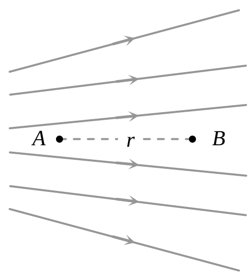
(a) The field is zero but potential is non-zero

(b) The field is non-zero but potential is zero

(c) Both field and potential are zero

(d) Both field and potential are non-zero

11. Figure shows the electric lines of force emerging from a charged body. If the electric field at A and B are E_A and E_B respectively and if the displacement 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) $E_A = \frac{E_B}{r^2}$

12. A conductor with a positive charge
(a) Is always at $+ve$ potential
(b) Is always at zero potential
(c) Is always at negative potential
(d) May be at $+ve$, zero or $-ve$ potential

13. A metallic sphere has a charge of $10\mu C$. A unit negative charge is brought from A to B both $100cm$ away from the sphere but A being east of it while B being on west. The net work done is
(a) Zero (b) $2/10$ *joule*
(c) $-2/10$ *joule* (d) $-1/10$ *joule*

14. Two plates are $2cm$ apart, a potential difference of 10 *volt* is applied between them, the electric field between the plates is
(a) $20\ N/C$ (b) $500\ N/C$
(c) $5\ N/C$ (d) $250\ N/C$

15. There is an electric field E in X-direction. If the work done on moving a charge $0.2C$ through a distance of $2m$ along a line making an angle 60° with the X-axis is 4.0, what is the value of E
(a) $\sqrt{3}\ N/C$ (b) $4\ N/C$
(c) $5\ N/C$ (d) None of these

16. Four equal charges Q are placed at the four corners of a square of each side is 'a'. Work done in removing a charge $-Q$ from its centre to infinity is
(a) 0 (b) $\frac{\sqrt{2}Q^2}{4\pi\varepsilon_0 a}$
(c) $\frac{\sqrt{2}Q^2}{\pi\varepsilon_0 a}$ (d) $\frac{Q^2}{2\pi\varepsilon_0 a}$

17. A particle A has charge $+q$ and a particle B has charge $+4q$ with each of them having the same mass m. When allowed to fall from rest through the same electric potential difference, the ratio of their speed $\frac{v_A}{v_B}$ will become
(a) $2:1$ (b) $1:2$
(c) $1:4$ (d) $4:1$

18. Angle between equipotential surface and lines of force is
(a) Zero (b) 180°
(c) 90° (d) 45°

19. At a certain distance from a point charge the electric field is $500\ V/m$ and the potential is $3000\ V$. What is this distance
(a) $6m$ (b) $12m$
(c) $36m$ (d) $144m$

20. Two charge $+q$ and $-q$ are situated at a certain distance. At the point exactly midway between them
(a) Electric field and potential both are zero
(b) Electric field is zero but potential is not zero
(c) Electric field is not zero but potential is zero
(d) Neither electric field nor potential is zero

21. Four identical charges $+50\mu C$ each are placed, one at each corner of a square of side $2m$. How much external energy is required to bring another charge of $+50\mu C$ from infinity to the centre of the square
$\left(\text{Given } \frac{1}{4\pi\varepsilon_0} = 9\times 10^9 \frac{Nm^2}{C^2}\right)$
(a) $64J$ (b) $41J$
(c) $16J$ (d) $10J$

22. A charge of $5C$ experiences a force of $5000N$ when it is kept in a uniform electric field. What is the potential difference between two points separated by a distance of $1cm$
(a) $10V$ (b) $250V$
(c) $1000V$ (d) $2500V$

23. Two insulated charged conducting spheres of radii $20cm$ and $15cm$ respectively and having an equal charge of $10C$ are connected by a copper wire and then they are separated. Then
(a) Both the spheres will have the same charge of $10C$
(b) Surface charge density on the $20cm$ sphere will be greater than that on the $15cm$ sphere

(c) Surface charge density on the $15\,cm$ sphere will be greater than that on the $20\,cm$ sphere

(d) Surface charge density on the two spheres will be equal

24. Two point charges $100\,\mu C$ and $5\,\mu C$ are placed at points A and B respectively with $AB = 40\,cm$. The work done by external force in displacing the charge $5\,\mu C$ from B to C, where $BC = 30\,cm$, angle $ABC = \frac{\pi}{2}$ and $\frac{1}{4\pi\varepsilon_0} = 9\times10^9\,Nm^2/C^2$

(a) $9\,J$ (b) $\frac{81}{20}J$

(c) $\frac{9}{25}J$ (d) $-\frac{9}{4}J$

25. Equal charges are given to two spheres of different radii. The potential will

(a) Be more on the smaller sphere

(b) Be more on the bigger sphere

(c) Be equal on both the spheres

(d) Depend on the nature of the materials of the spheres

26. An alpha particle is accelerated through a potential difference of $10^6\,volt$. Its kinetic energy will be

(a) $1\,MeV$ (b) $2\,MeV$

(c) $4\,MeV$ (d) $8\,MeV$

27. A charge of $5\,C$ is given a displacement of $0.5\,m$. The work done in the process is $10\,J$. The potential difference between the two points will be

(a) $2\,V$ (b) $0.25\,V$

(c) $1\,V$ (d) $25\,V$

28. The electric potential V is given as a function of distance x (metre) by $V = (5x^2 + 10x - 9)\,volt$. Value of electric field at $x = 1$ is

(a) $20\,V/m$ (b) $6\,V/m$

(c) $11\,V/m$ (d) $-23\,V/m$

29. How much kinetic energy will be gained by an $\alpha-$particle in going from a point at $70\,V$ to another point at $50\,V$

(a) $40\,eV$ (b) $40\,keV$

(c) $40\,MeV$ (d) $0\,eV$

30. If a charged spherical conductor of radius $10\,cm$ has 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) $\frac{1}{3}V$ (b) $\frac{2}{3}V$

(c) $\frac{3}{2}V$ (d) $3V$

31. Two unlike charges of magnitude q are separated by a distance $2d$. The potential at a point midway between them is

(a) Zero (b) $\frac{1}{4\pi\varepsilon_0}$

(c) $\frac{1}{4\pi\varepsilon_0}.\frac{q}{d}$ (d) $\frac{1}{4\pi\varepsilon_0}.\frac{2q}{d^2}$

32. A proton is accelerated through 50,000 V. Its energy will increase by

(a) 5000 eV (b) $8\times10^{-15}\,J$

(c) 5000 J (d) 50,000 J

33. When a proton is accelerated through 1V, then its kinetic energy will be

(a) 1840 eV (b) 13.6 eV

(c) 1 eV (d) 0.54 eV

34. Two charges of $4\mu C$ each are placed at the corners A and B of an equilateral triangle of side length 0.2 m in air. The electric potential at C is $\left[\frac{1}{4\pi\varepsilon_0} = 9\times10^9\frac{N\text{-}m^2}{C^2}\right]$

(a) $9\times10^4\,V$ (b) $18\times10^4\,V$

(c) $36\times10^4\,V$ (d) $36\times10^{-4}\,V$

35. The displacement of a charge Q in the electric field $E = e_1\hat{i} + e_2\hat{j} + e_3\hat{k}$ is $\hat{r} = a\hat{i} + b\hat{j}$. The work done is

(a) $Q(ae_1 + be_2)$ (b) $Q\sqrt{(ae_1)^2 + (be_2)^2}$

(c) $Q(e_1+e_2)\sqrt{a^2+b^2}$ (d) $Q(\sqrt{e_1^2+e_2^2})\,(a+b)$

1. (a) Inside the hollow sphere, at any point the potential is constant.

2. (d) The force is perpendicular to the displacement.

3. (b) Because current flows from higher potential to lower potential.

4. (a) The electric potential $V(x, y, z) = 4x^2$ *volt*

Now $\vec{E} = -\left(\hat{i}\frac{\partial V}{\partial x} + \hat{j}\frac{\partial V}{\partial y} + \hat{k}\frac{\partial V}{\partial z}\right)$

Now $\frac{\partial V}{\partial x} = 8x, \frac{\partial V}{\partial y} = 0$ and $\frac{\partial V}{\partial z} = 0$

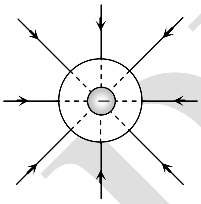
Hence $\vec{E} = -8x\hat{i}$, so at point (1*m*, 0, 2*m*)

$\vec{E} = -8\hat{i}$ *volt/metre* or 8 along negative *X*-axis.

5. (b) Since potential inside the hollow sphere is same as that on the surface.

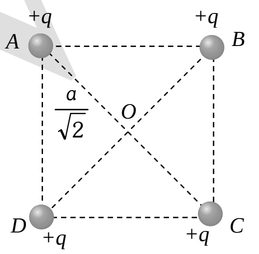
6. (d) On the equipotential surface, electric field is normal to the charged surface (where potential exists) so that no work will be done.

7. (c) Electric lines force due to negative charge are radially inward.



8. (b) Potential at the centre *O*, $V = 4 \times \frac{1}{4\pi\varepsilon_0} \cdot \frac{Q}{a/\sqrt{2}}$

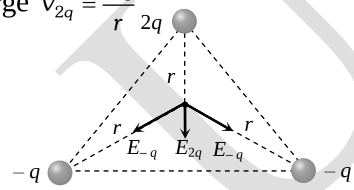
where $Q = \frac{10}{3} \times 10^{-9} C$ and $a = 8\,cm = 8 \times 10^{-2} m$



So $V = 5 \times 9 \times 10^9 \times \frac{\frac{10}{3} \times 10^{-9}}{\frac{8 \times 10^{-2}}{\sqrt{2}}} = 1500\sqrt{2}$ *volt*

9. (b) $\because E = -\frac{dV}{dX} \Rightarrow V_x = -xE_0$

10. (b) Obviously, from charge configuration, at the centre electric field is non-zero. Potential at the centre due to 2*q* charge $V_{2q} = \frac{2q}{r}$



and potential due to – *q* charge

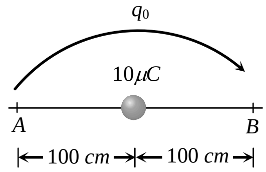
$V_{-q} = -\frac{q}{r}$ (*r* = distance of centre point)

$\therefore$ Total potential $V = V_{2q} + V_{-q} + V_{-q} = 0$

11. (a) In non-uniform electric field. Intensity is more, where the lines are more denser.

12. (d) May be at positive, zero or negative potential, it is according to the way one defines the zero potential.

13. (a)



Since $V_A = V_B$ so $W_{A \to B} = 0$

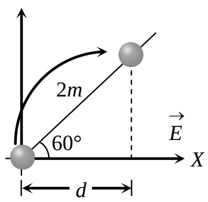
14. (b) $E = \frac{V}{d} = \frac{10}{2 \times 10^{-2}} = 500\, N/C$

15. (d) $W = qV = qE.d$

$\Rightarrow 4 = 0.2 \times E \times (2 \cos 60^o)$

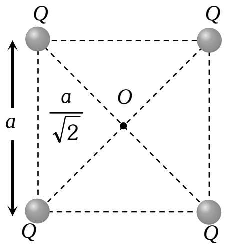
$= 0.2\, E \times (2 \times 0.5)$

$\therefore\; E = \frac{4}{0.2} = 20\, NC^{-1}$



16. (c) Potential at centre O of the square

$$V_O = 4\left(\frac{Q}{4\pi\varepsilon_0(a/\sqrt{2})}\right)$$



Work done in shifting ($-Q$) charge from centre to infinity

$$W = -Q(V_\infty - V_O) = QV_0$$

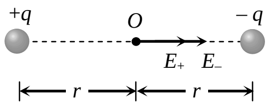
$$= \frac{4\sqrt{2}\,Q^2}{4\pi\varepsilon_0 a} = \frac{\sqrt{2}Q^2}{\pi\varepsilon_0 a}$$

17. (b) Using $v = \sqrt{\frac{2QV}{m}} \Rightarrow v \propto \sqrt{Q} \Rightarrow \frac{v_A}{v_B} = \sqrt{\frac{Q_A}{Q_B}} = \sqrt{\frac{q}{4q}} = \frac{1}{2}$

18. (c) Lines of force is perpendicular to the equipotential surface. Hence angle = 90^o

19. (a) $V = E\times r \Rightarrow r = \frac{V}{E} = \frac{3000}{500} = 6\,m$

20. (c) At O, $E \neq 0$, $V = 0$



21. (a) Potential at the centre of square

$$V = 4\times\left(\frac{9\times10^9\times50\times10^{-6}}{2/\sqrt{2}}\right) = 90\sqrt{2}\times10^4 V$$

Work done in bringing a charge (q = 50 μC) from ∞ to centre (O) of the square is $W = q(V_0 - V_\infty) = qV_0$

$$\Rightarrow W = 50\times10^{-6}\times90\sqrt{2}\times10^4 = 64J$$

22. (a) $F = QE = \frac{QV}{d} \Rightarrow 5000 = \frac{5\times V}{10^{-2}} \Rightarrow V = 10\,volt$

23. (c) After redistribution, charges on them will be different, but they will acquire common potential

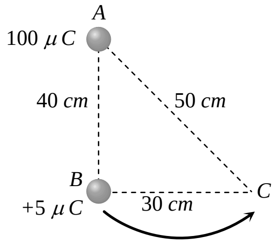
i.e. $k\frac{Q_1}{r_1} = k\frac{Q_2}{r_2} \Rightarrow \frac{Q_1}{Q_2} = \frac{r_1}{r_2}$

As $\sigma = \frac{Q}{4\pi r^2} \Rightarrow \frac{\sigma_1}{\sigma_2} = \frac{Q_1}{Q_2}\times\frac{r_2^2}{r_1^2} \Rightarrow \frac{\sigma_1}{\sigma_2} = \frac{r_2}{r_1} \Rightarrow \sigma \propto \frac{1}{r}$

i.e. surface charge density on smaller sphere will be more.

24. (d) Work done in displacing charge of 5 μC from B to C is

$W = 5\times10^{-6}(V_C - V_B)$ where



$$V_B = 9\times10^9\times\frac{100\times10^{-6}}{0.4} = \frac{9}{4}\times10^6 V$$

and $V_C = 9\times10^9\times\frac{100\times10^{-6}}{0.5} = \frac{9}{5}\times10^6 V$

So $W = 5\times10^{-6}\times\left(\frac{9}{5}\times10^6 - \frac{9}{4}\times10^6\right) = -\frac{9}{4}J$

25. (a) $V = \frac{kq}{R}$ *i.e.* $V \propto \frac{1}{R}$

$\therefore$ Potential on smaller sphere will be more.

26. (b) $K = qV = 2e\times10^6 J = \frac{2e\times10^6}{e}eV = 2MeV$

27. (a) Since $W = qV \Rightarrow 20 = 5\times V \Rightarrow V = 2$ *volts*

28. (a) $E = -\frac{dV}{dx} = -\frac{d}{dx}(5x^2 + 10x - 9) = -10x - 10$

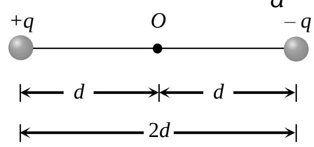
$\therefore (E)_{x=1} = -10\times1 - 10 = -20\,V/m$

29. (a) $KE = q(V_1 - V_2) = 2\times1.6\times10^{-19}\times(70-50) = 40\,eV$

30. (b) Potential inside the sphere will be same as that on its surface *i.e.* $V = V_{surface} = \frac{q}{10}$ *stat volt* , $V_{out} = \frac{q}{15}$ *stat volt*

$\therefore \frac{V_{out}}{V} = \frac{2}{3} \Rightarrow V_{out} = \frac{2}{3}V$

31. (a) Potential at mid point O, $V = \frac{kq}{d} + \frac{k(-q)}{d} = 0$

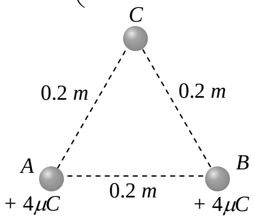


32. (b) Kinetic energy $K = Q.V \Rightarrow K = (+e)$ (50000 V)

$= 50000\ eV = 50000 \times 1.6 \times 10^{-19}\ J = 8 \times 10^{-15}\ J$

33. (c) $\Delta KE = qV = eV = e \times 1 = 1 eV$

34. (c) Potential at $C = \left(9 \times 10^9 \times \frac{4 \times 10^{-6}}{0.2}\right) \times 2 = 36 \times 10^4\ V$



35. (a) By using $W = Q(\vec{E}.\Delta\vec{r})$

$\Rightarrow W = Q[(e_1\hat{i} + e_2\hat{j} + e_3\hat{k}).(a\hat{i} + b\hat{j})] = Q(e_1 a + e_2 b)$