ABLES KOTA

In a certain region of space with volume 0.2 m^3, the electric potential is found to be 5 V throughout. The magnitude of electric field in this region is

(a) zero (b) 0.5 N/C

(c) 1 N/C (d) 5 N/C

$V = 0.2^3$

$V = 5$ volt

$E = 0$

$E = -\frac{dV}{dy}$

$E = 0$

A bullet of mass 2 g is having a charge of 2 μC. Through what potential difference must it be accelerated, starting from rest, to acquire a speed of 10 m/s ?

(a) 5 kV

(b) 50 kV

(c) 5 V

(d) 50 V

$m = 2\times10^{-3}$ kg

$q = 2\times10^{-6}$ C

V → KE = qV

$qV = \frac{1}{2}mv^2$

$qV = \frac{1}{2}mv^2$

$2\times10^{-6}\times V = \frac{1}{2}\times2\times10^{-3}\times10^2$

$V = \frac{10^{-1}}{2\times10^{-6}}$

$V = \frac{1}{2}\times10^5$

$= 5\times10^4 = 50\times10^3$ Volt

$= 50$ kV

$V = 5\times10^2$

The electric potential at a point in free space due to charge Q coulomb is $Q \times 10^{11}$ volts. The electric field at that point is

(a) $4\pi\varepsilon_0 Q \times 10^{20}$ volt/m

(b) $12\pi\varepsilon_0 Q \times 10^{22}$ volt/m

(c) $4\pi\varepsilon_0 Q \times 10^{22}$ volt/m ✓

(d) $12\pi\varepsilon_0 Q \times 10^{20}$ volt/m

Q •———— r ————• $E = ?$

$V = Q \times 10^{11} = \frac{KQ}{r}$

$\frac{K}{r} = 10^{11}$

$r = \frac{K}{10^{11}}$

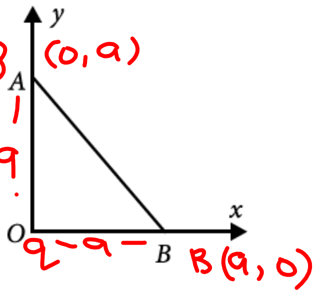
$E = \frac{KQ}{r^2}$

$E = \frac{KQ}{\frac{K^2}{(10^{11})^2}}$

$E = \frac{KQ \times 10^{22}}{K^2}$

$E = \frac{Q \times 10^{22}}{\frac{1}{4\pi\varepsilon_0}} = 4\pi\varepsilon_0 Q \times 10^{22}$ V/m

As per the diagram a point charge $+q$ is placed at the origin O. Work done in taking another point charge $-Q$ from the point A [coordinates $(0, a)$] to another point B [coordinates $(a, 0)$] along the straight path AB is



(a) zero ✓

(b) $\left(\dfrac{qQ}{4\pi\varepsilon_0}\dfrac{1}{a^2}\right)\cdot\sqrt{2}\,a$

(c) $\left(\dfrac{-qQ}{4\pi\varepsilon_0}\dfrac{1}{a^2}\right)\cdot\sqrt{2}\,a$

(d) $\left(\dfrac{qQ}{4\pi\varepsilon_0}\dfrac{1}{a^2}\right)\cdot\dfrac{a}{\sqrt{2}}$

$W = -Q[V_f - V_i]$

$W = -Q[V_B - V_A]$

$W = -Q\left[\dfrac{kq}{a} - \dfrac{kq}{a}\right]$

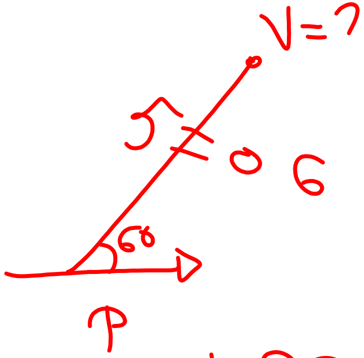
$-Q \times 0 = 0$

ABLES KOTA

A short electric dipole has a dipole moment of 16×10^{-9} C m. The electric potential due to the dipole at a point at a distance of 0.6 m from the centre of the dipole, situated on a line making an angle of 60° with the dipole axis is

$$\left(\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \text{ N m}^2/\text{C}^2\right)$$

(a) 50 V
(b) 200 V
(c) 400 V
(d) zero



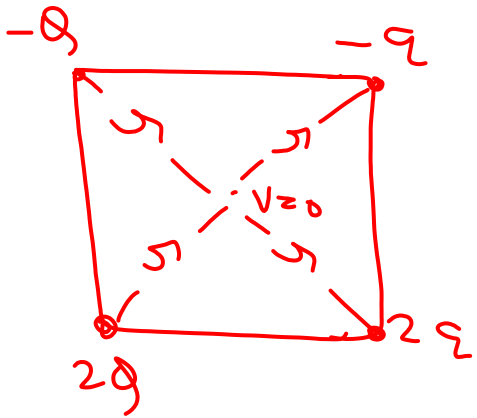
Four point charges $-Q$, $-q$, $2q$ and $2Q$ are placed, one at each corner of the square. The relation between Q and q for which the potential at the centre of the square is zero is

(a) $Q = -q$

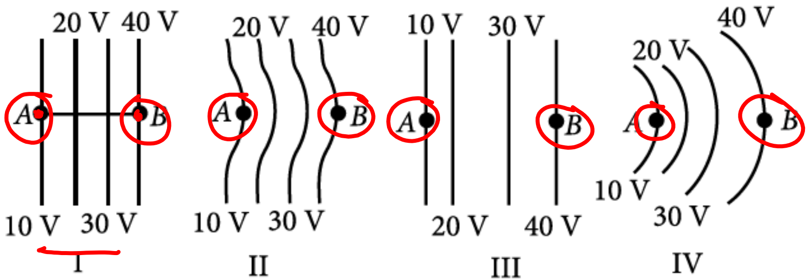
(b) $Q = -\frac{1}{q}$

(c) $Q = q$

(d) $Q = \frac{1}{q}$



The diagrams below show regions of equipotentials.



A positive charge is moved from A to B in each diagram.

(a) In all the four cases the work done is the same.

(b) Minimum work is required to move q in figure (I).

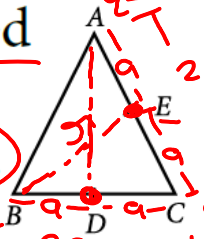
(c) Maximum work is required to move q in figure (II).

(d) Maximum work is required to move q in figure (III).

$W = q(V_f - V_A)$

$= q[V_B - V_A]$

Three charges, each $+q$, are placed at the corners of an isosceles triangle ABC of sides BC and AC, $2a$. D and E are the mid points of BC and CA. The work done in taking a charge Q from D to E is



(a) $\dfrac{3qQ}{4\pi\varepsilon_0 a}$

(b) $\dfrac{3qQ}{8\pi\varepsilon_0 a}$

(c) $\dfrac{qQ}{4\pi\varepsilon_0 a}$

(d) zero

The electric potential at a point (x, y, z) is given by $V = -x^2y - xz^3 + 4$. The electric field at that point is

(a) $\vec{E} = \hat{i}\, 2xy + \hat{j}(x^2 + y^2) + \hat{k}(3xz - y^2)$

(b) $\vec{E} = \hat{i}\, z^3 + \hat{j}\, xyz + \hat{k}\, z^2$

(c) $\vec{E} = \hat{i}(2xy - z^3) + \hat{j}\, xy^2 + \hat{k}\, 3z^2 x$

(d) $\vec{E} = \hat{i}(2xy + z^3) + \hat{j}\, x^2 + \hat{k}\, 3xz^2$

$V = -x^2y - xz^3 + 4$

$E_x = -\frac{\partial V}{\partial x}\hat{i}$

$= -\left[-2xy - 1z^3\right]\hat{i}$

$E_x = (2xy + z^3)\hat{i}$

$E_y = -\frac{\partial V}{\partial y} = -\left[-x^2 - 0\right]\hat{j}$

$E_y = +x^2\hat{j}$

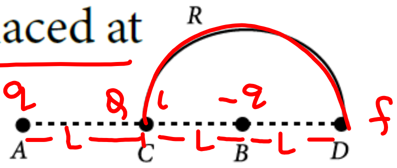
$E_z = -\frac{\partial V}{\partial z}\hat{k} = -\left(-x3z^2\right)\hat{k}$

$E_z = +3xz^2\hat{k}$

$\vec{E} = E_x\hat{i} + E_y\hat{j} + E_z\hat{k}$

$\vec{E} = (2xy + z^3)\hat{i} + x^2\hat{j} + 3xz^2\hat{k}$

Charges $+q$ and $-q$ are placed at points A and B respectively which are a distance $2L$ apart, C is the midpoint between A and B. The work done in moving a charge $+Q$ along the semicircle CRD is



(a) $\dfrac{qQ}{2\pi\varepsilon_0 L}$

(b) $\dfrac{qQ}{6\pi\varepsilon_0 L}$

(c) $-\dfrac{qQ}{6\pi\varepsilon_0 L}$

(d) $\dfrac{qQ}{4\pi\varepsilon_0 L}$

1	2	3	4	5	6	7	8	9	10
A	B	C	A	B	A	A	D	D	C

Two resistors of resistance 100 Ω & 200 Ω are connected in parallel in an electrical ckt. The ratio of the thermal energy developed in 100 Ω to that in 200 Ω in a given time.

(a) 2:1

(b) 1:4

(c) 4:1

(d) 1:2

$$E = P \cdot t$$

$$E = \frac{V^2}{R} \times t$$

$$\frac{E_1}{E_2} = \frac{V^2 t \times 200}{100 \times V^2 t} \quad (2:1)$$

$$E_1 = \frac{V^2}{100} \times t$$

$$E_2 = \frac{V^2}{200} \times t$$

(2) Two hollow conducting sphere of radeii R_1 & R_2 $[R_1 >> R_2]$ have equal charge. The potential would be

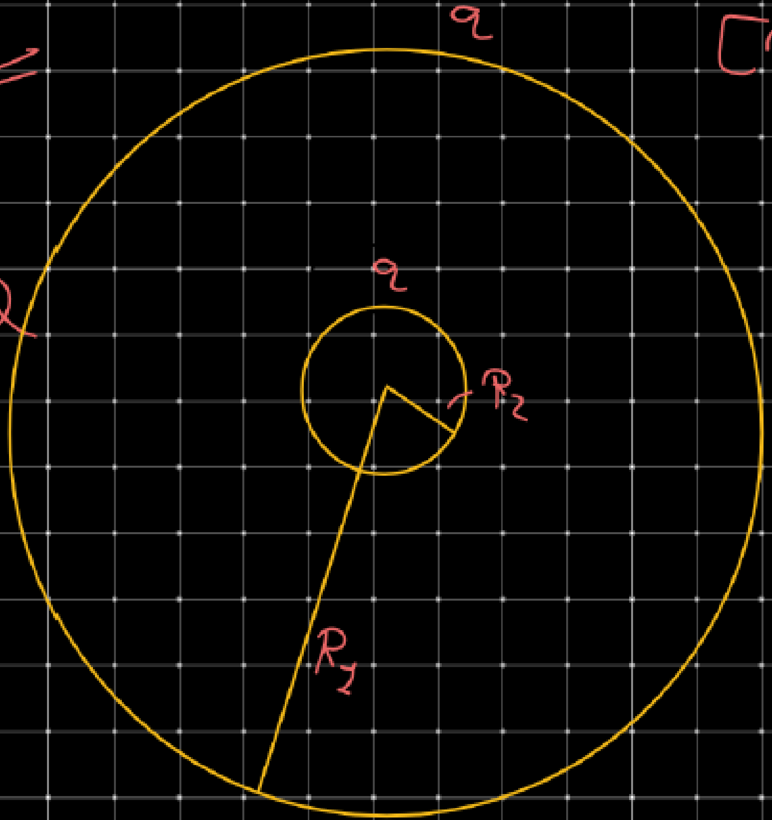
(a) more on smaller sphere ✓

(b) Equal on both the sphere

(c) dependent on the material property of the sphere.

(d) more on bigger sphere

$[R_1 >> R_2]$



Smaller $V_s = \frac{kq}{R_1} + \frac{kq}{R_2}$

$V_b = \frac{kq}{R_1} + \frac{kq}{R_1}$

Q) A long solenoid of radius 1mm has 100 turn per mm. If 1 Amp current flow in the solenoid, the magnetic field strength at the centre of the solenoid is

(a) 12.56×10^{-2} T.

(b) 12.56×10^{-4} T.

(c) 6.28×10^{-4} T.

(d) 6.28×10^{-2} T.

$n = 100/mm$

$n = 100/10^{-3} m = 100 \times 10^{3}$ turn/m

$= 10^{5}$ turn/m

$B = \mu_0 n i$

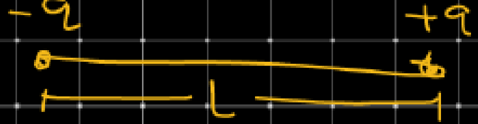
$B = 4\pi \times 10^{-7} \times 10^{5} \times 1$

$= 4\pi \times 10^{-2}$

$= 4 \times 3.14 \times 10^{-2}$

$= 12.56 \times 10^{-2}$ T

Q) Two point charges (−q) & (+q) are placed at a distance L as shown in figure



The magnitude of electric field intensity at a distance R (R >> L) varies as.

(a) $\frac{1}{R^3}$ (c) $\frac{1}{R^6}$

(b) $\frac{1}{R^4}$ (d) $\frac{1}{R^2}$

$$E = \frac{kP}{r^3}\sqrt{1+3\cos^2\theta}$$

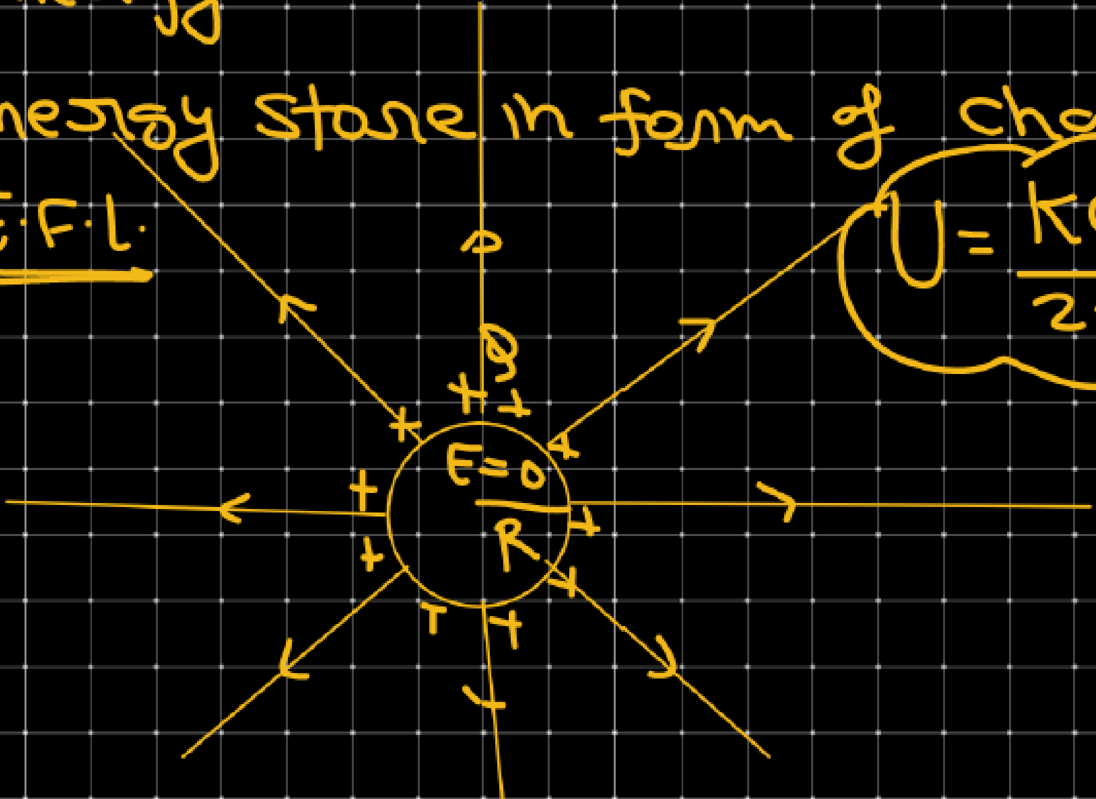
$$E \propto \frac{1}{r^3}$$

$$E \propto \frac{1}{R^3}$$

Capacitor

- It is a device which provide instant Energy.
- Energy store in form of Charge /

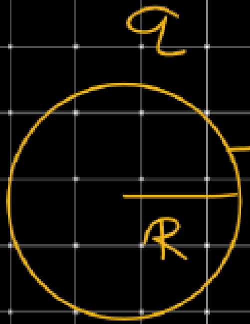
E.F.L.



$$U = \frac{KQ^2}{2R}$$

↳ Capacitance of a Capacitor [C] :-

$$q \propto V \qquad V = \frac{W}{q}$$



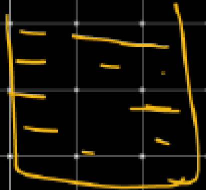
$$V = \frac{Kq}{R}$$

$$q \propto V$$

$$q = CV \Rightarrow C = \frac{q}{V}$$

C → Capacitance of Capacitor

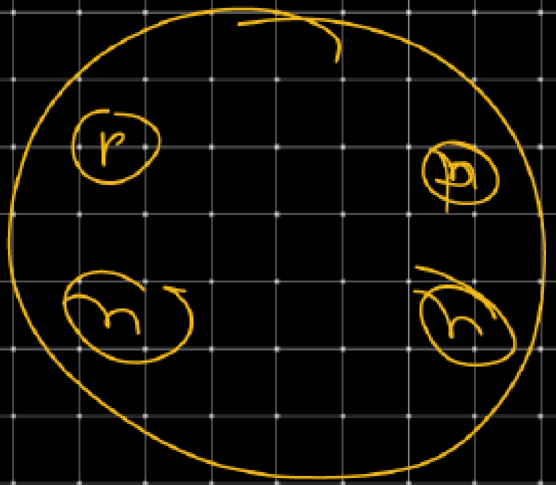
C → SI Unit = $\frac{C}{Volt}$ = Farad.



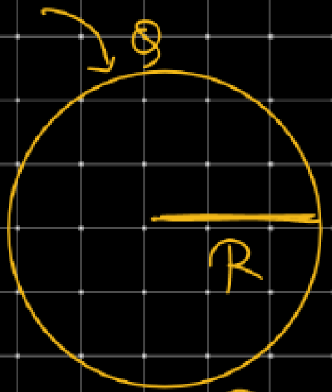
$$\Downarrow \quad [C] = \frac{[AT][AT]}{[ML^2T^{-2}]} = \frac{[A^2T^2]}{[ML^2T^{-2}]} = [M^{-1}L^{-2}A^2T^4]$$

range = 10^{-15} m

$> \boxed{10^{-15} m}$

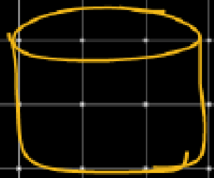


Q1) Capacitance of Spherical Conductor.



$$Q = CV$$

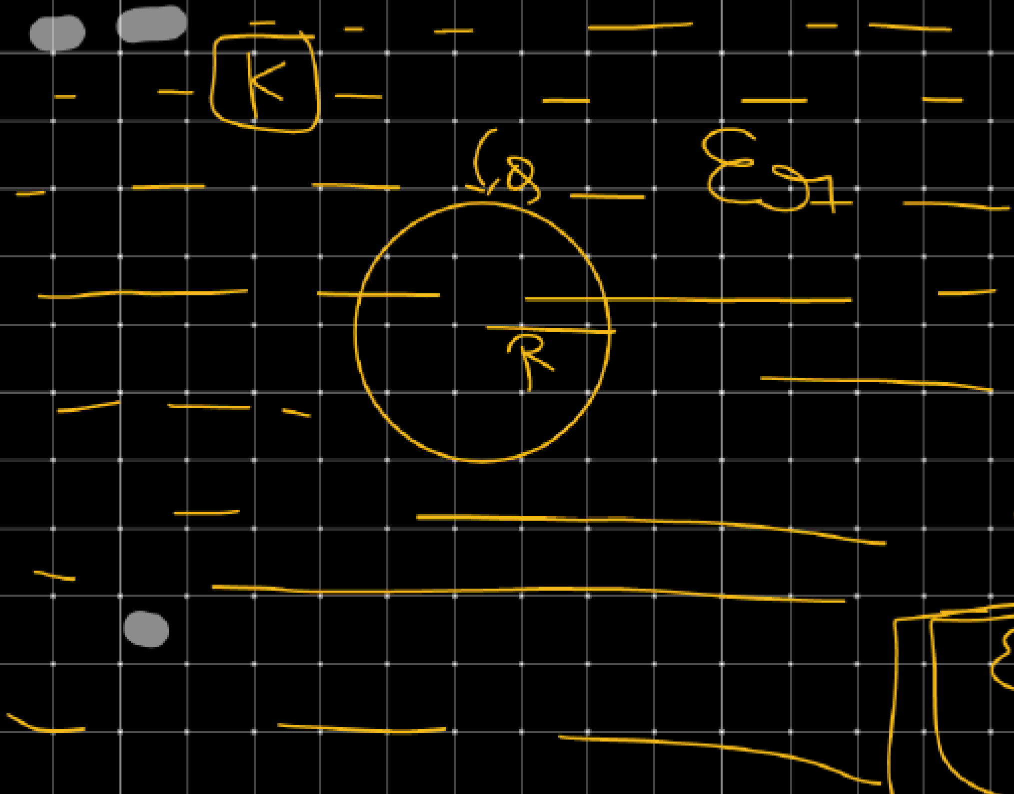
$$C = \frac{Q}{V}$$



$$C = \frac{Q}{\frac{KQ}{R}} = \frac{R}{K} = \frac{R}{\frac{1}{4\pi\varepsilon_0}} = \boxed{4\pi\varepsilon_0 R}$$

→ depends on → dimension.

→ medium.



$$C = \frac{Q}{V}$$

$$C = \frac{Q}{\frac{1}{4\pi\varepsilon_0\varepsilon_r}\frac{Q}{R}}$$

$$C_m = 4\pi\varepsilon_0\varepsilon_r R$$

$$C_m = (4\pi\varepsilon_0 R)K$$

$$\varepsilon_m = K\varepsilon_r$$

Q1) A sphere of radius R-m placed in vacuum have Capacitance 10μF. find its Capacitance when it placed in water medium.

Sol

$$\mathcal{E}_m = K\,\mathcal{E}_{vac}$$

$$= 81 \times 10\,\mu F$$

$$\boxed{\mathcal{E}_m = 810\,\mu F}$$

$$\mathcal{E}_m = 810\,\mu F$$