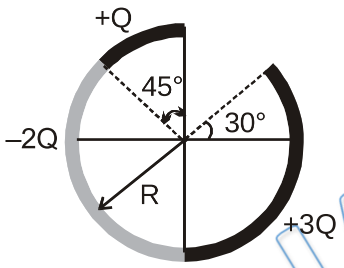
DPP – 4 (Electrostatics)

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/93

Video Solution on YouTube:- https://youtu.be/OlriAKSU7iM

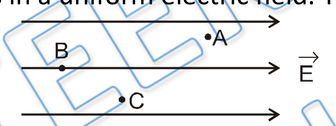
Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/39

Q 1. Figure shows three circular arcs, each of radius R and total charge as indicated. The net electric potential at the centre of curvature is:



(a) $\frac{Q}{2\pi\varepsilon_0 R}$ (b) $\frac{Q}{4\pi\varepsilon_0 R}$ (c) $\frac{2Q}{\pi\varepsilon_0 R}$ (d) $\frac{Q}{\pi\varepsilon_0 R}$

Q 2. A, B and C are three points in a uniform electric field. The electric potential is:

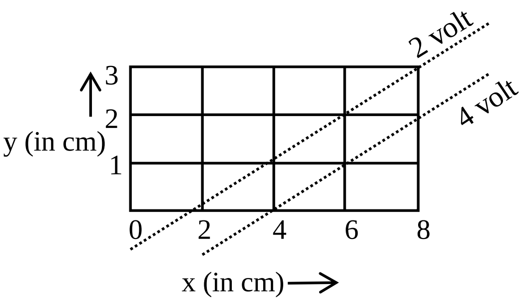


(a) maximum at B
(b) maximum at C
(c) same at all the three points A, B and C
(d) maximum at A

Q 3. In a region the potential is represented by V(x, y, z) = 6x – 8xy –8y + 6yz, where V is in volts and x, y, z, are in meters. The electric force experienced by a charge of 2 coulomb situated at point (1, 1,1) is:

(a) $6\sqrt{5}$N (b) 30N (c) 24N (d) $4\sqrt{35}$N

Q 4. Figure below shows two equipotential lines in xy-plane for an electric field. The scales are marked. Electric field in the space between these equipotential lines are respectively

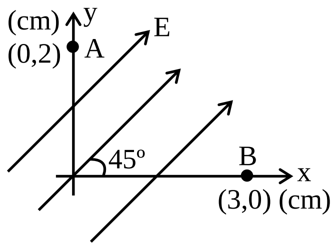


(a) + 100 i – 200 j V/m
(b) – 100 i + 200 j V/m
(c) + 200 i+ 100 j V/m
(d) – 200 i – 100 j V/m

Q 5. The equation of an equipotential line in an electric field is y = 2x, then the electric field strength vector at (1, 2) may be -

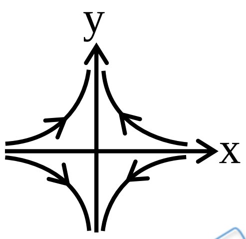
(a) 4 i + 3 j (b) 4 i + 8j (c) 8 i + 4 j (d) – 8i + 4 j

Q 6. A uniform electric field of 400 V/m is directed at 45º above the x-axis as shown in figure. The potential difference $V_A - V_B$ is given by–

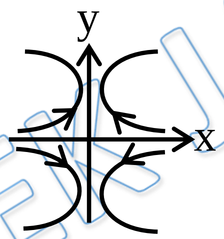


(a) 0 V (b) 4V (c) 6.4V (d) 2.8V

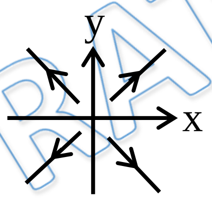
Q 7. The potential field depends on x and y coordinates as V = $(x^2 - y^2)$. Corresponding electric field lines in x-y plane as shown in Fig -



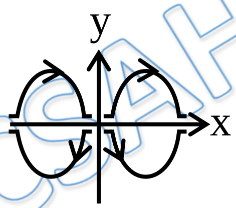
(a)



(b)



(c)



(d)

Q 8. The potential field of an electric field $\vec{E} = (y\hat{i} + x\hat{j})$ is

(a) V = –xy + constant (b) V = –(x + y) + constant

(c) V = - $(x^2 + y^2)$ + constant (d) V = constant

Q 9. A nonconducting ring of radius 0.5 m carries a total charge of 1.11×10^{-10} C distributed nonuniformly on its circumference, producing an electric field $\vec{E}$ everywhere in space. The value of the line integral $\int_{l=\infty}^{l=0} -\vec{E}.\vec{dl}$ (*l* = 0 being the centre of the ring) in volts is

(a) +2 (b) –1 (c) –2 (d) 0

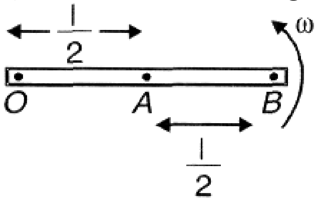
Q 10. Two points are at distances a and b (a < b) from a long string of charge per unit length λ. The potential difference between the points is proportional to

(a) $\frac{b}{a}$ (b) $\frac{b^2}{a^2}$ (c) $\sqrt{\frac{b}{a}}$ (d) ln (b/a)

Q 11. On the axis of uniformly charged ring of radius R magnitude of rate of change of potential is maximum at

(a) Centre of ring
(b) Distance .5R from centre of ring
(c) Distance .7R from centre of ring
(d) Distance R from ring

Q 12. A conducting rod of length L rotates about its one end with angular velocity ω Potential difference between A and B is {m & e = mass and charge on electron)

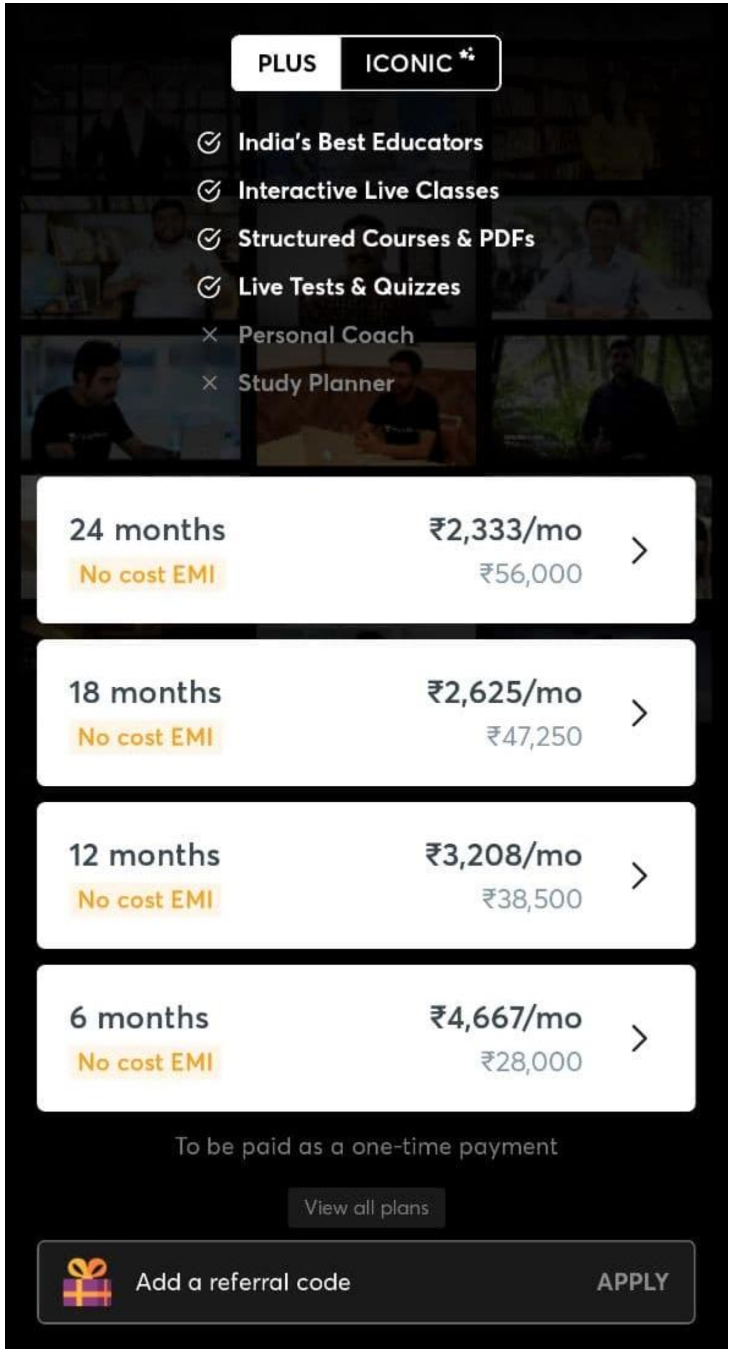


(a) $\frac{m\omega^2 l^2}{e}$ (b) $\frac{3m\omega^2 l^2}{4e}$ (c) $\frac{3m\omega^2 l^2}{8e}$ (d) zero

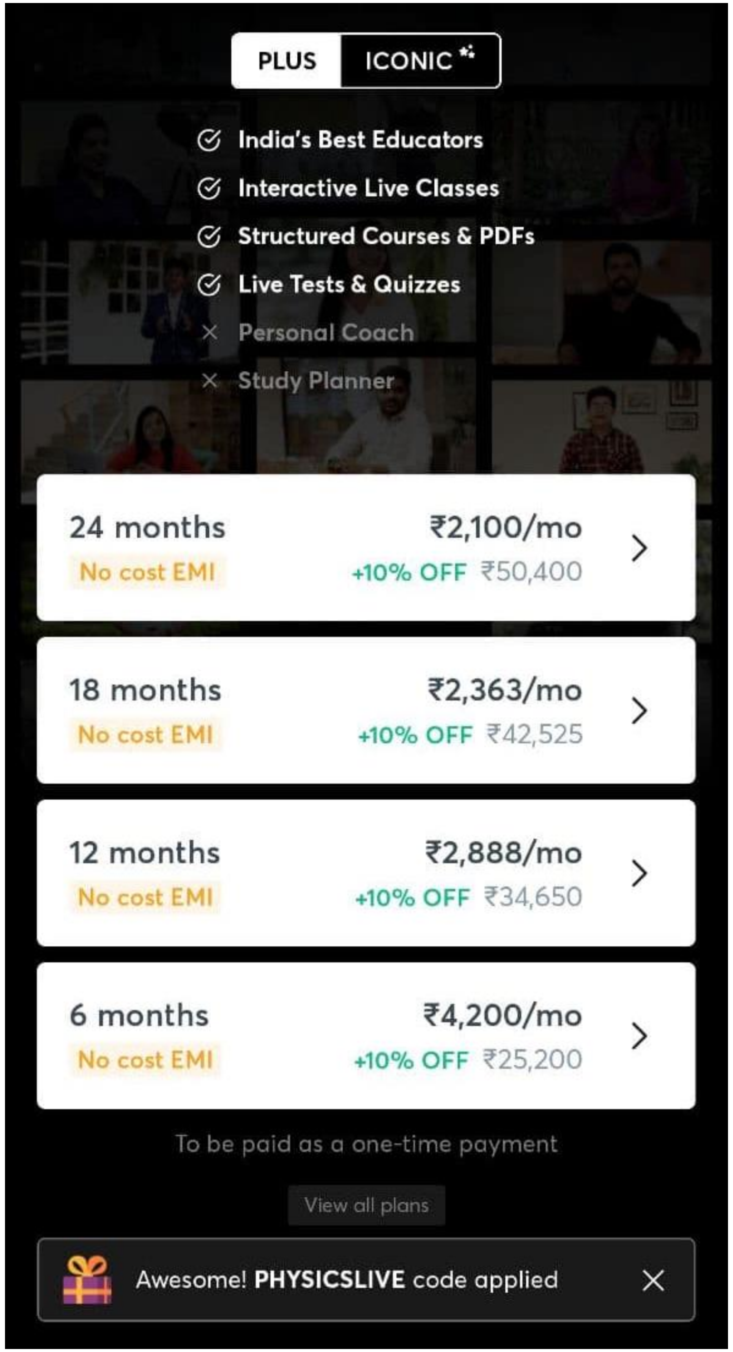
Q 13. In a uniform electric field, the potential of origin is V and V/2 at each of the points (a, 0, 0), (0, b, 0), (0, 0, c). The potential at (a, b, c) will be
(a) V/2 (b) -3V/2 (c) –V/2 (d) -V

Answer Key

Q.1 a	**Q.2 a**	**Q.3 d**	**Q.4 b**	**Q.5 d**
Q.6 d	**Q.7 a**	**Q.8 a**	**Q.9 a**	**Q.10 d**
Q.11 c	**Q.12 c**	**Q.13 c**		



PHYSICSLIVE



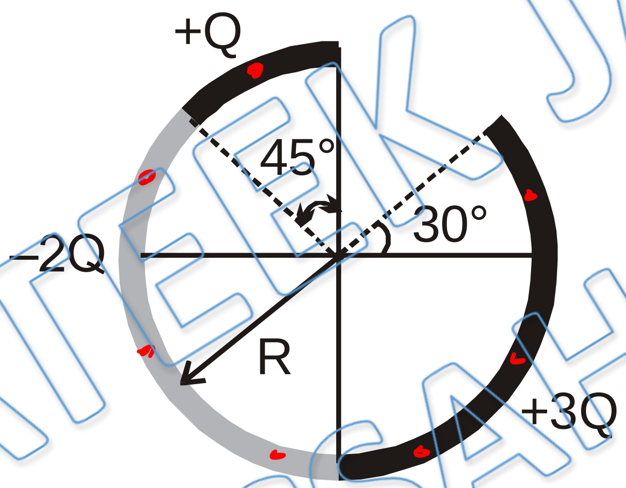
Use code PHYSICSLIVE to get 10% OFF on Unacademy PLUS.

Written Solution

DPP- 4 Electrostatics : Electric Potential

By Physicsaholics Team

Q1) Figure shows three circular arcs, each of radius R and total charge as indicated. The net elecric potential at the centre of curvature is :



$V = \frac{K \Sigma q}{R}$

$= \frac{K(3Q + Q - 2Q)}{R}$

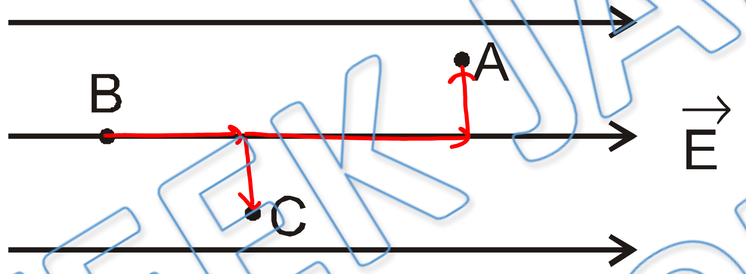
$= \frac{2KQ}{R}$

$= \frac{Q}{2\pi\epsilon_0 R}$

(a) $\frac{Q}{2\pi\varepsilon_0 R}$ (b) $\frac{Q}{4\pi\varepsilon_0 R}$ (c) $\frac{2Q}{\pi\varepsilon_0 R}$ (d) $\frac{Q}{\pi\varepsilon_0 R}$

Q2) A, B and C are three points in a uniform electric field. The electric potential is :

$V_B > V_C > V_A$



(A) maximum at B

(B) maximum at C

(C) same at all the three points A, B and C

(D) maximum at A

Q3) In a region the potential is represented by V(x, y, z) = 6x – 8xy –8y + 6yz, where V is in volts and x, y, z, are in meters. The electric force experienced by a charge of 2 coulomb situated at point (1, 1,1) is :

$V = 6x - 8xy - 8y + 6yz$

$E_x = -\frac{\partial V}{\partial x} = -[6 - 8y] = -[6-8] = 2$

$E_y = -\frac{\partial V}{\partial y} = -[-8x - 8 + 6z] = -[-8-8+6] = 10$

$E_z = -\frac{\partial V}{\partial z} = -[6y] = -6$

(a) $6\sqrt{5}$N (b) 30N (c) 24N (d) $4\sqrt{35}$N ✓

$\vec{E} = 2\hat{i} + 10\hat{j} - 6\hat{k}$

$\vec{F} = q\vec{E} = 2[2\hat{i} + 10\hat{j} - 6\hat{k}]$

$F = 2\sqrt{4+100+36} = 2\sqrt{140} = 4\sqrt{35}$ N

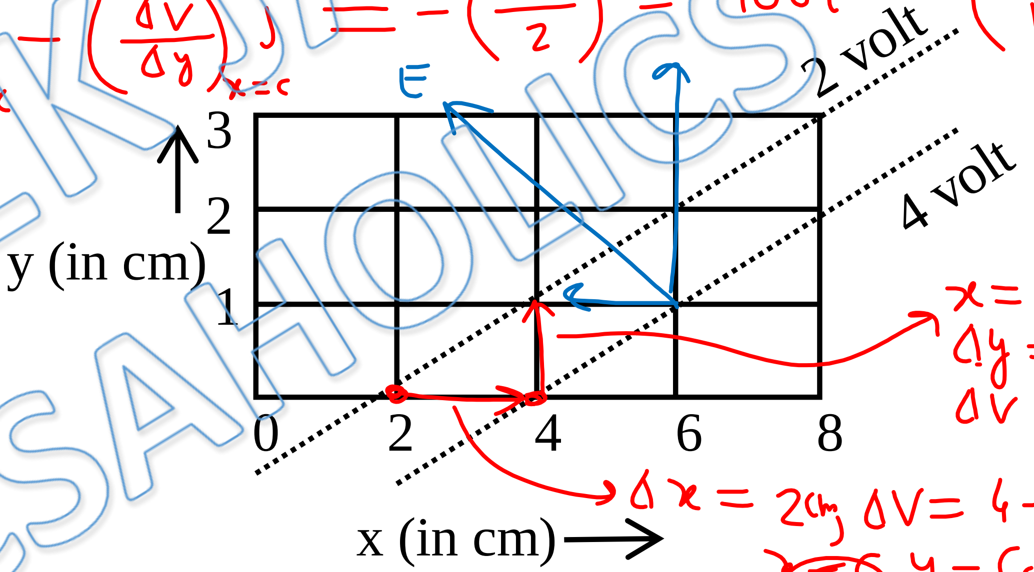
Q4) Figure below shows two equipotential lines in xy-plane for an electric field. The scales are marked. Electric field in the space between these equipotential lines are respectively

(a) + 100 i – 200 j V/m

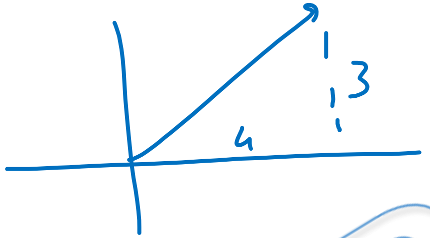
(b) – 100 i + 200 j V/m

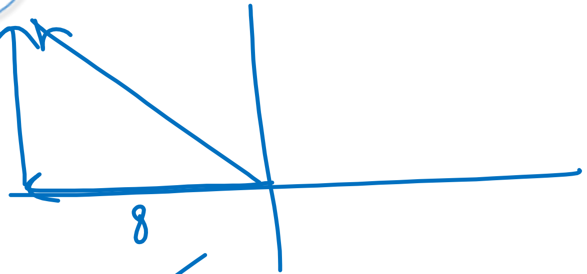
(c) + 200 i+ 100 j V/m

(d) – 200 i – 100 j V/m

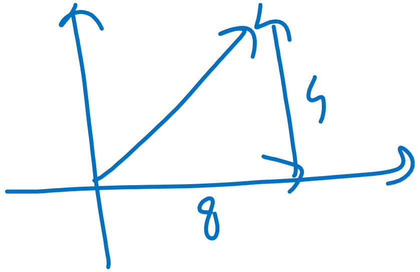


Q5) The equation of an equipotential line in an electric field is y = 2x, then the electric field strength vector at (1, 2) may be -





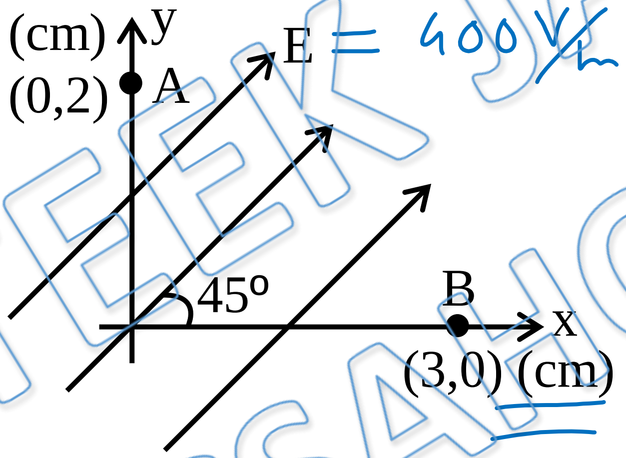
(a) 4 i + 3 j (b) 4 i + 8j (c) 8 i + 4 j (d) – 8i + 4 j



Q6) A uniform electric field of 400 V/m is directed at 45° above the x-axis as shown in figure. The potential difference $V_A - V_B$ is given by–

A is final B is initial

$\overrightarrow{\Delta r} = (-3\hat{i} + 2\hat{j})$ cm



E = 400 V/m

$dV = -\vec{E}\cdot\vec{dr}$

$\Delta V = -\vec{E}\cdot\overrightarrow{\Delta r}$

$= -(200\sqrt{2}\,\hat{i} + 200\sqrt{2}\,\hat{j})\cdot(-3\hat{i} + 2\hat{j}) \times 10^{-2}$

$= -(-600\sqrt{2} + 400\sqrt{2}) \times 10^{-2}$

(a) 0 V

(b) 4V

(c) 6.4V

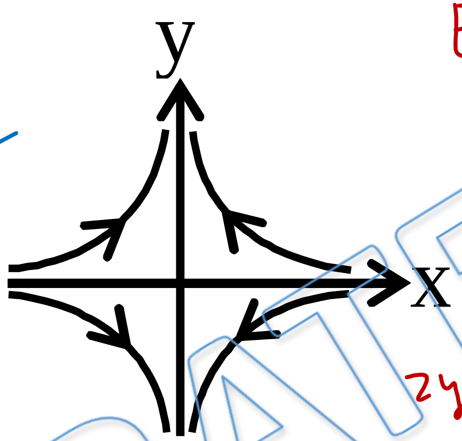
(d) 2.8V

$\Delta V = 200\sqrt{2}\,V \times 10^{-2}$

$= 2\sqrt{2}\,V$

Q7) The potential field depends on x and y coordinates as V = $(x^2 - y^2)$. Corresponding electric field lines in x-y plane as shown in Fig -

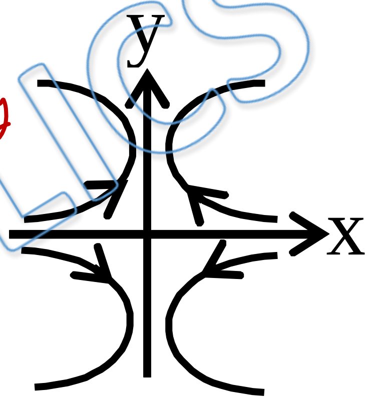
(a)



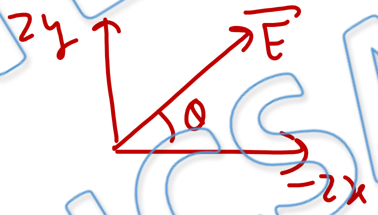
$E_x = -\frac{\partial V}{\partial x} = -2x$

$E_y = -\frac{\partial V}{\partial y} = -(-2y) = 2y$

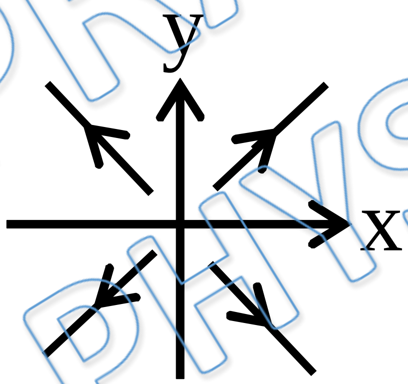
(b)



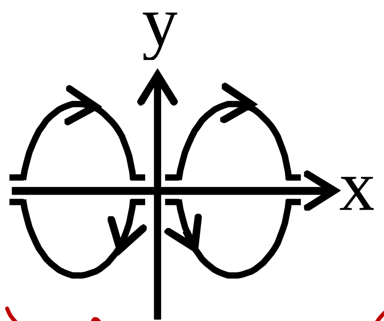
$\vec{E} = -2x\,\hat{i} + 2y\,\hat{j}$



(c)



(d)



$\tan\theta = \frac{2y}{-2x} = \frac{dy}{dx}$

$\int \frac{dy}{y} + \int \frac{dx}{x} = 0$

$\ln y + \ln x = C \Rightarrow \ln xy = C \Rightarrow xy = C$

Q8) The potential field of an electric field $\vec{E} = (y\hat{i} + x\hat{j})$ is

$$V = \int_{x,y}^{r_0 \to \text{reference}} \vec{E}\cdot\vec{dr} = \int_{x,y}^{x_0,y_0} (y\hat{i} + x\hat{j})\cdot(dx\,\hat{i} + dy\,\hat{j})$$

(a) V = –xy + constant ✓

(b) V = –(x + y) + constant

(c) V = - (x^2 + y^2) + constant

(d) V = constant

$$V = \int_{x,y}^{x_0,y_0} y\,dx + x\,dy = \int_{x,y}^{x_0,y_0} d(xy) = \left[xy\right]_{x,y}^{x_0,y_0}$$

$$= x_0y_0 - xy$$

$$= -xy + c$$

Q9) A nonconducting ring of radius 0.5 m carries a total charge of 1.11×10^{-10} C distributed nonuniformly on its circumference, producing an electric field $\vec{E}$ everywhere in space. The value of the line integral $\int_{l=\infty}^{l=0} -\vec{E}.\vec{dl}$ ($l = 0$ being the centre of the ring) in volts is

$q = 1.11 \times 10^{-10}$ C

$R = .5$ m

$$-\int_{l=\infty}^{l=0} \vec{E}\,\vec{dl} = \int_{l=0}^{l=\infty} \vec{E}\,\vec{dl} = V \text{ at } l = 0$$

(a) +2 (b) –1 (c) –2 (d) 0

$$= V \text{ at Centre} = \frac{Kq}{R}$$

$$= \frac{9 \times 10^{9} \times 1.11 \times 10^{-10}}{.5} = 2V$$

Q10) Two points are at distances a and b (a < b) from a long string of charge per unit length λ. The potential difference between the points is proportional to

(a) $\frac{b}{a}$ (b) $\frac{b^2}{a^2}$ (c) $\sqrt{\frac{b}{a}}$ (d) ln (b/a)

$E = \frac{2K\lambda}{r}$

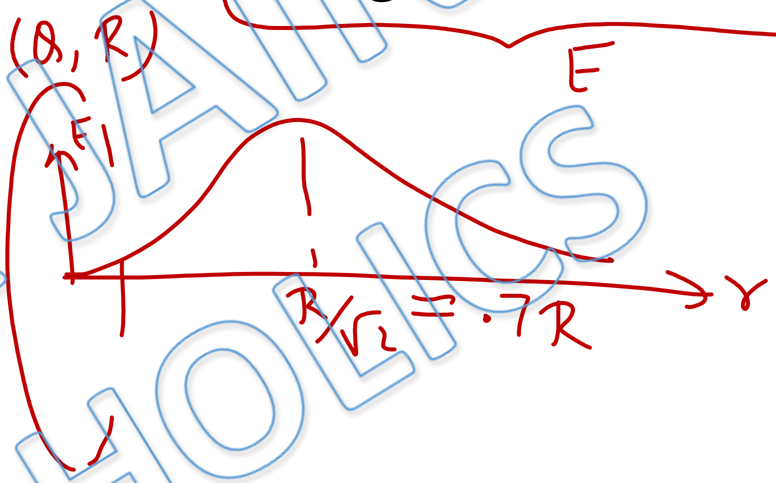
$dV = -\vec{E}\cdot\vec{dr}$

$dV = -\frac{2K\lambda}{r}dr$

$\int_{V_A}^{V_B} dV = -2K\lambda\int_a^b \frac{dr}{r}$

$V_B - V_A = -2K\lambda \ln(b/a)$

Q11) On the axis of uniformly charged ring of radius R magnitude of rate of change of potential is maximum at



(a) Centre of ring

(b) Distance .5R from centre of ring

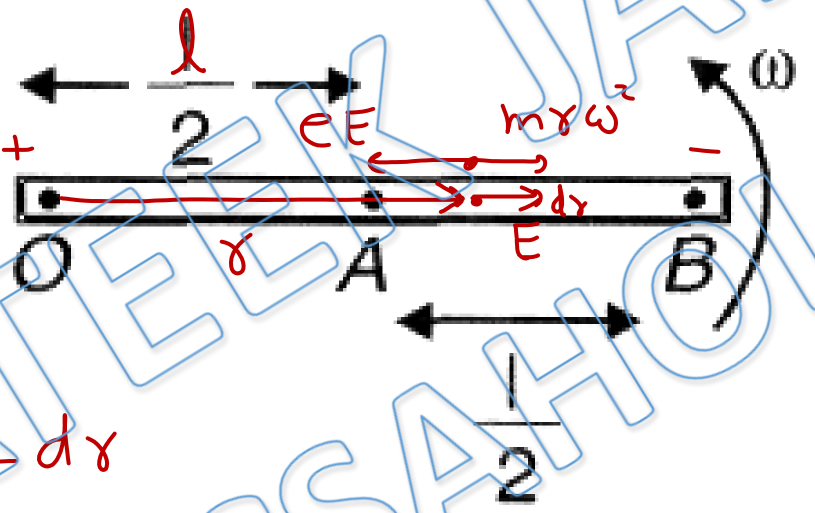
(c) Distance .7R from centre of ring

(d) Distance R from ring

Q12) A conducting rod of length l rotates about its one end with angular velocity ω Potential difference between A and B is {m & e = mass and charge on electron)

$$eE = mr\omega^2$$

$$E = \frac{m\omega^2 r}{e}$$



$$dV = -\vec{E}\cdot\vec{dr}$$

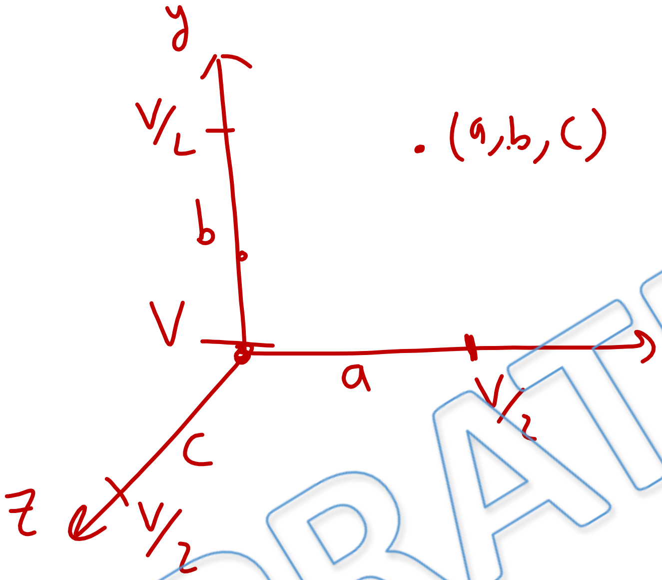
$$dV = -\frac{m\omega^2 r}{e}\,dr$$

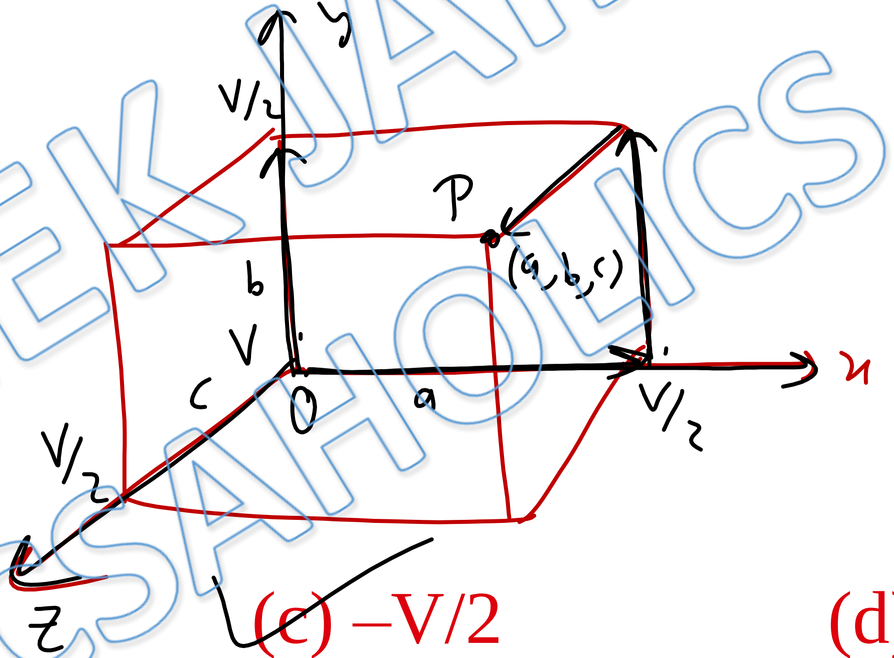
(a) $\frac{m\omega^2 l^2}{e}$ (b) $\frac{3m\omega^2 l^2}{4e}$ (c) $\frac{3m\omega^2 l^2}{8e}$ (d) zero

$$\int_{V_A}^{V_B} dV = -\frac{m\omega^2}{e}\int_{l/2}^{l} r\,dr \Rightarrow V_B - V_A = -\frac{m\omega^2}{2e}\left[r^2\right]_{l/2}^{l}$$

$$V_A - V_B = \frac{m\omega^2}{2e} \times \frac{3l^2}{4}$$

Q13) In a uniform electric field the potential of origin is V and V/2 at each of the points (a, 0, 0), (0, b, 0), (0, 0, c). The potential at (a, b, c) will be





(a) V/2 (b) -3V/2 (c) –V/2 (d) -V

Potential drop in moving from O to P

$= \frac{V}{2} + \frac{V}{2} + \frac{V}{2} = \frac{3V}{2}$

final potential = Initial potential - drop $= -\frac{V}{2}$

For Video Solution of this DPP, Click on below link

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/93

Video Solution on YouTube:- https://youtu.be/OlriAKSU7iM

Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/39

SUBSCRIBE

@Physicsaholics

@Physicsaholics_prateek

@NEET_Physics
@IITJEE_Physics

physicsaholics.com

Unacademy

CLICK

Chalo Niklo