Physicsaholics

DPP - 2 (Electrostatics)

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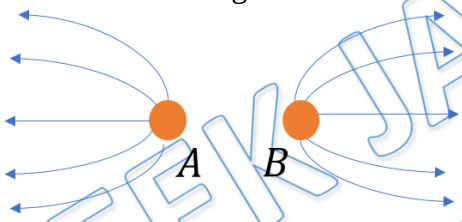
Q 1. Unit of electric field intensity is:
(Where N = Newton, and C = Coulomb)
(a) NC (b) N/C
(c) NC^2 (d) N/C^2

Q 2. Fig. shows electric lines of force due to point charges q_1 and q_2 placed at points A and B respectively. Write the nature of charge on them:



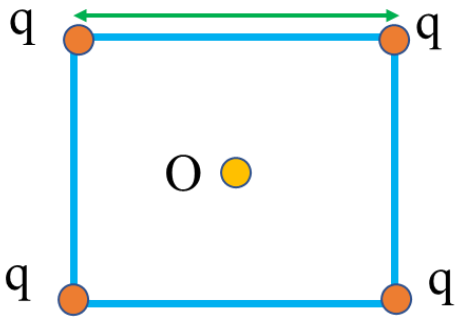
(a) q_1=positive, q_2 = negative (b) q_1= negative, q_2 = positive
(c) both are positive (d) both are negative

Q 3. A test charge +5C experiences a net force of 20 N due to electric field at a point A in an electric field region. What is the net electric field intensity at point A?
(a) 5 N/C (b) 4 N/C
(c) 5 N/C^2 (d) cannot be determined

Q 4. Which among the following statements is true with regard to electric field lines?
(a) Electric field lines always intersect
(b) Electric field lines may or may not intersect
(c) Electric field lines can be seen
(d) Electric field lines never intersect

Q 5. The conventional direction of electric field is:
(a) Positive charge to negative charge
(b) Negative charge to positive charge
(c) No specific direction
(d) Direction cannot be determined

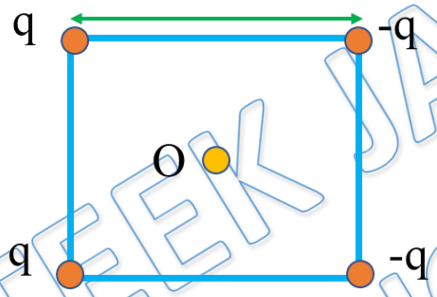
Q 6. Calculate the electric field intensity at the centre 'O' of square?



(a) $\frac{kq}{d^2}$ (b) $\frac{2kq}{d^2}$

(c) zero (d) None of these

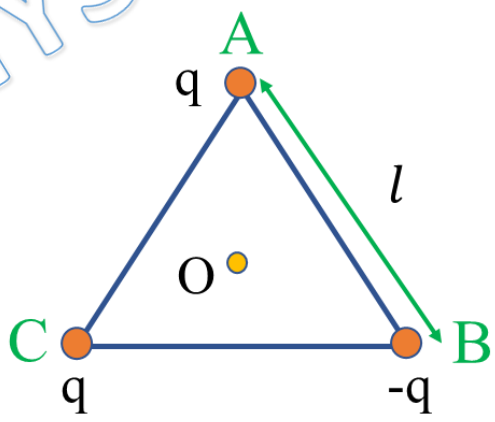
Q 7. Calculate the electric field intensity at the centre 'O' of square?



(a) $\frac{kq}{d^2}$ (b) $\frac{2\sqrt{2}kq}{d^2}$

(c) $\frac{4\sqrt{2}kq}{d^2}$ (d) None of these

Q 8. Calculate the magnitude of electric field intensity at the centroid of equilateral triangle, and its direction?



(a) $\frac{3kq}{l^2}$ towards A (b) $\frac{6kq}{l^2}$ towards B

(c) $\frac{2kq}{l^2}$ towards B (d) None of these

Q 9. The maximum electric field intensity on the axis of a uniformly charged ring of charge Q and radius R will be?

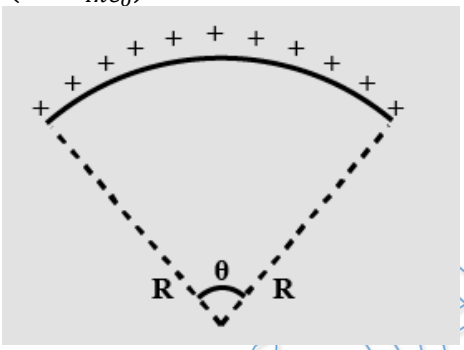
(a) $\frac{1}{4\pi\varepsilon_o}\frac{Q}{(3\sqrt{3}R^2)}$

(b) $\frac{1}{4\pi\varepsilon_o}\frac{2Q}{(3R^2)}$

(c) $\frac{1}{4\pi\varepsilon_o}\frac{2Q}{(3\sqrt{3}R^2)}$

(d) $\frac{1}{4\pi\varepsilon_o}\frac{3Q}{(2\sqrt{2}R^2)}$

Q 10. A charge '+Q' is uniformly distributed along the circular arc of radius 'R' as shown in the figure. The magnitude of the force experienced by the point charge +q placed at the centre of curvature is $\left(k = \frac{1}{4\pi\varepsilon_o}\right)$



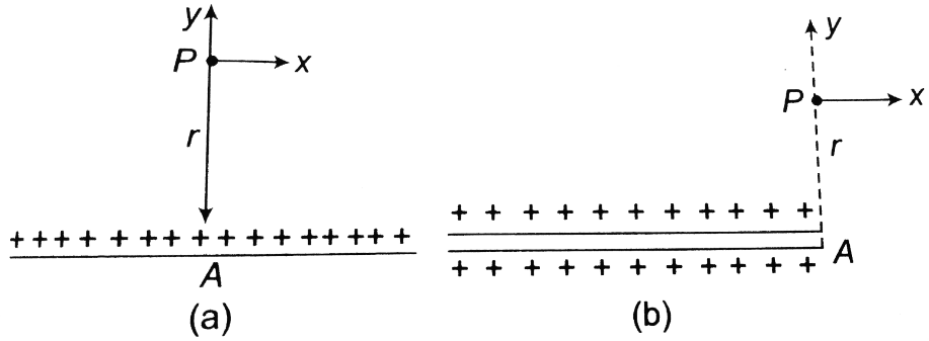
(a) $\frac{kQq\sin\left(\frac{\theta}{2}\right)}{(R^2\theta)}$

(b) $\frac{2kQq\sin\left(\frac{\theta}{2}\right)}{(R^2\theta)}$

(c) $\frac{3kQq\sin\left(\frac{\theta}{2}\right)}{(R^2\theta)}$

(d) $\frac{2kQq\sin\left(\frac{\theta}{2}\right)}{(R\theta)}$

Q 11. Electric field , due to an infinite line of change, as shown in figure at a point P at a distance r from the line is E. If wire is folded at point A, so that both parts lie alongside as shown in figure(b), then express electric field at P in vector form:



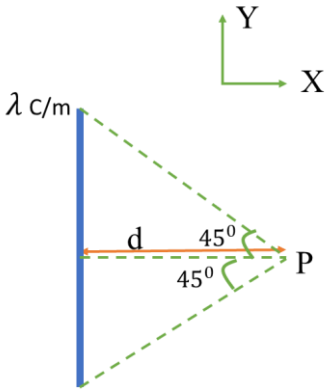
(a) $\frac{E}{2}\hat{\imath} + \frac{E}{2}\hat{\jmath}$

(b) $E\hat{\imath} + E\hat{\jmath}$

(c) $\sqrt{2}E\hat{\imath} + \sqrt{2}E\hat{\jmath}$

(d) $\frac{E}{\sqrt{2}}\hat{\imath} + \frac{E}{\sqrt{2}}\hat{\jmath}$

Q 12. Linear charge density of finite charged wire is $+\lambda\ C/m$ (where λ is a positive constant). Find electric field intensity at point 'P': $\left(k = \frac{1}{4\pi\varepsilon_o}\right)$



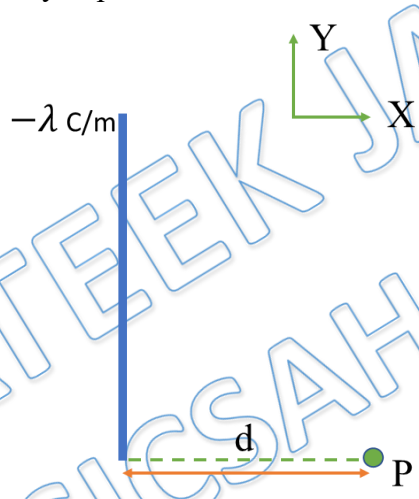
(a) $\frac{\sqrt{2}k\lambda}{d}\hat{\imath}$

(b) $\frac{\sqrt{2}k\lambda}{d}\hat{\imath} - \frac{\sqrt{2}k\lambda}{d}\hat{\jmath}$

(c) $\frac{\sqrt{2}k\lambda}{d}\hat{\imath} - \frac{k\lambda}{d}\hat{\jmath}$

(d) $\frac{\sqrt{2}k\lambda}{d}\hat{\imath} + \frac{\sqrt{2}k\lambda}{d}\hat{\jmath}$

Q 13. Linear charge density of finite charged wire is $-\lambda\, C/m$ (where λ is positive constant). Find electric field intensity at point 'P':



(a) $-\frac{k\lambda}{d}\hat{\imath} - \frac{k\lambda}{d}\hat{\jmath}$

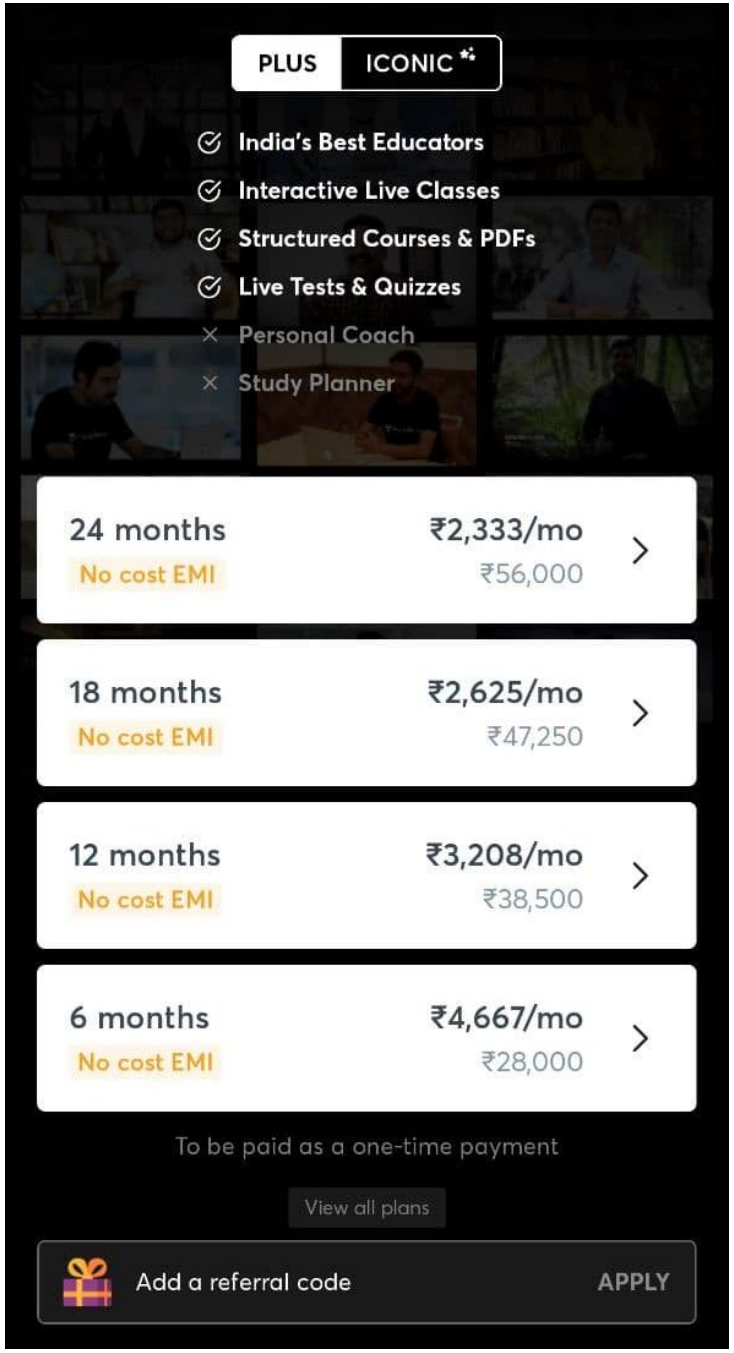
(b) $\frac{k\lambda}{d}\hat{\imath} - \frac{k\lambda}{d}\hat{\jmath}$

(c) $\frac{k\lambda}{d}\hat{\imath} + \frac{k\lambda}{d}\hat{\jmath}$

(d) $-\frac{k\lambda}{d}\hat{\imath} + \frac{k\lambda}{d}\hat{\jmath}$

Answer Key

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



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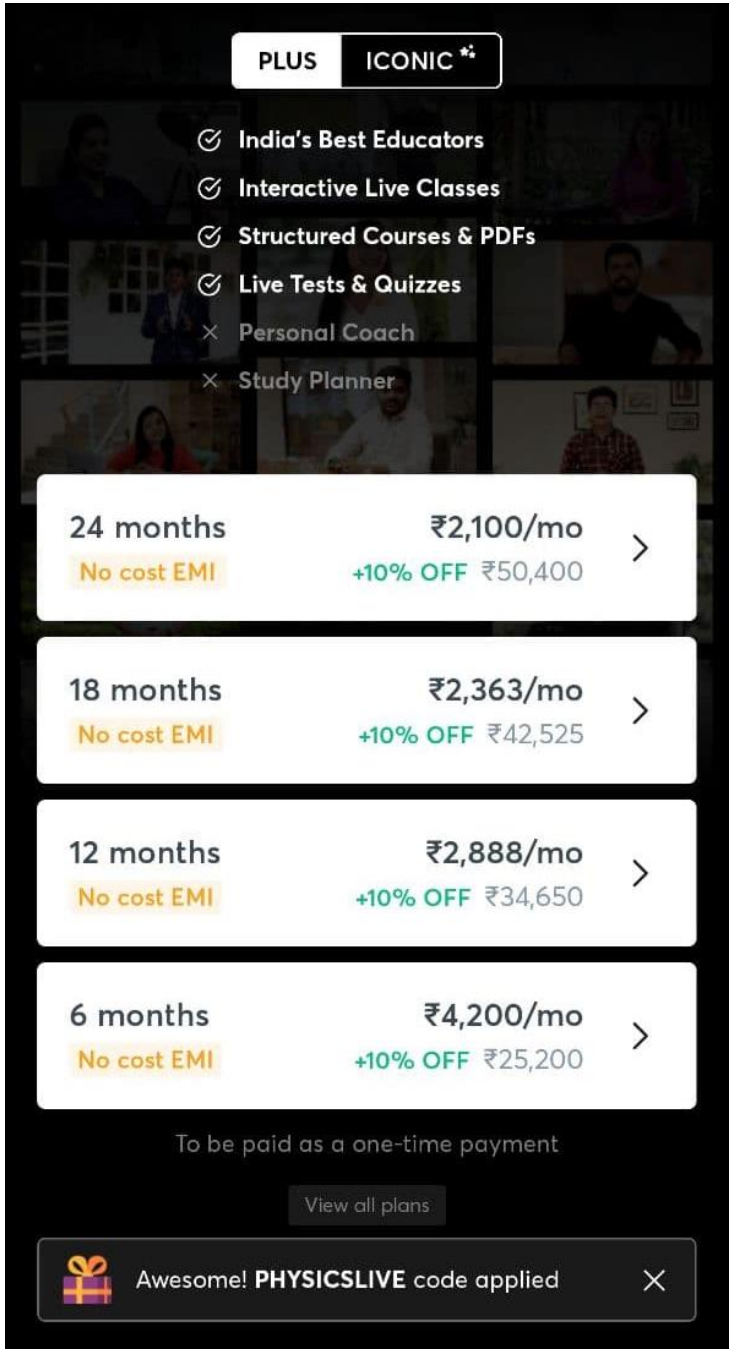


Written Solution

DPP-2 Electrostatics: Electric field

(Due to Point charge, linear charge distribution & Charged Ring)

By Physicsaholics Team

Solution: 1

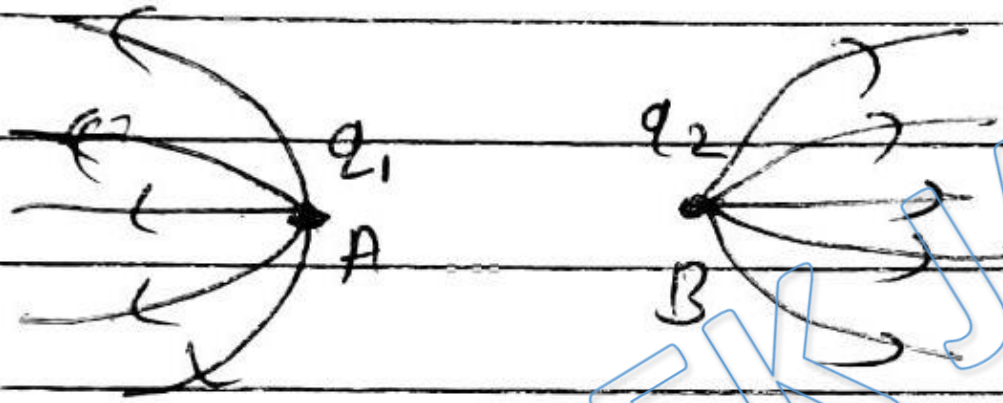
Unit of Electric field

$$E = \frac{F}{q}$$

$\therefore$ Unit of 'E' = N/C

Ans. b

Solution: 2



Direction of Electric field lines due to both charges (q_1 & q_2) are away from charge → so", Both charges (q_1 & q_2) are positive.

Ans. c

Solution: 3

$$F = qE$$

$$E = \frac{F}{q}$$

$$E = \frac{20}{5}$$

$$\boxed{E = 4\ N/C}$$

Ans. b

Solution: 4

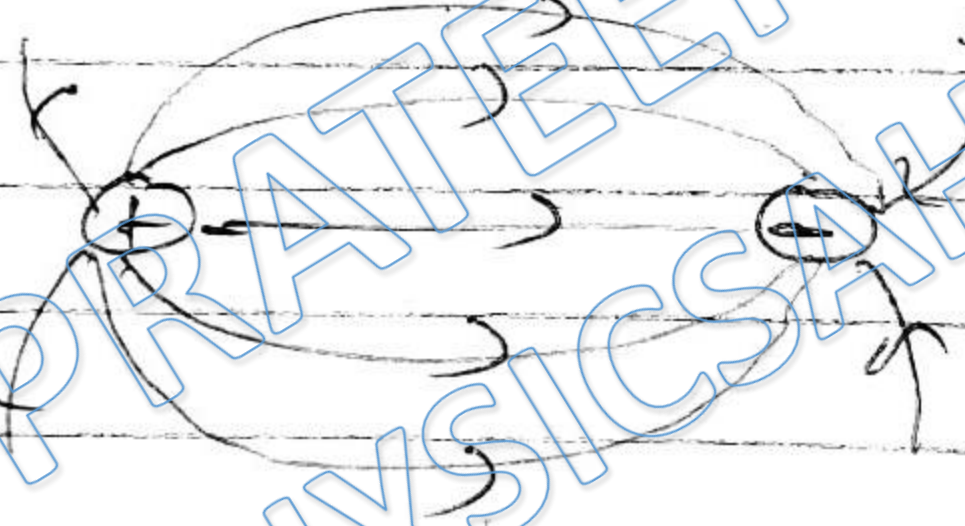
Electric field lines never intersects:

When two lines intersect each other, tangents are drawn at that point indicating two directions of electric field lines, which is impossible.

Ans. d

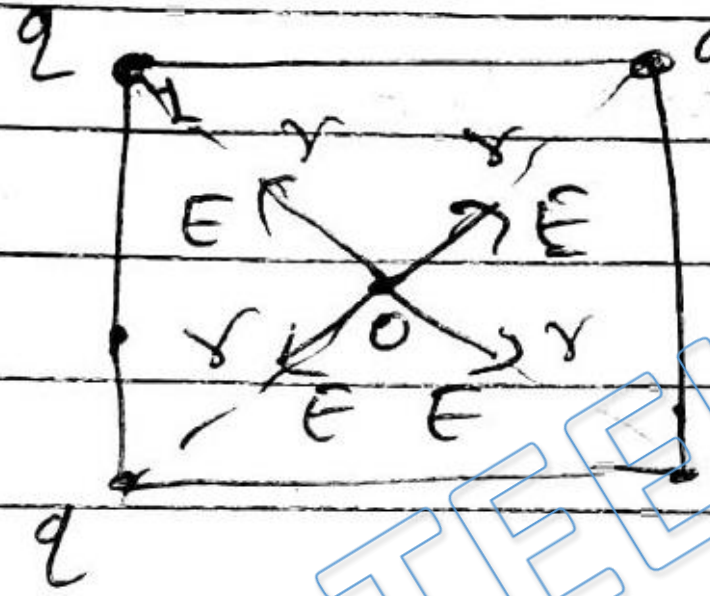
Solution: 5

conventional direction of electric field is : Positive to negative



Ans. a

Solution: 6

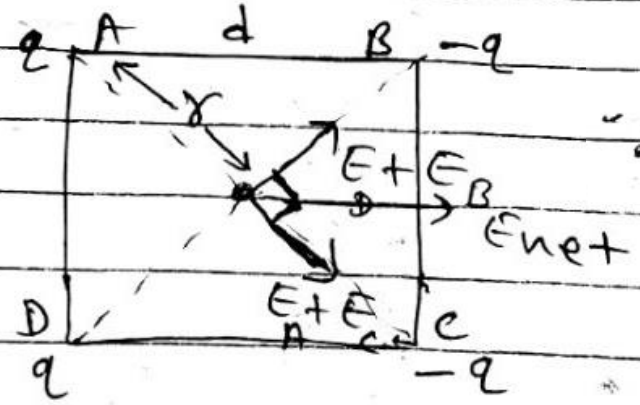


Magnitude of Electric field due to all the charges will be same, because, distance of point 'O' & charges for all are same.

$\therefore \boxed{E_{net} = 0}$

Ans. c

Solution: 7



$\therefore r = \frac{d}{\sqrt{2}}$

$\therefore E_A = E_C = \frac{kq}{r^2} = \frac{2kq}{d^2}$

& $E_D = E_B = \frac{kq^2}{r^2} = \frac{2kq}{d^2}$

$\therefore r = \frac{d}{\sqrt{2}}$

$\therefore E_{net} = \sqrt{(2E_A)^2 + (2E_C)^2}$

$= 2\sqrt{E_A^2 + E_C^2}$

$= 2\sqrt{E_A^2 + E_C^2}$

$\therefore$ Magnitude of E_A & E_C is also same so; $E_{net} = 2\sqrt{2E_A^2}$

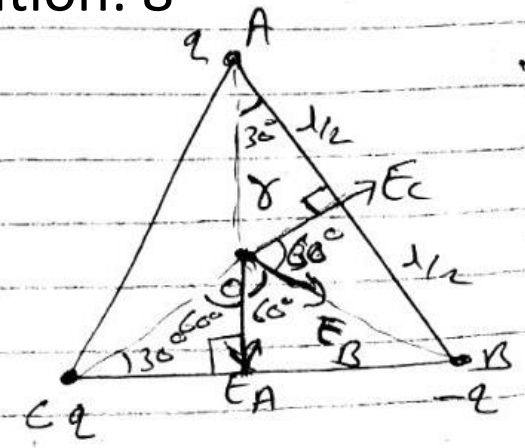
$\therefore E_{net} = 2(\sqrt{2}E_A)$

$E_{net} = 2\sqrt{2}\left(\frac{2kq}{d^2}\right)$

$$\boxed{E_{net} = \frac{4\sqrt{2}kq}{d^2}}$$

Ans. c

Solution: 8



$\cos 30° = l/2\gamma$

$$\gamma = \frac{l}{\sqrt{3}}$$

Magnitude of E_A, E_B & E_C are same, as magnitude of charg and distance of poin 'O' is same from all charges

$$\therefore |E_A| = |E_B| = |E_C| = E = \frac{kq}{\gamma^2} = \frac{3kq}{l^2}$$

4. E_A & E_C are at 120°

4. E_A & E_C are at 120°

then their resultnt will be in dirn of B

and magnitude of resultnt will be $= \sqrt{E^2 + E^2 + 2(E)E\cos(120°)}$

$= E$

So, $E_{net} = 2E$ [on Point A] in dirn towards B

$$\therefore E_{net} = 2\left(\frac{3kq}{l^2}\right) = \frac{6kq}{l^2}$$

Ans. b

Solution: 9

Electric field on axis of charged ring:

$$E = \frac{kQx}{(R^2+x^2)^{3/2}}$$

$\because$ Max electric field is for $x = \pm \frac{R}{\sqrt{2}}$

$$\therefore E_{max} = \frac{kQ\,\frac{R}{\sqrt{2}}}{\left(R^2+\frac{R^2}{2}\right)^{3/2}}$$

$$E_{max} = \frac{kQR}{\sqrt{2}\left(\frac{3R^2}{2}\right)^{3/2}}$$

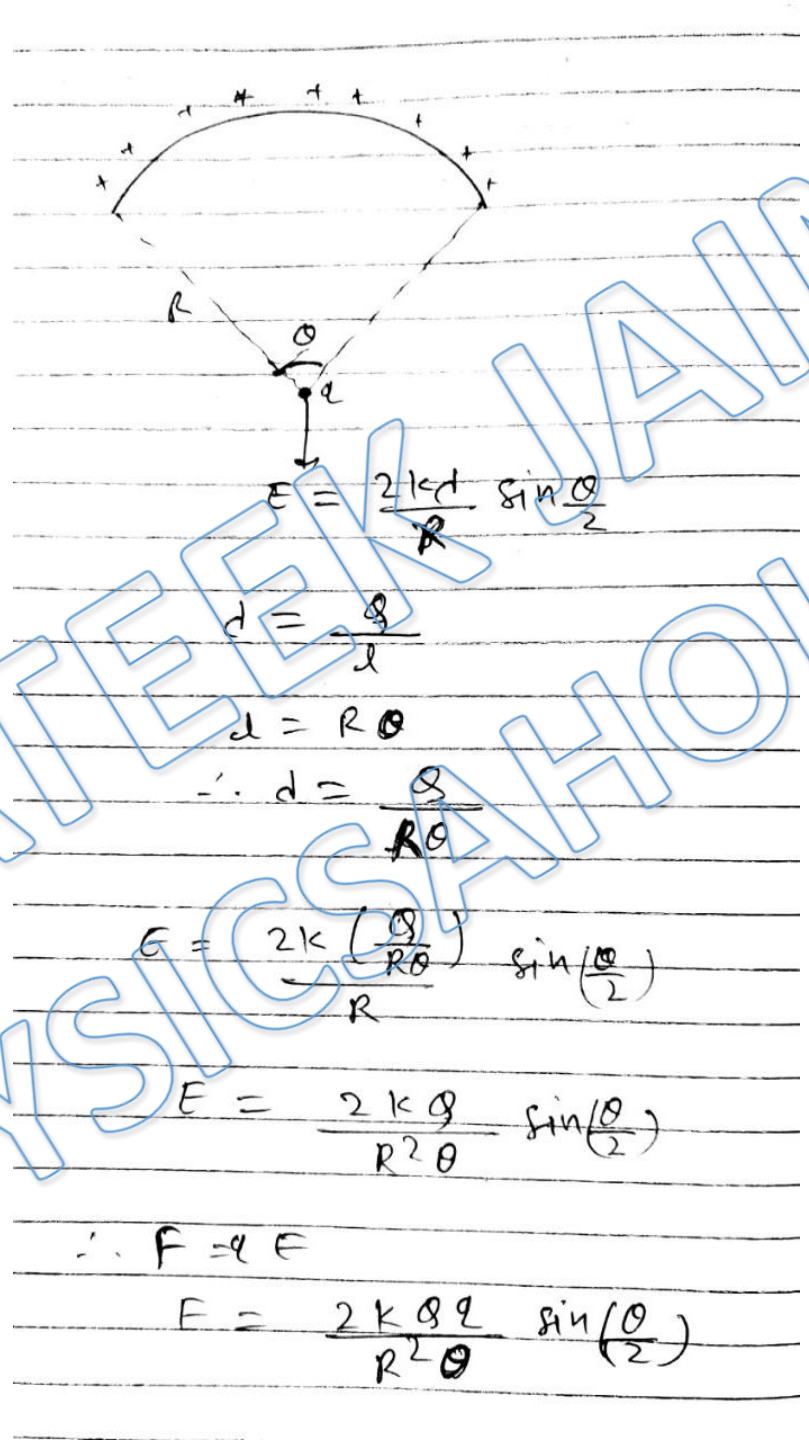
$$E_{max} = \frac{kQR(2\sqrt{2})}{\sqrt{2}(3\sqrt{3})R^3}$$

$$E_{max} = \frac{2kQ}{3\sqrt{3}R^2}$$

$$\boxed{E_{max} = \frac{1}{4\pi\epsilon_0}\frac{2Q}{(3\sqrt{3}R^2)}}$$

Ans. c

Solution: 10



$$E = \frac{2kd}{R}\sin\frac{\theta}{2}$$

$$d = \frac{Q}{l}$$

$$l = R\theta$$

$$\therefore d = \frac{Q}{R\theta}$$

$$E = \frac{2k\left(\frac{Q}{R\theta}\right)}{R}\sin\left(\frac{\theta}{2}\right)$$

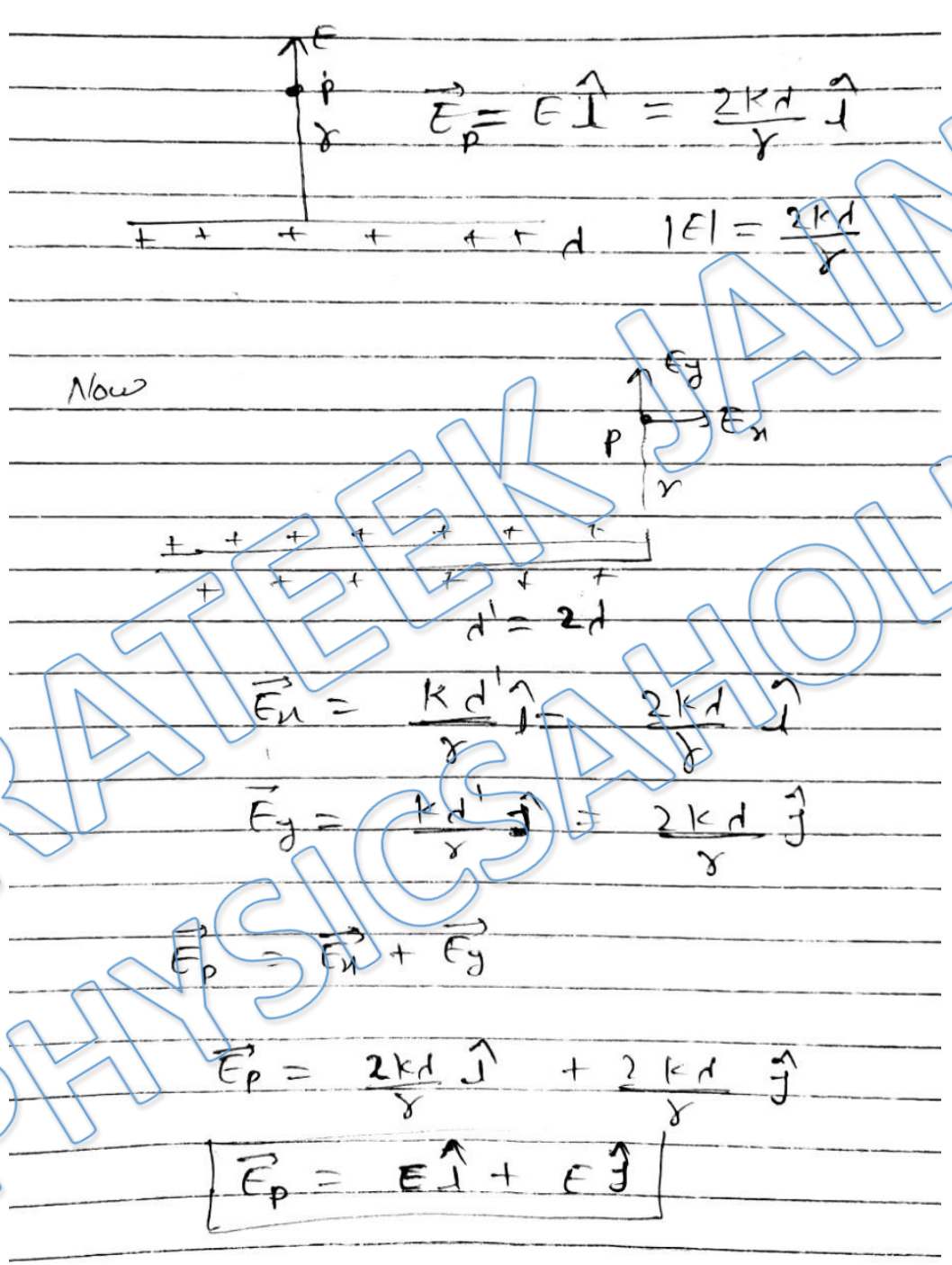
$$E = \frac{2kQ}{R^2\theta}\sin\left(\frac{\theta}{2}\right)$$

$$\therefore F = qE$$

$$F = \frac{2kQq}{R^2\theta}\sin\left(\frac{\theta}{2}\right)$$

Ans. b

Solution: 11



$$\vec{E}_p = E\hat{i} = \frac{2kd}{r}\hat{i}$$

$$|E| = \frac{2kd}{r}$$

$$\vec{E}_x = \frac{kd'}{r}\hat{i} = \frac{2kd}{r}\hat{i}$$

$$\vec{E}_y = \frac{kd'}{r}\hat{j} = \frac{2kd}{r}\hat{j}$$

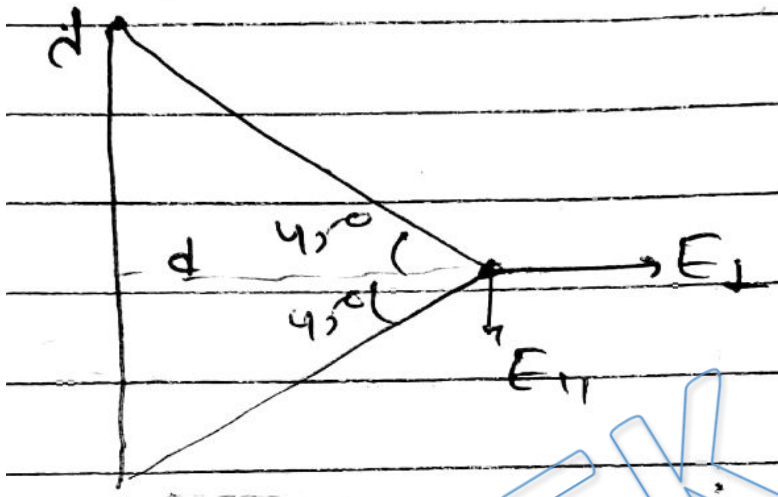
$$\vec{E}_p = \vec{E}_x + \vec{E}_y$$

$$\vec{E}_p = \frac{2kd}{r}\hat{i} + \frac{2kd}{r}\hat{j}$$

$$\boxed{\vec{E}_p = E\hat{i} + E\hat{j}}$$

Ans. b

Solution: 12



$$E_\perp = \frac{kq}{d}(\sin\alpha + \sin\beta)$$

$$= \frac{kq}{d}[\sin 45^\circ + \sin 45^\circ]$$

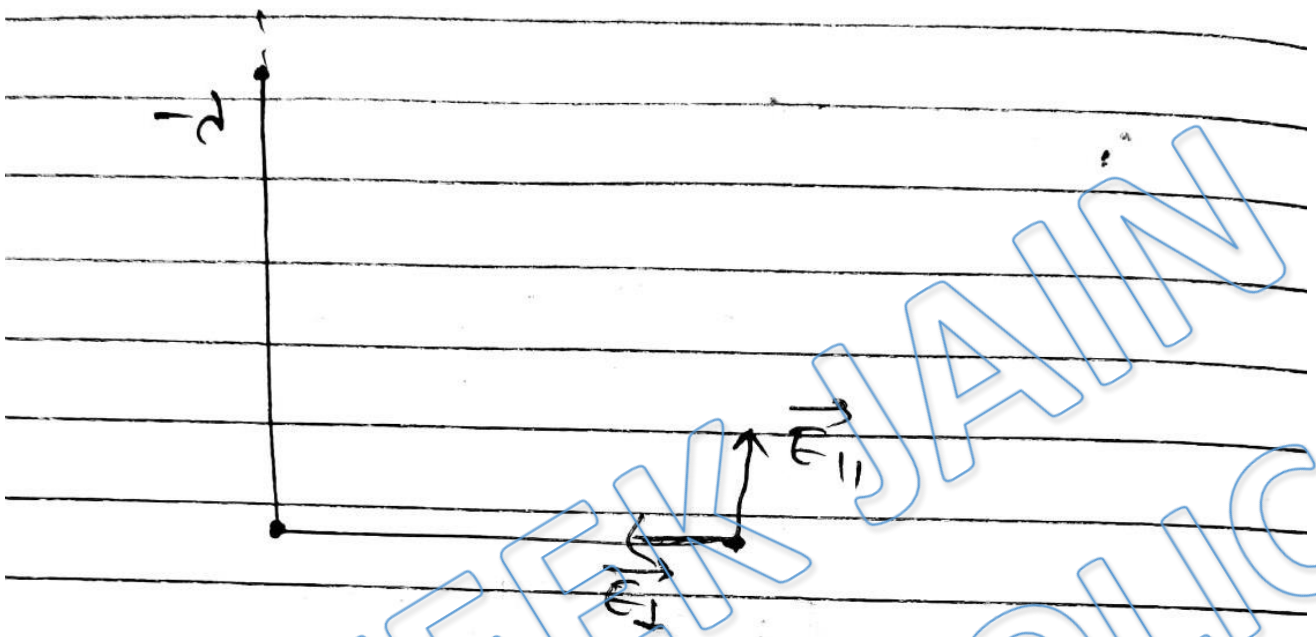
$$E_\perp = \sqrt{2}\,\frac{kq}{d}$$

$$E_\parallel = \frac{kq}{d}[\cos 45^\circ - \cos 45^\circ] = 0$$

$$\therefore \vec{E} = E_\perp \hat{\jmath} = \frac{\sqrt{2}\,kq}{d}\hat{\jmath}$$

Ans. a

Solution: 13



$$\vec{E}_{\perp} = \frac{kq}{d}(\sin 90^\circ + \sin 0^\circ)(-\hat{i})$$

$$\vec{E}_{\perp} = \frac{kq}{d}(-\hat{i})$$

$$\vec{E}_{11} = \frac{kq}{d}(\cos 0^\circ - \cos 90^\circ)(\hat{j})$$

$$\vec{E}_{11} = \frac{kq}{d}(\hat{j})$$

$$\vec{E}_p = \vec{E}_{\perp} + \vec{E}_{11} = -\frac{kq}{d}\hat{i} + \frac{kq}{d}\hat{j}$$

Ans. d

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