CLASS 12 BOARDS

ELECTRIC CHARGE AND FIELDS

ये 10 सवाल पक्का आएंगे

+ MINDMAPS

Dropped Chapters

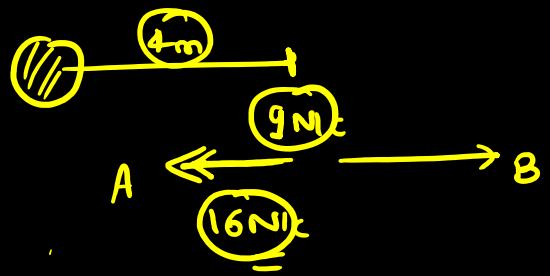
Chapter	Page No. of Old NCERT	Dropped Topics/Chapters
Chapter 1: Electric Charges and Fields	2-7	1.2 Electric Charge (delete only activity with paper strips and making electroscope)
		1.3 Conductors and Insulators (delete only concept of earthing)
		1.4 Charging by Induction
	47-50	Exercises 1.13, 1.25–1.34

New Syllabus

The magnitude of the electric field due to a point charge object at a distance of 4.0 m is 9 N/C. From the same charged object the electric field of magnitude, 16 N/C will be at a distance of **CBSE 2023**

(a) 1 m (b) 2 m

(c) 3 m (d) 4 m



$\uparrow E = K\frac{q}{r^2}\downarrow$

New Syllabus

SOLUTION

$$E = k\frac{q}{r^2}$$

$$g = k\frac{q}{4^2}$$

$$16 = k\frac{q}{r^2}$$

$$\frac{3^2}{4^2} = \frac{9}{16} = \frac{r^2}{4^2}$$

$$r = 3m$$

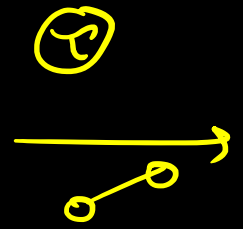
New Syllabus

An electric dipole of dipole moment 2×10^{-8} C-m in a uniform electric field experiences a maximum torque of 6×10^{-1} N-m. The magnitude of electric field is

CBSE 2023

(a) $2.2 \times 10^{3}\ \text{Vm}^{-1}$ (b) $1.2 \times 10^{4}\ \text{Vm}^{-1}$

(c) $5.0 \times 10^{7}\ \text{Vm}^{-1}$ (d) $4.2 \times 10^{3}\ \text{Vm}^{-1}$



$\tau_{max} = 6 \times 10^{-1}$ N·m

$P = 2 \times 10^{-8}$ C-m

$E = ?$

Concept $\Rightarrow$ $\tau = PE\sin\theta$

$\tau_{max} = PE$

$6 \times 10^{-1} = 2 \times 10^{-8} \times E$

$E = ?$

New Syllabus

SOLUTION

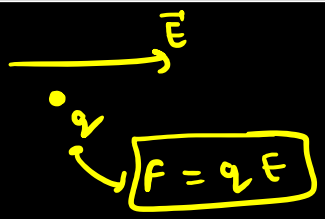
New Syllabus

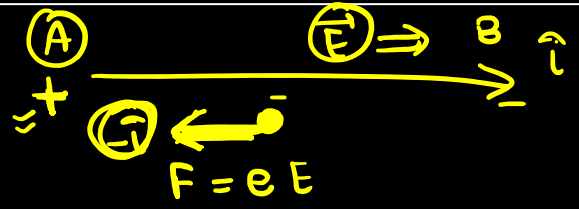
An electron experiences a force $(1.6\times10^{-19}\ \text{N})\,\hat{i}$ in an electric field **E**. The electric field **E** is **CBSE 2023**

(a) $\left(1.0\times10^{19}\frac{\text{N}}{\text{C}}\right)\hat{i}$ (b) $-\left(1.0\times10^{19}\frac{\text{N}}{\text{C}}\right)\hat{i}$

(c) $\left(1.0\times10^{-19}\frac{\text{N}}{\text{C}}\right)\hat{i}$ (d) $-\left(1.0\times10^{-19}\frac{\text{N}}{\text{C}}\right)\hat{i}$

Concept :-)





Sol^n :-)

$F = eE$

$1.6\times10^{-16} = -1.6\times10^{-19}\times E$

$E = -ve$

New Syllabus

SOLUTION

New Syllabus

Two parallel large thin metal sheets have equal surface densities $26.4 \times 10^{-12}\ C/m^2$ of opposite signs. The electric field between these sheets is **CBSE SQP 2022-23**

(a) 1.5 N/C

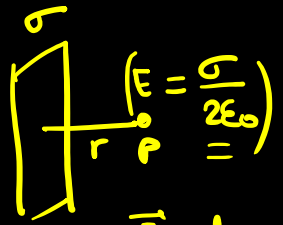
(b) 1.5×10^{-16} N/C

(c) 3×10^{-10} N/C

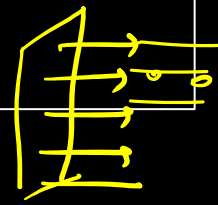
(d) 3 N/C

$E = \frac{26.4 \times 10^{-12}}{8.85 \times 10^{-12}}$

* Concept $\Rightarrow \sigma = \frac{Q}{A}$



* to find the net $\vec{E}$ at a point we image a unit positive test charge at that point.



New Syllabus

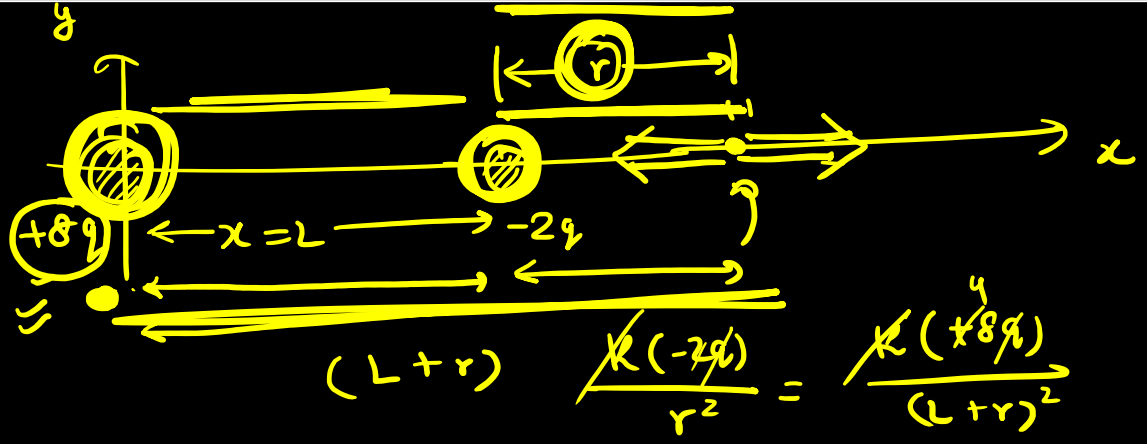
SOLUTION

New Syllabus

Two point charges $+8q$ and $-2q$ are located at $x = 0$ and $x = L$ respectively. The point on X-axis at which net electric field is zero due to these charges is

CBSE SQP 2022-23

(a) $8L$ (b) $4L$ (c) $2L$ (d) L



New Syllabus

SOLUTION

$$\frac{1}{r^2} = \frac{4}{(L+r)^2}$$

$$\frac{1}{(2r)^2} = \frac{1}{(L+r)^2}$$

$$2r = L + r$$

$$\boxed{r = L}$$

Two point charges placed in a medium of dielectric constant 5 are at a distance r between them, experience an electrostatic force F. The electrostatic force between them in vacuum at the same distance r will be

CBSE SQP 2021-22

(a) ~~F~~ (b) F (c) $F/2$ (d) $F/5$

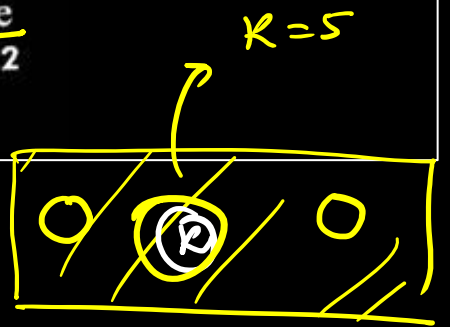
"Concept" ⇒

$$F_v = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$$

$$F' = \frac{1}{4\pi\varepsilon_0 K}\frac{q_1 q_2}{r^2}$$

$$\boxed{F' = \frac{F_v}{K}} \Rightarrow F = \frac{F_v}{5}$$

$$\boxed{F_v = 5F}$$



= Vacuum

New Syllabus

SOLUTION

New Syllabus

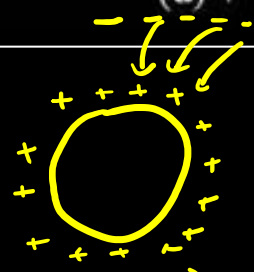
An object has charge of 1 C and gains 5.0×10^{18} electrons. The net charge on the object becomes

CBSE 2022 (Term-I)

(a) – 0.80 C (b) + 0.80 C

(c) + 1.80 C (d) + 0.20 C

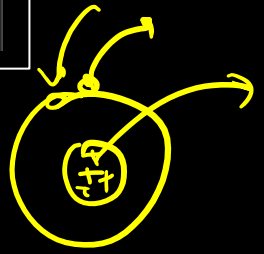
Concept →



e^- add → -ive

e^- remove → +ive

$q = ne$



Sol.. ⇒ Starting = +1 C

add = $-ne = -5 \times 10^{18} \times 1.6 \times 10^{-19}$

$= -0.8$ C

Net charge = 1 − .8 = +.2C =

New Syllabus

SOLUTION

New Syllabus

Very Short Answer Type

New Syllabus

Torque acting on an electric dipole placed in an uniform electric field is maximum when the angle between the electric field and the dipole moment is ....?.... .

All India 2020

$\tau = pE\sin\theta$ → $\theta = 90°$

$\tau_{max} = pE \Rightarrow$ at $\theta = 90°$

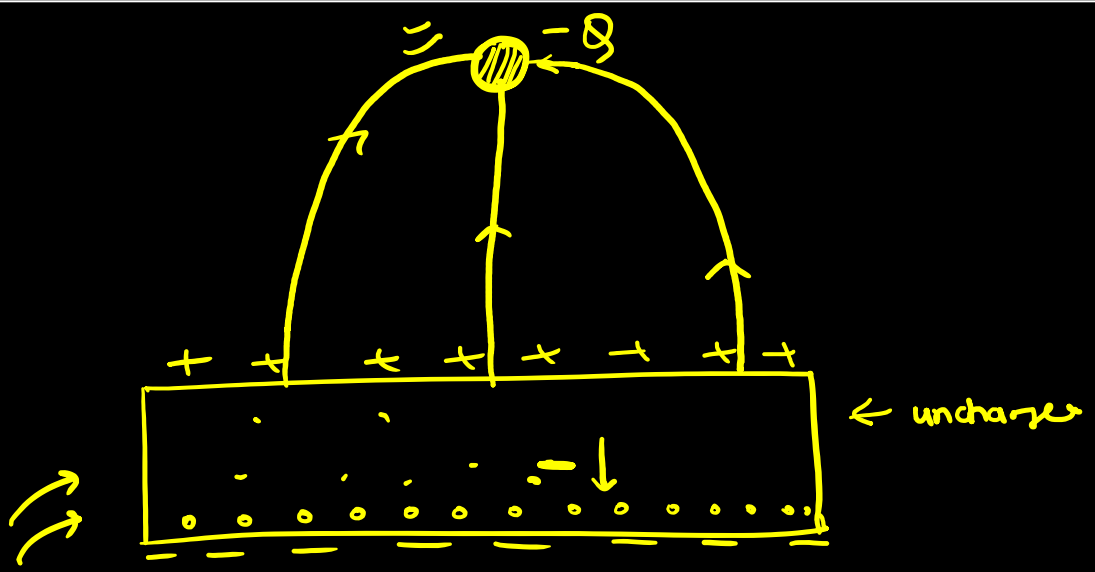
New Syllabus

SOLUTION

New Syllabus

Draw the pattern of electric field lines, when a point charge $-Q$ is kept near an uncharged conducting plate.

Delhi 2019



New Syllabus

SOLUTION

New Syllabus

Draw a pattern of electric field lines due to two positive charges placed a distance d apart. **All India 2019**

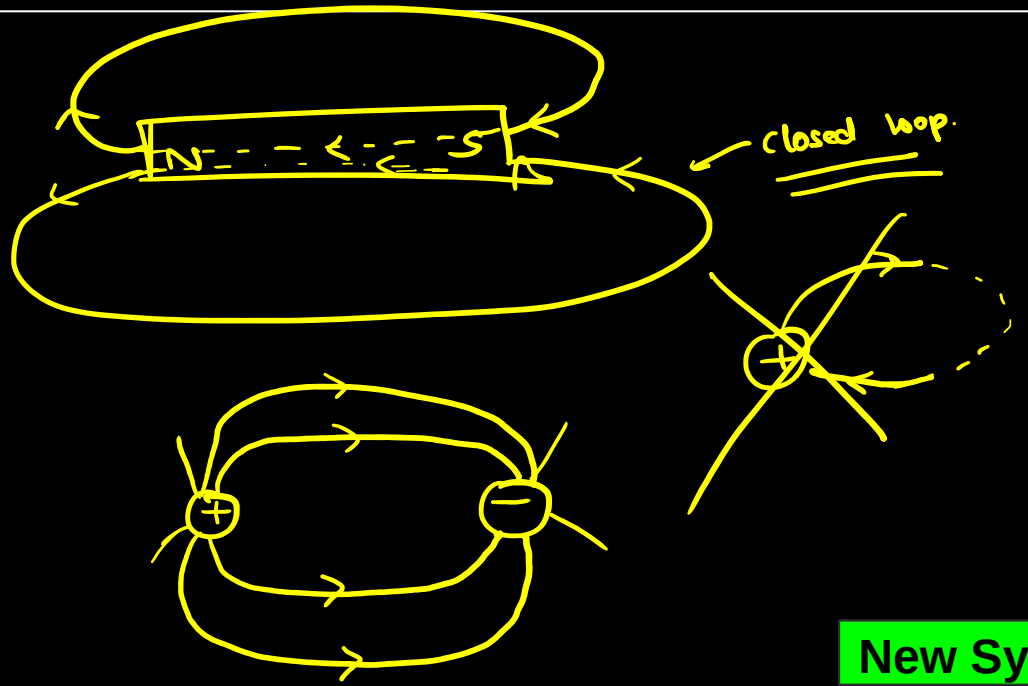
New Syllabus

SOLUTION

New Syllabus

Why do the electrostatic field lines not form closed loop?

All India 2014, Delhi 2012



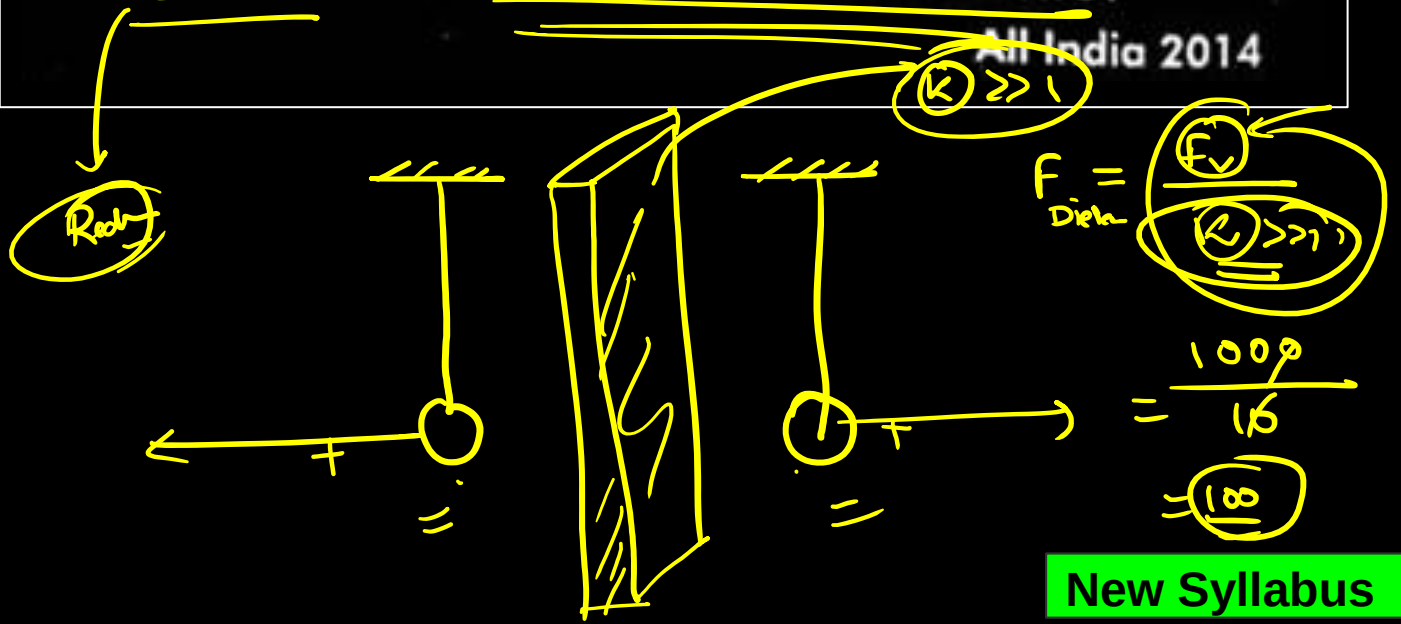
New Syllabus

SOLUTION

New Syllabus

Two identical balls having same positive charge q coulomb are suspended by two insulating strings of equal length. What would be the effect on the force when a plastic sheet is inserted between the two?

All India 2014



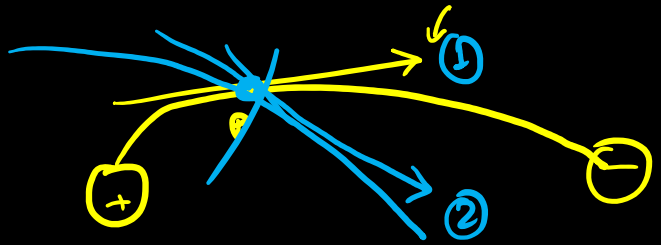
New Syllabus

SOLUTION

New Syllabus

Why do the electric field lines never cross each other?

All India 2014



New Syllabus

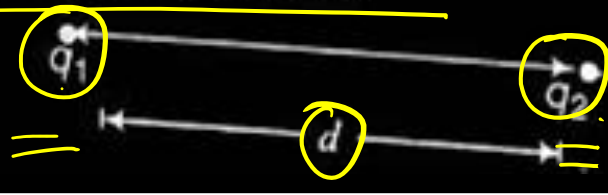
SOLUTION

New Syllabus

Two point charges q_1 and q_2 are placed at a distance d apart as shown in the figure.

The electric field intensity is zero at the point P on the line joining them as shown. Write two conclusions that you can draw from this.

Delhi 2014C



(1.) nature of q_1 & q_2 is same.

(2.) $|q_2| < |q_1|$

New Syllabus

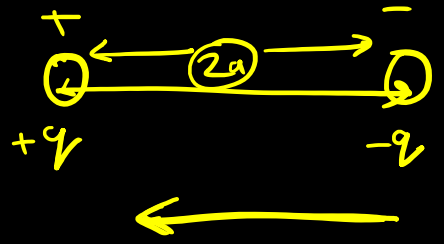
SOLUTION

New Syllabus

Define dipole moment of an electric dipole. Is it a scalar quantity or a vector quantity?

Foreign 2012; All india 2011

$\vec{p} = (2a)\,q$



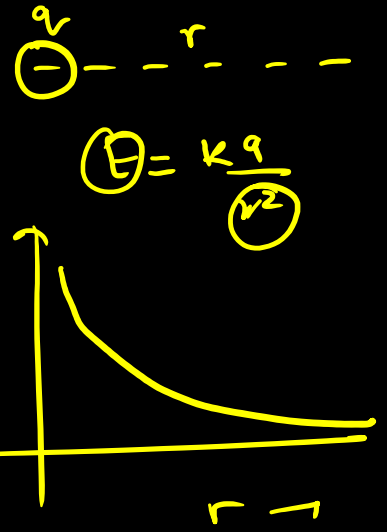
New Syllabus

SOLUTION

New Syllabus

Draw a plot showing the variation of electric field E with distance r due to a point charge q. Delhi 2012

$E \propto \frac{1}{r^2}$



New Syllabus

SOLUTION

New Syllabus

In which orientation, a dipole placed in a uniform electric field is in (i) stable equilibrium (ii) unstable equilibrium?

Delhi 2011

Stable

$F_{net} = 0 \Rightarrow$ Eqbm

$\theta = 180°$

"unstable"

$F_{net} = 0 \Rightarrow$ Eqbm

$\theta = 0$

Stable

New Syllabus

SOLUTION

New Syllabus

Short Answer Type- 2 Marks

New Syllabus

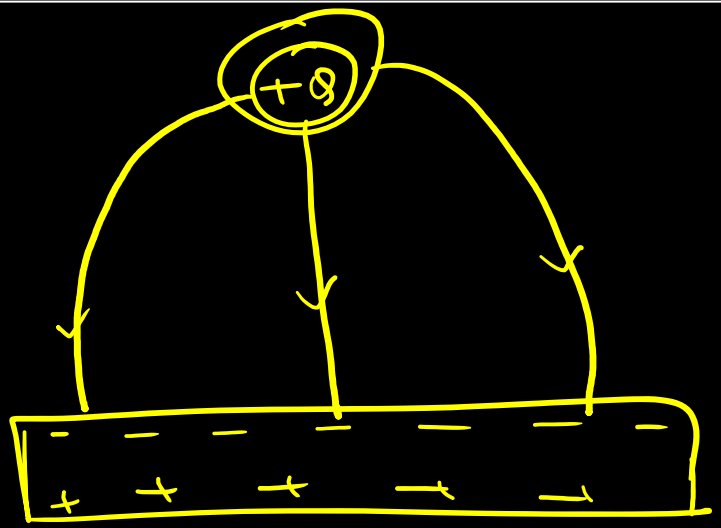
An electric dipole of dipole moment $\mathbf{p}$ is kept in a uniform electric field $\mathbf{E}$. Show graphically the variation of torque acting on the dipole (τ) with its orientation θ in the field. Find the orientation in which torque is (i) zero and (ii) maximum. **CBSE 2023**

New Syllabus

SOLUTION

New Syllabus

Point charge $(+Q)$ is kept in the vicinity of an uncharged conducting plate. Sketch electric field lines between the charge and the plate. **Foreign 2014**



New Syllabus

SOLUTION

New Syllabus

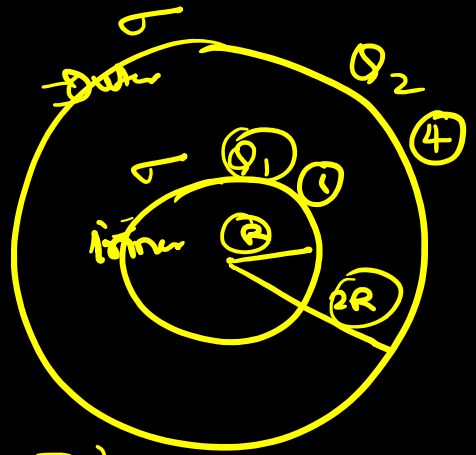
Two concentric metallic spherical shells of radii R and $2R$ are given charge Q_1 and Q_2, respectively. The surface charge densities on the outer surfaces of the shells are equal. Determine the ratio $Q_1 : Q_2$. **Foreign 2013**

Concept ⇒ $\sigma = \frac{Q}{A}$

Sol ⇒ $\sigma_{inner} = \sigma_{outer}$

$$\frac{Q_1}{2\pi R^2} = \frac{Q_2}{2\pi (2R)^2}$$

$$\frac{Q_1}{Q_2} = \frac{R^2}{4R^2} = \frac{1}{4}$$



New Syllabus

SOLUTION

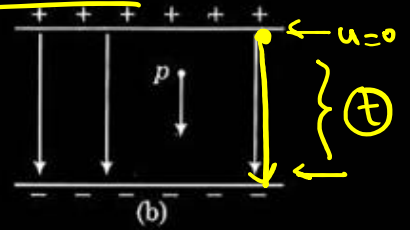
New Syllabus

3 Marks Questions

New Syllabus

An electron falls through a distance of 1.5 cm in a uniform electric field of magnitude 2.0×10^4 N/C (Fig. a)

(i) Calculate the time it takes to fall through this distance starting from rest.



(ii) If the direction of the field is reversed (Fig. b) keeping its magnitude unchanged, calculate the time taken by a proton to fall through this distance starting from rest.

CBSE 2018C

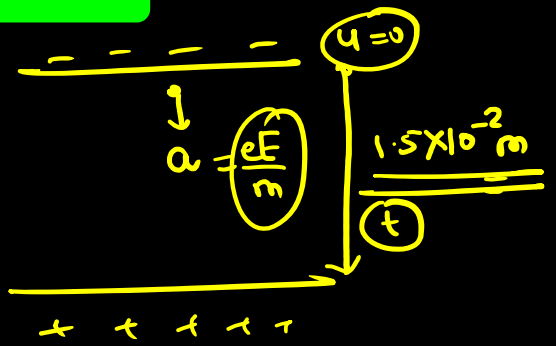
$F_e = eE$

$a = \frac{F_e}{m}$

$a = \frac{eE}{m} =$

New Syllabus

SOLUTION



$$S = ut + \frac{1}{2}at^2$$

$$t = \sqrt{\frac{2s}{a}}$$

$$\Rightarrow t = \sqrt{\frac{2sm}{eE}}$$

New Syllabus

(i) Obtain the expression for the torque τ experienced by an electric dipole of dipole moment $\mathbf{p}$ in a uniform electric field $\mathbf{E}$.

(ii) What will happen, if the field were non-uniform?

Delhi 2017

derivation

* Dipole

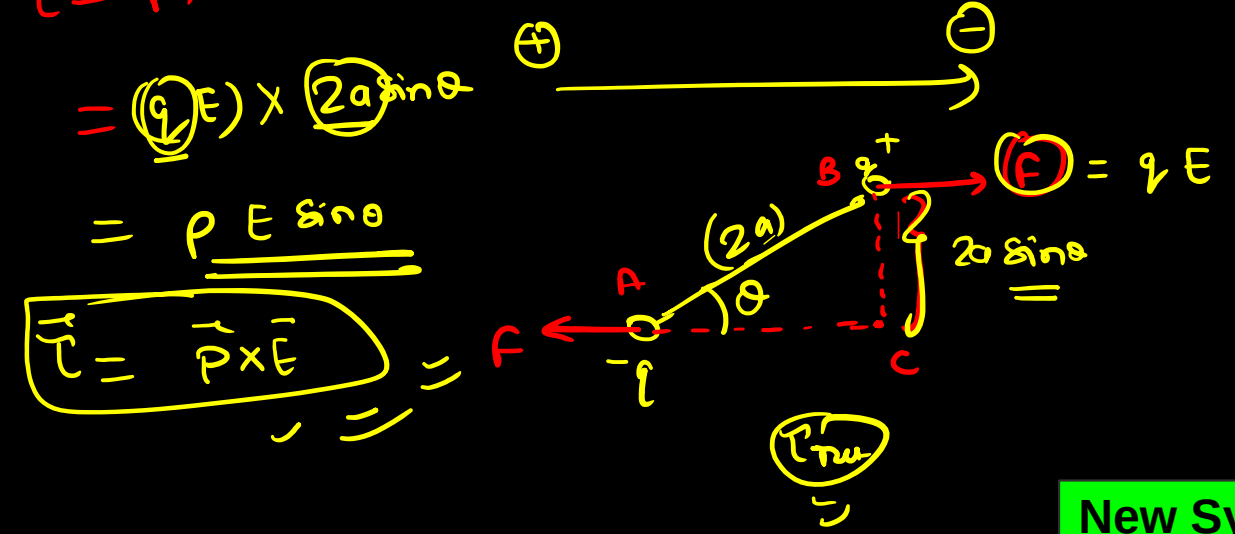
* τ

$\tau = F \times BC$

$= (qE) \times 2a\sin\theta$

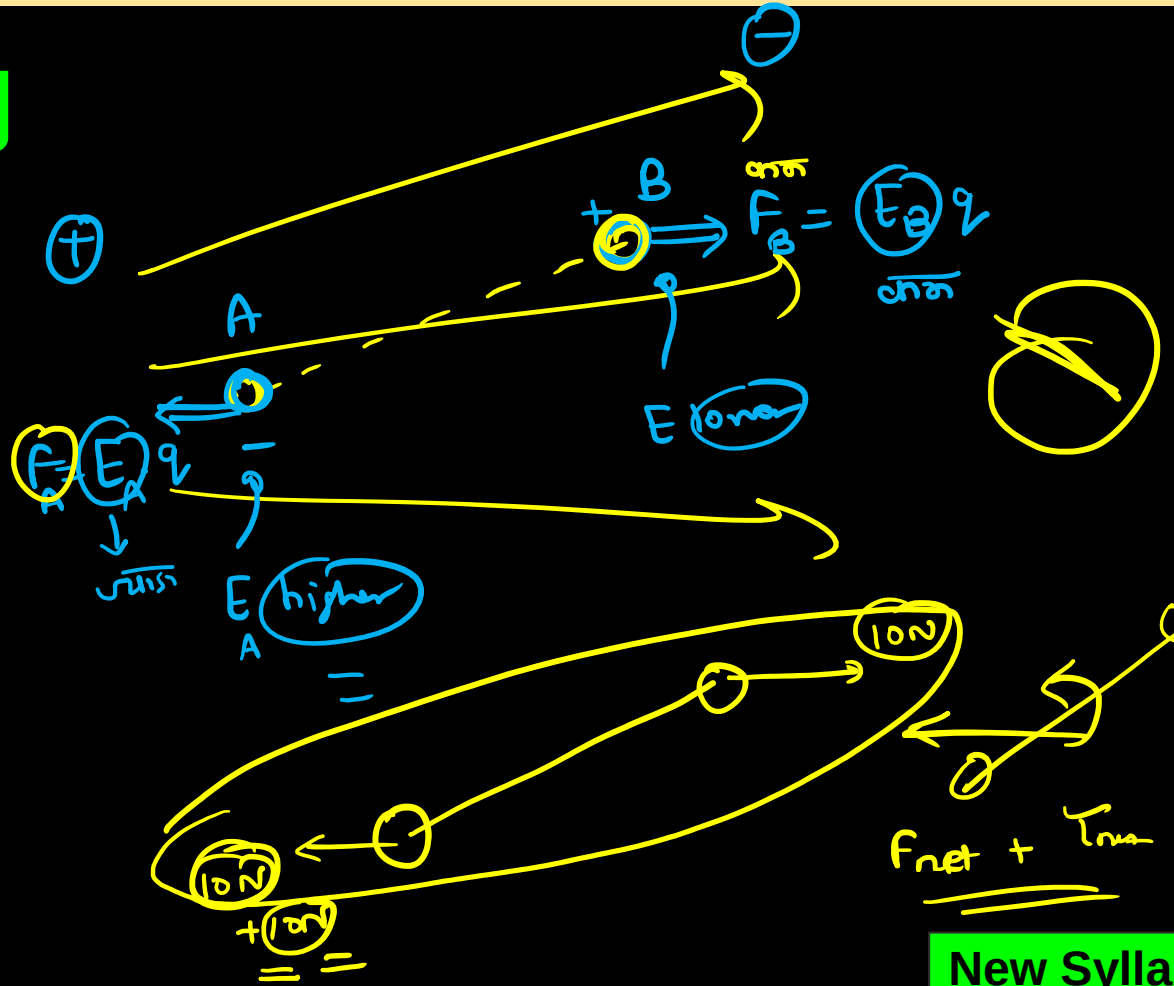
$= pE\sin\theta$

$\vec{\tau} = \vec{p} \times \vec{E}$



New Syllabus

SOLUTION



5 Marks Questions

New Syllabus

(i) Define an ideal electric dipole. Give an example.

(ii) Derive an expression for the torque experienced by an electric dipole in a uniform electric field. What is net force acting on this dipole.

(iii) An electric dipole of length 2 cm is placed with its axis making an angle of 60° with respect to uniform electric field of 10^5 N/C.

If it experiences a torque of $8\sqrt{3}$ Nm, calculate the magnitude of charge on the dipole, and its potential energy.

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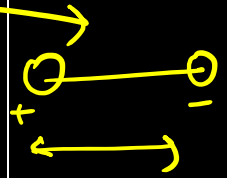
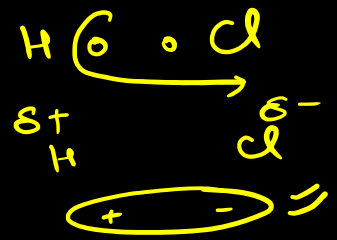




New Syllabus

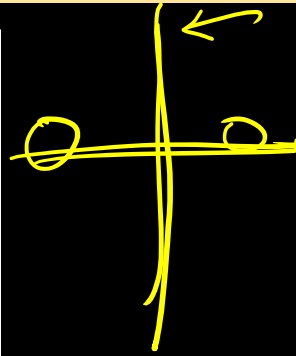
SOLUTION

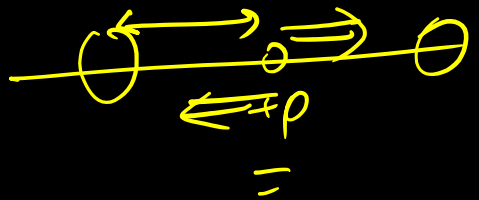
New Syllabus

(i) Derive an expression for the electric field at any point on the equatorial line of an electric dipole.

(ii) Two identical point charges q each are kept 2 m apart in air. A third point charge Q of unknown magnitude and sign is placed on the line joining the charges such that the system remains in equilibrium. Find the position and nature of Q.

Delhi 2019





New Syllabus

SOLUTION

All the Best

New Syllabus

CBSE PYQ : Subject : chapter name

New Syllabus