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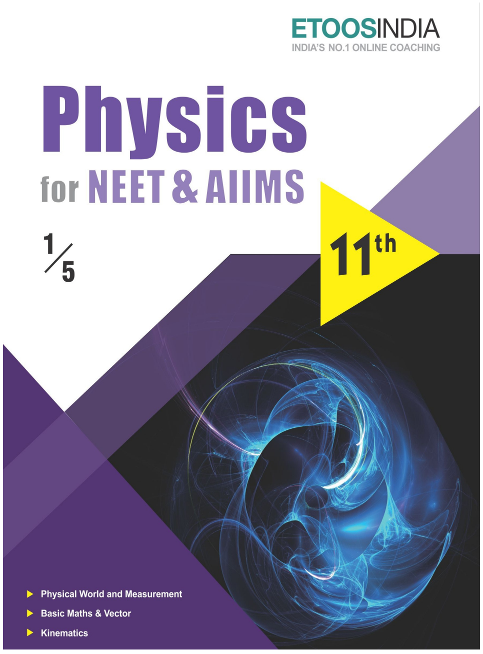
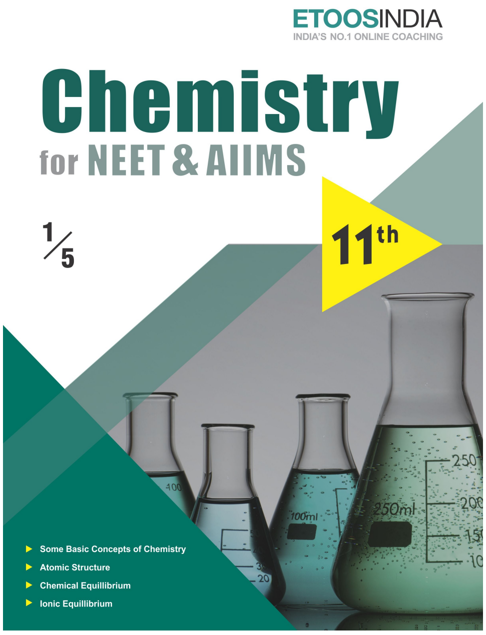
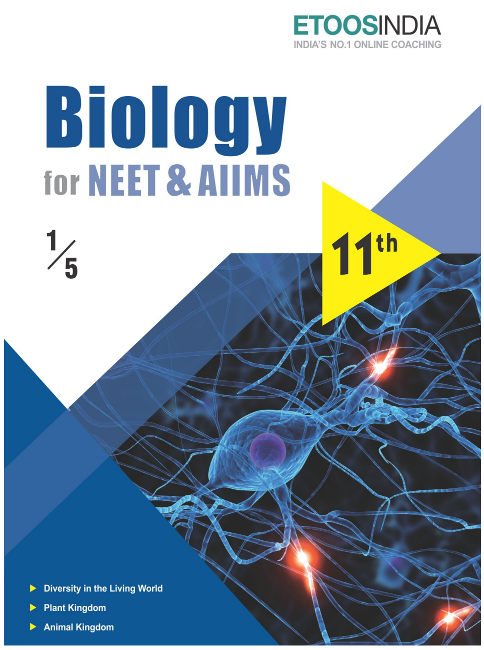
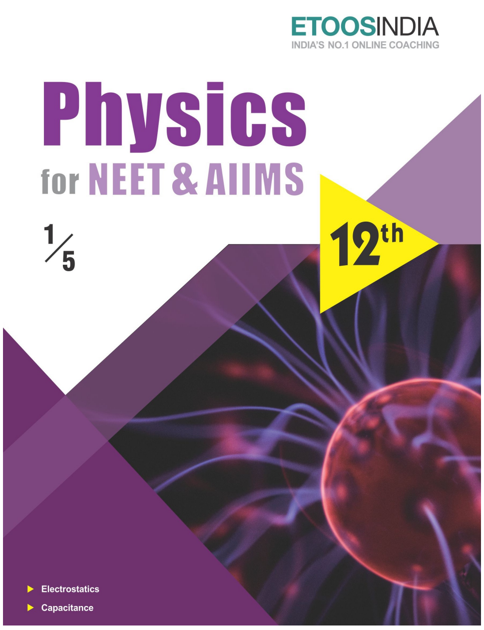
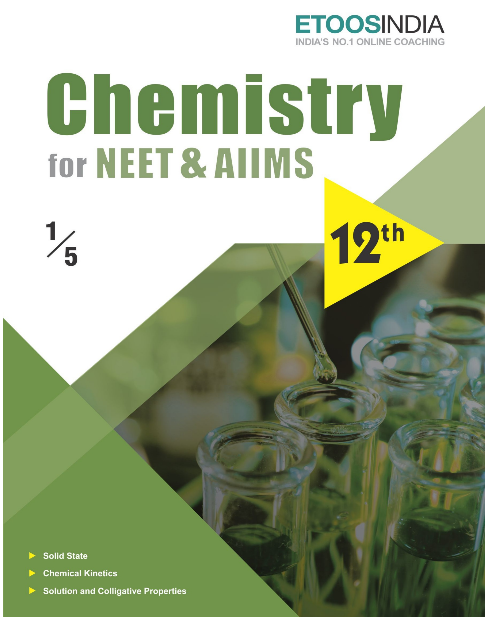
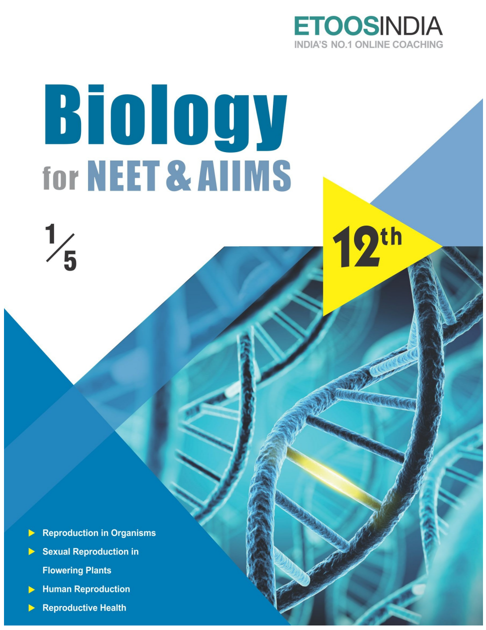












ETOOS Comprehensive Study Material
For NEET & AIIMS

CHAPTER 01

ELECTROSTATICS

There are many ways of knocking electrons out of atoms. The simplest is to rub two surfaces together.

"FRED HOYLE"

INTRODUCTION

Electromagnetism is, almost unarguably, the most important basic technology in the world today. Almost every modern device, from cars to kitchen appliances to computers, is dependent upon it. Life, for msot of us, would be almost unimaginable without electromagetism. In fact, electromagnetism cuts such a wide path through modern life that the teaching of electromagnetism has developed into several different specialities. Initially electricity and magnetism were classified as independent phenomena, but different specialities. Initially electricity and magnetism were classified as independent phenomena, but after some experiments (we will discuss later) it was found they are interrelated so we use the name **Electromagnetism.** In electromagnetism we have to study basic properties of electromagnetic force and field (the term field will be introduced in later section). The electromagnetic force between charged particles is one of the fundamental force of nature. WE being this chapter by describing some of the basic properties of one manifestation of the electromagnetic force, the electrostatic force between charges (the force between two charges when they are at rest) under the heading **electrostatics.**

ETOOS KEY POINTS

(i) $(W_{\infty \to P})_{ext}$ can also be called as the work done by external agent against the electric force on a unit positive charge due to the source charge.

(ii) Write both W and q with proper sign.

Properties

(i) Potential is a scalar quantity, its value may be positive, negative or zero.

(ii) S.I. Unit of potential is volt = $\frac{\text{joule}}{\text{coulmb}}$ and its dimensional formula is $[M^1L^2T^{-3}I^{-1}]$.

(iii) Electric potential at a point is also equal to the negative of the work done by the electric field in taking
the point charge from reference point (i.e. infinity) to that point.

(iv) Electric potential due to a positive charge is always positive and due to negative charge it is always negative except at infinity. (taking $V_\infty = 0$).

(v) Potential decreases in the direction of electric field.

(vi) $V = V_1 + V_2 + V_3 + ...$

USE OF POTENTIAL

If we know the potential at some point (in terms of numerical value or in terms of formula) then we can find out the work done by electric force when charge moves from point 'P' to ∞ by the formula

$$W_{ep})_{p \to \infty} = qV_p$$

Ex. A charge 2μC is taken from infinity to a point in an electric field, without changing its velocity. If work done against electrostatic forces is –40μJ, then find the potential at that point.

Sol. $V = \frac{W_{ext}}{q} = \frac{-40\mu J}{2\mu C} = -20\ V$

Ex. When charge 10 μC is shifted from infinity to a point in an electric field, it is found that work done by electrostatic forces is –10 μJ. If the charge is doubled and taken again from infinity to the same point without accelerating it, then find the amount of work done by electric field and against electric field.

Sol. $W_{ext})_{\infty \to p} = -w_{el})_{\infty \to p} = w_{el})_{p \to \infty} = 10\ \mu J$

because ΔKE = 0

$\therefore \quad V_p = \frac{(W_{ext})_{\infty \to p}}{20\mu C} = \frac{10\mu J}{10\mu C} = 1V$

So, if now the charge is doubled and taken from infinity then

$1 = \frac{w_{ext})_{\infty \to p}}{20\mu C} \Rightarrow$ or $W_{ext})_{\infty \to P} = 20\ \mu J \Rightarrow \quad W_{el})_{\infty \to P} = -20\ \mu J$

Ex. A charge 3μC is released from rest from a point P where electric potential is 20 V then its kinetic energy when it reaches infinity is :

Sol. $W_{el} = \Delta K = K_f - 0$

$\therefore \quad W_{el})_{P \to \infty} = qV_P = 60\ \mu J \qquad$ So, $\quad K_f = 60\ \mu J$

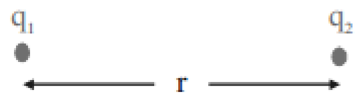
Etoos Tips & Formulas

1. Electric Charge

Charge of a material body is that property due to which it interacts with other charges. There are two kinds of charges-positive and negative. S.I. unit is coulomb. Charge is quantized, conserved, and additive.

2. Coulomb`s law

Force between two charges $\vec{F} = \frac{1}{4\pi \in_0 \in_r} \frac{q_1 q_2}{r^2} \hat{r}$ $\in_r$ = dielectric constant



Note : The Law is applicable only for static and point charges. Moving charges may result in magnetic interaction. And if charges are extended, induction may change the charge distribution.

3. Principle Of Superposition

Force on a point charge due to many charges is given by

$$\vec{F} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + ...$$

Note : The force due to one charge is not affected by the presence of other charges.

4. Electric Field or Electric Intensity or Electric Field Strength (Vector Quantity)

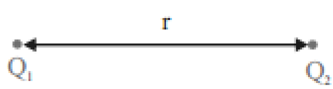
In the surrounding region of a charge there exist a physical property due to which other charge experiences a force. The direction of electric field is direction of force experienced by a positively charged particle and the magnitude of the field (electric field intensity) is the force experienced by a unit charge.

$$\vec{E} = \frac{\vec{F}}{q}$$ unit is N/C or V/m.

5. Electric field intensity due to charge Q

$$\vec{E} = \lim_{q_0 \to 0} \frac{\vec{F}}{q_0} = \frac{1}{4\pi \in_0} \frac{Q}{r^2} \hat{r}$$

6. Null point for two charges



If $|Q_1| > |Q_2|$

$\Rightarrow$ Null point near Q2

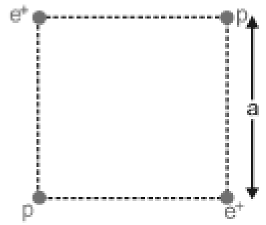
$$x = \frac{\sqrt{Q_1}\, r}{\sqrt{Q_1} \pm \sqrt{Q_2}}$$

(+) for like charges

(–) for unlike charges

SOLVED EXAMPLE

Ex. 1 Two positrons (e^+) and two protons (P) are kept on four corners of a square of side a as shown in figure. The mass of proton is much larger than the mass of positron. Let q denotes the charge on the proton as well as the positron then the kinetic energies of one of the positrons and one of the protons respectively after a very long time will be –



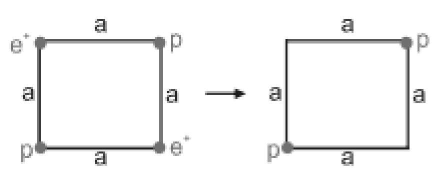
(A) $\frac{q^2}{4\pi\in_0 a}\left(1+\frac{1}{2\sqrt{2}}\right), \frac{q^2}{4\pi\in_0 a}\left(1+\frac{1}{2\sqrt{2}}\right)$

(B) $\frac{q^2}{2\pi\in_0 a}, \frac{q^2}{4\sqrt{2}\pi\in_0 a}$

(C) $\frac{q^2}{4\pi\in_0 a}, \frac{q^2}{4\pi\in_0 a}$

(D) $\frac{q^2}{2\pi\in_0 a}\left(1+\frac{1}{4\sqrt{2}}\right), \frac{q^2}{8\sqrt{2}\pi\in_0 a}$

Sol. As mass of proton >>> mass of positron so initial acceleration of positron is much larger than proton. Therefore positron reach far away in very short time as compare to proton.



$$2K_{e^+} = \left(\frac{4kq^2}{a} + \frac{2kq^2}{a\sqrt{2}}\right) - \frac{kq^2}{a\sqrt{2}}$$

$$\Rightarrow K_{e^+} = \frac{q^2}{2\pi\in_0 a}\left(1+\frac{1}{4\sqrt{2}}\right) \text{ and}$$

$$2K_p = \frac{kq^2}{a\sqrt{2}} - 0 \Rightarrow K_p = \frac{q^2}{8\sqrt{2}\pi\in_0 a}$$

Ex. 2 For a spherically symmetrical charge distribution, electric field at a distance r from the centre of sphere is $\vec{E} = kr^7\hat{r}$, where k is a constant. What will be the volume charge density at a distance r from the centre of sphere ?

(A) $\rho = 9k\varepsilon_0 r^6$ **(B)** $\rho = 5k\varepsilon_0 r^3$

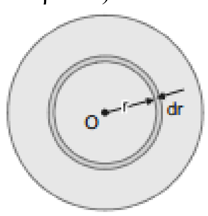
(C) $\rho = 3k\varepsilon_0 r^4$ **(D)** $\rho = 9k\varepsilon_0 r^0$

Sol. By using Gauss law $\oint \vec{E}\cdot d\vec{S} = \frac{q}{\in_0}$

$$\Rightarrow (E)(4\pi r^2) = \frac{\int \rho(4\pi r^2 dr)}{\in_0}$$

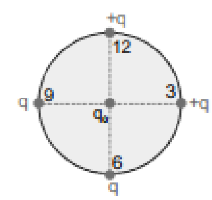
(Note : Check dimensionally that $\rho \propto r^6$)

$$(kr^7)(4\pi r^2) = \frac{\int \rho(4\pi r^2 dr)}{\in_0}$$



$$\Rightarrow k\varepsilon_0 r^9 = \int \rho r^2 dr$$

Ex. 3 Four charges are placed at the circumference of a dial clock as shown in figure. If the clock has only hour hand, then the resultant force on a charge q_0 placed at the centre, points in the direction which shows the time as :–



(A) 1:30

(B) 7:30

(C) 4:30

(D) 10:30

Sol. **(B)**

Ex. 4 A small electric dipole is placed at origin with its dipole moment directed along positive x-axis. The direction of electric field at point (2, 2√2,0) is

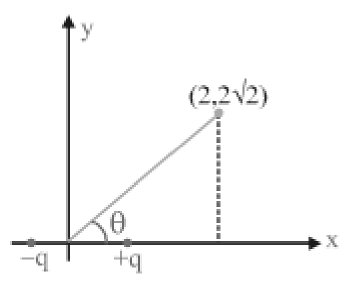
(A) along z-axis

(B) along y-axis

(C) along negative y-axis

(D) along negative z-axis

Sol.



Exercise # 1 SINGLE OBJECTIVE NEET LEVEL

1. The law, governing the force between electric charges is known as
(A) Ampere's law (B) Ohm's law
(C) Faraday's law (D) Coulomb's law

2. When the distance between the charged particles is halved, the force between them becomes
(A) One-fourth (B) Half
(C) Double (D) Four times

3. There are two charges +1 microcoulombs and +5 microcoulombs. The ratio of the forces acting on them will be
(A) 1 : 5 (B) 1 : 1
(C) 5 : 1 (D) 1 : 25

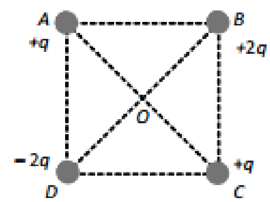
4. A charge q_1 exerts some force on a second charge q_2. If third charge q_3 is brought near, the force q_1 of exerted on q_2
(A) Decreases
(B) Increases
(C) Remains unchanged
(D) Increases if q_3 is of the same sign as q_1 and decreases if q_3 is of opposite sign

5. F_g and F_3 represents gravitational and electrostatic force respectively between electrons situated at a distance 10 cm. The ratio of F_g/F_e is of the order of
(A) 1042 (B) 10
(C) 1 (D) 10^{-43}

6. The ratio of the forces between two small spheres with constant charge (a) in air (b) in a medium of dielectric constant K is
(A) 1 : K (B) K : 1
(C) $1 : K^2$ (D) $K^2 : 1$

7. A soap bubble is given a negative charge, then its radius
(A) Decreases
(B) Increases
(C) Remains unchanged
(D) Nothing can be predicted as information is insufficient

8. Four charges are arranged at the corners of a square ABCD, as shown in the adjoining figure. The force on the charge kept at the centre O is



(A) Zero
(B) Along the diagonal AC
(C) Along the diagonal BD
(D) Perpendicular to side AB

9. In the absence of other conductors, the surface charge density
(A) Is proportional to the charge on the conductor and its surface area
(B) Inversely proportional to the charge and directly proportional to the surface area
(C) Directly proportional to the charge and inversely proportional to the surface area
(D) Inversely proportional to the charge and the surface area

10. A body can be negatively charged by
(A) Giving excess of electrons to it
(B) Removing some electrons from it
(C) Giving some protons to it
(D) Removing some neutrons from it

11. A charge q is placed at the centre of the line joining two equal charges Q. The system of the three charges will be in equilibrium, if q is equal to
(A) $-\frac{Q}{2}$ (B) $-\frac{Q}{4}$
(C) $+\frac{Q}{4}$ (D) $+\frac{Q}{2}$

12. 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

Exercise # 2 SINGLE OBJECTIVE AIIMS LEVEL

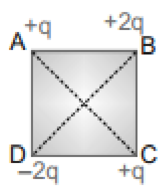
1. Two point charges + 9e and +e are kept 16 cm. apart from each other. Where should a third charge q be placed between them so that the system is in equilibrium state :

(A) 24 cm from + 9e (B) 12 cm from +9e
(C) 24 cm from + e (D) 12 cm from + e

2. Using mass (M), length (L), time (T) and current (A) as fundamental quantities, the dimension of permittivity is :

(A) $ML^{-2}T^2A$ (B) $M^{-1}L^{-3}T^4A^2$
(C) $MLT^{-2}A$ (D) $ML^2T^{-1}A^2$

3. Four charges are arranged at the corners of a square ABCD as shown in the figure. The force on the charge kept at the centre O will be



(A) perpendicular to side AB
(B) along the diagonal BD
(C) along the diagonal AC
(D) zero

4. Two equal negative charges –q are fixed at point (0, –a) and (0, a) on y–axis. A positive charge Q is released from rest at the point (2a, 0) on the x–axis. The charge Q will :

(A) execute simple harmonic motion about the origin
(B) move to the origin and remain at rest
(C) move to infinity
(D) execute oscillatory but not simple harmonic motion

5. When charge is given to a soap bubble, it shows

(A) an increase in size
(B) sometimes an increase and sometimes a decrease in size
(C) no change in size
(D) none of these

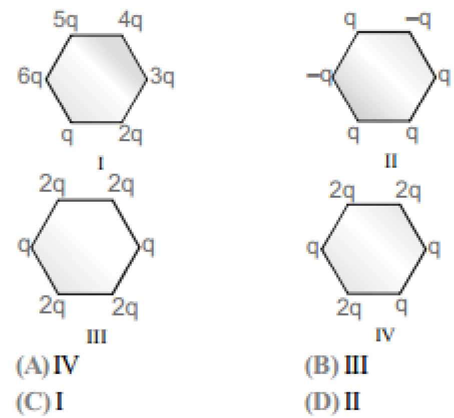
6. An electron of mass m_e, initially at rest, moves through a certain distance in a uniform electric field in time t_1. A proton of mass m_p, also, initially at rest, takes time t_2 to move through an equal distance in this uniform electric field. Neglecting the effect of gravity, the ratio t_2/t_1 is nearly equal to :

(A) 1 (B) $(m_p/m_e)^{1/2}$
(C) $(m_e/m_p)^{1/2}$ (D) 1836

7. Two infinite linear charges are placed parallel to each other at a distance 0.1 m from each other. If the linear charge density on each is 5 μC/m, then the force acting on a unit length of each linear charge will be

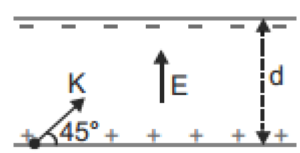
(A) 2.5 N/m (B) 3.25 N/m
(C) 4.5 N/m (D) 7.5 N/m

8. Figures below show regular hexagon, the charges are placed at the vertices. In which of the following cases the electric field at the centre is zero.



(A) IV (B) III
(C) I (D) II

9. An electron is projected as in figure with kinetic energy K, at an angle θ = 45° between two charged plates. The magnitude of the electric field so that the electron just fails to strike the upper plate, should be greater than:



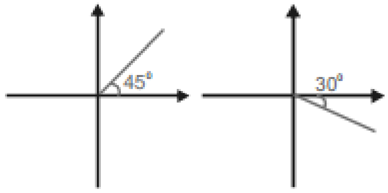
(A) $\frac{K}{qd}$ (B) $\frac{2K}{qd}$

(C) $\frac{K}{2qd}$ (D) Infinite

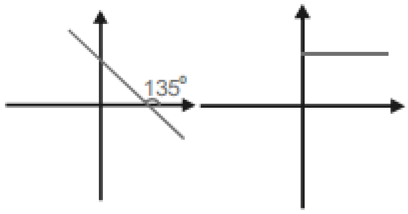
Exercise # 3 | PART - 1 | MATRIX MATCH COLUMN

1. Column–I shows graphs of electric potential V versus x and y in a certain region for four situations. Column–II shows the range of angle which the electric field vector makes with poisitive x–direction

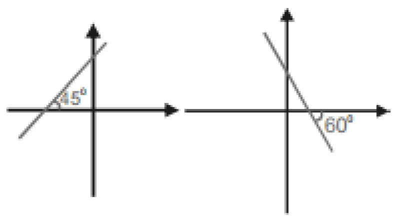
Column–I : V versus x, V versus y | **Column–II : Range of angle**

(A) 

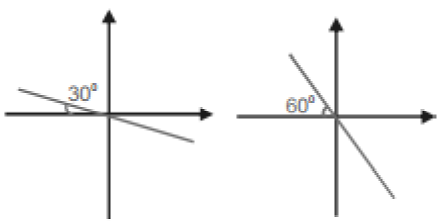
(P) $0^0 \le \theta < 45^0$

(B) 

(Q) $45^0 \le \theta < 90^0$

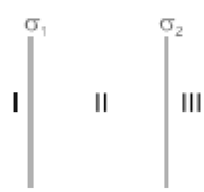
(C) 

(R) $90^0 \le \theta < 135^0$

(D) 

(S) $135^0 \le \theta < 180^0$

2. Two parallel metallic plates have surface charge densities σ_1 and σ_2 as shown in figure.



	Column–I		Column–II
(A)	If $\sigma_1 + \sigma_2 = 0$	(P)	Electric field in region III is towards right
(B)	If $\sigma_1 + \sigma_2 > 0$	(Q)	Electric field in region I is zero
(C)	If $\sigma_1 + \sigma_2 < 0$	(R)	Electric field in region I is towards right
		(S)	Nothing can be said

Exercise # 4 PART - 1 PREVIOUS YEAR (NEET/AIPMT)

1. A charged wire is bent in the form of a semicircular arc of radius a. If charge per unit length is λ coulomb/metre, the electric field at the centre O is [CBSE AIPMT 2000]

(A) $\frac{\lambda}{2\pi a^2 \varepsilon_0}$ (B) $\frac{\lambda}{4\pi^2 \varepsilon_0 a}$

(C) $\frac{\lambda}{2\pi\varepsilon_0 a}$ (D) zero

2. A charge q is placed at the corner of a cube of side a. The electric flux through the cube is [CBSE AIPMT 2000]

(A) $\frac{q}{\varepsilon_0}$ (B) $\frac{q}{3\varepsilon_0}$

(C) $\frac{q}{6\varepsilon_0}$ (D) $\frac{q}{8\varepsilon_0}$

3. A charge q μC is placed at the centre of a cube of a side 0.1 m, then the electric flux diverging from each face of the cube is [CBSE AIPMT 2001]

(A) $\frac{q\times10^{-6}}{24\varepsilon_0}$ (B) $\frac{q\times10^{-4}}{\varepsilon_0}$

(C) $\frac{q\times10^{-6}}{6\varepsilon_0}$ (D) $\frac{q\times10^{-4}}{12\varepsilon_0}$

4. Identical charges (–q) are placed at each corners of a cube of side b, then the electrostatic potential energy of charge (+q) placed at the centre of the cube will be [CBSE AIPMT 2002]

(A) $-\frac{4\sqrt{2}q^2}{\pi\varepsilon_0}$ (B) $\frac{8\sqrt{2}q^2}{\pi\varepsilon_0 b}$

(C) $-\frac{4q^2}{\sqrt{3}\pi\varepsilon_0 b}$ (D) $\frac{8\sqrt{2}q^2}{4\pi\varepsilon_0 b}$

5. An electron is moving round the nucleus of a hydrogen atom in a circular orbit of radius r. The coloumb force F between the two is [CBSE AIPMT 2003]

(A) $k\frac{e^2}{r^3}r$ (B) $-k\frac{e^2}{r^3}r$

(C) $k\frac{e^2}{r^3}\hat{r}$ (D) $-k\frac{e^2}{r^3}\hat{r}$

(where, $k=\frac{1}{4\pi\varepsilon_0}$)

6. A charge q is located at the centre of a cube. The electric flux through any face is [CBSE AIPMT 2003]

(A) $\frac{\pi q}{6(4\pi\varepsilon_0)}$ (B) $\frac{q}{6(4\pi\varepsilon_0)}$

(C) $\frac{2\pi q}{6(4\pi\varepsilon_0)}$ (D) $\frac{4\pi q}{6(4\pi\varepsilon_0)}$

7. An electric dipole has the magnitude of its chatge as q and its dipole moment p. It is placed in a uniform electric field E. If its dipole moment is along the direction of the field, the force on it and its potential energy are respectively [CBSE AIPMT 2004]

(A) 2 qE and minimum (B) qE and pE

(C) Zero and minimum (D) qE and maximum

8. A bullet of mass 2 g is having charge of 2 μC. Through what potential difference must it be accelerated, starting from rest, to acquire a speed of 10 m/s ? [CBSE AIPMT 2004]

(A) 5 kV (B) 50 kV

(C) 5 V (D) 50 V

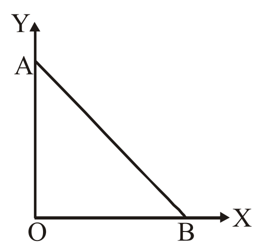
9. As per this diagram a point charge +q is place at the origin O. Work done in taking another point charge –Q from the point A [coordinates (0, a)] to another point B [coordinates (a,0)] along the straight path AB is [CBSE AIPMT 2005]

(A) Zero

(B) $\left(\frac{-qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\sqrt{2}a$

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

(D) $\left(\frac{qQ}{4\pi\varepsilon_0}\frac{1}{a^2}\right)\sqrt{2}a$



MOCK TEST

STRAIGHT OBJECTIVE TYPE

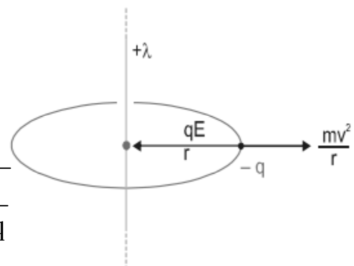
1. A point charge + Q is placed at the centroid of an equilateral triangle. When a second charge + Q is placed at a vertex of the triangle, the magnitude of the electrostatic force on the central charge is 8 N. The magnitude of the net force on the central charge when a third charge + Q is placed at another vertex of the triangle is:

(A) zero (B) 4 N (C) $4\sqrt{2}$ N (D) 8 N

2. The electric field inside a sphere which carries a volume charge density proportional to the distance from the origin $\rho = \alpha r$ (α is a constant) is :

(A) $\frac{\alpha r^3}{4 \epsilon_0}$ (B) $\frac{\alpha r^2}{4 \epsilon_0}$ (C) $\frac{\alpha r^2}{3 \epsilon_0}$ (D) none of these

3. A particle of charge - q & mass *m* moves in a circle of radius *r* around an infinitely long line charge of linear charge density $+\lambda$. Then time period of revolution of charge will be :

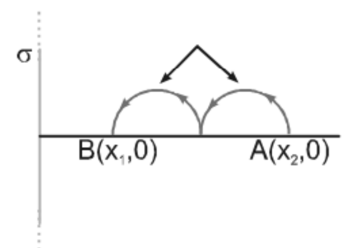


(A) $T = 2\pi r \sqrt{\frac{m}{2k\lambda q}}$ (B) $T^2 = \frac{4\pi^2 m}{2k\lambda q} r^3$

(C) $T = \frac{1}{2\pi r}\sqrt{\frac{2k\lambda q}{m}}$ (D) $T = \frac{1}{2\pi r}\sqrt{\frac{m}{2k\lambda q}}$

where $k = \frac{1}{4\pi\epsilon_0}$

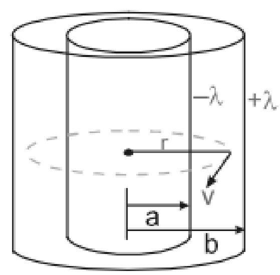
4. An infinitely long plate has surface charge density σ. As shown in the fig, a point charge q is moved from A to B. Net work done by electric field is:



(A) $\frac{\sigma q}{2\epsilon_0}(x_1 - x_2)$ (B) $\frac{\sigma q}{2\epsilon_0}(x_2 - x_1)$

(C) $\frac{\sigma q}{\epsilon_0}(x_2 - x_1)$ (D) $\frac{\sigma q}{\epsilon_0}(2\pi r + r)$

5. Figure shows two large cylindrical shells having uniform linear charge densities $+\lambda$ and $-\lambda$. Radius of inner cylinder is 'a' and that of outer cylinder is 'b'. A charged particle of mass m, charge q revolves in a circle of radius r (where a < r < b). Then it's speed 'v' is : (Neglect gravity and assume the radii of both the cylinders to be very small in comparison to their length.)



(A) $\sqrt{\frac{\lambda q}{2\pi\epsilon_0 m}}$ (B) $\sqrt{\frac{2\lambda q}{\pi\epsilon_0 m}}$

(C) $\sqrt{\frac{\lambda q}{\pi\epsilon_0 m}}$ (D) $\sqrt{\frac{\lambda q}{4\pi\varepsilon_0 m}}$

11th Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

PHYSICS

Module-1

1. Physical World & Measurements
2. Basic Maths & Vector
3. Kinematics

Module-2

1. Law of Motion & Friction
2. Work, Energy & Power

Module-3

1. Motion of system of particles & Rigid Body
2. Gravitation

Module-4

1. Mechanical Properties of Matter
2. Thermal Properties of Matter

Module-5

1. Oscillations
2. Waves

CHEMISTRY

Module-1(PC)

1. Some Basic Conceps of Chemistry
2. Atomic Structure
3. Chemical Equilibrium
4. Ionic Equilibrium

Module-2(PC)

1. Thermodynamics & Thermochemistry
2. Redox Reaction
3. States Of Matter (Gaseous & Liquid)

Module-3(IC)

1. Periodic Table
2. Chemical Bonding
3. Hydrogen & Its Compounds
4. S-Block

Module-4(OC)

1. Nomenclature of Organic Compounds
2. Isomerism
3. General Organic Chemistry

Module-5(OC)

1. Reaction Mechanism
2. Hydrocarbon
3. Aromatic Hydrocarbon
4. Environmental Chemistry & Analysis Of Organic Compounds

BIOLOGY

Module-1

1. Diversity in the Living World
2. Plant Kingdom
3. Animal Kingdom

Module-2

1. Morphology in Flowering Plants
2. Anatomy of Flowering Plants
3. Structural Organization in Animals

Module-3

1. Cell: The Unit of Life
2. Biomolecules
3. Cell Cycle & Cell Division
4. Transport in Plants
5. Mineral Nutrition

Module-4

1. Photosynthesis in Higher Plants
2. Respiration in Plants
3. Plant Growth and Development
4. Digestion & Absorption
5. Breathing & Exchange of Gases

Module-5

1. Body Fluids & Its Circulation
2. Excretory Products & Their Elimination
3. Locomotion & Its Movement
4. Neural Control & Coordination
5. Chemical Coordination and Integration

12^{th} Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

PHYSICS

Module-1
1. Electrostatics
2. Capacitance

Module-2
1. Current Electricity
2. Magnetic Effect of Current and Magnetism

Module-3
1. Electromagnetic Induction
2. Alternating Current

Module-4
1. Geometrical Optics
2. Wave Optics

Module-5
1. Modern Physics
2. Nuclear Physics
3. Solids & Semiconductor Devices
4. Electromagnetic Waves

CHEMISTRY

Module-1(PC)
1. Solid State
2. Chemical Kinetics
3. Solutions and Colligative Properties

Module-2(PC)
1. Electrochemistry
2. Surface Chemistry

Module-3(IC)
1. P-Block Elements
2. Transition Elements (d & f block)
3. Co-ordination Compound
4. Metallurgy

Module-4(OC)
1. HaloAlkanes & HaloArenes
2. Alcohol, Phenol & Ether
3. Aldehyde, Ketone & Carboxylic Acid

Module-5(OC)
1. Nitrogen & Its Derivatives
2. Biomolecules & Polymers
3. Chemistry in Everyday Life

BIOLOGY

Module-1
1. Reproduction in Organisms
2. Sexual Reproduction in Flowering Plants
3. Human Reproduction
4. Reproductive Health

Module-2
1. Principles of Inheritance and Variation
2. Molecular Basis of Inheritance
3. Evolution

Module-3
1. Human Health and Disease
2. Strategies for Enhancement in Food Production
3. Microbes in Human Welfare

Module-4
1. Biotechnology: Principles and Processes
2. Biotechnology and Its Applications
3. Organisms and Populations

Module-5
1. Ecosystem
2. Biodiversity and Conservation
3. Environmental Issues