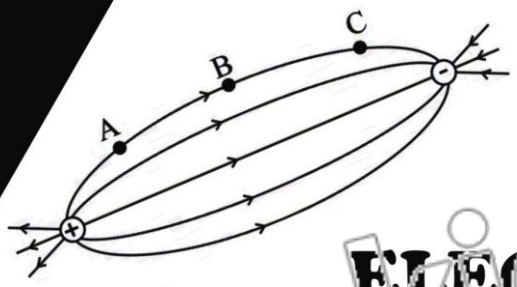

Chapter 12

ELECTROSTATICS

TOPICAL MULTIPLE-CHOICE QUESTIONS

Topic 12.1:

Coulomb's Law

(1) SI unit of permittivity of free space is

(a) $C^2 N^{-1} m^{-2}$ **(b)** $N m^2 C^{-1}$

(c) $N m^2 C^{-1}$ **(d)** $N m C^{-2}$

(2) The value of $4\pi\epsilon_o$ is

(a) 9×10^9 NmC^{-2} **(b)** $\frac{1}{9\times10^9 Nm^2C^{-2}}$

(c) 1 NmC^{-2} **(d)** 8.85×10^{-12} NmC^{-2}

(3) The relative permittivity of air is

(a) 1 **(b)** 3.7

(c) 7.8 **(d)** 1.0006

(4) Coulomb's force is represented by

(a) $F = \frac{kq_1q_2}{r^2}$ **(b)** $F = 4\pi\varepsilon_o \frac{q_1q_2}{r^2}$

(c) $F = \frac{1}{4\pi\varepsilon_o}\frac{q_1q_2}{r^2}$ **(d)** $F = \frac{1}{4\pi\varepsilon_o}\frac{q_1q_2}{r}$

(5) Like charges

(a) attract each other **(b)** repel each other

(c) both a and b **(d)** none of these

(6) The value of $\hat{I}_o$ is

(a) 8.85×10^{-12} $N^{-1} m^{-2} C^2$ **(b)** 8.85×10^{-10} $N m^{-2} C^2$

(c) 8.85×10^{-12} $N^{-1} m^2 C^{-2}$ **(d)** 8.85×10^{-12} $Nm^{-2} C$

(7) The unit of relative Permittivity e_r for water is

(a) $N m^{-1} C^2$ **(b)** $N m^2 C^{-2}$

(c) $Nm^{-1} C^{-2}$ **(d)** no unit

(8) The relation for the force in a medium of relative permittivity e_r is given by

(a) $F¢ = \frac{F}{e_r}$ **(b)** $F = \frac{F¢}{e_r}$

(c) $F¢ = e_r F$ **(d)** $F¢ = \frac{F}{\hat{I}_o}$

(9) If the distance between two charges becomes double then the force between them become.

(a) one half **(b)** $\frac{1}{4} times$

(c) double half **(d)** none of these

(10) The value of relative permittivity ε_r for vacuum is

(a) 78.5 **(b)** 2

(c) 1 **(d)** 1.0006

(11) The value of k depends upon

(a) quantity of charges **(b)** nature of medium between the charges

(c) both a and b **(d)** none of these

(12) The first measurement of the force between electric charges was made in 1874 by

(a) Charles coulomb **(b)** Ampere

(c) Albert Einstein **(d)** Thomson

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(13) The electrostatic force between two charges is 42 N. If we place a dielectric of ε_r = 2.1 between the charges then the force become equal to: LHR-2019 (G-II)

(a) 42 N **(b)** 84 N

(c) 20 N **(d)** 2 N

(14) The value of charge on 1.0×10^7 electrons is: LHR-2019 (G-II)

(a) 1.6×10^{-12}C **(b)** 1.6×10^{11}C

(c) 1.6×10^{-19}C **(d)** 1.6×10^{19}C

(15) Value of ε_r for air is; MIRPUR (AJK) 2017

(a) 1.6 **(b)** 1.96

(c) 1.986 **(d)** 1.0006

(16) In SI units, the value of permittivity of free space (ε_o) is SGD-2017 (G-I)

(a) $9\times10^9 Nm^2C^{-2}$ **(b)** 9×10^{-9} $C^2N^{-1}m^{-2}$

(c) 8.85×10^{12} $C^2N^{-1}m^{-2}$ **(d)** 8.85×10^{-12} $C^2N^{-1}m^{-2}$

(17) If the charges are doubled and the distance between them is also doubled, then Coulomb's force will be: RWP-2019 (G-I)

(a) double **(b)** halved

(c) remains same **(d)** four times

(18) The minimum value of charge on free particle is: SGD-2020 (G-I)

(a) 2/3e **(b)** 1/3e

(c) –2/3e **(d)** e

(19) Value of ε_o in Coulomb's law is DGK-2017 (G-I)

(a) 9×10^9 Nm^2C^{-1} **(b)** 8.85×10^{-12} $C^2N^{-1}m^{-2}$

(c) 9×10^9 $N^{-1}m^{-2}C$ **(d)** 8.85×10^{-12} $C^{-2}Nm^2$

(20) Presence of dielectric between two charges always DGK-2017 (G-II)

(a) reduces the electric force **(b)** enhances the electric force

(c) does not effect electric force **(d)** doubles the electric force

(21) Force between two similar unit charges placed one meter a part in air is: BWP-2017 (G-I)

(a) one newton **(b)** 9×10^9 N

(c) 9×10^{-9} N **(d)** zero newton

(22) The study of electric charges at rest under the action of electric forces is known as:

MTN-2019 (G-I)

(a) Electromagnetism **(b)** Electrostatics
(c) Magnetic Induction **(d)** Electric field

(23) The number of electrons is one coulomb charged is equal to. MTN-2022 (G-I)
(a) 1.6×10^{-19} **(b)** 6.25×10^{-19}
(c) 6.25×10^{18} **(d)** 6.25×10^{19}

(24) The force between two charges is 36N and if the dielectric constant 3.6 value is inserted, then force reduces to_____. RWP-2022 (G-I)
(a) zero **(b)** 72N
(c) 25N **(d)** 10N

(25) If the distance between two charges is halved and each charge is also doubled, then the force between two changes becomes _____ times. RWP-2022 (G-I)
(a) two **(b)** sixteen
(c) eight **(d)** four

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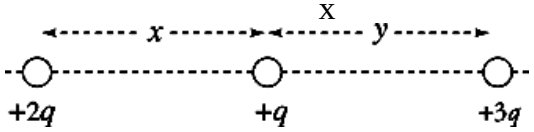
(26) If a body A is charged with charge q, and is touched with neutral body B and then with neutral body C. What will be the charge on C after the contact?
(a) q **(b)** q/2
(c) q/3 **(d)** q/4

(27) The figure below shows three-point charges, all positive. If the net electric force on the center charge is zero, what is the value of $\frac{y}{x}$?



(a) $\frac{4}{9}$ **(b)** $\sqrt{\frac{2}{3}}$
(c) $\sqrt{\frac{3}{2}}$ **(d)** $\frac{3}{2}$

Topic 12.2:

Field of Forces

(28) The electric field intensity at infinite distance from point charge is
(a) infinite **(b)** zero
(c) positive **(d)** negative

(29) The direction of field lines around a charge '–q' is
(a) radialy inward **(b)** radialy outward
(c) parallel **(d)** anti parallel

(30) The unit of electric intensity is
(a) NC **(b)** NsC
(c) NC^{-2} **(d)** NC^{-1}

(31) Electric field intensity is a
(a) scalar quantity **(b)** vector quantity
(c) linear quantity **(d)** none of these

(32) The force per unit charge is called
(a) Electric force **(b)** Electric potential

(c) Electric Intensity **(d)** Electric dipole

(33) The direction of electric field Intensity is

(a) along the direction of charge **(b)** perpendicular to the direction of force

(c) along the direction of force **(d)** none of these

(34) If the distance of the point from the point charge becomes $\frac{1}{2}$, the Electric field in intensity becomes

(a) half **(b)** double

(c) $\frac{1}{4}$ times **(d)** none of these

(35) Static charges creates

(a) electric field **(b)** magnetic field

(c) both a and b **(d)** gravitational field

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(36) The force on an electron in a field of 1×10^{8} NC^{-1} will be: FSD-2019 (G-I)

(a) 1.6×10^{-8} N **(b)** 1.6×10^{-11} N

(c) 1.6×10^{-19} N **(d)** 1.6×10^{-27} N

(37) A charge of 4 C is in the field of intensity 4 N/C. the force on charge is DGK-2022 (G-II)

(a) 1 N **(b)** 4 N

(c) 8 N **(d)** 16 N

(38) Unit of electric intensity is same as: LHR-2022 (G-II)

(a) Force **(b)** Potential gradient

(c) Viscosity **(d)** Magnetic field

ENTRY TEST MCQS

(39) A gold nucleus (radius r) is represented by the symbol $^{197}_{79}$Au. Taking e as the elementary charge and ε_o as the permittivity of free space, what is the electric field strength at the surface of an isolated gold nucleus?

(a) Zero **(b)** $\frac{197e}{4\pi\varepsilon_o r^2}$

(c) $\frac{79e}{4\pi\varepsilon_o r^2}$ **(d)** $\frac{79e^2}{4\pi\varepsilon_o r^2}$

Topic 12.3:

Electric Field Lines

(40) The electric field lines are _____ in case of two identical point charges by certain distance

(a) curved **(b)** straight

(c) circular **(d)** none of these

(41) Electric field lines are originated from

(a) negative charges **(b)** positive charges

(c) both of a & b **(d)** none of these

(42) The electric lines are farther apart where field is

(a) strong **(b)** zero
(c) weak **(d)** none of these

(43) As electric field lines provide information about the electric force exerted on a charge, the lines commonly called

(a) lines of strength **(b)** lines of field
(c) lines of force **(d)** lines of flux

(44) In central region of a parallel plate capacitor the electric field lines are

(a) perpendicular **(b)** parallel
(c) orthogonal **(d)** curved

(45) A visual representation of electric field can be obtained in terms of

(a) electric flux **(b)** electric lines of force
(c) electric field lines **(d)** both b and c

(46) A unit positive charge + q_o placed any where in the vicinity of a positive point charge, experiences a repulsive force directed.

(a) radially inward **(b)** radially out ward
(c) radially zero **(d)** none of these

(47) The electric lines of force

(a) start from positive charge and end to the negative charge
(b) start from negative charge and end to the positive charge
(c) both a and b
(d) none of these

(48) Usually test charge is taken as

(a) negative charge **(b)** positive charge
(c) both a and b **(d)** none of these

(49) An imaginary path along which a unit positive charge moves in an electric field is called

(a) Magnetic line of force **(b)** An electric line of force
(c) direction of the charge **(d)** trajectory of charge

(50) The directions of the resultant electric intensities is given by

(a) circle drawn to the field lines **(b)** Parabola drawn to the field lines
(c) Tangent drawn to the field lines **(d)** ellipse drawn to the field lines

(51) The tangent to field line at any point gives the

(a) force of electric field **(b)** direction of electric field
(c) magnitude of electric field **(d)** none of these

(52) The electric field has

(a) one dimension **(b)** two dimension
(c) three dimension **(d)** dimension less

(53) If the line of force cross, then E could have

(a) no direction **(b)** one direction
(c) more than one direction **(d)** none of these

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(54) A rubber ball of radius 2 cm has a charge of 5 μc on its surface, which is uniformly distributed, the value of $\vec{E}$ at its centre is: RWP-2019 (G-I)

(a) 10 NC^{-1} **(b)** Zero

(c) 2.5 NC^{-1} **(d)** 5×10^{-6} NC^{-1}

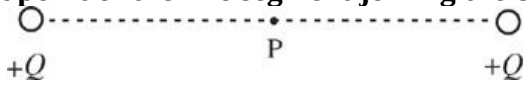
(55) The idea for electric field lines was proposed by DGK-2017 (G-I)

(a) Henry **(b)** Michael Faraday

(c) Ampere **(d)** Ohm

ENTRY TEST MCQS

(56) The figure below shows two-point charges, +*Q* and +*Q*. If the right-hand charge were absent, the electric field at Point P due to +*Q* would have a strength of *E*. With the right-hand charge in place, what is the strength of the total electric field at P, which lies at the midpoint of the line segment joining the charges?



(a) 0 **(b)** $\frac{E}{4}$

(c) $\frac{E}{2}$ **(d)** 2E

Topic 12.4:

Application of Electrostatics

(57) The drum in a photocopier is coated with a layer of

(a) copper **(b)** silver

(c) selenium **(d)** aluminum

(58) Selenium becomes conductor in light, so it is called

(a) super conductor **(b)** semi-conductor

(c) photo conductor **(d)** insulator

(59) Photocopier and inkjet printer are the application of

(a) magnetism **(b)** electromagnetism

(c) electrostatics **(d)** electricity

(60) The charged droplets are deflected into a

(a) electrodes **(b)** toner

(c) gutter **(d)** nozzle of print head

(61) Aluminium is an excellent

(a) conductor **(b)** insulator

(c) semi-conductor **(d)** diode

(62) The special dry powder used in xerography called

(a) toner **(b)** drum

(c) charging electrodes **(d)** gutter

(63) In ink-Jet printers, the droplets are passed through

(a) gutter **(b)** charging electrodes

(c) deflecting plates **(d)** both b and c

(64) Inkjet printer head ejects a

(a) turbulent flow of ink droplets **(b)** steady flow of ink droplets

(c) irregular flow of ink droplets **(d)** none of these

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(65) Selenium is a **GRW-2019 (G-II)**

(a) conductor **(b)** insulator
(c) photoconductor **(d)** semi-conductor

(66) The word "Xerography" means **SGD-2017 (G-II)**

(a) take photograph **(b)** dry writing
(c) writing by machine **(d)** paint something

(67) Photo copier and inject printer are the application of. **SGD-2020 (G-II)**

(a) magnetism **(b)** electricity
(c) electromagnetism **(d)** electrostatics

(63) Photocopier and inkjet printers are the application of. **BWP-2022 (G-I)**

(a) Electricity **(b)** Magnetism
(c) Electrostatics **(d)** Electromagnetism

ENTRY TEST MCQS

(69) Which of the following is not the application of electrostatics?

(a) Photocopier **(b)** Inkject printer
(c) Laser printer **(d)** Transformer

Topic 12.5:

Electric Flux

(70) The flux through any closed surface will be maximum, if its surface makes angle with the electric field of

(a) 0^o **(b)** 90^o
(c) 180^o **(d)** 45^o

(71) If surface is parallel to the electric field, then its electric flux will be

(a) minimum **(b)** maximum
(c) zero **(d)** constant

(72) When vector area is parallel to electric intensity, the electric flux is

(a) maximum **(b)** minimum
(c) zero **(d)** constant

(73) The unit of electric flux is

(a) Nm^2C^{-1} **(b)** $Nm^{-1}C^{-1}$
(c) NmC^{-1} **(d)** NmC^{-2}

(74) Electric flux would be negative when

(a) $\vec{A}$ is perpendicular to $\vec{E}$ **(b)** $\vec{A}$ is along $\vec{E}$
(c) both a and b **(d)** $\vec{A}$ is anti parallel to $\vec{E}$

(75) The electric flux through any closed surface depends upon the

(a) medium only
(b) charge only
(c) medium and charge enclosed by the closed surface
(d) shape of surface

(76) Electric flux is defined mathematically as

(a) $f = EA$ **(b)** $\frac{E}{f} = A$

(c) $\frac{E}{A} = f$ **(d)** $\frac{A}{E} = f$

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(77) S.I Unit of electric flux is MTN-2022 (G-I)
(a) NmC^{-1} **(b)** $Nm^{-1}C^{-1}$
(c) Nm^2C^{-1} **(d)** Nm^2C^{-1}

(78) Electric flux is maximum, when angle between E and surface area is: FSD-2019 (G-I)
(a) 0° **(b)** 90°
(c) 180° **(d)** 45°

(79) SI unit of electric flux is DGK-2022 (G-I), RWP-2022 (G-II)
(a) NC^{-1} **(b)** $N.m^2.C^{-1}$
(c) $N.m.C^{-1}$ **(d)** $N.C^{-1}.m^2$

(80) Electric flux through a closed surface enclosing a charge depends on: LHR-2022 (G-II)
(a) Medium **(b)** Size
(c) Shape **(d)** Location of charge

ENTRY TEST MCQS

(81) Electric flux linked with a surface will be minimum when angle between electric intensity and vector area is
(a) 60° **(b)** 90°
(c) 30° **(d)** 0°

(82) Flux passing through an area does not depend upon:
(a) Charge enclosed **(b)** Shape of hypothetical surface
(c) Medium **(d)** Both a and b

Topic 12.6, 12.7 & 12.8:

Electric Flux through A Surface Enclosing A Charge
Gauss's Law and Application of Gauss's law

(83) An imaginary closed surface which passes through the point at which electric intensity is to be calculated is called
(a) Newtonian's surface **(b)** coulombs surface
(c) Gaussian's surface **(d)** Millikan's surface

(84) Surface density of charge is
(a) charge x area **(b)** charge / area
(c) area / charge **(d)** charge / volt

(85) The flux through any closed surface is _____ the total charge enclosed by the closed surface
(a) $\frac{1}{\varepsilon_o}$ **(b)** $\frac{2}{\varepsilon_o}$
(c) ε_o **(d)** ε_r

(86) The mathematical expression of Gauss's law is
(a) $\Phi_e = \frac{1}{Q\varepsilon_o}$ **(b)** $\Phi_e = \frac{\varepsilon_o}{Q}$

(c) $\Phi_e = Q\varepsilon_o$ **(d)** $\Phi_e = \dfrac{Q}{\varepsilon_o}$

(87) Electric flux is a
(a) scalar quantity **(b)** vector quantity
(c) linear quantity **(d)** none of theses

(88) Flux through the closed surface depends upon
(a) shape of the surface **(b)** geometry of the surface
(c) independent of shape and geometry **(d)** all of these

(89) The interior of a hollow charged metal surface has
(a) maximum charge **(b)** small charge
(c) no charge **(d)** negligible charge

(90) Gauss's law is applied to calculate the
(a) electric intensity due to different charge configuration
(b) electric intensity due to negative charges only
(c) electric intensity due to positive charges only
(d) none of these

(91) The total flux f through a closed surface having charge q at its center is

(a) $\phi_e = \dfrac{q}{\varepsilon_o}$ **(b)** $\phi_e = \dfrac{q}{r^2}$

(c) $\phi_e = \dfrac{kq}{\varepsilon_o}$ **(d)** $\phi_e = \dfrac{\varepsilon_o}{q}$

(92) Unit of surface charge density is

(a) $\dfrac{C}{kg}$ **(b)** $\dfrac{C}{m}$

(c) $\dfrac{C}{m^2}$ **(d)** $\dfrac{C}{m^3}$

(93) Gaussian surface is a
(a) imaginary surface **(b)** an open surface
(c) curved surface **(d)** plane surface

(94) Electric intensity inside the hollow charged sphere is
(a) minimum **(b)** maximum
(c) zero **(d)** none of these

(95) Electric intensity due to an infinite sheet of charge is given by
(a) $\vec{E} = \dfrac{s}{2\hat{I}_o}\hat{r}$ **(b)** $\vec{E} = \dfrac{s}{\hat{I}_o}\hat{r}$
(c) $\vec{E} = \dfrac{2\hat{I}}{s}\hat{r}$ **(d)** $\vec{E} = \dfrac{q}{\hat{I}_o}\hat{r}$

(96) Electric Intensity due to oppositely charge plates is given by
(a) $\vec{E} = \dfrac{s}{2\hat{I}_o}\hat{r}$ **(b)** $\vec{E} = \dfrac{s}{\hat{I}_o}\hat{r}$
(c) $\vec{E} = \dfrac{2q}{\hat{I}_o}\hat{r}$ **(d)** $\vec{E} = \dfrac{qs}{\hat{I}_o}\hat{r}$

(97) The f_e through the surface of sphere of radius r due to a point charge placed at its center depends upon
(a) radius of sphere **(b)** quantity of charge outside the sphere

(c) quantity of charge inside the sphere **(d)** surface area of sphere

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(98) Electrical field intensity between oppositely charged parallel plates is **GRW-2022 (G-I)**

(a) $\frac{2\sigma}{\varepsilon_o}$ **(b)** $\frac{\sigma}{\varepsilon_o}$

(c) $\frac{\sigma}{2\varepsilon_o}$ **(d)** $\frac{\varepsilon_o}{2\sigma}$

(99) A rubber ball of radius 2cm has a charge of 5μC on its surface, which is uniformly distributed. The value of E at its center is **SGD-2020 (G-I)**

(a) 10 NC^{-1} **(b) 0**

(c) 2.5 NC^{-1} **(d)** 5×10^{-6} NC^{-1}

ENTRY TEST MCQS

(100) A point particle with charge q is at the center of a Gaussian surface in the form of a cube. The electric flux through any one face of the cube is

(a) $\frac{q}{\varepsilon_o}$ **(b)** $\frac{q}{6\varepsilon_o}$

(c) $\frac{q}{4\varepsilon_o}$ **(d)** $\frac{q}{4\varepsilon_o}$

(101) What will be the new surface density if electric intensity is increased to 3 times?

(a) 9σ **(b)** σ/3

(c) 3σ **(d)** σ/27

Topic 12.9:

Electric Potential

(102) Electric potential energy and electric potential difference are related as

(a) $\Delta U = \frac{q_o}{q}$ **(b)** $\Delta U = q_o \Delta V$

(c) $\Delta U = \frac{\Delta V}{q_o}$ **(d)** $U = \frac{\Delta V}{\Delta r}$

(103) Two charge -10C and +10C are placed 10cm apart potential at the centre of line joining two charges is

(a) 2V **(b)** –2V

(c) zero **(d)** 4 volt

(104) The difference of potential energy per unit charge is called

(a) electric potential **(b)** potential difference

(c) absolute potential **(d)** all of these

(105) The relation $-\frac{\Delta V}{\Delta r}$ is called

(a) potential difference **(b)** potential energy

(c) potential gradient **(d)** absolute potential

(106) The amount of work done to move a unit positive charge from one point to another against the E is measure of

(a) Electric potential difference between two points

(b) capacitance
(c) Intensity of E
(d) Resistance between two points

(107) 1 volt =
(a) JC^{-1} **(b)** JC
(c) CJ^{1} **(d)** $J^{-1}C^{-1}$

(108) An ECG records _____ between points on human skin
(a) voltage **(b)** current
(c) electric flux **(d)** all of these

(109) SI unit of potential difference
(a) ampere **(b)** Pascal
(c) Henry **(d)** volt

(110) ERG is used to diagnose
(a) skin cancer **(b)** abnormal behavior of brain
(c) diseases of eye **(d)** Lungs cancer

(111) In relation $E = -\frac{VV}{Vr}$ **then negative sign indicate that the direction of E is along the**
(a) increasing potential **(b)** decreasing potential
(c) zero potential **(d)** none of these

(112) The general expression for electric potential V_r at a distance r from q is
(a) $V_r = 4p\,\hat{I}_o \frac{q}{r}$ **(b)** $V_r = \frac{1}{k}\ \frac{q}{r}$
(c) $V_r = k\frac{q}{r}$ **(d)** $V_r = \frac{1}{4p\,\hat{I}_o}\ \frac{r}{q}$

(113) ERG stands for
(a) electro graphy **(b)** electro retinography
(c) electro radiography **(d)** none of these

(114) The magnitude of electric field between two separated charged plates can be calculated by using
(a) $E = DVd$ **(b)** $E = \frac{DV}{d}$
(c) $E = \frac{DV}{d^2}$ **(d)** $E = \frac{DV^2}{d}$

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(115) When a dielectric material is inserted between the plates of a capacitor, the potential difference between the plates. **GRW-2022 (G-I)**
(a) Does not change **(b)** Increase
(c) Decrease **(d)** None of these

(116) Th potential difference between two plates is 100 volts and separation of the plates 5 cm than potential gradient is **GRW-2022 (G-II)**
(a) 2000 NC^{-1} **(b)** 20 NC^{-1}
(c) 5000 NC^{-1} **(d)** 2 NC^{-1}

(117) Negative of potential gradient is equal to: **MTN-2019 (G-II)**

(a) Magnetic intensity **(b)** Electric flux
(c) Magnetic flux **(d)** Electric intensity

(118) Electro-Encepalo-Graphy (EEG) is the diagnostic test for the working of SWL-2017

(a) eye **(b)** heart
(c) brain **(d)** lungs

(119) Electroretinography is used for the diagnosis of abnormality in the: **BWP-2019 (G-II)**

(a) Eyes **(b)** Ears
(c) Throat **(d)** Heart

(120) $\frac{V}{m}$ **is unit of:** **BWP-2022 (G-II)**

(a) Magnetic Field intensity **(b)** Electric field intensity
(c) Electric force **(d)** Gravitational force

(121) The absolute potential at a point distant 20cm form a charge of 2μC is: **BWP-2022 (G-II)**

(a) 9×10^2V **(b)** 9×10^3V
(c) 9×10^4V **(d)** 9×10^5V

(122) The difference of potential energy between two points per unit charge is: **LHR-2022 (G-I)**

(a) Electrical potential **(b)** Potential difference
(c) Absolute potential **(d)** All of these

ENTRY TEST MCQS

(123) A and B are two points in an electric field. If the work done in carrying 4.0 coulomb of electric charge from A to B is 16.0 joule, the potential difference between A and B is

(a) Zero **(b)** 2.0 V
(c) 4.0 V **(d)** 16.0 V

(124) The large horizontal metal plates are separated by 4 mm. The lower plate is at a potential of –6V.

What potential should be applied to the upper plate to create an electric field of strength 4000 Vm^{-1} Upwards in the space between the plates?

(a) +22 V **(b)** –10 V
(c) +10 V **(d)** –22 V

Topic 12.10:

Electron Volt

(125) 1.6×10^{-19} J is equal to

(a) 1C **(b)** 1 volt
(c) 1eV **(d)** 1 N-m

(126) Electron volt is the unit of

(a) energy **(b)** potential gradient
(c) rate of change of potential with distance **(d)** both b and c

(127) A particle carrying a charge of 2e falls through a potential difference of 3V. The energy required by it.

(a) 9.6×10^{-19}J **(b)** 9.6×10^{-16}J
(c) 1.6×10^{19}J **(d)** 6.25×10^{18}J

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(128) The electron volt (eV) is the unit of **CRW-2019 (G-II)**
(a) electric current **(b)** electric energy
(c) electric potential **(d)** electric flux

(129) The product of charge and potential difference is **SGD-2017 (G-II)**
(a) flux **(b)** current
(c) energy **(d)** power

(130) If an electron is accelerated through a potential difference of 10 V, then energy gained by electron is: **FSD-2019 (G-I)**
(a) 1.6×10^{-20} J **(b)** 1.6 eV
(c) 10 eV **(d)** 1.6×10^{-19} eV

(131) Which one of the following relation is correct? **RWP-2019 (G-I)**
(a) joule = volt × ampere **(b)** joule = coulomb / volt
(c) joule = volt / ampere **(d)** joule = coulomb × volt

(132) One coulomb charge contains the number of electrons **SWL-2017**
(a) 6.25×10^{18} **(b)** 1.6×10^{-19}
(c) 9×10^{9} **(d)** 1.6×10^{19}

(133) A particle carrying a charge 2e falls through a potential difference of 3V. The energy acquired by it is : **MTN-2019 (G-I)**
(a) 9.6×10^{-18} J **(b)** 9.6×10^{-19} J
(c) 1.6×10^{-19} J **(d)** 9.6×10^{-17} J

(134) A particle having a charge of 2e falls through a potential difference of 3.0 volts. **BWP-2022 (G-I)**
(a) 6.0 eV **(b)** 5.0 eV
(c) 4.0 eV **(d)** 8.0 eV

ENTRY TEST MCQS

(135) A charge of 0.10C accelerated through a potential difference of 1000V acquires kinetic energy of
(a) 200 J **(b)** 10 J
(c) 100 J **(d)** 100 eV

Topic 12.11:

Electric and Gravitational Forces

(136) Electrostatic force as compared to the gravitational force is
(a) Very weak **(b)** very strong
(c) equal **(d)** half of the gravitational field

(137) If the electric and gravitational force on an electron placed in a uniform electric field balance each other, then the electric intensity will be
(a) mg/q **(b)** qg/m
(c) m/qg **(d)** q/mg

(138) Gravitational force is an
(a) attractive force **(b)** repulsive force

(c) nuclear force **(d)** none of these

(139) Electrostatic force is a _____ force

(a) attractive **(b)** repulsive force

(c) may be attractive or repulsive **(d)** none of these

PAST PAPER MCQS

(140) Gravitational force cannot be: FSD-2022 (G-I)

(a) mass dependent **(b)** distance dependent

(c) Shielded **(d)** Stronger than electric force

Topic No. 12.3

Charge on an Electron by Millikan's Method

(141) The minimum charge on an oil droplet measured by Millikan's was equal to charge on

(a) proton **(b)** neutron

(c) nucleus **(d)** electron

(142) The charge on the droplet in Millikan's experiment was calculated by the formula

(a) q = mg/dV **(b)** $q = \frac{V}{mgd}$

(c) q = mgd/V **(d)** q=d/mgV

(143) In Millikan's experiment, the oil drop can be suspended between two plates when gravitational force is equal to

(a) Magnetic force **(b)** electric force

(c) Normal force **(d)** all of these

(144) An electric field that balance the weight of an electron will act

(a) downward **(b)** upward

(c) along the surface of sphere **(d)** all of these

(145) The radius of droplet in Millikan's method can be given by

(a) $r^2 = \frac{9\eta v_t}{2\rho g}$ **(b)** $r^2 = \frac{3\eta v_t}{2\rho g}$

(c) $r^2 = \frac{6\pi\eta v_t}{2\rho g}$ **(d)** $r^2 = \frac{9\pi\eta v_t}{2\rho g}$

(146) According to Stoke's law

(a) $F = \frac{4}{3} p r^3 f$ **(b)** $F = \frac{mgd}{V}$

(c) $F = 6 ph\, rv$ **(d)** $F = \frac{V}{mgd}$

(147) The oil drop in Millikan's experiment, is suspended by

(a) nuclear force and gravitational force **(b)** gravitational force and coulomb force

(c) electrostatic force and frictional force **(d)** none of these

PAST PAPER MCQS

(148) It is required to suspended a proton of charge 'q' and mass 'm' in an electric field the strength of the field must be: LHR-2019 (G-II)

(a) $E = \frac{mg}{qv}$ **(b)** $E = \frac{mg}{q}$

(c) $E = \frac{q}{mg}$ **(d)** $E = \frac{qv}{B}$

(149) The mass of oil droplet in measuring charge in Millikan method is calculated by. **MTN 2022 (G-II)**

(a) Stokes's law **(b)** Coulomb's law
(c) Newton's gravitational law **(d)** Faraday's law

ENTRY TEST MCQS

(150) A proton (mass = 1.67×10^{-27} kg) on entering in a vertical electric field E is bounced. Then the electric field strength is

(a) 10^{-9} Vm^{-1} **(b)** 10^{+7} Vm^{-1}
(c) 10^{-7} Vm^{-1} **(d)** 10^{-8} Vm^{-1}

Topic 12.13, Topic 12.14:

Capacitor, Capacitance of a Parallel Plate Capacitor,

(151) The space between the plates of a capacitor is filled by

(a) Conductor **(b)** insulator
(c) super conductor **(d)** none of these

(152) If air is the dielectric between plates of a capacitor, by doubling the distance between the plates and reducing area to $\frac{1}{3}$ of the original value, its capacitance becomes

(a) 10 times **(b)** 6 times
(c) $\frac{1}{6}$ times **(d)** 90 times

(153) If air is replaced by a dielectric in parallel plate capacitor, then the potential difference

(a) decreases **(b)** increases
(c) remain constant **(d)** both a and b

(154) Equivalent capacitance is greater than individual capacitances in

(a) series combination **(b)** Parallel combination
(c) both a and b **(d)** none of these

(155) Capacitor stores energy in the form of

(a) electric field **(b)** magnetic field
(c) both of these **(d)** gravitational field

(156) Capacitance of parallel plate capacitor does not depend upon

(a) separation of the plates **(b)** area of the plates
(c) medium between the plates **(d)** nature of the material of the plates

(157) The unit of capacitance

(a) $\frac{C}{V}$ **(b)** Farad
(c) $\frac{s}{\Omega}$ **(d)** all of these

(158) Capacitance in the presence of medium is given by:

(a) $\frac{A\varepsilon_r\varepsilon_o}{r^2}$ **(b)** $\frac{A\varepsilon_r}{r^2}$

(c) $\frac{A\varepsilon_r\varepsilon_o}{d}$ **(d)** $\frac{A\varepsilon_r}{d}$

(159) The expression for dielectric constant is given by

(a) $\varepsilon_r = \frac{C_{med}}{C_{vac}}$ **(b)** $\varepsilon_r = \frac{C_{vac}}{C_{med}}$

(c) $\varepsilon_r = C_{vac} \times C_{med}$ **(d)** $\varepsilon_r = \frac{1}{C_{vac} \times C_{med}}$

(160) The ability of a capacitor to store charges is called

(a) inductance **(b)** capacitance
(c) resistance **(d)** conductance

(161) 1 Pico-farad =

(a) 10^{-6} F **(b)** 10^{-12} F
(c) 10^{-9} F **(d)** 10^{-15} F

(162) If dielectric medium is placed between the plates of capacitor, its capacitance

(a) increases **(b)** decreases
(c) remain same **(d)** none of these

(163) When capacitors are connected in series then the effective capacitance

(a) decreases **(b)** increases
(c) become zero **(d)** none of these

(164) If the distance between the plates increases the capacitance

(a) increases **(b)** decreases
(c) remain same **(d)** none of these

PAST PAPER MCQS

(165) Coulomb per volt is called: **LHR-2021 (G-II)**

(a) Ampere **(b)** Joule
(c) Henry **(d)** Farad

(166) Capacitance of parallel plate capacitor can be increased by. **MTN-2022 (G-II)**

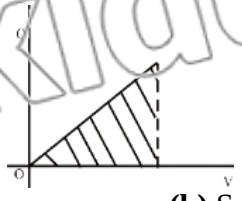
(a) decreasing area of plates **(b)** increasing separation between plates
(c) increasing potential **(d)** increasing dielectric material

ENTRY TEST MCQS

(167) The capacitance of a parallel plate capacitor is independent of

(a) Area of plates **(b)** Nature of metal of plates
(c) Separation of plates **(d)** Dielectric between plates

(168) The graph shows the growth of charge with potential difference between plates. The area under the graph shows



(a) Capacitance **(b)** Separation of plates
(c) Energy stored **(d)** Electric intensity

Topic 12.15:

Electric Polarization of Dielectric

(169) The increase in the capacitance can be done due to

(a) parallel combination **(b)** series combination
(c) polarization **(d)** both a and c

(170) The dielectric consists of atoms and molecules which
(a) have electrically positive charge on the average
(b) have electrically negative charge on the average
(c) are electrically neutral on the average
(d) none of these

(171) Two equal and opposite charges separated by a small distance are said to be
(a) tripole **(b)** polaroid
(c) monopole **(d)** dipole

(172) When the molecules of the dielectric under the action of electric field become dipoles, then the dielectric is said to be
(a) unpolarized **(b)** polarized
(c) charged **(d)** none of these

(173) Due to polarization of the dielectric the capacitance of the capacitor.
(a) increases **(b)** decreases
(c) zero **(d)** no charge

PAST PAPER MCQS

(174) Due to polarization , electric field E in a capacitor: GRW-2019 (G-I)
(a) increase **(b)** decreases
(c) first increases then decreases **(d)** remains same

(175) The space between the plates of the capacitor is filled by a dielectric of dielectric constant 'k'. The capacitance of the capacitor: LHR-2022 (G-I)
(a) Increased by a factor 'k' **(b)** Increased by a factor 'k^2'
(c) Decreased by factor 'k' **(d)** Remains unchanged

ENTRY TEST MCQS

(176) A capacitor of capacitance C is connected to battery of emf V_0. Without removing the battery, a dielectric of strength ε_r is inserted between the parallel plates of the capacitor C, then the charge on the capacitor is
(a) CV_0 **(b)** $\varepsilon_r CV_0$
(c) $\frac{CV_0}{\varepsilon_r}$ **(d)** None of these

(177) Due to polarization _____ between the plates of capacitor _____
(a) E, decreases **(b)** V, decrease
(c) σ, decrease **(d)** All of these

Topic 12.16:

Energy Stored in a Capacitor

(178) In a charged capacitor, the energy is stored in the form of
(a) magnetic field **(b)** electric field
(c) nuclear field **(d)** gravitational field

(179) For a capacitor the charge per unit volume is called
(a) surface charge density
(b) volume charge density
(c) energy stored in the capacitor

(d) energy density

(180) When potential in a capacitor rises from 0 to V, then average potential difference is

(a) V **(b)** –V

(c) $\frac{V+V}{2}$ **(d)** $\frac{V}{2}$

(181) The expression for energy density is

(a) $\frac{1}{2}\in_o\in_r \frac{AE^2d^2}{2}$ **(b)** $\in_r\in_o \frac{E^2Ad}{2}$

(c) $\frac{1}{2}\frac{\in_o\in_r E^2}{Ad}$ **(d)** $\frac{1}{2}\in_o\in_r E^2$

(182) 1Farad =

(a) Cs^{-1} **(b)** Cm^{-1}

(c) $C\ V^{-1}$ **(d)** $V\ C^{-1}$

(183) The energy stored in the capacitor given by

(a) $\frac{1}{2}CV$ **(b)** $\frac{1}{2}CV^2$

(c) $2CV^2$ **(d)** $\frac{1}{2}C^2V$

PAST PAPER MCQS

(184) If the potential difference across two plates of capacitor is doubled, the energy in it will be: LHR-2021 (G-I)

(a) Two times **(b)** Eight times

(c) Four times **(d)** Remains same

(185) A one farad capacitor is charged to 100 V and then discharge through 1 KΩ resistance the total energy dissipated through resistor is GRW-2022 (G-II)

(a) 5 kJ **(b)** 10 kJ

(c) 2 kJ **(d)** 100 kJ

ENTRY TEST MCQS

(186) A capacitor is fully charged and disconnected from cell. A dielectric is placed between the plates of capacitor, such that polarization occurs. What happened with capacitance, voltage and energy stored in capacitor respectively?

	Capacitance	Voltage	Energy
(a)	Increase	Increase	increase
(b)	Increase	decrease	Increase
(c)	Decrease	decrease	Decrease
(d)	Increase	decrease	Decrease

(187) A capacitor is charged with a battery and energy stored is U. After disconnecting battery another capacitor of same capacity is connected in parallel to the first capacitor. Then energy stored in each capacitor is

(a) U/2 **(b)** U/4

(c) 4U **(d)** 2U

(188) A capacitor having a capacity 2.0 micro farad is charged to 200 volts and then the plates of the capacitor are connected to a resistance wire. The heat produced in joules will be

(a) 4×10^{4}J **(b)** 4×10^{10}J
(c) 4×10^{-2}J **(d)** 2×10^{-4}J

Topic 12.17:

Charging and Discharging of a Capacitor

(189) If RC is small, then capacitor will be charged and discharged

(a) slowly **(b)** with medium speed
(c) quickly **(d)** a and c

(190) The product RC is called

(a) decay constant **(b)** constant
(c) time constant **(d)** resistance of capacitor

(191) The unit of RC is

(a) Ohm farad **(b)** Coulomb
(c) Second **(d)** both a and c

PAST PAPER MCQS

(192) If time constant in RC circuit is small, then capacitor is charged or discharged: **GRW-2019 (G-I)**

(a) slowly **(b)** rapidly
(c) at constant rate **(d)** intermittently

(193) Second/ohm is equal to **DGK-2022 (G-I, II)**

(a) Coulomb **(b)** Farad
(c) Joule **(d)** Ampere

ENTRY TEST MCQS

(194) When an RC circuit is connected across a battery amount of charge deposited on plates is ……times the equilibrium charge after one time constant.

(a) 0.63 **(b)** 0.67
(c) 0.75 **(d)** 0.86

(195) A capacitor charges and discharges

(a) Rapidly **(b)** Linearly
(c) Exponentially **(d)** Logarithmically

ANSWER KEYS

(Topical Multiple Choice Questions)

1	A	21	A	41	B	61	A	81	B	101	C	121	C	141	D	161	B	181	D
2	B	22	B	42	C	62	A	82	B	102	B	122	B	142	C	162	A	182	C
3	D	23	C	43	C	63	D	83	C	103	C	123	C	143	B	163	A	183	B
4	C	24	D	44	B	64	B	84	B	104	B	124	D	144	B	164	B	184	C
5	B	25	B	45	D	65	C	85	A	105	C	125	C	145	A	165	D	185	A
6	A	26	D	46	B	66	B	86	D	106	A	126	A	146	C	166	D	186	D
7	D	27	C	47	A	67	D	87	A	107	A	127	A	147	B	167	B	187	B
8	A	28	B	48	B	68	C	88	C	108	A	128	B	148	B	168	C	188	C
9	B	29	B	49	B	69	D	89	C	109	D	129	C	149	A	169	C	189	C
10	C	30	D	50	C	70	B	90	A	110	C	130	C	150	C	170	C	190	C
11	B	31	B	51	B	71	C	91	A	111	B	131	D	151	B	171	D	191	C
12	A	32	C	52	C	72	A	92	C	112	C	132	A	152	C	172	B	192	B
13	C	33	C	53	C	73	A	93	A	113	B	133	B	153	A	173	A	193	A
14	A	34	D	54	B	74	D	94	C	114	B	134	A	154	B	174	B	194	A
15	D	35	A	55	B	75	C	95	A	115	C	135	C	155	A	175	A	195	C
16	D	36	B	56	A	76	A	96	B	116	B	136	B	156	D	176	B		
17	C	37	D	57	C	77	D	97	C	117	D	137	A	157	D	177	D		
18	D	38	B	58	C	78	B	98	B	118	C	138	A	158	C	178	B		
19	B	39	C	59	C	79	D	99	B	119	A	139	C	159	A	179	B		
20	A	40	A	60	C	80	A	100	B	120	B	140	C	160	B	180	D		

KIPS TOPICAL SHORT QUESTIONS

12.1 COLOUMB'S LAW

(1) What is Inverse Square Law?

Ans: Inverse square law states that a physical quantity is inversely proportional to the square of the distance from the source of that physical quantity.

i. Coulomb's law $F_e \propto \frac{1}{r^2}$ **ii.** Gravitational law $F_G \propto \frac{1}{r^2}$

(2) How the orbit of planets will be modified, if the planets were electrically charged?

Ans: A planet with maximum charge has central position and all other planets will start orbiting about it with different radii.

(3) Prove that Coulomb's force is a mutual force.

Ans: Coulomb's force is a mutual force, it means that force $\vec{F}_{21}$, exerted on q_2 by q_1 would be equal and opposite to force $\vec{F}_{12}$ exerted on q_1 by q_2

Let $\hat{r}_{21}$ is the unit vector directed from q_1 to q_2 then

$\vec{F}_{21} = k \frac{q_1 q_2}{r^2} \hat{r}_{21}$ ----------(1)

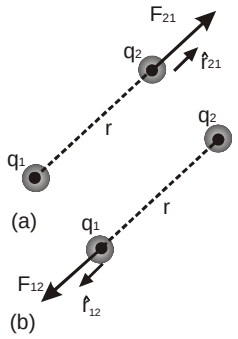
Let r_{12} is unit vector form q_2 to q_1 then $\vec{F}_{12} = \frac{k q_1 q_2}{r^2} \hat{r}_{12}$

from the figure $\hat{r}_{12} = - \hat{r}_{21}$ put it in eq. (2)

$\vec{F}_{12} = - k \frac{q_1 q_2}{r^2} \hat{r}_{21}$ ----------(3)

comparing equations (1) and (3)

$\vec{F}_{21} = - \vec{F}_{12}$ thus proved.



(4) If the distance between two-point charges is halved, what will be the new value of force?

Ans: By Coloumb's law

$$F = k \frac{q_1 q_2}{r^2} \quad \text{.....(i)}$$

If $r' = r/2$

So equation (i) becomes

$$F' = k \frac{q_1 q_2}{(r/2)^2}$$

$$F' = 4k \frac{q_1 q_2}{r^2}$$

$$F' = 4F$$

Hence new force is four times the original force.

(5) Define Coulomb's law.

Ans: Coulombs law is stated as "The force between two point charges is directly proportional to the product of the magnitudes of charges and inversely proportional to the square of the distance between them."

If q_1 and q_2 are points charges and are separated by distance r, then according to coulomb's law.

$F \propto q_1 q_2$ ----------(i)

$F \propto \frac{1}{r^2}$ ----------(ii)

From eq. (i) and (ii)

$F \propto \frac{q_1 q_2}{r^2}$

$F = k \frac{q_1 q_2}{r^2}$

Where K is constant of proportionality. Its value depends upon nature of medium between the charges and the system of units in which F,q and r are measured.

(6) What is the effect of medium between the charges on electrostatic force?

Ans: If the medium between charges is insulator, it is usually referred as dielectric. It has been found that the presence of dielectric always reduces the electrostatic force by a factor which is a constant for a given dielectric, this constant is known as relative permittivity and is represented by ε_r.

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

and $$F' = \frac{1}{\epsilon_r} F$$

(7) What is the coulomb's force between two similar charges if the distance between the charges is doubled?

Ans: Let q_1 and q_2 are two similar charges separated by a distance r, then force of repulsion $\vec{F}$ between them is

$$\vec{F} = \frac{1}{4\pi\varepsilon_o} \frac{q^2}{r^2} \hat{r}$$

When distance between the charges is doubled then new force is

$$\vec{F}' = \frac{1}{4\pi\varepsilon_o} \frac{q^2}{(2r)^2} \hat{r}$$

$$\vec{F}' = \frac{1}{4} \left(\frac{1}{4\pi\varepsilon_o} \frac{q^2}{r^2} \hat{r} \right)$$

It is the force between two similar charges, when distance between them is doubled.

$$\vec{F}' = \frac{1}{4} \vec{F}$$

This shows that "magnitude of force reduces by a factor of 4 and no change in the direction of force occur."

PAST PAPER SHORT QUESTION

(8) What is Coulomb's law and effect of dielectric on Coulomb's law? **RWP-2019 (G-I)**

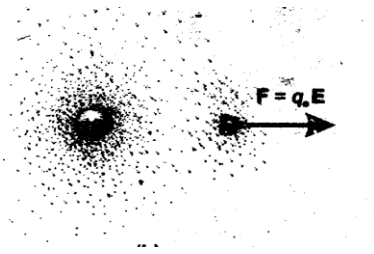
(9) Describe the force or forces on a positive point charge when placed between parallel plates. (a) With similar and equal charges (b) With opposites and equal charges

BWP-2022 (G-I), FSD-2022 (G-I)

12.2 FIELDS OF FORCE

(10) Define electric field

Ans: It is space or region around an electric charge within which its effect can be felt by placing a unit positive charge.



Dots surrounding the Positive charge indicates the presence of electric Field. The density of the dots is proportional to the Strength of the electric field at different points.

(11) What is electric intensity?

Ans: The electric field intensity at a point is defined as the force experienced by a unit positive test charge placed at that point.

Let $\vec{F}$ be the force experienced by a positive test charge q_o placed at point P, then the electric intensity at P is given by

$$\vec{E} = \frac{\vec{F}}{q_o} = \frac{N}{C}$$

It is a vector quantity.

PAST PAPER SHORT QUESTION

(12) Show that N/C = V / m OR Show that $\frac{1\,\text{Volt}}{1\,\text{meter}} = \frac{1\,\text{Newton}}{1\,\text{Coulomb}}$

LHR-2019 (G-I), RWP-2022 (G-II), BWP-2022 (G-II)

(13) What is electric intensity? What is its SI units? **LHR-2019 (G-II)**

(14) Define electric force and write its formula. Also give SI units. **MTN-2019 (G-II)**

(15) Distinguish between electric field and electric field intensity. **RWP-2022 (G-I)**

12.3 ELECTRIC FIELD LINES

(16) Define electric field lines. What information do these lines provide?

Ans: Imaginary lines drawn to indicate the path of test charge when it is placed in the field of a source charge are called electric field lines.

Tangent to field line at a point gives the direction of electric field at that point and number of electric field lines passing through unit area gives the magnitude of field intensity.

(17) Write any two characteristics of electric field lines.

Ans: The characteristics of electric field lines are given below.

(i) Electric field lines originate from positive charges and end on negative charges.

(ii) The tangent to a field line at any point gives the direction of the electric field at that point.

(18) Comment on the uni-direction of electric line of force. **DGK-2017 (G-II)**

Ans: The direction of electric field lines at any point can be found by drawing tangent on the field lines and as we know tangent at any point have only one direction whether line is curved or straight.

PAST PAPER SHORT QUESTION

(19) Write five properties of electric lines of force.

SWL-2019, GRW-2019 (G-I), LHR-2022 (G-I), DGK-2022 (G-II)

(20) Electric field lines provide information about the strength of the electric field. Describe electric field intensity in terms of field lines. **LHR-2021 (G-I)**

(21) How a sensitive electric apparatus is shielded from electric fields? . **LHR-2021 (G-II)**

(22) If a point charge 'q' of mass m is released in a non-uniform electric field lines pointing in the same direction, will it make a rectilinear motion?

SGD-2017 (G-I), DGK-2017 (G-II), LHR-2022 (G-II)

(23) Electric lines of force never cross. Why?

SGD-2017 (G-I), BWP-2017 (G-I), DGK-2017, DGK-2022 (G-I), RWP-2022 (G-I)

(24) Comment on the uni-direction of electric line of force. **DGK-2017 (G-II)**

12.4 APPLICATIONS OF ELECTROSTATICS

(25) Write a short note on inkjet printer.

Ans: Tiny droplets of ink ejecting from nozzle of inkjet printer passes through 'charging electrodes' and 'deflecting plates. Whenever ink is not to be placed on the paper, computer turn on the charging electrodes, giving ink droplets a net charge. The deflecting plates divert them into gutter and whenever ink is to be placed on paper, computer turn off the charging electrodes, now neutral drops move straight to paper.

(26) What do you mean by Xerography? **MIRPUR (AJK) 2015**

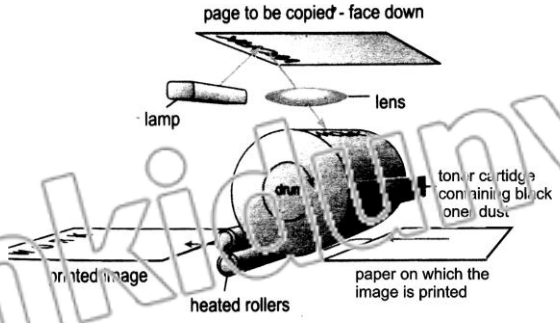
Ans: It is composed of two words 'xeros' and "graphos" meaning "dry writing". Therefore, the copying process is called xerography.

In xerography, we use a dry black powder (toner) which is given a negative charge and selenium coated cylinder when exposed to light get positive charge then toner stick with the page and heating rollers are used for permanent impression.

(27) Write the names of main parts of xerography and draw its diagram. MTN-2019 (G-II)

Ans: Photocopier consists of following parts.

i) Lamp ii) Drum iii) Selenium surface iv) Toner v) Paper vi) Rollers



PAST PAPER SHORT QUESTION

(28) Distinguish between conductor and photo-conductor. **SGD-2017 (G-II)**

(29) Write the names of main parts of xerography and draw its diagram. **MTN-2019 (G-II)**

12.5 ELECTRIC FLUX

(30) Define electric flux and give its unit.

Ans: "The number of field lines passing through a certain element of area held perpendicular to the direction of electric field is known as electric flux through that area."

Or

The dot product of electric intensity and vector area.

It is denoted by ϕ. It is defined by the following relation:

$\phi = \vec{E}.\vec{A}$ = EA cosθ. Its S.I unit is Nm^2C^{-1}.It is a scalar quantity.

(31) What are factors upon which electric flux depend?

Ans: It depends upon.

(1) Electric intensity

(2) Area of surface

(3) Orientation of surface relative to field. (The orientation is determined by angle between outward normal to surface and direction of electric field).

It is defined by the relation

$\Phi = \vec{E}.\vec{A}$.

(32) Mention two situations of vector area in electric flux.

Ans:

(i) When area is perpendicular to electric field:-

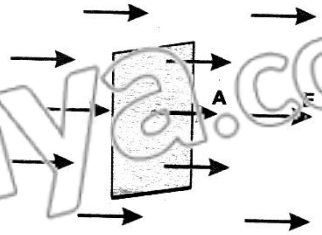
If an area is held perpendicular to electric field, then $\theta = 0^o$

Φ_e = EA cos θ

Φ_e = EA cos 0°

Φ_e = EA

In this situation the number of lines passing through area is maximum.



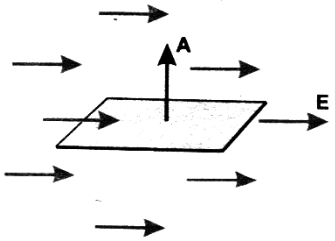
(ii) When area is parallel to electric field:-

If area is held parallel to electric field then number of lines passing through it is zero so we can write as

Φ_e = EA cos θ

as $\theta = 90^o$

$= EA\cos 90^o$



$\Phi_e = 0$

PAST PAPER SHORT QUESTION

(33) What are factors upon which electric flux depends? **LHR-2017 (G-I), MTN-2019 (G-I)**

(34) Mention two situations of vector area in electric flux. **DGK-2017 (G-I)**

(35) Define electric force and electric flux. **BWP-2019 (G-II)**

(36) Define electric flux also write down its SI unit. **DGK-2022 (G-II)**

12.6 ELECTRIC FLUX THROUGH A SURFACE ENCLOSING A CHARGE
12.7 GAUSS'S LAW

(37) Does electric flux through a closed surface enclosing a charge depend upon shape of the surface?

Ans: NO**,** Electric flux through the closed surface enclosing charge depend upon magnitude of charge and medium only.

(38) Find flux through a closed surface having no charge?

Ans: By Gauss's Law

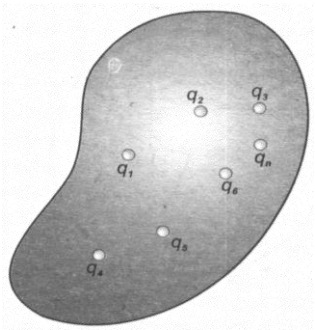
$$f_e = \frac{1}{e_o} Q$$

$$Q = 0$$

Hence, Flux is also zero.

(39) State Gauss's law.

Ans: "The flux through any closed surface is $\frac{1}{\epsilon_o}$ times the total charge enclosed in it."



i.e. $$\phi_e = \frac{1}{\epsilon_o} \times Q$$

If $\phi_1, \phi_2, \phi_3, \ldots\ldots, \phi_n$ denote the fluxes due to charges $q_1, q_2, \ldots\ldots\ldots q_n$ respectively then total flux through this closed surface is calculated as

$\phi_e = \phi_1 + \phi_2 + \ldots\ldots\ldots + \phi_n$

$$= \frac{q_1}{\epsilon_0} + \frac{q_2}{\epsilon_0} + \ldots\ldots\ldots\ldots + \frac{q_n}{\epsilon_0}$$

$$= \frac{1}{\epsilon_0}\left(q_1 + q_2 + \ldots\ldots + q_n\right)$$

$$= \frac{1}{\epsilon_0} \sum_{i=1}^{n} q_i$$

$$= \frac{1}{\epsilon_0} \times \text{total charge enclosed by surface.}$$

$$\phi_e = \frac{1}{\epsilon_0} \times Q$$

12.8 APPLICATIONS OF GAUSS'S LAW

(40) Find electric intensity of field inside a hollow charge sphere.

GRW-2019 (G-II), (FSD 2013)

Ans: $\Phi_e = \frac{q}{\varepsilon_0}$

$= \frac{0}{\varepsilon_0}$ (Since q = 0)

Since $\Phi_e = 0$

$\vec{E} \cdot \vec{A} = 0$

as $\vec{A} \neq 0$, So

$\vec{E} = 0$

Thus, interior of a hollow charged metal surface is a field free region. It means any apparatus placed within a metal enclosure is shielded from electric fields.

(41) What is the effect on electric field intensity if surface charge density of infinite sheet of charge is increased?

Ans: Electric field intensity near an infinite sheet of charge depends upon surface charge density by formula

$$E = \frac{\sigma}{2\varepsilon_0}$$

i.e $E \propto \sigma$

Hence, electric field will increase by increasing the surface charge density.

PAST PAPER SHORT QUESTION

(42) Is $\vec{E}$ necessarily zero inside a charged rubber balloon if balloon is spherical? Assume that charge is distributed uniformly over the surface.

LHR-2017(G-I), LHR-2021 (G-II), RWP-2022 (G-II)

(43) Find electric intensity of field inside a hollow charge sphere.

GRW-2019 (G-II), DGK-2022 (G-I), LHR-2022 (G-II)

(44) State Gauss's law of electric flux. Write down it mathematical form.

RWP-2019 (G-I), LHR-2022 (G-I)

12.9 ELECTRIC POTENTIAL

(45) What is meant by equipotential surface? Do they intersect each other?

Ans: If the potential at every point on the surface is same, then it is called equipotential surface. It is impossible for two surfaces to intersect each other because there would be two values of potential at a single point, which is not possible.

(46) If the absolute potential at a point is zero, can Electric Intensity be zero or not?

Ans: If we consider a point midway between two equal and opposite charges, then electric potential at that point is zero, but electric intensity has specific value.

But, If the point lies at infinite distance from a charged body, then both potential and Electric Intensity would be zero.

(47) What do EEG and ERG stand for? Between which two quantities these graphs are obtained.

Ans: EEG stands for electro encephalography and ERG stands for electro retino graphy. For both of these graph is drawn between potential difference and time.

(48) Prove that $1\frac{\text{Volt}}{\text{meter}} = 1\frac{\text{newton}}{\text{coulomb}}$

Ans:

$$\text{L.H.S.} = \frac{\text{Joule/coulomb}}{\text{meter}}$$

$$= \frac{\text{Joule}}{\text{meter} \times \text{coulomb}}$$

$$= \frac{\text{newton} \times \text{meter}}{\text{meter} \times \text{coulomb}}$$

$$= \frac{\text{newton}}{\text{coulomb}} = \text{R.H.S}$$

Thus, $\frac{\text{Volt}}{\text{meter}} = \frac{\text{newton}}{\text{coulomb}}$

(49) Define electric potential energy.

Ans: It is defined as the energy stored in the charge 'q' by virtue of its position in an electric field. Let V be the electric potential at a point in an electric field then the electrical potential energy will be given by

$$\text{Electric P.E.} = U = qV$$

The unit of electric potential energy is joule.

(50) Define absolute potential. Give its unit.

Ans: Absolute Potential:

"The amount of work done in bringing a unit positive charge from infinity to a point against the electric field with constant velocity is called absolute electric potential at that point."

Unit:

Absolute electric potential is expressed in unit of "volt" defined as "joule per coulomb." i.e $1\text{V} = 1\frac{\text{J}}{\text{C}}$.

(51) Define the term potential gradient?

Ans: It is defined as the change in potential w.r.t. distance

$$E = -\frac{\Delta V}{\Delta r}$$

The quantity $\frac{\Delta V}{\Delta r}$ gives maximum rate of change of potential with distance because distance between two plates is minimum. It is called as potential gradient.

So electric intensity is equal to negative of gradient of potential.

Negative sign indicates that the direction of E is along decreasing potential.

(52) Differentiate between electric potential and electric potential difference. **GRW-2019 (G-I)**

Ans: "Absolute potential or electric potential at any point in an electric field is equal to the work done in bringing a unit +ve charge from infinity to that point keeping it in equilibrium" is called electric potential at that point.

Potential difference between two points A and B is given as.

$$V_B - V_A = \frac{W_{AB}}{q_o}$$

If we take point A is at infinity, $V_A = 0$. So the electric potential at point B is

$$V_B - 0 = \frac{W_{B\infty}}{q_o}$$

$$V_B = \frac{W_{B\infty}}{q_o}$$

By dropping the subscripts

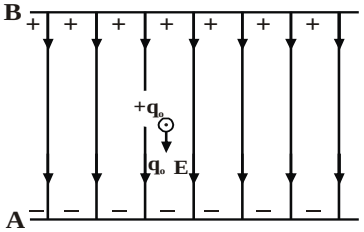
or simply

$$V = \frac{W}{q_o}$$

Both potential and potential difference are scalar quantities because both W and q are scalars.

(53) Prove that $E = -\frac{\Delta V}{\Delta r}$ **GRW-2019 (G-II)**

Ans. Let us consider electric field between two oppositely charged parallel metal plates.



The P.D. b/w these plates is

$$\Delta V = V_B - V_A$$

$$\Delta V = \frac{W_{AB}}{q_o} \quad \text{.....(i)}$$

$$W_{AB} = \vec{F} \cdot \vec{d}$$

$$= Fd \cos\theta$$

$$= Fd \cos 180° \quad (\text{since } \theta = 180^o)$$

$$W = -Fd \quad (\cos 180^o = -1)$$

–ve sign indicates that F must be applied opposite to q_oE, so that the charge remains in equilibrium.

Since $F = E\,q_o$

So $W_{AB} = -q_o\,Ed$

By putting value of W_{AB} in eq (i) we get

$$\Delta V = -\frac{q_o Ed}{q_o}$$

$$\Delta V = -Ed$$

$$E = -\frac{\Delta V}{d}$$

If plates A and B are separated by infinitesimally small distance Δr, the eq above comes as.

$$E = -\frac{\Delta V}{\Delta r} \quad \text{..... (ii)}$$

PAST PAPER SHORT QUESTION

(54) The potential is constant throughout a given region of space. Is the electric field zero or non-zero in this region? Explain. **LHR-2017(G-I), SGD-2017 (G-II), DGK-2022 (G-I)**

(55) Differentiate between electric potential and electric potential difference. **GRW-2019 (G-I)**

(56) Prove that $E = -\frac{\Delta V}{\Delta r}$ **GRW-2019 (G-II), BWP-2022 (G-I)**

(57) Do electrons tend to go to region of high potential or of low potential?
LHR-2021 (G-I,II), SWL-2017, DGK-2022 (G-II), LHR-2022 (G-I)

(58) Define electric potential and give its S.I unit. **SGD-2017 (G-I)**

(59) Define potential gradient and show that $E = -\frac{\Delta V}{\Delta r}$ **FSD-2019 (G-I), FSD-2022 (G-I)**

(60) What is potential gradient? Give its units. **BWP-2016 (G-I), SWL-2016, 2017**

(61) Comment on electric field in region of constant potential. **DGK-2017 (G-I)**

(62) You follow an electric field line due to a positive point charge. Do electric field and potential increase or decrease? **DGK-2017 (G-I), LHR-2022 (G-I)**

(63) What is EEG and ERG? **ESD-2022 (G-I)**

12.10 ELECTRON VOLT

(64) Electron volt is a unit of energy or potential difference? Explain?

Ans: It is unit of energy, which is used in atomic physics. It is the amount of energy lost or gained by an electron, when it is moved b/w two points having a P.D of one volt.

$1eV = 1.6 \quad 10^{-19}J$

(65) A particle having a charge of 20 electrons on it, falls through a potential difference of 100 volts. Calculate its energy in joules.

Ans: The energy will be

$E = q\Delta V$

When $q = 20e$ & $\Delta V = 100V$

is $E = (20e)\ (100V)$

$E = 2000\ eV$

But $1eV = 1.6 \times 10^{-19}J$

is $E = 2000 \times 1.6 \times 10^{-19}J$

$= 3200 \times 10^{-19}\ J$

$E = 3.2 \times 10^{-16}J$

(66) Define electron volt and prove that $1eV = 1.6 \times 10^{-19}\ J$

Ans: "One electron volt is the amount of energy acquired or lost by an electron when it is displaced across two points having P.D one volt".

When a particle of charge q moves from point A with potential V_A to point B with potential V_B keeping it in equilibrium, the change in P.E of the particle is

$\Delta U = q\ (V_B - V_A)$

$\Delta U = q\ \Delta V$

If no external force acts on charge to maintain equilibrium, the change in P.E appears in the form of change in K.E i.e.

$\Delta K.E = q\ \Delta V$

For an electron $q = e = 1.6 \times 10^{-19}$ C and $\Delta V = 1$ volt

$\Delta K.E = e\ \Delta V$

$= (1.6 \times 10^{-19}\ C)\ (1\ volt)$

$= 1.6 \times 10^{-19}\ C \times \frac{J}{C}$

$\Delta K.E = 1.6 \times 10^{-19}\ J$

This energy is called 1 electron volt so

$1eV = 1.6 \times 10^{-19}J$

(67) Convert 1 Joule into electron-Volt **GRW-2014**

Ans: As we know

$1\ eV = 1.6 \times 10^{-19}\ J$

$\frac{1}{1.6 \times 10^{-19}}\ eV = 1\ J$

$6.25 \times 10^{18}\ eV = 1\ J$

PAST PAPER SHORT QUESTION

(68) A particle carrying a charge of 2e falls through a potential difference of 3.0 V. Calculate the energy acquired by it. **SGD-2017 (G-II), SWL- 2019**

(69) Define electron volt and prove that $1eV = 1.6 \times 10^{-19}$ J.

BWP-2017 (G-I), RWP-2022 (G-II)

12.11 Electrical and Gravitational Forces

(70) What is the Differences between F_e and F_g?

Ans:

GRAVITATION FORCE	ELECTRIC FORCE
F_G is only attractive.	F_e is attractive between opposite charges while repulsive between similar charges.
F_G is given by $F_G = \frac{Gm_1m_2}{r^2}$	F_e is given by $F_e = \frac{kq_1q_2}{r^2}$
Constant G is very small i.e $G = 6.67 \times 10^{-11}\ Nm^2/kg^2$	Constant is very large i.e. $k = 9\times10^9\ Nm^2/C^2$
F_G is very weak.	F_e is very strong.
F_G can not be shielded.	F_e can be shielded.
$F_G = 10^{-36}F_e$	$F_e = 10^{36}F_G$

(71) What is the similarities between F_e and F_g?

Ans:

- Both Follow inverse square law
- Both are long range forces
- Both are basic forces of nature
- Both are conservative forces

PAST PAPER SHORT QUESTION

(72) What are similarities between electrostatic force and gravitational force? **LHR-2017 (G-I)**

(73) Give a comparison of electric and gravitational forces. . **LHR-2021 (G-II), DGK-2022 (G-I)**

(74) What are the similarities and difference between electric and gravitational forces?

SGD-2017 (G-I)

(75) Write two differences between electrical and gravitational forces.

SWL-2017, FSD-2019 (G-I)

12.12 CHARGE ON AN ELECTRON BY MILLIKAN'S METHOD

(76) Describe the principle of Millikan's oil drop method.

Ans: the basic principle of Millikan's oil drop method is that the gravitational force 'F_g' acting on the droplet is equal to the electrical force

$$F_e = F_g$$

$$qE = mg$$

12.13 CAPACITOR

(77) Define Capacitance of a capacitor? Write down its units.

Ans: Capacitance:

"Ability of a capacitor to store charge is called capacitance of a capacitor."
It is denoted by "C." In quantitative terms, it is defined as "magnitude of charge stored on one plate of capacitor per unit applied voltage."

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

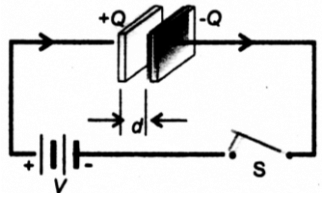
Units: S.I unit of capacitance is farad (F) defined as "Charge of one coulombs, given to one of the plates of a parallel plate capacitor, produces a potential difference of one volt between them."

$$1F = 1\frac{C}{V}$$

In practical applications submultiples of farad like pF, nF, μF & mF are used as unit of capacitance.

(78) What is capacitor? Define unit of capacitance. **SGD-2015**

Ans: "A device which is used to store an electric charge and energy is called capacitor"



Unit of capacitance:
S.I unit of capacitance is farad (F) defined as one coulomb per volt.

$$1F = 1\frac{C}{V}$$

PAST PAPER SHORT QUESTION

(79) Define capacitor and farad. **BWP-2019 (G-II), RWP-2022 (G-I)**

(80) How can you identify that which plate of a capacitor is positively charged?

BWP-2022 (G-II)

12.14 CAPACITANCE OF A PARALLEL PLATE CAPACITOR

(81) Why does capacitance of a capacitor increase when a dielectric material is inserted between its plates? **FSD-2012**

Ans: When dielectric is introduced between plates of charged capacitor then it will be polarized and atoms become dipole which have electric field opposite to external electric field between plates so resultant electric field decreases

$$E = \frac{\Delta V}{d}$$

So Potential difference between plates decreases due to decease in electric field strength then by formula

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

Capacitance will increase

(82) How will capacitance of parallel plate capacitors be affected if area of plates is doubled and separation between them is halved? **FSD-2013**

Ans: As we know that

$$C_{vac} = \frac{A\varepsilon_0}{d} \qquad \text{.....(i)}$$

As given

$$A' = 2A$$

$$d' = \frac{d}{2}$$

So equation (i) becomes

$$C' = \frac{2A\varepsilon_o}{d/2}$$

$$C' = \frac{4A\varepsilon_o}{d}$$

$$C' = 4C$$

Hence, capacitance becomes four times

(83) Write down the factors on which capacitance of capacitor depends upon.

Ans: As we know that $C_{vac} = \frac{A\varepsilon_0}{d}$

Capacitance of capacitor depends upon the following factors.

(i) Area of plates of capacitor

(ii) Separation between the plate

(iii) Medium between the plates

12.15 ELECTRIC POLARIZATION OF THE DIELECTRIC

(84) What is meant by Electric polarization?

Ans: "The phenomenon, in which atoms/molecules of a material become electric dipoles on introducing that material in an externally applied electric field, is known as Electric polarization." As its result,

(i) Atoms/molecules are elongated along the applied electric field.

(ii) Net electric charge appears on the outer face of the surface of the material.

(85) What changes takes place when polarization of Dielectric occurs?

Ans: Following changes take place:

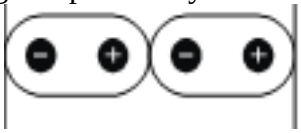
(i) Atoms/molecules become electric dipoles

(ii) Net charge appears on the outer surface of dielectric, but as a whole, it remains electrically neutral.

(iii) Electric field is produced in the inside as well as outside of the dielectric, opposite to the applied electric field.

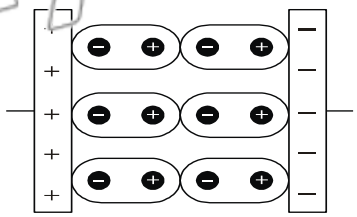
(86) What is Dipole? SGD-2013

Ans: Two equal but opposite charges separated by small distance are known as dipole



(87) What is polarization and how dipoles are formed in dielectric? RWP-2014

Ans: Dielectric consists of atoms and molecules which are electrically neutral. In the absence of electric field, the centre of positive and negative charge coincides. But when molecules of dielectric are placed in electric field between the plates of capacitor then there is some displacement occur in the center of negative and center of positive charge. Therefore, molecules become dipole and substance is said to be polarized and process is called electric polarization.



Dipole:

Two equal and opposite charges separated by small distance are said to form dipole.

PAST PAPER SHORT QUESTION

(88) Define and write relation for dielectric constant in terms of capacitances of a capacitor. **LHR-2021 (G-I)**

(89) What is meant by electric polarization? **LHR-2022 (G-II)**

12.16 ENERGY STORED IN A CAPACITOR

(90) What will be effect on the energy stored by capacitor if potential difference between the plates of capacitor becomes double?

Ans: As we know that

$$U. = \frac{1}{2}CV^2$$

If V become double then energy stored becomes four times

(91) Prove that $U. = \frac{1}{2}CV^2$

Ans: When Q=0 then potential difference = 0
and when charge = Q then let potential difference =V

Thus, average potential difference = $\frac{0+V}{2} = \frac{V}{2}$

But potential difference = $\frac{P.E}{q}$

Then $\frac{P.E}{q} = \frac{V}{2}$

or $P.E = \frac{1}{2}qV$ ---------- (1)

As $q = CV$

$P.E = \frac{1}{2}CV^2$ ---------- (2)

12.17 CHARGING AND DISCHARGING OF CAPACITOR

(92) Show that RC = t?

Ans: As,

$V = IR$

$V = \frac{q}{t}.R$ Q q = CV

$t = \frac{q}{V}R$ $\frac{q}{V} = C$

$t = RC$

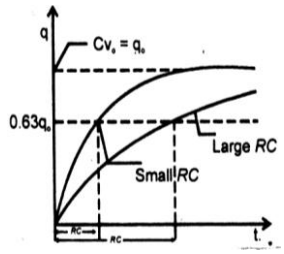
(93) What is role of capacitor in working of wind shield wipers of cars? OR Why is principle behind the working of wind shield wipers of cars?

Ans: The charging / discharging of a capacitor enables some wind shield wipers of cars to be used intermittently during a light drizzle. In this mode of operation the wipers remain off for a while and then turn on briefly. The timing of the on-off cycle is determined by the time constant of a resistor-capacitor combination.

(94) What depend on the slow or fast charging discharging of a capacitor?

Ans: Slow or fast charging, discharging of a capacitor depends on value of resistance connected across it in R-C series combination. For slow charging, discharging, high resistance is connected, across R-C series combination and for fast charging, discharging, low resistance is connected in this combination.

(95) Define time constant for RC circuit. Also draw (q–t) graph for charging capacitor in RC circuit.



Ans: This time t=RC after which the charge on the capacitor grows to 0.63 times of its maximum value is called time constant of the capacitor.

(96) The time constant of a series RC circuit is t=RC. Verify that an ohm times farad is equivalent to second. **SWL-2013**

Ans: Ohm's law in terms of potential difference V, current I and resistance R can be written as,

$V = IR$

Putting $I = \frac{q}{t}$, this equation transforms into the equation,

$V = \frac{q}{t}R$

or $R = \frac{V \times t}{q}$ (i)

According to equation q = CV, C=q/V (ii)

Multiplying equation (i) and (ii)

$RC = \frac{V \times t}{q} \times \frac{q}{V} = t$

Hence 1ohm×1 farad=1 second

Where ohms is the unit of resistance R

PAST PAPER SHORT QUESTION

(97) Define time constant for RC circuit. Also draw (q–t) graph for charging capacitor in RC circuit. **BWP-2017 (G-I)**

(98) How much is the amount of charge at start of discharging of capacitor and start of charging of a capacitor. **DGK-2017 (G-II)**

Prove that 1 ohm × 1 farad = 1 second. **RWP-2022 (G-I, II)**