Question Bank

DSC- B Electricity And Magnetism -I (Paper III)

1 Select the most correct alternative.

(01) The scalar product of a vector with itself is equal to ……………

(a) its magnitude
(b) square of its magnitude
(c) zero
(d) infinity

(02) If the vector product of two non-zero vectors is zero, the vectors must be ....

(a) either parallel or antiparallel
(b) perpendicular
(c) inclined at an angle $45°$ with each other
(d) always antiparallel

(03) If magnitude of $\vec{A} \times \vec{B} = AB$, then the two vectors must be ……………

(a) parallel to each other
(b) antiparallel to each other
(c) perpendicular to each other
(d) co-planer

(04) The relation between linear velocity $\vec{v}$, the radius vector $\vec{r}$ and angular velocity $\vec{\omega}$ of a particle is …………..

(a) $\vec{v} = \vec{r} \times \vec{\omega}$
(b) $\vec{v} = \vec{\omega} \times \vec{r}$
(c) $\vec{\omega} = \vec{v} \times \vec{r}$
(d) $\vec{\omega} = \vec{r} \times \vec{v}$

(05) The gradient of a scalar function $(\vec{\nabla}\phi)$ is ....

(a) a vector
(b) a scalar
(c) used to represent equipotential surface.
(d) always zero

(06) The gradient of a scalar function is .....

(a) the maximum rate of change of the function in space.
(b) the minimum rate of change of the function in space.
(c) the constant
(d) always a scalar function

(07) The divergence of a vector field $\vec{\nabla} \cdot \vec{V}$ is .....

(a) a scalar
(b) a vector
(c) a constant
(d) a unit vector

(08) $\vec{\nabla} \cdot \vec{V}$ represents the total flux flowing out in the vector field ....

(a) per unit volume

(b) per unit length.

(c) per unit area

(d) per unit mass

(09) In symbolic form, the Gauss' divergence theorem is ....

(a) $\iiint_V \vec{\nabla} \cdot \vec{F} d V = \iint_S \vec{F} \cdot \hat{n} d S$

(b) $\iint_V \vec{\nabla} \times \vec{F} d V = \iint_F \vec{F} \cdot \hat{n} d S$

(c) $\iiint_S \vec{\nabla} \cdot \vec{F} d V = \iint_S \vec{F} \times \hat{n} d S$

(d) $\iiint_V \vec{\nabla} \times \vec{\nabla} F \cdot d V = \iint_S \vec{F} \cdot \hat{n} d S$

(10) In symbolic form, the Stoke's theorem in space is .....

(a) $\oint_C \vec{F} \cdot d\vec{r} = \iint_s (\vec{\nabla} \times \vec{F}) \cdot \hat{n} d S$

$(b) \oint_C \vec{F} \times d\vec{r} = \iint_S (\vec{\nabla} \times \vec{F}) \cdot \hat{n} dS$

(c) $\oint_C \vec{F} \cdot d\vec{r} = \iint_S (\vec{\nabla} \cdot \vec{F}) \cdot \hat{n} dS$

(d) $\oint_c \vec{F}. d\vec{r} = \iint_s (\vec{\nabla} \times \vec{F}) \times \hat{n} dS$

(11) The total number of electric field lines passing a given area in a unit time is known as the ....

(a) electric field

(b) electric flux

(c) electric potential

(d) electric charge

(12) Electric flux Φ due to electric field E, passing through the surface area S is given as ....

(a) $\phi = E/S$

(b) $\Phi = E \times S$

(c) $\Phi = E.S$

(d) $\phi = E - S$

(13) The total electric flux through a closed surface is equal to the ratio of the total charge enclosed by the surface to the permittivity of the medium in which charges are situated. This is .... law

(a) Gauss

(b) Coulomb's

(c) Biot-Savart

(d) Amperes

(14) The amount of work done in bringing a unit positive charge from infinity to a given point against the direction of electric field is called the .... at that point

(a) electric field

(b) electric flux

(c) electric force

(d) electric potential

(15) Coulomb's law is only true for point charges whose sizes are,

(a) medium

(b) very large

(c) very small

(d) none of the above

(16) As per Coulomb's law, force of attraction or repulsion between two-point charges is directly proportional to.

(a) sum of the magnitude of charges
(b) square of the distance between them
(c) product of the magnitude of charges
(d) cube of the distance

(17) If F is force acting on test charge q_o, electric field intensity E would be given by ......

(a) $E = F - q_o$
(b) $E = F/q_o$
(c) $E = F + q_o$
(d) $E = q_o/F$

(18) A potential due to point charge at a distance r from it is proportional to......

(a) r
(b) $\frac{1}{r}$
(c) r^2
(d) $\frac{1}{r^2}$

(19) An electric field inside the spherical shell of radius R is .....

(a) $E = \infty$
(b) $E = 0$
(c) $E = \frac{q}{4\pi\varepsilon_0 r^2}$
(d) $E = \frac{q}{4\pi\varepsilon_0 r}$

(20) The capacitance of an isolated spherical conductor of radius R is ......

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

(21) The capacitance of a parallel plate capacitor is .....

(a) $C = 4\pi\varepsilon_0 R$
(b) 0
(c) $C = \frac{\varepsilon_0 A}{d}$
(d) $C = \varepsilon_0 A d$

(22) Ability of capacitor to store charge depends upon

(a) area of plates
(b) distance between plates
(c) type of dielectric used
(d) all of above

(23) As per Coulomb's law, force of attraction or repulsion between two-point charges is inversely proportional to ....

(a) sum of the magnitude of charges
(b) square of the distance between them
(c) product of the magnitude of charges
(d) cube of the distance

(24) Capacitor plates are separated by an insulator known as ....

(a) non-metal
(b) dielectric
(c) paper
(d) wood

(25) Charge on capacitor plates is directly proportional to ....

(a) Current
(b) electric field intensity
(c) potential difference
(d) resistance

(26) In order to store charge, a device used is called ......

(a) electric box
(b) capacitor
(c) resistor
(d) inductor

(27) Field lines always emerge from ....

(a) positive charge
(b) negative charge
(c) can be both charges
(d) the central point of both charges

(28) Capacitance of a capacitor is $100\mu F$ and potential difference between plates is 50 volts then charge stored on each plate is ......

(a) $10 \mathrm{~mC}$
(b) $5 \mathrm{~mC}$
(c) $4 \mathrm{~mC}$
(d) $15 \mathrm{~mC}$

(29) If W is work done in moving a positive charge q from infinity to a certain point in field, electric potential V at this point would be equal to ....

(a) $V = W/q$
(b) $V = q/W$
(c) $V = W \times q$
(d) $V = W + q$

(30) Unit for electric field intensity is

(a) N
(b) Ns
(c) NC^{-1}
(d) NC

(31) The presence of a dielectric between the plates of a capacitor results in ....

(a) decreasing its capacitance
(b) increasing its capacitance
(c) Zero capacitance
(d) constant capacitance

(32) The electric flux through a closed surface depends on the ......

(a) Position of the charge enclosed by the surface
(b) Magnitude of the charge enclosed by the surface.
(c) The shape of the surface
(d) none of the above

(33) The formation of dipole is due to two equal and dissimilar point charges placed at a ....

(d) short distance
(b) long distance
(c) above each other
(d) none of these

(34) The energy stored in the capacitor of capacitance C and potential V is given as ....

(a) $\frac{1}{2}C^2V^2$

(b) $\frac{1}{2}C^2V$

(c) $\frac{1}{2}CV^2$

(d) $\frac{1}{2}$CV

(35) The electric displacement vector $\vec{D}$ is given by the relation.......

(a) $\vec{D} = \varepsilon_0\vec{P} + \vec{E}$

(b) $\vec{D} = \varepsilon_0\vec{E} + \vec{P}$

(c) $\vec{D} = \varepsilon_0\vec{P} - \vec{E}$

(d) $\vec{D} = \varepsilon_0\vec{E} - \vec{P}$

(36) The susceptibility of a dielectric medium of constant k is ......

(a) equal to k

(b) less than k

(c) greater than k

(d) zero

(37) The presence of a dielectric between the plates of a capacitor results in ....

(a) decreasing its capacitance

(b) increasing its capacitance

(c) Zero capacitance

(d) constant capacitance

(38) The total electric flux through a closed surface is equal to the ratio of the total charge enclosed by the surface to the permittivity of the medium in which charges are situated. This is .... law

(a) Gauss

(b) Coulomb's

(c) Biot-Savart

(d) Amperes

(39) The amount of work done in bringing a unit positive charge from infinity to a given point against the direction of electric field is called the .... at that point

(a) electric field

(b) electric flux

(c) electric force

(d) electric potential

(40) Capacitor plates are separated by an insulator known as ....

(a) non-metal

(b) dielectric

(c) paper

(d) wood

(41) Charge on capacitor plates is directly proportional to ....

(a) Current

(b) electric field intensity

(c) potential difference

(d) resistance

2. Short answer questions.

1) Define scalar or dot product of two vectors. State its characteristic
2) Obtain an expression for work done by a force in displacing a body. Hence obtain the relation for the power consumed during the displacement.
3) Define vector product or cross product of two vectors. State right hand rule and right-handed screw rule about the direction of the resultant vector.
4) State some characteristics of cross product of two vectors.
5) If $\vec{A} = \vec{i}\, A_x + \vec{j}\, A_y + \vec{k}\, A_z$ and $\vec{B} = \vec{i}\, B_x + \vec{j}\, B_y + \vec{k}\, B_z$ then show that.
6) Give the interpretation of magnitude of $\vec{A} \times \vec{B}$.
7) Write a note on del operator.
8) Define gradient of a scalar field. Show that $d\phi = \text{grad}\ \phi . \overrightarrow{dr}$, where notations have their usual meaning.
9) Explain the physical significance of the gradient of a scalar function.
10) Explain electric flux of electric field.
11) Define electric field, electric flux, and electric potential.
12) Derive relation between electric field and electric potential.
13) State and prove Gauss' law in electrostatics.
14) Obtain an expression for electric potential due to point charge at a distance r from it.
15) Derive an expression for electric field at a point inside the charged spherical shell.
16) Derive an expression for electric field at a point inside the charged sphere.
17) Obtain an expression for capacitance of spherical condenser.
18) Obtain an expression for capacitance of cylindrical condenser.
19) Explain dielectric polarization.

3. Long answer questions.

1) Define divergence of a vector field. Obtain an expression for it. Explain the physical significance of the divergence of a vector field.
2) Define the curl of a vector field. Obtain an expression for it.
3) State and prove Gauss' divergence theorem in vector field.
4) Explain the physical significance of Gauss' divergence theorem in vectors.
5) State and prove Stoke's theorem about a vector field.
6) What is electric dipole? Obtain an expression for electric potential due to electric dipole, at a point at a distance r form center of the dipole.
7) Obtain an expression for electric field at a point outside the charged spherical shell.
8) Obtain an expression for electric field at a point outside the charged sphere.
9) Show that capacitance of an isolated spherical conductor is proportional to its radius.
10) Obtain an expression for capacitance of a parallel plate capacitor.
11) Show that the energy stored per unit volume in electrostatic field is $\frac{1}{2}\varepsilon_0 E^2$.
12) Show that, for a parallel plate capacitor completely filled with dielectric, electric displacement vector is given as $\vec{D} = \varepsilon_0\vec{E} + \vec{P}$.
13) Obtain Gauss' theorem for dielectric medium.
14) Obtain an expression for a capacitance of a parallel plate capacitor completely filled with dielectric.