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Department of Physics

Question Bank

Paper **III**- DSC-B **Electricity and Magnetism-I**

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Unit I- Vector Calculus

- **Multiple Choice Questions (Correct answer is shown in red color)**

1) The divergence of vector field is.....

A) a scalar B) a vector C) a constant D) a unit vector

2) The gradient of scalar field is.....

A) a scalar B) a vector C) a constant D) a unit vector

3) If div $\vec{V} = 0$, the vector is called as.....

A) normal B) irrotational C) solenoidal D) a unit vector

4) 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

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

A) per unit mass B) per unit area

C) per unit length D) per unit volume

6) In symbolic form the Gauss' divergence theorem is.....

A) $\iiint_v \vec{\nabla} \cdot \vec{F}\, dV = \iint_s \vec{F} \cdot \hat{n} ds$

B) $\iiint_v \vec{\nabla} \times \vec{F}\, dV = \iint_s \vec{F} \cdot \hat{n} ds$

C) $\iiint_v \vec{\nabla} \cdot \vec{F}\, dV = \iint_s \vec{F} \times \hat{n} ds$

D) $\iiint_v \vec{\nabla} \times \vec{\nabla} \vec{F}\, dV = \iint_s \vec{F} \cdot \hat{n} ds$

7) In symbolic form the Stoke's divergence theorem is.....

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

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

8) The del operator is called as.....

A) Gradient

B) Curl

C) Divergence

D) Vector differential operator

9) Curl of gradient of a vector is.....

A) Unity

B) Zero

C) Null vector

D) Depends on the constants of the vector

10) Which of the following theorem use the curl operation?

A) Green's theorem

B) Gauss Divergence theorem

C) Stoke's theorem

D) Maxwell's equation

11) If curl $\vec{V} = 0$, the vector is called as.....

A) solenoidal

B) irrorational

C) normal

D) a unit vector

12) Stoke's' diversion theorem converts.....

A) volume integral into surface integral

B) surface integral into volume integral

C) volume integral into line integral

D) line integral into surface integral

13) Gauss' diversion theorem converts.....

A) volume integral line integral

B) surface integral into volume integral

C) volume integral into surface integral

D) line integral into surface integral

14) In hydrodynamics the vector $\vec{V}$ can be considered as.....

A) volume of fluid

B) velocity of fluid

C) potential of fluid

D) speed of fluid

15) Scalar Triple Product is also called as

A) dot product

B) cross product

C) vector product

D) mixed product

- **Short Answer Questions**

1.Write note on Del Operator.

2.Define the curl of vector field. Obtain an expression for it.

3.Give interpretation of magnitude of $\vec{A} \times \vec{B}$.

4.Show that $d\varphi = grad\varphi \cdot d\vec{r}$

5.State Guass divergence theorem and Stoke's theorem.

- **Long Answer Questions**

1.Define gradient of scalar field. Explain its physical significance.

2.Define divergence of vector field. Explain its physical significance.

3.State and Prove Gauss divergence theorem in vector field.

4.State and prove Stoke's theorem in vector field.

Unit II- Electrostatics

- **Multiple Choice Questions (Correct answer is shown in red color)**

1) 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) $\frac{1}{r^2}$

2) The electric field inside the spherical shell of radius R is

A) $E = \infty$ B) $E = 0$ C) $E = \frac{q}{4\pi\varepsilon_o r^2}$ D) $E = \frac{q}{4\pi\varepsilon_o r}$

3) The total number of electric lines passing a given area in a unit time is known as

A) electric field B) electric flux C) electric potential D) electric charge

4) Electric flux ϕ due to electric field E, passing through the surface area S is given as.....

A) $\varphi = E/S$ B) $\varphi = E \times S$ C) $\varphi = E \cdot S$ D) $\varphi = E - S$

5) 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) Biot-Savart C) Coulomb's D) Amperes

6) 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 force C) electric flux D) electric potential

7) Coulomb's law is only true for point charges whose sizes are.....

A) medium B) very small C) very large D) none of the above

8) 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

9) 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) $E = q_o/F$

10) 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

11) Electric field intensity is .....quantity.

A) scalar B) vector C)positive D) infinite

12) Unit of electric field intensity is.....

A) N B) NC^{-1} C) Ns D) NC

13) 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) the volume of the surface

14) S.I unit of electric flux is.....

A) Nm^2C^1 B) $Nm^{-2}C^{-1}$ C) $Nm^{-2}C^1$ D) Nm^2C^{-1}

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

A) $V = W/q$ B) $W = q/V$ C) $W = V \times q$ D) $V = W + q$

16) Electric Field lines always emerge from....

A) positive charge

B) negative charge

C) can be both charges

D) the central point of both charges

17)Electric Field lines start from .... charges and end at ..... charges.

A) positive, negative B) negative, positive C) positive, infinite D) infinite, negative

18) The capacitance of an isolated spherical conductor of radius R is…….

A) $C = 4\pi \in_o R$ B) $C = \frac{\in_o A}{d}$ C) $C = \frac{4\pi \in o}{R}$ D) $C = 2\pi \in_o R$

19) The capacitance of an isolated spherical conductor of radius R is…….

A) $C = 4\pi \in_o R$ B)) $C = \frac{\in_o A}{d}$ C)) $C = \frac{\in_o A}{2d}$ D) $C = \in_o Ad$

20) Ability of capacitor to store charge depends upon…..

A) area of plates B)distance between plates

C) type of dielectric used D) all the above

21)Capacitor plates are separated by an insulator known as…….

A) non-metal B) dielectric C) paper D) wood

22) Charge on capacitor plates is directly proportional to.....

A) current B)electric field intensity

C)potential difference D)resistance

23) in order to store charge, a device is called....

A)electric flux B)capacitor C) resistor D)inductor

24)Capacitance of a capacitor is 100μF and potential difference between plates is 50 volts then charge stored on each plate is.....

A) 10 mC B)5mC C)4mC D)15mC

25) 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

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

A)short distance B) long distance C)above each other D) none of these

27) 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)$\frac{1}{2}CV$

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

A) $\vec{D} = \varepsilon_o \vec{P} + \vec{E}$ B)$\vec{D} = \varepsilon_o \vec{E} + \vec{P}$ C)$\vec{D} = \varepsilon_o \vec{P} - \vec{E}$ D)$\vec{D} = \varepsilon_o \vec{E} - \vec{P}$

29) The susceptibility of a dielectric medium of constant k is.....

A) equal to k B) less than k C) greater than k D) zero

30) S. I unit of Polarization *P* is ....

A) C/m^2 B) Cm C) C^2/m D)C^2m^2

31) S. I unit of Polarization $\vec{p}$ is ....

A) C/m^2 B) Cm C) C^2/m D)C^2m^2

32) Displacement vector $\vec{D}$ is due to.....charges

A) bound B) induced C) free D)selfbound

33) The capacitance of isolated capacitor is ..... to its radius.

A) directly proportional B) inversely proportional

C) equal to D) double

34) The electric field on the spherical shell of radius R is.....

A) $E = \frac{q}{4\pi\varepsilon_o R}$ B) $E = \frac{\sigma R^2}{\varepsilon_o r^2}$ C) $E = \frac{\sigma}{\varepsilon_o}$ D) $E = \frac{q}{4\pi\varepsilon_o r^2}$

35) The electric field outside the spherical shell of radius R is....

A) $E = \frac{q}{4\pi\varepsilon_o R^2}$ B) $E = \frac{\sigma}{\varepsilon_o}$ C) $E = \frac{\sigma r^2}{\varepsilon_o R^2}$ D) $E = \frac{\sigma R^2}{\varepsilon_o r^2}$

36) The electric potential due to charge +q at point r is given by....

A) $V = \frac{q}{4\pi\varepsilon_o r}$ B) $V = \frac{q}{4\pi\varepsilon_o r^2}$ C) $V = \frac{q}{4\pi\varepsilon_o r^3}$ D) $V = 0$

37) The electric potential due to dipole given by....

A) $V = \frac{p\cos\theta}{4\pi\varepsilon_o r}$ B) $V = \frac{p\cos\theta}{4\pi\varepsilon_o r^2}$ C) $V = \frac{p\cos\theta}{4\pi\varepsilon_o}$ D) $V = -\frac{p\cos\theta}{4\pi\varepsilon_o r^2}$

38)The electric potential due to dipole when the point is on the axis of dipole is given by....

A) $V = \frac{p\cos\theta}{4\pi\varepsilon_o r}$ B) $V = 0$ C) $V = \frac{p}{4\pi\varepsilon_o r^2}$ D) $V = \frac{p}{4\pi\varepsilon_o r^3}$

39)The electric potential due to dipole when the point is on the equator of dipole is given by...

A) $V = \frac{p\cos\theta}{4\pi\varepsilon_o r}$ B) $V = 0$ C) $V = \frac{p}{4\pi\varepsilon_o r^2}$ D) $V = \frac{p}{4\pi\varepsilon_o r^3}$

40) The radial component of electric field due to dipole is.....

A) $E = \frac{1}{4\pi\varepsilon_o}\left(\frac{p\sin\theta}{r^2}\right)$ B) $E = \frac{1}{4\pi\varepsilon_o}\left(\frac{p\cos\theta}{r^3}\right)$

C) $E = \frac{1}{4\pi\varepsilon_o}\left(\frac{p\sin\theta}{r^3}\right)$ D) $E = \frac{1}{4\pi\varepsilon_o}\left(\frac{2p\cos\theta}{r^3}\right)$

41) The transverse component of electric field due to dipole is.....

A) $E = \frac{1}{4\pi\varepsilon_o}\left(\frac{p\sin\theta}{r^2}\right)$ B) $E = \frac{1}{4\pi\varepsilon_o}\left(\frac{p\cos\theta}{r^3}\right)$

C) $E = \frac{1}{4\pi\varepsilon_o}\left(\frac{p\sin\theta}{r^3}\right)$ D) $E = \frac{1}{4\pi\varepsilon_o}\left(\frac{2p\cos\theta}{r^3}\right)$

42) The electric field inside the sphere of radius R is...

A) $E = \frac{q}{4\pi\varepsilon_o R^3}$ B) $E = \frac{qr}{4\pi\varepsilon_o R^2}$ C) $E = \frac{\sigma r^2}{\varepsilon_o R^2}$ D) $E = \frac{qr}{4\pi\varepsilon_o R^3}$

43) The electric field on the sphere of radius R is

A) $E = \frac{q}{4\pi\varepsilon_o R^2}$ B) $E = \frac{qr}{4\pi\varepsilon_o R^2}$ C) $E = \frac{\sigma r^2}{\varepsilon_o R^2}$ D) $E = \frac{qr}{4\pi\varepsilon_o R^3}$

44) The electric field outside the sphere of radius R is

A) $E = \frac{q}{4\pi\varepsilon_o R^2}$ B) $E = \frac{q}{4\pi\varepsilon_o r^2}$ C) $E = \frac{\sigma r^2}{\varepsilon_o R^2}$ D) $E = \frac{qr}{4\pi\varepsilon_o R^3}$

45) Volume charge density of sphere of radius r is.....

A) $\rho = \frac{q}{\frac{4}{3}\pi\varepsilon_o r^3}$ B) $\rho = \frac{q}{\frac{4}{3}\pi\varepsilon_o r^2}$ C) $\rho = \frac{q}{\frac{4}{3}\pi r^3}$ D) $\rho = \frac{1}{\frac{4}{3}\pi r^3}$

46) Surface charge density of spherical shell having radius r is.....

A) $\sigma = \frac{q}{4\pi r^2}$ B) $\sigma = \frac{q}{\frac{4}{3}\pi r^2}$ C) $\sigma = \frac{q}{4\pi\varepsilon_o r^2}$ D) $\sigma = \frac{1}{4\pi r}$

- **Short Answer Questions**

1.Show that the energy stored per unit volume in electrostatic field $\frac{1}{2}\varepsilon_o E^2$

2.Obtain an expression for electric field at a point outside the charged spherical shell.

3.Obtain an expression for electric field at a point inside the charged spherical shell.

4.Obtain an expression for electric field at a point outside the charged sphere.

5.Show that capacitance of an isolated spherical conductor is proportional to its radius.

6.Obtain an expression for capacitance of parallel plate capacitor completely filled with dielectric..

7.Obtain an expression for capacitance of spherical condenser.

8.Obtain an expression for capacitance of cylindrical condenser.

9.Explain dielectric polarization.

10.Show that, for parallel plate capacitor completely filled with dielectric, electric displacement vector is given as $\vec{D} = \varepsilon_o \vec{E} + \vec{P}$.

11.Obtain Gauss theorem for dielectric medium.

12.Explain electric flux of electric field.

13.Define electric field, electric flux and electric potential.

14.Derive relation between electric field and electric potential.

15.Obtain an expression for capacitance of isolated capacitor.

- **Long Answer Questions**

1. Obtain an expression for electric potential due to a point charge at a distance r from it.

2. State and Prove Gauss law in electrostatics.

3. Obtain an expression for capacitance of parallel plate capacitor.

4. What is electric dipole? Obtain an expression for electric potential due to electric dipole, at a point at a distance r from centre of the dipole.

5. Obtain an expression for capacitance of parallel plate capacitor.

6. Derive an expression $\emptyset = \frac{q}{\epsilon_o}$