TWO MARKS QUESTIONS

1. What is a Scalar quantity?

A Quantity which has magnitude only is called Scalar quantity. It is represented by length. Eg: Temperature, Mass, Volume and Energy.

2. What is a Vector quantity?

A Quantity which has both magnitude and direction is called Vector quantity. It is graphically represented by a line with an arrow to show magnitude and direction.EG: Force, Velocity, and Acceleration

3. Define Unit Vector?

A vector A has both magnitude and direction. The *magnitude* of A is a scalar written as A or |A|. A *unit vector* a_A along A is defined as a vector whose magnitude is unity (i.e., 1) and its direction is along A, that is,

$$\text{Unit vector } a_A = \frac{A}{|A|}$$

$|a_A| = 1$. Thus we may write A as $A = Aa_A$, which completely specifies A in terms of its magnitude A and its direction a_A.

4. Give the properties of Vectors.

S.NO	LAWS	ADDITION	MULTIPLICATION
	Commutative	A + B = B + A	$kA = Ak$
	Associative	A + (B + C) = (A + B) + C	$k(l\,A) = (kl)A$
	Distributive	$k(A + B) = kA + kB$	

5. Define Scalar or Dot Product.

The **dot product** of two vectors A and B, wrilten as A • B. is defined geometrically as the product of the magnitudes of A and B and the cosine of the angle between them.
Thus:

$$A \cdot B = AB \cos \theta_{AB}$$

6. Define Cross or Vector product.

The **cross product** of two vectors A and B. written as A X B. is a vector quantity whose magnitude is ihe area of the parallopiped formed by A and B, and is in the direction of advance of a right-handed screw as A is turned into B.
Thus

$$A \times B = AB \sin \theta_{AB} \overrightarrow{a_n}$$

7. Define Coordinate system and give its types.

A system in which a vector can be described by its length, direction ,projections, angles or components is Coordinate system.

There are three types in coordinate system.

a) rectangular coordinate system: x, y, z
b) Cylindrical coordinate system: r, Φ, z
c) Spherical coordinate system: r, Θ, Φ

8. Give the conversion of cylindrical to Cartesian and Cartesian to cylindrical.

cylindrical to Cartesian	Cartesian to cylindrical.
Given (r, Φ, z)	Given (x,y,z)
$x = r \cos \Phi$	$r = \sqrt{x^2 + y^2}$
$y = r \sin \Phi$	$\Phi = \tan^{-1}(y/x)$
$z = z$	$z = z$

9. Give the conversion of Cartesian to spherical.

Given (x , y , z)

$r = \sqrt{x^2 + y^2 + z^2} \quad r \geq 0$

$\theta = \cos^{-1}(z / r) \quad 0 \leq \theta \leq \pi$

$\Phi = \tan^{-1}(y/x) \quad 0 \leq \Phi \leq 2\pi$

10. Give the conversion of spherical to Cartesian

Given (r, θ, Φ)

$x = r \sin \theta \cos \Phi$

$y = r \sin \theta \sin \Phi$

$z = r \cos \theta$

11. Define Gradient.

The gradient of a scalar is a vector. Consider V be the unique function of x,y,z co ordinates in rectangular system. This is the scalar function and denoted as V(x,y,z). The vector operates in Cartesian system denoted ∇ called del.

The vector operator, $\nabla = \frac{\partial}{\partial x}\overline{\boldsymbol{a_x}} + \frac{\partial}{\partial y}\overline{\boldsymbol{a_y}} + \frac{\partial}{\partial z}\overline{\boldsymbol{a_z}}$

The scalar operator, $\nabla.V = \frac{\partial V}{\partial x}\overline{\boldsymbol{a_x}} + \frac{\partial v}{\partial y}\overline{\boldsymbol{a_y}} + \frac{\partial v}{\partial z}\overline{\boldsymbol{a_z}}$

i.e, ∇.V = grad V

12. Define divergence

Divergence of vector field D at a point P is the outward flux per unit volume as the volume shrinks about point P. i.e, $\mathbf{lim} \quad \Delta \boldsymbol{V} \to \mathbf{0}$ representing differential volume element at point P.

Divergence of D = div D = $\mathbf{lim}_{\Delta V \to 0} \oint_S \frac{A.ds}{\Delta V}$

Div A = ∇.D – divergence of D

∇= vector operator = $\frac{\partial}{\partial x}\boldsymbol{D_x} + \frac{\partial}{\partial y}\boldsymbol{D_y} + \frac{\partial}{\partial z}\boldsymbol{D_z}$

13. Define curl

The curl of A is an axial (or rotational) vector whose magnitude is the maximum circulation of A per unit area as the area lends to zero and whose direction is the normal direction of the area when the area is oriented so as to make the circulation maximum.

The circulation of a vector field around a closed path is given by curl of a vector. Mathematically it is defined as,

$$(\boldsymbol{curl\ of\ H})\boldsymbol{N} = \lim_{\Delta S_N \to 0}\left(\frac{\oint \boldsymbol{H.dl}}{\Delta S_N}\right)$$

14. Define divergence theorem.

The volume integral of the divergence of a vector field over a volume is equal to the surface integral of the normal component of this vector over the surface bounding this volume.

$$\iiint_V \nabla.\vec{A}\ dv = \oiint \vec{A}.ds$$

15. Define stokes theorem

Stokes's theorem states that the circulation of a vector field A around a (closed) path is equal to the surface integral of the curl of A over the open surface *S* bounded by L provided that A and ∇ X A are continuous S.

$$\oint H.dl = \iint_s \nabla \times H\, ds$$

16. State coulomb's law

Coulomb's law states that the force f between two point charges (Q1 and Q2 is):

i. Along the line joining them
ii. Directly proportional to the product Q1Q2of the charges
iii. Inversely proportional to the square of the distance *R* between them.
iv. Point charge is a hypothetical charge located at a single point in space. It is an idealized

$$\mathbf{F} = \frac{\mathbf{1}}{\mathbf{4\pi\varepsilon}}\frac{\mathbf{Q_1Q_2}}{\mathbf{R^2}}$$

17. What are the types of charge distributors?

There are 4 types of charge distributors, namely

a) Line charge
b) Point charge
c) Surface charge
d) Volume charge

18. Define line, surface, volume charge density

Line charge density is denoted asρ_L. it is the ratio of total charge in coulomb to total length in meters

$$\rho_L = \frac{TOTAL\ CHARGE\ IN\ COLUME}{TOTAL\ LENGTH\ OF\ THE\ LINE}(C/M)$$

Surface charge density is denoted asρ_S. it is the ratio of total charge in coulomb to total Surface area in meter^2

$$\rho_S = \frac{TOTAL\ CHARGE\ IN\ COLUME}{TOTAL\ \text{SURFACE AREA}} (C/M^2)$$

Volume charge density is denoted asρ_L. it is the ratio of total charge in coulomb to total Volume in meter^3

$$\rho_V = \frac{TOTAL\ CHARGE\ IN\ COLUME}{TOTAL\ \text{VOLUME}} (C/M^3)$$

19. Define electric field intensity

The electric field intensity (or electric field strength) K is the force per unit charge when placed in the electric field.

Thus $E = \lim_{Q \to 0} \frac{F}{Q}$

or simply $E = \frac{F}{Q}$

20. Write the formula for electric field intensity due to line, Surface and Volume charge.

- Electric field intensity due to line $E = \int \frac{\rho L.dl}{4\Pi\xi 0R^2} \hat{a}_R$
- Electric field intensity due to Surface $E = \int \frac{\rho S.ds}{4\Pi\xi 0R^2} \hat{a}_R$
- Electric field intensity due to Volume $E = \int \frac{\rho V.dV}{4\Pi\xi 0R^2} \hat{a}_R$

Where E- Electric field intensity due to line charge
L- Line charge density
R- Distance between the point and small element line, surface, volume charge
ρ_S- surface charge density
ρ_V = volume charge density

21.Give the principle of superposition.

If a system consists of n point charges namely $q_1, q_2 \ldots\ldots q_n$, then the force on its charge is given by the vector sum of all the individual forces given by coulombs law. This is linear superstition.

22.Define Potential .

Work done in moving a unit positive charge from infinity to any point is called potential. Unit is volts.

23 .Give the relation between electric field and potential.

$$E = \frac{V}{d} \text{V/m}$$

Where E – Electric field intensity
V – potential
d – distance.

24. Give the potential due to electrical dipole.

$$V = \frac{Qd\,Cos\,\theta}{4\pi\Sigma 0 r^2} \text{ volts.}$$

where V - potential due to electrical dipole
d - distance between the two charges
r - distance between point and the origin.
ξ_0 - permittivity of free space.

25. Define Electric flux and flux density.

The flux due to the electric field E can be calculated using the general definition of flux. For practical reasons, however, this quantity is not usually considered as the most useful flux in electrostatics. Also the electric field intensity is dependent on the medium in which the charge is placed. Suppose a new vector field D independent of the medium is defined by

$$D = \varepsilon E$$

$$D = \frac{Q}{4\pi {R_{12}}^2}$$

26.State Gauss law.

The electric flux through the surface is equal to the total charge enclosed by the surface(for any closed surface)

$$\iint D.ds = Q$$

where D – flux density vector at any point P.
ds – small vector area in the surface at point P.
Q - total charge enclosed by the surface.

27.Give the applications of Gauss law.

- To find the electric field intensity fro symmetrical or uniform charge configurations.
- To find the electric field intensity for unsymmetrical or non uniform field.

28. Give the relationship between potential gradient and electric field.

$$E = - \nabla V$$

In rectangular co ordinate system,

$$\nabla.V = \frac{\partial V}{\partial x}\overline{a_x} + \frac{\partial v}{\partial y}\overline{a_y} + \frac{\partial v}{\partial z}\overline{a_z}$$

In cylindrical system,

$$\nabla.V = \frac{\partial v}{\partial \rho}a\rho + \frac{1}{\rho}\frac{\partial v}{\partial \varphi}a\varphi + \frac{\partial v}{\partial z}az$$

In spherical system,

$$\nabla.V = \frac{\partial v}{\partial r}ar + \frac{1}{r}\frac{\partial v}{\partial \theta}a\theta + \frac{1}{r sin\theta}\frac{\partial v}{\partial \varphi}a\varphi$$

29. What is the difference between absolute potential and potential difference.

When the potential is measured with respect to specified reference position which is to be assumed to be zero potential, is called absolute potential at that point. Such a reference position is generally assumed to be at infinity, which is at zero potential. The potential difference between the absolute potentials of the two points.

30. Write Gauss Divergence theorem.

According to Gauss law,

$$Q = \int D.dS = \int_{V1} \rho_V \, dV$$

$$= \text{Total charge enclosed } Q = \int_{V1} \rho_V \, dV$$

$$Q = \int D.dS = \int_{V1} \rho_V \, dV$$

By applying divergence theorem to the middle term,

$$\oint D.dS = \int \nabla.D \, dV$$

Comparing the two volume integrals,

$$\rho_V = \nabla.D$$

This is the first of the four Maxwell's equations to be derived.

PART B

1. A uniform line charge $\rho_{L=}$ 25NC/m lies on the x=3m and y=4m in free space. Find the electric field intensity at a point (2, 3, 15) m.
2. Given that potential V=10sinθ cosφ/r^2 find the electric flux density D at (2,π/2,0).
3. Transform $\overrightarrow{a_r}$ to spherical coordinate system at point P(r=4, θ= π/2, φ= π/4).
4. State and explain Stoke's theorem and derive Divergence theorem.
5. A point charge Q_1=300 μc located at (1,-1,-3)m experiences a force $\overrightarrow{F_1} = 8\overrightarrow{a_x} - 8\overrightarrow{a_y} + 4\overrightarrow{a_z}\,(N)$ due to point charge Q_2 at (3, -3,-2) m. Find the charge Q_2.
6. Explain about the electric field intensity due to various Continuous charge distributions.
7. Define electric flux density and derive the relation between flux density and field intensity.
8. State and prove Gauss's law, Gauss divergence theorem and also describe the applications of Gauss's law.
9. Write the short notes on

i) Curl ii) Divergence iii) Gradient iv) Principle of Superposition

v) Electric field intensity due to 'n' number of charges

10. Derive the expression for potential due to an electric dipole at any point P. Also find electric field intensity at the same point.
11. Explain about the co ordinates systems.
12. Derive the expression for potential difference between the infinite line.
13. What is absolute electric potential and Calculate potential differences for different configurations
14. Electrostatic energy and energy density
15. If V = ($2x^2y$ +20z -$4x^2$+y^2) volts, find E and D at P (6, -2.5, 3).
16. Verify Stokes theorem for a vector field, F=r^2cosφa_r+z sinφ a_z around the path L defined by 0≤ r≤ 3, 0≤φ≤450and z =0

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