Electromagnetic Field Theory

1) **Which of the following relations is valid ?**
   (a) $\vec{A}$ X ($\vec{B}$ X $\vec{C}$) = ($\vec{A}$. $\vec{B}$) $\vec{C}$ – ($\vec{A}$. $\vec{C}$) $\vec{B}$
   (b) $\vec{A}$ X ($\vec{B}$ X $\vec{C}$) = ($\vec{A}$ X $\vec{B}$) $\vec{C}$ - ($\vec{A}$. $\vec{C}$) $\vec{B}$
   (c) $\vec{A}$ X ($\vec{B}$ X $\vec{C}$) = ($\vec{A}$. $\vec{C}$) $\vec{B}$ – ($\vec{A}$. $\vec{B}$) $\vec{C}$
   (d) **None of the above**

   =Answer (c) $\vec{A}$ X ($\vec{B}$ X $\vec{C}$) = ($\vec{A}$. $\vec{C}$) $\vec{B}$ – ($\vec{A}$. $\vec{B}$) $\vec{C}$

2) **A vector is specified as**

   $\vec{G}$ = 12xy $\hat{u}_x$ + 12(x + 2)$\hat{u}_y$ + 18 z^2 $\hat{u}_z$

   The $\vec{G}$ at point P (2 , 1 , -2) is

   (a) 4 $\hat{u}_x$ + 6 $\hat{u}_y$ + 4 $\hat{u}_z$ (b) 48 $\hat{u}_x$ + 36 $\hat{u}_y$ + 40 $\hat{u}_z$
   (c) 8 $\hat{u}_x$ + 3 $\hat{u}_y$ + 4 $\hat{u}_z$ (d) 24 $\hat{u}_x$ + 48 $\hat{u}_y$ + 72 $\hat{u}_z$

   = Answer (d) 24 $\hat{u}_x$ + 48 $\hat{u}_y$ + 72 $\hat{u}_z$

   Given,

   $\vec{G}$ = 12xy $\hat{u}_x$ + 12(x+2) $\hat{u}_y$ + 18 z^2 $\hat{u}_z$
   = 12(2)(1) $\hat{u}_x$ + 12(2+2) $\hat{u}_y$ + 18$(-2)^2$ $\hat{u}_z$
   = 24 $\hat{u}_x$ + 48 $\hat{u}_y$ + 72 $\hat{u}_z$

3) **We say that scalar field V is harmonic only if its _______ is zero.**
   (a) curl (b) divergence (c) gradient (d) Laplacian

   = Answer (d) Laplacian

4) **Which of the following vector fields is a uniform vector field ?**
   (a) 5z$\hat{a}_z$ (b) 3$x^2z\hat{a}_z$ (c) $\hat{a}_x$ + 2$\hat{a}_y$ (d) 2x$\hat{a}_x$ – 3$\hat{a}_z$

   = Answer (c) $\hat{a}_x$ + 2$\hat{a}_y$

A vector field is said to be uniform or constant,if it does not depend on space variants x,y or z.Of the given answers only (c) is independent of variables x,y and z.

5) **The scalar triple product $\vec{A}$.($\vec{A}$ X $\vec{B}$) has the value**
   (a) $\vec{A}$.$\vec{B}$ (b) zero (c) $\vec{A}$X$\vec{B}$ (d) None of these

   = Answer (b) zero

$$\vec{A}.(\vec{A}X\vec{B}) = \begin{vmatrix} A_x & A_y & A_z \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix}$$

Since, two rows of determinant are same, the value of determinant reduces to zero.

$\vec{A}.(\vec{A}X\vec{B}) = 0$

6) **The result of $\vec{A}.(\vec{B}X\vec{C})$**
   (a) **Is scalar (b) depends on $\vec{C}$ (c) depends on $\vec{A}$ (d) is vector**

= Answer (a) is scalar

7) **The vector component of $\vec{F} = 6\hat{u}_x + 4\hat{u}_y + 2\hat{u}_z$ that is perpendicular to $\vec{G} = 2\hat{u}_x + 2\hat{u}_y - 1\hat{u}_z$ is**
   (a) **$2\hat{u}_x + 4\hat{u}_z$ (b) $\hat{u}_x + \hat{u}_y + \hat{u}_z$ (c) $2\hat{u}_x - 2\hat{u}_y$ (d) $\hat{u}_x + 3\hat{u}_y + 2\hat{u}_z$**

= Answer (a) $2\hat{u}_x + 4\hat{u}_z$

The vector component of $\vec{F}$ perpendicular to $\vec{G}$

$= F - \frac{F.G}{G^2}.G$

$= (6,4,2) - \frac{(6,4,2).(2,2,-1)}{(2^2+2^2+1^2)}(2,2,-1)$

= (6,4,2) – (4,4,-2)

= (6-4),(4-4),{2-(-2)}

= (2,0,4)

$= 2\hat{u}_x + 0\hat{u}_y + 4\hat{u}_z$

$= 2\hat{u}_x + 4\hat{u}_z$

8) **The equivalent coordinate of**
   $\vec{A} = 2\hat{a}_x - 2\hat{a}_y + 3\hat{a}_z$
   In cylindrical coordinate system is
   (a) $(\sqrt{17},\frac{3\pi}{4},3)$ (b) $(\sqrt{17},\frac{\pi}{4},3)$ (c) $(\sqrt{8},\frac{\pi}{4},3)$ (d) $(\sqrt{8},\frac{3\pi}{4},3)$

= Answer (d) $(\sqrt{8},\frac{3\pi}{4},3)$

We know that in cylindrical coordinate system,

$\rho = \sqrt{x^2 + y^2}$

$= \sqrt{2^2 + (-2)^2}$

$= \sqrt{4 + 4}$

$= \sqrt{8}$

$\varphi = tan^{-1}(\frac{y}{x})$

$= tan^{-1}(\frac{-2}{2})$

$= tan^{-1}(-1)$

$= tan^{-1}\{tan(-45)\}$

$= tan^{-1}\{tan(\frac{\pi}{2} - (-\frac{\pi}{4})\}$

$= tan^{-1}\{tan(\frac{\pi}{2} + \frac{\pi}{4})\}$

$= tan^{-1}(tan\frac{3\pi}{4})$

$= \frac{3\pi}{4}$

Z = 3

9) Statement 1 $|\nabla V|$ gives the minimum rate of change per unit distance.
   Statement 2 If $\vec{A} = \nabla V$,then V is said to be scalar potential of $\vec{A}$.
   Statement 1 and 2 are respectively
   (a) true,true (b) false,true (c) false,false (d) true,false

= Answer (c) false,false

1. $|\nabla V|$ given maximum rate of change of V per unit distance.
2. $\because \vec{A} = -\nabla V$

10) Consider $\vec{A} = 3\hat{a}_x + 4\hat{a}_y$ and $\vec{B} = 7\hat{a}_y - 2\hat{a}_z$ .The smaller angle between the two vectors $\vec{A}$ and $\vec{B}$ will be
   (a) 39.72^0 (b) 27.93^0 (c) 41.9^0 (d) 19.4^0

= Answer (a) 39.72^0

$$\vec{A} X \vec{B} = \begin{vmatrix} a_x & a_y & a_z \\ 3 & 4 & 0 \\ 0 & 7 & -2 \end{vmatrix}$$

$= -8a_x + 6a_y + 21a_z$

$|\vec{A}| = \sqrt{3^2 + 4^2 + 0^2}$

$= 5$

$|\vec{B}| = \sqrt{7^2 + (-2)^2}$

$= 7.28$

$|AXB|$ = $\sqrt{(-8)^2 + (6)^2 + (21)^2}$

$|\vec{A}X\vec{B}|$ = 23.25

Since, $|\vec{A}X\vec{B}|$ = $|\vec{A}||\vec{B}|$ sinθ

=> sinθ = $|\vec{A}$ X $\vec{B}|/|\vec{A}|\vec{B}|$

=> sinθ = $\frac{23.25}{5X7.28}$

=> sinθ = 0.638

=> θ = sin^{-1}(0.638)

∴ θ = 39.72^0

11) If the angle between the vectors $\vec{A}$ = 3$\hat{a}_x$ + 2$\hat{a}_y$ + 4$\hat{a}_z$ and $\vec{B}$ = - $\hat{a}_x$ - $\hat{a}_y$ + $B_z\hat{a}_z$ is 45^0, the value of B_z will be
(I) 27.03 (II) 1.25 (III) – 0.101
(a) Both (I) and (III) (b) Only (I) (c) Only (II) (d) All of these

= Answer (a) Both (I) and (III)

We know that,

$\vec{A}.\vec{B}$ = AB Cosθ ---------(i) Type equation here.

$\vec{A}$ = $\sqrt{3^2 + 2^2 + 4^2}$

= $\sqrt{29}$

$\vec{B}$ = $\sqrt{(-1)^2 + (-1)^2 + B^2{}_z}$

= $\sqrt{2 + {B_z}^2}$

$\vec{A}.\vec{B}$ = (3$\hat{a}_x$ + 2$\hat{a}_y$ + 4$\hat{a}_z$). (- $\hat{a}_x$ - $\hat{a}_y$ + $B_z\hat{a}_z$)

= - 5 + 4B_z

∴ Cos 45^0 = 0.707

From (i),

-5 + 4B_z = $\sqrt{29}$ $\sqrt{2 + {B_z}^2}$ x 0.707

=> $(-5 + 4B_z)^2$ = 29(2+B_z^2) x $(0.707)^2$ [By squaring both sides]Type equation here.

=> 25 – 40B_z + 16B_z^2 = 29.03 + 14.52B_z^2

=> 1.48 B_z^2 – 40 B_z - 4.03 = 0

∴ B_z = 27.03 or 0.101

12) A field is given as $\vec{F}$ = xy$\hat{u}_x$ + yz$\hat{u}_y$ + zx$\hat{u}_z$. The value of double integral I = $\int_0^4 \int_0^2 \vec{F}.\widehat{u_y}$ dzdx in the plane y = 10 will be
(a) 80 (b) 56 (c) 75 (d) 85

= Answer (a) 80

F.u_x = F_y = yz

I = $\int_0^4 \int_0^2 yz\ dz\ dx$

= $\int_0^4 [\int_0^2 yz\ dz]$ dx

= $\int_0^4 2y\ dx$

= 2(4)y

= 8y

At y = 10 , I = 80

13) If $\vec{A}$ is a vector orthogonal to $\vec{B}$ then $\vec{A}$X($\vec{B}$X$\vec{C}$) is equal to
(a) – ($\vec{B}.\vec{C}$) $\vec{A}$ (b) – ($\vec{A}.\vec{C}$) $\vec{B}$ (c) ($\vec{A}.\vec{C}$) $\vec{B}$ (d) $\vec{A}$ ($\vec{B}.\vec{C}$)

= Answer (c) ($\vec{A}.\vec{C}$) $\vec{B}$

We know that,

$\vec{A}$X($\vec{B}$X$\vec{C}$) = $\vec{B}$($\vec{A}.\vec{C}$) - $\vec{C}$($\vec{A}.\vec{B}$)Type equation here.

= $\vec{B}$($\vec{A}.\vec{C}$) [∵ $\vec{A}$ and $\vec{B}$ are orthogonal then $\vec{A}.\vec{B}$ = 0]

14) Gauss's lawType equation here.
(a) $\nabla.\vec{D} = \rho_v$ and $\oint_s \vec{D}.d\vec{s} = \int_v \rho_v dv$
(b) $\nabla.\vec{B}$ = 0 and $\oint_s \vec{B}.d\vec{S}$ = 0
(c) $\nabla \times \vec{E}$ = 0 and $\oint_L \vec{E}.d\vec{L}$ = 0
(d) $\nabla \times \vec{H}$ = J and $\oint \vec{H}.d\vec{L} = \int_s \vec{J}.d\vec{S}$

= Answer (a) $\nabla.\vec{D} = \rho_v$ and $\oint_s \vec{D}.d\vec{s} = \int_v \rho_v dv$

15) Non-existence of magnetic monopole

(a) $\nabla.\vec{D} = \rho_v$ and $\oint_s \vec{D}.d\vec{s} = \int_v \rho_v dv$

(b) $\nabla.\vec{B} = 0$ and $\oint_s \vec{B}.d\vec{S} = 0$

(c) $\nabla \times \vec{E} = 0$ and $\oint_L \vec{E}.d\vec{L} = 0$

(d) $\nabla \times \vec{H} = J$ and $\oint \vec{H}.d\vec{L} = \int_s \vec{J}.d\vec{S}$

= Answer (b) $\nabla.\vec{B} = 0$ and $\oint_s \vec{B}.d\vec{S} = 0$

16) Conservative nature of electrostatic field

(a) $\nabla.\vec{D} = \rho_v$ and $\oint_s \vec{D}.d\vec{s} = \int_v \rho_v dv$

(b) $\nabla.\vec{B} = 0$ and $\oint_s \vec{B}.d\vec{S} = 0$

(c) $\nabla \times \vec{E} = 0$ and $\oint_L \vec{E}.d\vec{L} = 0$

(d) $\nabla \times \vec{H} = J$ and $\oint \vec{H}.d\vec{L} = \int_s \vec{J}.d\vec{S}$

= Answer (c) $\nabla \times \vec{E} = 0$ and $\oint_L \vec{E}.d\vec{L} = 0$

17) Ampere's law

(a) $\nabla.\vec{D} = \rho_v$ and $\oint_s \vec{D}.d\vec{s} = \int_v \rho_v dv$

(b) $\nabla.\vec{B} = 0$ and $\oint_s \vec{B}.d\vec{S} = 0$

(c) $\nabla \times \vec{E} = 0$ and $\oint_L \vec{E}.d\vec{L} = 0$Type equation here.

(d) $\nabla \times \vec{H} = J$ and $\oint \vec{H}.d\vec{L} = \int_s \vec{J}.d\vec{S}$

= Answer (d) $\nabla \times \vec{H} = J$ and $\oint \vec{H}.d\vec{L} = \int_s \vec{J}.d\vec{S}$

18) Maxwell's equation

(a) $\nabla X\vec{E} = -\frac{\partial \vec{B}}{\partial t}$

(b) $\nabla X\vec{H} = J + \frac{\partial \vec{D}}{\partial t}$

(c) $\nabla.\vec{D} = \rho_v$

(d) $\nabla.\vec{B} = 0$

(e) All of the above

= Answer (e) All of the above

19) Unit of Reflection Co-efficient (Γ)
   (a) None of these
   (b) N-m/H
   (c) N/C
   (d) N

   = Answer (a) None of these

20) Unit of transmission co-efficient (τ)
   (a) No unit
   (b) N-m/cm
   (c) Coulomb
   (d) Ohm

   = Answer (a) No unit

21) Given, $\vec{E} = \vec{E}\sin(\omega t - \beta z)\hat{a}_y$ in free space then B will be given as
   (a) $-\frac{\vec{E_m}}{\omega}\beta sin(\omega t - \beta z)\widehat{a_z}$
   (b) $-\frac{\vec{E_m}}{\omega}\beta cos(\omega t - \beta z)\widehat{a_n}$
   (c) $-\frac{\vec{E_m}}{\omega}\beta sin(\omega t - \beta z)\widehat{a_y}$
   (d) None of the above

   = Answer (a) $-\frac{\vec{E_m}}{\omega}\beta sin(\omega t - \beta z)\widehat{a_z}$

22) If ω is the angular velocity and β is the phase constant,group velocity is given by
   (a) $\frac{d\omega}{d\beta}$ (b) $\frac{\beta}{\omega}$ (c) $\frac{\omega}{\beta}$ (d) $\frac{d\beta}{d\omega}$

   = Answer (a) $\frac{d\omega}{d\beta}$

23) A material has angle of loss tangent equal to $\frac{\pi}{4}$ rad then the material is
   (a) Conductor (b) insulator (c) semiconductor (d) cannot be determined

   = Answer (c) semiconductor

24) The phasor $\widehat{H_s}$ of the incident wave in air is
   (a) $16e^{-j\frac{2\pi x\widehat{u_z}}{3}}\frac{\mu A}{m}$ (b) – $16e^{-j\frac{2\pi x\widehat{u_z}}{3}}\frac{\mu A}{m}$

   (b) $16e^{-j\frac{2\pi x\widehat{u_z}}{3}} mA/m$ (d) - $16e^{-j\frac{2\pi x\widehat{u_z}}{3}} mA/m$

= Answer (a) $16e^{-j\frac{2\pi x\widehat{u_z}}{3}} \frac{\mu A}{m}$

25) The $\vec{E}$-field of total wave in air is

(a) J12 sin($\frac{2\pi}{3}x$) $\widehat{u_y}$ mv/m (b) - J12 sin($\frac{2\pi}{3}x$) $\widehat{u_y}$ mv/m

(c) 12 cos($\frac{2\pi}{3}x$) $\widehat{u_y}$ mv/m (d) - 12 cos($\frac{2\pi}{3}x$) $\widehat{u_y}$ mv/m

= Answer (b) - J12 sin($\frac{2\pi}{3}x$) $\widehat{u_y}$ mv/m

26) The location in air nearest to the conducting plate,where total $\vec{E}$ is zero,is

(a) x = 1.5 m (b) x = - 1.5 m (c) x = 3 m (d) x = - 3 m

= Answer (b) x = - 1.5 m

27) The phasor magnetic field intensity for a 400 MHz uniform plane wave propagating in a certain lossless material is (6$\widehat{u_y}$ - J5$\widehat{u_x}$) e^{-j18x} A/m.The phase velocity $\overrightarrow{v_p}$ is

(a) 6.43 X 10^6 m/s (b) 2.2 X 10^7 m/s

(c) 1.4 X 10^8 m/s (d) None of these

= Answer (c) 1.4 X 10^8 m/s

$\overrightarrow{v_p} = \frac{\omega}{\beta}$

$= \frac{2\pi \, X \, 400 \, X \, 10^6}{18}$

= 1.4 X 10^8 m/s

28) Unit of phase velocity (v_p)

(a) Metre (b) Newton (c) Calorie (d) metre/second

= Answer (d) metre/second

29) A Transverse Electromagnetic (TEM) wave impinges obliquely on a dielectric boundary with $\epsilon_{r1} = 2$ and ϵ_{r2} = 1.The angle of incidence for total reflection is

(a) 30^0 (b) 60^0 (c) 45^0 (d) 90^0

= Answer (c) 45^0

$\frac{sin\theta_1}{sin\theta_2} = \frac{\sqrt{\epsilon_2}}{\sqrt{\epsilon_1}}$

For total reflection,

$\theta_2 = 90^0$

Then, $\theta_1 = sin^{-1}(\frac{1}{\sqrt{2}})$

$= 45^0$

30) The critical frequency f_c is the frequency at which EM wave will be

(a) reflected (b) neither reflected nor refracted (c) refracted (d) transmitted

= Answer (b) neither reflected nor refracted

31) The ratio $\frac{\sigma}{\omega\varepsilon}$ is called

(I)Intrinsic ratio (II) loss tangent (III) conduction ratio (IV) dissipation factor

(a) Only (III) (b) Only (II) (c) (II) and (IV) (d) (II) and (III)

= Answer (c) (II) and (IV)

32) A parallel wave is incident from air to polystyrene (μ_r = 1 , ε_r = 2.6) at Brewster's angle.The transmission angle is

(a) 31.8^0 **(b)** 58.2^0 **(c)** 64.3^0 **(d)** 25.7^0

= Answer (a) 31.8^0

Since,both media are non-magnetic.

tan $\theta_B = \sqrt{\frac{\epsilon_1}{\epsilon_2}}$

$= \sqrt{\frac{2.6\epsilon_0}{\epsilon_0}}$

$= \sqrt{2.6}$

But cos $\theta_t = \frac{\eta_1}{\eta_2}$ **cos** θ_B

$= \frac{\eta_0}{\frac{\eta_0}{\sqrt{2.6}}}$ **cos** 58.2^0

$= \sqrt{2.6}$ **cos** 58.2^0

$\therefore \theta_t = 31.8^0$

33) **Maxwell's divergence equation for the magnetic field is giben by**

(a) $\nabla X\vec{B} = 0$ **(b)** $\nabla.\vec{B} = 0$ **(c)** $\nabla.\vec{B} = \rho$ **(d)** $\nabla X\vec{B} = \rho$

= Answer (b) $\nabla.\vec{B} = 0$

34) **When a lossy capacitor with a dielectric of permittivity ∈ and conductivity operates at a frequency ω , the loss tangent for the capacitor**

(a) $\frac{\omega\sigma}{\epsilon}$ (b) $\frac{\omega\varepsilon}{\sigma}$ (c) $\frac{\sigma}{\omega\varepsilon}$ (d) $\sigma\omega\varepsilon$

= Answer (c) $\frac{\sigma}{\omega\epsilon}$

35) **The work done in carrying a charge through an equipotential surface**

(a) is zero (b) depends on the charge Q (c) is infinity (d) depends on the distance

= Answer (a) is zero

36) **A monopole consists of**

(a) a single charge
(b) two positive and two negative charges
(c) two positive and one negative charges
(d) two negative and one positive charges

= Answer (a) a single charge

37) **If a wave is incident from medium 1 having μ_1 = 4 to medium 2 having μ_2 = 9 ,then the reflection co-efficient is (n_0 is the intrinsic impedance of free space.)**

(a) **1/9 (b) 1/5 (c) ¼ (d) none of these**

= Answer (b) 1/5

Refflection Co-efficient (τ) = $\frac{n_2 - n_1}{n_2 + n_1}$

$$= \frac{n_0\sqrt{\frac{\mu_2}{\varepsilon_2}} - n_0\sqrt{\frac{\mu_1}{\varepsilon_1}}}{n_0\sqrt{\frac{\mu_2}{\epsilon_2}} + n_0\sqrt{\frac{\mu_1}{\varepsilon_1}}}$$

$$= \frac{\sqrt{\mu_2} - \sqrt{\mu_1}}{\sqrt{\mu_1} + \sqrt{\mu_1}}$$

$$= \frac{3-2}{3+2}$$

$$= \frac{1}{5}$$

38) **Which of the following equations is not Maxwell's equation for static electromagnetic field in a linear homogeneous medium ?**

(a) $\nabla X\vec{D} = 0$ (b) $\nabla^2\vec{A} = \mu_0\vec{I}$ (c) $\nabla.\vec{B} = 0$ (d) $\oint \vec{B}.d\vec{I} = \mu_0 I$

= Answer (c) $\nabla.\vec{B} = 0$

39) **Which of the following relation is valid ?**

(a) $\vec{A}X(\vec{B}X\vec{C}) = (\vec{A}.\vec{B})\vec{C} - (\vec{A}\vec{C}).\vec{B}$

(b) $\vec{A}$X($\vec{B}$X$\vec{C}$) = ($\vec{A}$X$\vec{B}$)$\vec{C}$ – ($\vec{A}$.$\vec{C}$)X$\vec{B}$

(c) $\vec{A}$X($\vec{B}$X$\vec{C}$) = ($\vec{A}$.$\vec{C}$)$\vec{B}$ – ($\vec{A}$.$\vec{B}$)$\vec{C}$

(d) None of the above

= Answer (c) $\vec{A}$X($\vec{B}$X$\vec{C}$) = ($\vec{A}$.$\vec{C}$)$\vec{B}$ – ($\vec{A}$.$\vec{B}$)$\vec{C}$

40) If $\oint \vec{A}.d\vec{l} = 0$ $then, \vec{A}$ $is\ called$

(a) conservative field

(b) harmonic field

(c) vortex field

(d) irrotatioanal field

= Answer (a,d) irrotational field also conservative field

41) (∇ X $\nabla.\vec{A}$) is

(a) always a scalar

(b) always a vector

(c) meaningless

(d) Can be either a vector or a scalar

= Answer (c) meaningless

42) If (r,θ, $\emptyset$) represents a spherical coordinate system then,the range of coordinate variables r,θ, $\emptyset$ is

(a) 0≤r$<\infty$,0≤ $\theta \leq \pi$,0≤ $\emptyset \leq 2\pi$

(b) 0≤ $r \leq \infty$,-$\pi \leq \theta \leq \pi, -\pi \leq \emptyset \leq \pi$

(c) 0≤ $r \leq \infty, -\pi \leq \theta \leq \pi, 0 \leq \emptyset \leq 2\pi$

(d) 0≤ $r \leq \infty, 0 \leq \theta \leq 2\pi, 0 \leq \emptyset \leq \pi$

= Answer (a) 0≤r$<\infty$,0≤ $\theta \leq \pi$,0≤ $\emptyset \leq 2\pi$

43) In cylindrical coordinates Laplacian of a scalar V can be expressed as

(a) ∇^2V = $\frac{1}{\rho^2}\frac{\partial}{\partial\rho}(\rho\frac{\partial V}{\partial\rho})$ + $\frac{1}{\rho^2}(\frac{\partial^2 V}{\partial\emptyset^2})$ + $\frac{1}{\rho}\frac{\partial^2 V}{\partial z^2}$

(b) ∇^2V = $\frac{1}{\rho}\frac{\partial}{\partial\rho}(\frac{\partial V}{\partial\rho})$ + $\frac{1}{\rho}(\frac{\partial^2 V}{\partial\emptyset^2})$ + $\frac{\partial^2 V}{\partial z^2}$

(c) ∇^2V = $\frac{1}{\rho}\frac{\partial}{\partial\rho}(\rho\frac{\partial V}{\partial\rho})$ + $\frac{1}{\rho^2}(\frac{\partial^2 V}{\partial\emptyset^2})$ + $\frac{\partial^2 V}{\partial z^2}$

(d) ∇^2V = $\frac{1}{\rho^2}\frac{\partial}{\partial\rho}(\rho\frac{\partial V}{\partial\rho})$ + $\frac{1}{\rho}(\frac{\partial^2 V}{\partial\emptyset^2})$ + $\frac{\partial^2 V}{\partial z^2}$

= Answer (c) ∇^2V = $\frac{1}{\rho}\frac{\partial}{\partial\rho}(\rho\frac{\partial V}{\partial\rho})$ + $\frac{1}{\rho^2}(\frac{\partial^2 V}{\partial\emptyset^2})$ + $\frac{\partial^2 V}{\partial z^2}$

44) We say that scalar field V is harmonic only if its ………………is zero.

(a) curl (b) gradient (c) divergence (d) Laplacian

= Answer (d) Laplacian

45) The result of $\vec{A}.(\vec{B}X\vec{C})$ is

(a) a scalar (b) depends on $\vec{C}$ (c) depends on $\vec{C}$ (d) a vector

= Answer (a) a scalar

46) Statement 1 Dot product is commutative
Statement 2 Cross product is associativeType equation here.
Statement 1 and 2 are respectively
(a) False,false (b) true,false (c) true,true (d) false,true

= Answer (b) true,false

47) The vector component of $\vec{F}$ = 5$\widehat{u_x}$ - 3$\widehat{u_y}$ + 2$\widehat{u_z}$ that is parallel to $\vec{G}$ = 0.2$\hat{u}_x$ + 0.4$\widehat{u_y}$ + 0.6$\widehat{u_z}$ is
(a) 1.86$\widehat{u_x}$ + 0.93$\widehat{u_y}$ + 3.87$\widehat{u_z}$
(b) $\widehat{u_x}$ + 2$\widehat{u_y}$ + 3$\widehat{u_z}$
(c) 2.86$\widehat{u_x}$ + 1.93$\widehat{u_y}$ + 4.87$\widehat{u_z}$
(d) $\widehat{u_x}$ + 3$\widehat{u_y}$ + 2$\widehat{u_z}$

= Answer (b) $\widehat{u_x}$ + 2$\widehat{u_y}$ + 3$\widehat{u_z}$

= $\frac{\vec{F}.\vec{G}}{\vec{G^2}}\vec{G}$Type equation here.

= $\frac{(5,-3,5).(0.2,0.4,0.6)}{(0.2)^2+(0.4)^2+(0.6)^2}$(0.2,0.4,0.6)

= (1,2,3)

= $\widehat{u_x}$ + 2$\widehat{u_y}$ + 3$\widehat{u_z}$

48) Which of the following statement is/are correct for a scalar V ?

(I)The magnitude of ∇V equals the maximum rate of change in V per unit distance.

(II) ∇V points in the direction of maximum rate of change in V.

(III) If $\vec{A}$ = ∇V,then V is called as the scalar potential of $\vec{A}$.

(a) (I),(II),(III) (b) Only (I) (c) (I) and (II) (d) (II) and (III)

= Answer (a) (I),(II),(III)

49) Which oh the following pair of vectors are orthogonal ?
(a) $\vec{A}$ = 3$\widehat{a_x}$ + 2$\widehat{a_y}$ + $\widehat{a_z}$; $\vec{B}$ = - 2$\widehat{a_x}$ + 3$\widehat{a_y}$ - $\widehat{a_z}$
(b) $\vec{A}$ = $\widehat{a_x}$ + 2$\widehat{a_y}$ + $\widehat{a_z}$; $\vec{B}$ = - 3$\widehat{a}_x$- $\widehat{a_y}$ + $\widehat{a_z}$

(c) $\vec{A}$ = - 3$\widehat{a_x}$ + 2$\widehat{a_z}$; $\vec{B}$ = 4$\widehat{a_y}$ + 6$\widehat{a_z}$

(d) $\vec{A}$ **= - 4**$\widehat{a_x}$ **;** $\vec{B}$ **= -4**$\widehat{a_z}$

= Answer (d) $\vec{A}$ **= - 4**$\widehat{a_x}$ **;** $\vec{B}$ **= -4**$\widehat{a_z}$

50) **Two point charges Q_1 = 1 nC and Q_2 = 2 nC are at a distance apart.Which of the following statement is correct ?**

- **(a) The force on Q_2 is along the line joining them**
- **(b) The force on Q_1 is repulsive**
- **(c) As the distance between them decreases,the force on Q_1 increases linearly**
- **(d) The force on Q_2 is the same in magnitude as that on Q_1**

= Answer (c) As the distance between them decreases,the force on Q_1 increases linearly

51) In Fleming's left hand rule,the thumb points in the direction of …………….. and the first finger in the direction of

(a) induced emf,current (b) force,magnetic field

(c)force,current (d) magnetic field,current

= Answer (b) force,magnetic field

52) The unit of work is

(I)N/C (II) joule (III) N-m (IV) N/m

(a) (I) and (III) (b) (II) and (III) (c) (I) and (IV) (d) (II) and (IV)

= Answer (b) (II) and (III)

53) In a given field,divergence is zero at

- **(a) Source point**
- **(b) Sink point**
- **(c) Source and sink point**
- **(d) Neither source nor sink**

= Answer (d) Neither source nor sink

54) The intersection of an equipotential surface with a plane results in

- **(a) equipotential surface**
- **(b) equipotential line**
- **(c) equipotential plane**
- **(d) reference line**

= Answer (b) equipotential line

55) **An integration of any vector around closed path is always equal to integration of the curl of that vector throughout the surface enclosed by that path.The above statement is known as**

(a) Ampere's law (b) Stoke's theorem (c) Biot-Savart's law (d) Physical interpretation of curl

= Answer (b) Stoke's theorem

56) **At a conductor-dielectric boundary,the electric field is always**

(a) Zero (b) absent (c) normal to the surface (d) along the surface

= Answer (c) normal to the surface

57) **What is the major factor for determining whether a medium free space,lossless dielectric,lossy dielectric or good conductor ?**

(a) Reflection coefficient
(b) Attenuation constant
(c) Loss tangent
(d) Constitutive parameters (σ, ϵ, μ)

= Answer (c) Loss tangent

58) **State whether the given statements are true or false.**

Statement 1 Work done in moving a charge in closed path is zero.
Statement 2 Work done in moving a charge from A to B depends on the path.
(a) True,True (b) True,False (c) False,True (d) False,False

= Answer (b) True,False

59) **Statement 1 Inside a conductor,the electric field is always zero.**

Statement 2 A conductor is always an equipotential surface.
State whether the above statements are true or false.
(a) True,True (b) False,False (c) False,True (d) True,False

= Answer (a) True,True

60) **The line integral of the vector potential** $\vec{A}$ **around the boundary of a surface S,represents**

(a) flux through in the surfaces
(b) flux density in the surfaces
(c) magnetic density
(d) current density

= Answer (a) flux through in the surfaces

61) **Inside a hollow conducting sphere**

(a) electric field is zero
(b) electric field is a non-zero constant
(c) electric field changes with the magnitude of the charge given to the conductor

(d) electric field changes with distance from the centre of the sphere

= Answer (a) electric field is zero

62) The resistance of the insulation of a coaxial cable length L and conductivity σ (a and b raddi,inner and outer)

(a) $\frac{L}{\sigma A}$ (b) $\frac{1}{2\pi\sigma L}\log_e(\frac{b}{a})$ (c) $\frac{1}{2\pi\sigma L\log_e(\frac{b}{a})}$ (d) $2\pi\sigma L\log_e(\frac{b}{a})$

= Answer (b) $\frac{1}{2\pi\sigma L}\log_e(\frac{b}{a})$

63) If v,w,q stand for voltage,energy and charge,then v can be expressed as

(a) v = $\frac{dq}{dw}$ (b) v = $\frac{dw}{dq}$ (c) dv = $\frac{dw}{dq}$ (d) dv = $\frac{dq}{dw}$

= Answer (b) v = $\frac{dw}{dq}$

64) In a uniform electric field,field lines and equipotentials

(a) are parallel to one another
(b) intersect at 45^0
(c) intersect at 30^0
(d) are orthogonal

= Answer (d) are orthogonal

65) The laws of electromagnetic induction (Faraday's and Lenz's law are summarized in the following equation)

(a) e = iR (b) e = L$\frac{di}{dt}$ (c) e = - $\frac{d\psi}{dt}$ (d) None of these

= Answer (c) e = - $\frac{d\psi}{dt}$

66) Two parallel wires separated by a distance d are carrying a current I in the same direction.The magnetic field along a line running parallel to these wires and midway between them

(a) depends upon I
(b) is zero
(c) depends upon d
(d) depends upon the permeability of medium between the wires

= Answer (b) is zero

67) An electromagnetic field is radiate from

(a) a stationary point charge
(b) a capacitor with a DC voltage
(c) a conductor carrying a DC current

(d) an oscillating dipole

= Answer (d) an oscillating dipole

68) If $\vec{E}$ is the electric field intensity,$\nabla.(\nabla X\vec{E})$ is equal to

(a) $\vec{E}$ (b) $|\vec{E}|$ (c) null vector (d) zero

= Answer (d) zero

69) The magnetic field due to a conductor carrying current I at a distance R from the current is directly proportional to

(a) R^{-1} (b) R^2 (c) R (d) R^{-2}

= Answer (d) R^{-2}

70) Which of the following is not a source of magnetostatic fields ?

(a) a DC current in wire
(b) a permanent magnet
(c) an accelerated charge
(d) an electric field linearly changing with time

= Answer (c) an accelerated charge

71) Two parallel plate capacitors are separated by a distance d.They are maintained at potential 0 and V_1 respectively.TheType equation here. potential at any point between the plate isType equation here.

(a) $-V_1dz$ (b) $\frac{V_1}{d}z$ (c) - $\frac{V_1}{d}z$ (d) V_1dz

= Answer (b) $\frac{V_1}{d}z$

72) A loop is rotating about the Y-axis in a magnetic field $\vec{E}$ = $B_0\cos(\omega t + \emptyset)\widehat{a_x}$ tesla.The voltage in the loop is

(a) zero
(b) due to transformer action only
(c) due to rotation only
(d) due to both rotation and transformer action

= Answer (d) due to both rotation and transformer action

73) Which of the following field equations indicate that the free magnetic charges do not exist ?

(a) $\vec{H} = \int \frac{IdIXr}{4\pi r^2}$ (b) $\vec{H} = \frac{1}{\mu}(\nabla X\vec{A})$ (c) $\nabla.\vec{H} = 0$ (d) $\nabla X\vec{H} = \vec{j}$

= Answer (c) $\nabla.\vec{H} = 0$

74) Match list I with list II

List I	List II
P. $\vec{\nabla} X \vec{H} = \vec{J}$	1.Continuity equation
Q. $\int_c \vec{E}.\vec{u}_t = -\frac{d}{dt}\int_s B.ds$	2.Faraday's law
R. $\vec{\nabla}.\vec{J} = \frac{\partial}{\partial t}\rho_v$	3.Ampere's law
	4.Gauss's law
	5.Biot-Savart law

Codes

	P	Q	R
(a)	4	1	2
(b)	3	5	1
(c)	5	4	2
(d)	3	2	1

= Answer (d) 3 2 1

75) The Maxwell equation $\nabla X \vec{H} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$ is based on
(a) Ampere's law (b) Coulomb's law

(c)Gauss's law (d) Faraday's law

= Answer (a) Ampere's law

76) The unit of $\vec{\nabla} X \vec{H}$ is
(a) Ampere
(b) Ampere/metre
(c) Ampere/$metre^2$
(d) Ampere – metre

= Answer (c) Ampere/$metre^2$

77) A transmission line is distortion less,if
(a) RL = $\frac{1}{GC}$ (b) RL = GC (c) LG = RC (d) RG = LC

= Answer (c) LG = RC

78) Statement 1 Coulomb's law is applicable only point charges at rest.
Statement 2 While calculating force between charges,the sign of charges should be taken into account.
(a) true,true (b) false,false (c) true,false (d) false,true

= Answer (a) true,true

79) For a wave travelling in z direction.Which of the following relations are true for perfect dielectric medium ?

$(I)\ \frac{\partial E_y}{\partial z} = \frac{\partial B_x}{\partial t}, \frac{\partial E_x}{\partial z} = -\frac{\partial B_y}{\partial t}$

(II) $\frac{\partial H_y}{\partial z} = -\frac{\partial D_x}{\partial t}, \frac{\partial H_x}{\partial z} = \frac{\partial D_y}{\partial t}$

(III) $\frac{\partial E_y}{\partial z} = -\frac{\partial B_x}{\partial t}, \frac{\partial E_x}{\partial z} = -\frac{\partial B_y}{\partial t}$

(IV) $\frac{\partial E_y}{\partial x} = -\frac{\partial B_x}{\partial t}, \frac{\partial E_x}{\partial y} = -\frac{\partial B_y}{\partial t}$

(V) $\frac{\partial H_y}{\partial x} = -\frac{\partial D_x}{\partial t}, \frac{\partial H_x}{\partial y} = \frac{\partial D_y}{\partial t}$

(a) (I) and (II) (b) (II) and (III) (c) only (I) (d) (IV) and (V)

= Answer (a) (I) and (II)

80) The energy required to move 120 C through 3 V is
(a) 25 mJ (b) 360 J (c) 40 J (d) 2.78 mJ

= Answer (b) 360 J

Type equation here.

Type equation here.

Type equation here.

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Type equation here.