GOVERNMENT ZIRTIRI RESIDENTIAL SCIENCE COLLEGE

Subject: PHYSICS
Paper name: Electromagnetic Theory
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Semester: 6TH

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A. Multiple choice questions [25 (5 from each unit)]

1. When a plane electromagnetic wave enters from one medium into another, which of the following quantity remains unchanged?

   (a) Frequency

   (b) Electric field amplitude

   (c) Wavelength

   (d) Velocity

2. For normal incidence of an e.m. wave from media 1 to 2, the ratio of reflected intensity to the incidence intensity is (n_1 and n_2 are refractive indices at the two media)

   (a) $\left(\frac{2n_1}{n_1+n_2}\right)^2$

   (b) $\left(\frac{n_1-n_2}{n_1+n_2}\right)^2$

   (c) $\left(\frac{n_1+n_2}{n_1-n_2}\right)^2$

   (d) $\left(\frac{2n_2}{n_1+n_2}\right)^2$

3. An electric field $\vec{E}$ in terms of scalar potential V and vector potential $\vec{A}$ is

   (a) $\vec{\nabla}V - \frac{\partial \vec{A}}{\partial t}$

   (b) $-\vec{\nabla}V - \frac{\partial \vec{A}}{\partial t}$

   (c) $\vec{\nabla}.\vec{A} - \frac{\partial V}{\partial t}$

   (d) $-\vec{\nabla}.\vec{A} - \frac{\partial V}{\partial t}$

4. The integral form of Maxwell's equation originated from Faraday's law of electromagnetic induction is

   (a) $\int \vec{D}.\overrightarrow{ds} = \int \rho dV$

(b) $\int \vec{B}.\overrightarrow{ds} = 0$

(c) $\oint_c \vec{H}.\overrightarrow{dl} = \int \overrightarrow{I_c}.\overrightarrow{ds} + \int \frac{\partial \vec{D}}{\partial t}.\overrightarrow{ds}$

(d) $\oint_c \vec{E}.\overrightarrow{dl} = -\int \frac{\partial \vec{B}}{\partial t}.\overrightarrow{ds}$

5. Energy density in a magnetic field $\vec{B}$ is given by

(a) $\frac{B^2}{2\mu_o}$

(b) $\frac{B^2}{2\varepsilon_o}$

(c) $2\mu_o B$

(d) $\frac{2\mu_o}{B}$

6. The speed of light in free space is

(a) $\frac{1}{\sqrt{2\varepsilon_o\mu_o}}$

(b) $\sqrt{\varepsilon_o\mu_o}$

(c) $\sqrt{\frac{\varepsilon_o}{\mu_o}}$

(d) $\frac{1}{\sqrt{\varepsilon_o\mu_o}}$

7. The boundary conditions for perpendicular component of electric field at a conducting surface is

(a) $E_1^{\perp} = E_2^{\perp}$

(b) $\varepsilon_2 E_1^{\perp} = \varepsilon_1 E_2^{\perp}$

(c) $\varepsilon_1 E_1^{\perp} - \varepsilon_2 E_2^{\perp} = \sigma_f$

(d) $\varepsilon_1 E_1^{\perp} + \varepsilon_2 E_2^{\perp} = \sigma_f$

8. If the vector and scalar potentials in a region of space are respectively $\vec{A}$ and V, then the magnetic field there is expressed as

(a) $\vec{\nabla} \times \vec{A}$

(b) $-\vec{\nabla}V$

(c) $\vec{\nabla} \times \vec{A} - \vec{\nabla}V$

(d) $\vec{\nabla} \times \vec{A} + \vec{\nabla}V$

9. If the vector and scalar potentials in a region of space are respectively $\vec{A}$ and V, then the electrostatic field there is expressed as

(a) $-\vec{\nabla}V - \frac{\partial \vec{A}}{\partial t}$

(b) $-\vec{\nabla}V$

(c) $\vec{\nabla}.\vec{A} - \frac{\partial V}{\partial t}$

(d) $-\vec{\nabla}.\vec{A}-\frac{\partial V}{\partial t}$

10. The equation in continuity in electromagnetism is given by

(a) $\nabla\cdot\vec{J}+\frac{\partial\rho}{\partial t}=0$

(b) $\rho+\frac{\partial\vec{J}}{\partial t}=0$

(c) $\vec{J}=\sigma\vec{E}$

(d) $\nabla\cdot\vec{J}=0$

11. For steady current, the equation is given by

(a) $\vec{J}=\sigma\vec{E}$

(b) $\frac{\partial\vec{J}}{\partial t}=0$

(c) $\nabla\cdot\vec{J}=0$

(d) $\nabla\times\vec{J}=0$

12. The magnetic scalar potential exists in a region where the current density is

(a) 0

(b) 1

(c) -1

(d) ∞

13. The differential form of Faraday's law of electromagnetic induction is

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

(b) $\nabla\times\vec{E}=-\frac{\partial\vec{B}}{\partial t}$

(c) $\vec{E}=-\frac{\partial\vec{B}}{\partial t}$

(d) $\vec{B}=-\frac{\partial\vec{E}}{\partial t}$

14. $\vec{E}=\vec{E}_0e^{-i(\omega t-kx)}$ represents

(a) a wave propagating along +x direction

(b) a wave propagating along -x direction

(c) a wave propagating along any direction

(d) a stationary wave

15. For a plane monochromatic wave travelling in a dielectric medium, $\vec{E}$ and $\vec{H}$ are
    (a) in phase
    (b) in ant-phase
    (c) differ by phase of 90^0
    (d) differ by phase of 270^0

16. If u_E and u_M are respectively the electric and magnetic energy densities of plane e.m. wave propagating in free space, then
    (a) $u_E = 2u_M$
    (b) $u_E = u_M$
    (c) $2u_E = u_M$
    (d) $u_E + u_M = 0$

17. The imaginary part of the complex refractive index represents
    (a) The refractive index
    (b) The dielectric constant
    (c) The absorption of the wave in the medium
    (d) None of the above

18. For reflection from a denser dielectric medium, the electric field of the e.m. wave incident normally suffers
    (a) A phase change of 180^0
    (b) No phase change
    (c) A phase change of 90^0
    (d) A phase change of 270^0

19. The reflectance for a p-polarized wave is zero for an angle of incidence called
    (a) Newton's angle
    (b) Brewster's angle
    (c) Fresnel's angle
    (d) critical angle

20. Across the interface of two dielectric media of permittivities ε_1 and ε_2, we may have
    (a) $E_{1n} = E_{2n}, \qquad B_{1n} = B_{2n}$

(b) $\varepsilon_1 E_{1n} = \varepsilon_2 E_{2t}, \quad H_{1t} = H_{2n}$

(c) $\varepsilon_1 E_{1t} = \varepsilon_2 E_{2t}, \quad H_{1n} = H_{2n}$

(d) $E_{1t} = E_{2t}, \quad H_{1t} = H_{2t}$

21. According to Wien's displacement law of black body radiation, ($\lambda_{max} =$ $peak\ wavelength,\ T = absolute\ temperature, a = proportionality\ constant$)

(a) $\lambda_{max} = \frac{a}{T}$

(b) $\lambda_{max} = \frac{a}{T^2}$

(c) $\lambda_{max} = aT$

(d) $\lambda_{max} = aT^2$

22. Identify the correct statement

(a) Rayleigh-Jeans law agrees with experimental results at short wavelength.

(b) Inconsistency in Rayleigh-Jeans law occur at large wavelength.

(c) Rayleigh-Jeans law agrees with experimental results at large wavelength but strongly disagrees at short wavelength.

(d) Planck's law is an approximation of Rayleigh-Jeans law.

23. If *r* be the fraction of the total energy reflected (called *reflectance*), *a* be the fraction absorbed (*absorptance*) and *t* be the fraction transmitted (*transmittance*), then we have the relation:

(a) $r + a + t = 1$

(b) $r + a = 1 + t$

(c) $r + a + t = 0$

(d) $r + t = a + 1$

24. In 1884, Stefan and Boltzmann showed that the energy of the radiation per unit volume due to all wavelengths in the spectrum is proportional to the

(a) absolute temperature

(b) square of the absolute temperature

(c) cube of the absolute temperature

(d) fourth power of the absolute temperature

25. According to Planck's idea, the energy changes take place
    (a) only discontinuously and discretely
    (b) continuously taking any value possible
    (c) only when the black body is heated
    (d) only when the black body radiates

B. Fill up the blanks

1. The concept of 'displacement current' was first introduced by _____.
2. Poynting's theorem expresses the laws of conservation of _____.
3. Light is a form of electromagnetic wave which is _____ in nature.
4. The intrinsic impedance of free space has a value nearly _____.
5. The refractive index of a dielectric medium (n) and the dielectric constant (K) are related by the relation _____.
6. Electromagnetic waves are generated by _____ charged particles.
7. When an electromagnetic wave is incident on the surface of a body and is absorbed , then a _____ is exerted on the surface of the body.
8. The 'skin depth' is defined as the distance in a conducting medium at which the amplitude of e.m. waves falls to _____ of its value at the surface.
9. The production and detection of e.m. waves was first experimentally done by _____.
10. The plane containing the normal to the interface at the point of incidence and the wave vector of the incident wave is called the _____.
11. The total internal reflection occurs for all incident angles greater than or equal to the _____.
12. When an unpolarized light is incident on the surface of a dielectric at the _____, the reflected light is plane polarized.
13. A black body not only completely absorbs all the radiation falling on it but conversely behaves as a _____ when heated.
14. Wein's formula agrees with the experimental curves of black body radiation for _____ region.
15. Planck assumed the presence of harmonic oscillators of molecular dimensions. The number of oscillators emitting particular energy is given by the _____ statistical distribution law.

Key Answers

A. Multiple choice questions

1. (a)	**2. (b)**	**3. (b)**	**4. (d)**	**5. (a)**	**6. (d)**	**7. (c)**
8. (a)	**9. (b)**	**10. (a)**	**11. (c)**	**12.(a)**	**13. (b)**	**14. (a)**
15. (a)	**16.(b)**	**17. (c)**	**18. (a)**	**19. (b)**	**20. (d)**	**21.(a)**
22. (c)	**23. (a)**	**24.(d)**	**25. (a)**			

B. Fill up the blanks

1. Maxwell
2. Energy
3. Transverse
4. 377 ohms
5. $n = \sqrt{K}$
6. Accelerated
7. Radiation pressure
8. 1/e
9. Hertz
10. Plane of incidence
11. Critical angle
12. Brewster's angle
13. perfect radiator
14. short wavelength
15. Maxwell-Boltzmann

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