

QB365 Question Bank Software Study Materials

Electromagnetic Waves Important 2 Marks Questions With Answers (Book Back and Creative)

12th Standard

Physics

Total Marks : 40

2 Marks

20 x 2 = 40

- 1) The relative magnetic permeability of the medium is 2.5 and the relative electrical permittivity of the medium is 2.25. Compute the refractive index of the medium.

Answer : Dielectric constant (relative permittivity of the medium) is $\epsilon_r = 2.25$

Magnetic permeability is $\mu_r = 2.5$

Refractive index of the medium,

$$n = \sqrt{\epsilon_r \mu_r} = \sqrt{2.25 \times 2.5} = 2.37$$

- 2) Compute the speed of the electromagnetic wave in a medium if the amplitude of electric and magnetic fields are $3 \times 10^4 \text{ N C}^{-1}$ and $2 \times 10^{-4} \text{ T}$, respectively.

Answer : The amplitude of the electric field, $E_0 = 3 \times 10^4 \text{ NC}^{-1}$

The amplitude of the magnetic field, $B_0 = 2 \times 10^{-4} \text{ T}$. Therefore, speed of the electromagnetic wave in a medium is

$$v = \frac{3 \times 10^4}{2 \times 10^{-4}} = 1.5 \times 10^8 \text{ ms}^{-1}.$$

- 3) What is displacement current?

Answer : The displacement current can be defined as the current which comes into play in the region in which the electric field or the electric flux is changing with time.

- 4) What are electromagnetic waves?

Answer : An electromagnetic waves are the waves that are radiated by an accelerated charge which propagates through space as coupled electric and magnetic fields, oscillating perpendicular to each other and to the direction of propagation of the wave.

- 5) Write down the integral form of modified Ampere's circuital law.

Answer : $\oint_l \vec{B} \cdot d\vec{l} = \mu_0 i_c + \mu_0 \epsilon_0 \frac{d}{dt} \oint_s \vec{E} \cdot d\vec{A}$

- 6) Consider a parallel plate capacitor whose plates are closely spaced. Let R be the radius of the plates and the current in the wire connected to the plates is 5 A, calculate the displacement current through the surface passing between the plates by directly calculating the rate of change of flux of electric field through the surface.

Answer : Area of the capacitor = A

Radius = R

Current in the wire connected to the plates $I = 5 \text{ A}$

The electric field, between the plates of a parallel plate capacitor,

$$E = \frac{\sigma}{\epsilon_0}$$

$$E = \frac{Q}{A\epsilon_0}$$

Q is the charge accumulated at the positive plate.

$$\text{The flux of this field, } \phi_E = \frac{Q}{A\epsilon_0} \times A = \frac{Q}{\epsilon_0}$$

$$\text{Displacement current } i_d = \epsilon_0 \frac{d\phi_E}{dt}$$

$$= \epsilon_0 \frac{d}{dt} \left(\frac{Q}{\epsilon_0} \right) = i_c$$

$$\therefore i_d = 5 \text{ A} \quad (\because \text{The current through the capacitor } i_c = 5 \text{ A})$$

Displacement current = 5 A

- 7) A transmitter consists of LC circuit with an inductance of $1 \mu\text{H}$ and a capacitance of $1 \mu\text{F}$. What is the wavelength of the electromagnetic waves it emits?

Answer : Inductance $L = 1 \mu\text{H} = 1 \times 10^{-6} \text{ H}$

Capacitance $C = 1\mu\text{F} = 1 \times 10^{-6} \text{ F}$

$$\therefore \text{Frequency } f = \frac{1}{2\pi\sqrt{LC}}$$

$$f = \frac{1}{2\pi\sqrt{1 \times 10^{-6} \times 1 \times 10^{-6}}}$$

$$\text{Frequency of electromagnetic wave, } f = \frac{1}{2\pi \times 10^{-6}} \text{ Hz}$$

$$\therefore \text{Wavelength of electromagnetic wave } (\lambda) = \frac{C}{f}$$

$$\lambda = 3 \times 10^8 \times 2\pi \times 10^{-6}$$

$$= 6.28 \times 10^{-6} \times 3 \times 10^8$$

Wavelength, $\lambda = 18.84 \times 10^2 \text{ m}$

- 8) Write notes on Gauss' law in magnetism.

Answer : i) The surface integral of magnetic field over a closed surface is zero. Mathematically, $\oint \vec{B} \cdot d\vec{A} = 0$ (Gauss's law for magnetism) where \vec{B} is the magnetic field.

ii) This equation implies that the magnetic lines of force form a continuous closed path. In other words, it means that no isolated magnetic monopole exists.

- 9) Write notes on Ampere-Maxwell law.

Answer : (i) Ampere- Maxwell law relates the magnetic field around any closed path to the conduction current and displacement current through that path.

$$\oint_i \vec{B} \cdot d\vec{l} = \mu_0 i = \mu_0 (i_c + i_d)$$

(ii) $\oint_i \vec{B} \cdot d\vec{l} = \mu_0 i_C + \mu_0 \epsilon_0 \frac{d\Phi_E}{dt}$ where \vec{B} is the magnetic field.

(iii) This equation shows that both conduction current and displacement current produce magnetic field.

- 10) Why are e.m. waves non-mechanical?

Answer : Electromagnetic waves are produced by the accelerated charges not by the mechanical vibrations of particles. It travels with speed equals to the speed of light in vacuum.

- 11) Explain the concept of intensity of electromagnetic waves.

Answer : The energy crossing per unit area per unit time and perpendicular to the direction of propagation of the electromagnetic wave is called the intensity.

$$\text{Intensity, } I = [u] \text{ c or } I = \frac{\text{total electromagnetic energy}(U)}{\text{Surface area}(A) \times \text{time}(t)}$$

$$= \frac{\text{Power}(P)}{\text{Surfacearea}(A)}$$

- 12) Write the uses of Micro waves.

Answer : It is used in radar systems for aircraft navigation, speed of the vehicle, microwave oven for cooking, and very long-distance wireless communication through satellites.

- 13) Why are Infrared radiation referred to as heatwaves? Name the radiations, which are next to these radiation having

(i) shorter λ

(ii) longer λ .

Answer : Infrared radiation waves are produced by hot bodies and molecules so it is referred as heat waves. (eg. Sun)

(i) Electromagnetic waves having shorter λ than Infrared radiation are visible, U - v, X-rays, and γ - rays.

(ii) Electromagnetic waves having longer λ than Infrared radiation are microwaves, radiowaves.

- 14) Which part of the Electromagnetic spectrum is used in operating a RADAR and why?

Answer : Microwaves are used. They are considered suitable for radar systems for aircraft navigation due to their short wavelength or high frequency. Its wavelength range $1 \times 10^{-3} \text{ m}$ to $3 \times 10^{-1} \text{ m}$ and frequency range is $3 \times 10^{11} \text{ Hz}$ to $1 \times 10^9 \text{ Hz}$.

- 15) Which part of Electromagnetic is absorbed from sunlight by ozone layer?

(i) Write its source and

(ii) mention its uses.

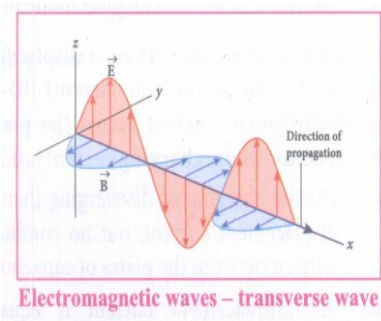
Answer : UV light is absorbed by the ozone layer

(i) Source: Sun, arc and ionized gases.

(ii) Uses: To destroy bacteria, sterilizing the surgical instruments, burglar alarm etc

- 16) Draw a diagram depicting oscillating electric and magnetic field of an electromagnetic wave.

Answer :



17) What is the origin of displacement current?

Answer : Displacement current does not arise due to motion of charge carriers but it arises due to time variation of electric flux.

18) How are electromagnetic waves classified?

Answer : Electromagnetic waves are classified into (i) Emission spectra and (ii) Absorption spectra

19) What is an emission spectrum?

Answer : When light emitted by a source is directly examined with a spectrometer, the emission spectrum is obtained.

20) What is meant by absorption spectrum?

Answer : When light emitted by a source is made to pass through an absorbing material and then examined with a spectrometer, an absorption spectrum is obtained.