



PHYSICS CLASS XII

CHAPTER – 8 ELECTROMAGNETIC WAVES

Q.1. What are the directions of electric and magnetic field vectors relative to each other and relative to the direction of propagation of electromagnetic waves?

Ans. Direction of electric field E , directions of magnetic field B and direction of propagation of wave are mutually perpendicular to one another.

Q.2. Name the electromagnetic waves which

(i) maintain the earth's warmth and

(ii) are used in aircraft navigation.

Ans. (i) Infrared rays maintain the earth's warmth.

(ii) Microwaves are used in aircraft navigation due to their short wavelength.

Q.3. Name the part of electromagnetic spectrum of wavelength 10^{-2} m and mention its one application.

Ans. Microwave.

Application Use in RADAR for aircraft navigation.

Q.4. Write the following radiations in ascending order in respect of their frequencies X-rays, Microwaves, UV rays and Radiowaves.

Ans. Radiowaves < Microwaves < UV rays < X-rays.

Q.5. Name the part of electromagnetic spectrum which is suitable for



(i) RADAR system

(ii) treatment of cancer and tumour.

Ans. (i) RADAR system Microwaves.

(ii) Treatment of cancer and tumour γ – rays

Q.6. Which part of electromagnetic spectrum is absorbed from sunlight by ozone layer?

Ans. UV (Ultraviolet) rays.

Q.7. Which of the following has the shortest wavelength. Microwaves, ultraviolet rays or X-rays?

Ans. X-rays.

Q.8. How are radiowaves produced?

Ans. Radiowaves produce due to oscillating charge particles.

Q.9. How are X-rays produced?

Ans. When electron strike a metal target. The electrons are emitted from heated filament and accelerated from the high voltage towards the metal target X-rays are produced when electron collide with atom and nuclei of metal target.

Q.10. How are microwave produced?

Ans. These waves are produced by special type vacuum tube such as klystrons, magnetrons and gun diodes.

Q.11. Name the physical quantity which remains same for microwave of wavelength 1mm and UV radiations of 1600 A in vacuum.



Ans. Speed remains same.

Q.12. Can a static charge particle produce EM wave?

Ans. No, only accelerated charged particle can produce EM wave.

Q.13. The current in a circuit containing a capacitor is 0.15 A. What is the displacement current and where does it exist?

Ans. We know that conventional current (I_C) is equal to displacement current (I_D).

$$\therefore I_C = I_D = 0.15 \text{ A}$$

It exists across the capacitor plate.

Q.14. Why is short wave band used for long distance radio broadcast?

Ans. Short waves are used in long distance broadcast because they are reflected by the ionosphere back to the surface of the earth. This way long distance can be reached.

Q.15. What physical quantity is the same for X-rays of wavelength 10^{-10} m, red light of wavelength 6800 Å and radiowaves of wavelength 500m?

Ans. Speed remains same but wavelength changes.

Q.16. A charged particle oscillates about its mean position with frequency 10^9 Hz. What is the frequency of EM wave produced by the oscillators?

Ans. 10^9 Hz.

The frequency of EM wave produced by the oscillator is same as that of oscillating charged particle about its equilibrium position.



Q.17. The amplitude of the magnetic field part of a harmonic electromagnetic wave in vacuum is $B_0 = 510$ nT. What is the amplitude of the electric field part of the wave?

Ans. Given, amplitude of the magnetic field part of harmonic electromagnetic wave is

$$B_0 = 510 \text{ nT} = 510 \times 10^{-9} \text{ T}$$

Speed of light in vacuum, $c = \frac{E_0}{B_0}$

where E_0 is the amplitude of electric part of the wave.

$$3 \times 10^8 = \frac{E_0}{510 \times 10^{-9}}$$

or $E_0 = 153 \text{ N/C}$

Thus, the amplitude of the electric field part of wave is 153 N/C.

Q.18. What is the frequency of electromagnetic waves produced by oscillating charge of frequency 10^4 to 10^8 Hz.

Ans. Radiowaves = 10^4 Hz to 10^8 Hz.

Q.19. Arrange the following in descending order of wavelength X-rays, radiowave, blue light, infrared light.

Ans. Radiowave > Infrared > Blue light > X – ray is descending order of wavelength.

Q.20. Which part of electromagnetic spectrum has largest penetrating power?

Ans. γ -rays have highest frequency range and hence highest penetrating power.



Q.21. In what way are the directions of the electric and magnetic field vectors representing an electromagnetic wave related to each other?

Ans. The direction of propagation of electromagnetic waves is along the direction of $E \times B$, where E and B are electric and magnetic fields.

Q.22. Name the electromagnetic waves used for studying crystal structure of solids. What is its frequency range?

Ans. X-rays are used to study the crystal structure of solids. Frequency range of X-rays is 10^{18} Hz to 10^{20} Hz.

Q.23. Name the electromagnetic radiation to which waves of wavelength in the range of 10^{-2} m belong. Give one use of this part of electromagnetic spectrum.

Ans. Microwaves have their wavelength in the range of 10^{-2} m, so they are used in RADAR communication.

Q.24. Name the electromagnetic radiation which can be produced by a klystron or a magnetron valve.

Ans. Electromagnetic wave produced by klystron or a magnetron valve is microwave.

Q.25. Why is small ozone layer on top of the stratosphere crucial for human survival?

Ans. Because ozone layer on top of stratosphere traps most of ultraviolet rays coming from the sun and prevents harmful impact of ultraviolet rays.



Q.26. State the reason why microwaves are best suited for long distance transmission of signals.

Ans. Microwave can travel as a beam in a signal because of their shorter wavelength and hence best suited for long distance transmission of signals.

Q.27. Why is the orientation of the portable radio with respect to broadcasting station important?

Ans. The orientation of the portable radio with respect to broadcasting station is important because the electromagnetic waves are plane polarized, so the receiving antenna should be parallel to the electric or magnetic vector part of the wave.

Q.28. Why does microwave oven heats up a food item containing water molecules most efficiently?

Ans. Microwave oven heats up the food items containing water molecules most efficiently because the frequency of microwaves matches the resonant frequency of water molecules.

Q.29. Explain briefly how electromagnetic waves are produced by an oscillating charge? How is the frequency of the electromagnetic waves produced related to that of the oscillating charge?

Ans. An oscillating charge is considered as the accelerating charge. This produces an oscillating electric field in space, which produces an oscillating magnetic field, that in turn again produces oscillating electric field and so on. These oscillating



electric and magnetic field thus keeps on regenerating each other as the wave propagates through the space. The frequency of the electromagnetic waves naturally equals the frequency of oscillation of the charge.

Q.30. Name the electricmagnetic radiation having the wavelength range from 1nm to 700 nm. Give its two important applications.

Ans. Infrared waves have the wavelength between 1 nm to 700 nm.

Uses

- (i) In remote control of TV, VCR, etc.
- (ii) Used in photography in thin mist.

Q.31. Identify the following electromagnetic radiations as per the frequencies given below. Write one application of each.

(i) 10^{20} Hz

(ii) 10^{12} Hz

(iii) 10^{11} Hz

Ans. (i) Gamma rays As food preservation.

(ii) Infrared wave in physical therapy.

(iii) Microwave In RADAR communication.

Q.32. Name the constituent radiation of electromagnetic spectrum which is used for

(i) aircraft navigation



(ii) studying crystal structure

Write the frequency range for each.

Ans. (i) Microwaves are used for aircraft navigation, their frequency range is 10^9 - 10^{12} Hz.

(ii) X-rays are used to study crystal structure, their frequency range is 10^{18} - 10^{20} Hz.

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