

Topic :- Electromagnetic Waves

1

(b)

Let $E =$ Energy falling on the surface per second $= 10 \text{ J}$

Momentum Of photons

$$p = \frac{h}{\lambda} = \frac{h}{(c_1 v)}$$
$$= \frac{hv}{c} = \frac{E}{c}$$

On reflection,

Change in momentum per second $= 2p = \frac{2E}{c}$

We know that,

Change in momentum per second $=$ force

$$F = \frac{2E}{c} = \frac{2 \times 10}{3 \times 10^8}$$
$$= 6.7 \times 10^{-8} \text{ N}$$

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(b)

$$v_{\text{ferrite}} = \frac{c}{\sqrt{\mu_r \epsilon_r}} = \frac{3 \times 10^8}{\sqrt{10 \times 10^{33}}} = 3 \times 10^6 \text{ ms}^{-1}$$

$$\lambda_{\text{ferrite}} = \frac{v_{\text{ferrite}}}{\nu} = \frac{3 \times 10^6}{90 \times 10^6} = 3.33 \times 10^{-2} \text{ m}$$

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(a)

The electromagnetic theory of light failed to explain photoelectric effect.

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(d)

Electromagnetic Waves are not deflected in electric and magnetic fields.

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(b)

The wavelength of X-rays is of the order of 1 \AA to 100 \AA . The wavelength of radiowaves is of the order of 10^9 \AA to $10^{1.4} \text{ \AA}$. The wavelength of microwaves is of the order of 10^7 \AA to 10^9 \AA .

Thus, $\lambda_X < \lambda_M < \lambda_R$

The waves with less wave length will have more energy.

Hence,

$$E_X > E_M > E_R$$

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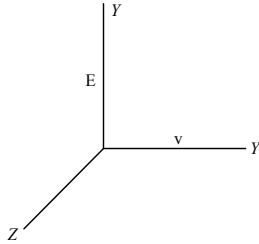
(a)

The frequency of Electromagnetic Wave along y – direction

$$\nu = 30 \text{ MHz}$$

The electric field component of the wave along y -direction.

$$E = 6 \text{ Vm}^{-1}$$



In Electromagnetic, the ratio of the amplitudes of electric and magnetic field is always constant and it is equal to velocity of the Electromagnetic Waves.

$$\text{ie, } \frac{E}{B} = c$$

$$\text{or } B = \frac{E}{c} = \frac{6}{3 \times 10^8}$$

$$\text{or } B = 2 \times 10^{-8} \text{ T}$$

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(b)

Ozone layer blocks the high energy radiations like UV ($3 \times 10^{-7} \text{ m}$)

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(c)

The relation between electric field vector \mathbf{E} , the displacement vector \mathbf{D} and the polarization vector \mathbf{P} for a dielectric placed in electric field \mathbf{E} is given by $\mathbf{D} = \epsilon_0 \mathbf{E} + \mathbf{P}$.

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(d)

Given refractive index

$$n = 1.5$$

Permeability $\mu_0 = 5 \times 10^{-7}$

$$n = \sqrt{\mu_r \epsilon_r}$$

$$\epsilon_r = \frac{n^2}{\mu_r}$$

$$\text{or } \rho = \frac{n^2 \mu_0}{\mu} \quad \left(\because \mu_r = \frac{\mu}{\mu_0} \right)$$

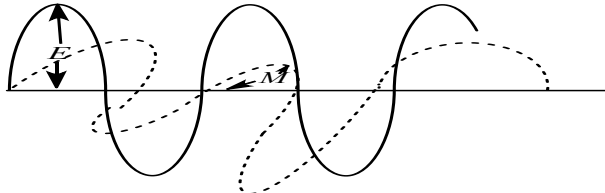
$$\text{or } \epsilon_r = \frac{(1.5)^2 \times 4\pi \times 10^{-7}}{5 \times 10^{-7}}$$

$$\text{or } \epsilon_r = 6$$

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(c)

The given wave in an Electromagnetic Waves. Electromagnetic radiation is a self propagating wave in space with electric and magnetic components. These components oscillate at right angles to each other and to the direction of propagation.



Electromagnetic wave

Hence, \mathbf{B} is along the z-axis at that time.

18. **(a)**
 Earth is heated by sun's infrared radiation. The earth also emits radiation most in infrared region. These radiations are reflected back due to heavy gases like CO_2 by atmosphere. These back radiation keep the earth's surface warm at night. This phenomenon is called green house effect. When the atmosphere were absent then temperature of earth falls
19. **(b)**
 The electromagnetic wave contains sinusoidally time varying electric and magnetic fields which act perpendicularly to each other as well as at right angle (90°) to the direction of propagation of waves, so it is quite clear that electromagnetic waves are transverse in nature. The field may be represented as
- $$E = E_0 \sin \omega \left(t - \frac{x}{v} \right)$$
- $$B = B_0 \sin \omega \left(t - \frac{x}{v} \right)$$
20. **(b)**
 The earth's atmosphere is transparent to visible light and radio waves, but absorbs X-rays. Thus, X-rays telescope cannot be used on surface of earth

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	B	B	A	C	C	D	A	B	A	B
Q.	11	12	13	14	15	16	17	18	19	20
A.	C	D	A	C	D	A	C	A	B	B

PE