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21 Electromagnetic Waves

1. Infrared radiation is detected by
(a) spectrometer (b) pyrometer
(c) nanometer (d) photometer.
(2002)

2. Electromagnetic waves are transverse in nature is evident by
(a) polarization (b) interference
(c) reflection (d) diffraction.
(2002)

3. Which of the following are not electromagnetic waves?
(a) cosmic rays (b) gamma rays
(c) β-rays (d) X-rays.
(2002)

4. Consider telecommunication through optical fibres. Which of the following statements is not true?
(a) Optical fibres can be of graded refractive index.
(b) Optical fibres are subject to electromagnetic interference from outside.
(c) Optical fibres have extremely low transmission loss.
(d) Optical fibres may have homogeneous core with a suitable cladding.
(2003)

5. An electromagnetic wave of frequency $\upsilon = 3.0$ MHz passes from vacuum into a dielectric medium with permitivity $\varepsilon = 4.0$. Then
(a) wavelength is doubled and the frequency remains unchanged
(b) wavelength is doubled and frequency becomes half
(c) wavelength is halved and frequency remains unchanged
(d) wavelength and frequency both remain unchanged.
(2004)

6. The rms value of the electric field of the light coming from the sun is 720 N/C. The average total energy density of the electromagnetic wave is
(a) 3.3×10^{-3} J/m^3 (b) 4.58×10^{-6} J/m^3
(c) 6.37×10^{-9} J/m^3 (d) 81.35×10^{-12} J/m^3.
(2006)

Answer Key

1.	(b)	**2.**	(a)	**3.**	(c)	**4.**	(b)	**5.**	(c)	**6.**	(b)

EXPLANATIONS

1. **(b) :** Infrared radiation produces thermal effect and is detected by pyrometer.

2. **(a) :** Polarization proves the transverse nature of electromagnetic waves.

3. **(c) :** β-rays are not electromagnetic waves.

4. **(b) :** Optical fibres are subject to electromagnetic intereference from outside.

5. **(c) :** During propogation of a wave from one medium to another, frequency remains constant and wavelength changes

$$\mu = \sqrt{\frac{\varepsilon}{\varepsilon_0}} = \sqrt{4} = 2$$

Since $\mu \propto \frac{1}{\lambda}$

$\therefore$ Wavelength is halved

Hence option (c) holds good.

6. **(b) :** $u = \frac{1}{2}\varepsilon_0 E_{rms}^2 + \frac{1}{2\mu_0} B_{rms}^2$

$$= \frac{1}{2}\varepsilon_0 E_{rms}^2 + \frac{1}{2\mu_0}\left(\frac{E_{rms}^2}{c^2}\right)$$

$$= \frac{1}{2}\varepsilon_0 E_{rms}^2 + \frac{1}{2\mu_0} E_{rms}^2 \varepsilon_0 \mu_0$$

$$= \frac{1}{2}\varepsilon_0 E_{rms}^2 + \frac{1}{2}\varepsilon_0 E_{rms}^2 = \varepsilon_0 E_{rms}^2$$

$= (8.85 \times 10^{-12}) \times (720)^2$

$= 4.58 \times 10^{-6}\ \text{Jm}^{-3}$.