Electromagnetic Waves

Q.No.1:
The magnetic field in a travelling electromagnetic wave has a peak value of 20 nT. The peak value of electric field strength is:

JEE 2013

A. 3 V/m
B. 6 V/m
C. 9 V/m
D. 12 V/m

Q.No.2: Match **List-I** (electromagnetic wave type) with **List-II** (its association/application) and select the correct option from the choices given below.

List-I		**List-II**	
(a)	Infrared waves	(i)	To treat muscular strain
(b)	Radio waves	(ii)	For broadcasting
(c)	X-rays	(iii)	To detect fracture of bones
(d)	Ultraviolet rays	(iv)	Absorbed by the ozone layer of the atmosphere

A.

	(a)	**(b)**	**(c)**	**(d)**
(1)	(iii)	(ii)	(i)	(iv)

B.

	(a)	**(b)**	**(c)**	**(d)**
(2)	(i)	(ii)	(iii)	(iv)

C.

	(a)	**(b)**	**(c)**	**(d)**
(3)	(iv)	(iii)	(ii)	(i)

D.

	(a)	**(b)**	**(c)**	**(d)**
(4)	(i)	(ii)	(iv)	(iii)

Q.No.3: During the propagation of electromagnetic waves in a medium,
A. electric energy density is equal to the magnetic energy density
B. both electric and magnetic energy densities are zero

C. electric energy density is double of the magnetic energy density

D. electric energy density is half of the magnetic energy density

Q.No.4: A red LED emits light at 0.1 watt uniformly around it. The amplitude of the electric field of the light at a distance of 1 m from the LED is **JEE 2015**

A. 1.73 V/m

B. 2.45 V/m

C. 5.48 V/m

D. 7.75 V/m

Q.No.5: An EM wave from air enters a medium. The electric fields are $\overrightarrow{\mathrm{E}}_1 = \mathrm{E}_{01}\,\hat{x}\,\cos\,\left[2\pi\nu\,\left(\frac{\mathrm{z}}{\mathrm{c}} - \mathrm{t}\right)\right]$ in air and $\overrightarrow{\mathrm{E}}_2 = \mathrm{E}_{02}\,\hat{x}\,\cos\,\left[\mathrm{k}\,\left(2\,z - \mathrm{ct}\right)\right]$ in medium, where the wave number k and frequency *v* refer to their values in air. The medium is non-magnetic. If $\in \mathrm{r}_1\ \mathrm{and}\ \in \mathrm{r}_2$ refer to relative permittivities of air and medium respectively, which of the following options is **correct**? **JEE 2018**

A. $\frac{\in \mathrm{r}_1}{\in \mathrm{r}_2} = \frac{1}{4}$

B. $\frac{\in \mathrm{r}_1}{\in \mathrm{r}_2} = \frac{1}{2}$

C. $\frac{\in \mathrm{r}_1}{\in \mathrm{r}_2} = 4$

D. $\frac{\in \mathrm{r}_1}{\in \mathrm{r}_2} = 2$

Q.No.6: The energy associated with electric field is (U_E) and with magnetic field is (U_B) for an electromagnetic wave in free space. Then: **JEE 2019**

A. $\mathrm{U}_\mathrm{E} = \frac{\mathrm{U}_\mathrm{B}}{2}$

B. $U_E > U_B$

C. $U_E < U_B$

D. $U_E = U_B$

Q.No.7: If the magnetic field of a plane electromagnetic wave is given by (The speed of light = 3×10^8 m/s)

$B = 100 \times 10^{-6}\ \sin\ \left[2\pi \times 2 \times 10^{15}\ \left(t - \frac{x}{c}\right)\right]$

then the maximum electric field associated with it is: **JEE 2019**

A. 6×10^4 N/C

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B. 3×10^4 N/C

C. 4×10^4 N/C

D. 4.5×10^4 N/C

Q.No.8: The electric field of a plane polarized electromagnetic wave in free space at time $t = 0$ is given by an expression $\overrightarrow{\mathrm{E}}(x,\ y) = 10\hat{j}\cos[(6x + 8z)]$. The magnetic field $\overrightarrow{\mathrm{B}}(x, z, t)$ is given by: (c is the velocity of light) **JEE 2019**

A. $\frac{1}{c}\left(6\hat{k} + 8\hat{i}\right)\ \cos[(6x - 8z + 10ct)]$

B. $\frac{1}{c}\left(6\hat{k} - 8\hat{i}\right)\ \cos[(6x + 8z - 10ct)]$

C. $\frac{1}{c}\left(6\hat{k} + 8\hat{i}\right)\ \cos[(6x + 8z - 10ct)]$

D. $\frac{1}{c}\left(6\hat{k} - 8\hat{i}\right)\ \cos[(6x + 8z + 10ct)]$

Q.No.9: An electromagnetic wave of intensity 50 Wm^{-2} enters in a medium of refractive index 'n' without any loss. The ratio of the magnitudes of electric fields, and the ratio of the magnitudes of magnetic fields of the wave before and after entering into the medium are respectively, given by: **JEE 2019**

A. $\left(\frac{1}{\sqrt{n}},\ \frac{1}{\sqrt{n}}\right)$

B. $\left(\sqrt{n},\ \sqrt{n}\right)$

C. $\left(\sqrt{n},\ \frac{1}{\sqrt{n}}\right)$

D. $\left(\frac{1}{\sqrt{n}},\ \sqrt{n}\right)$

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Q.No.10: A 27 mW laser beam has a cross-sectional area of 10 mm^2. The magnitude of the maximum electric field in this electromagnetic wave is given by:

[Given permittivity of pace $\in_0 = 9 \times 10^{-12}$ SI units, Speed of light $c = 3 \times 10^8$ m/s] **JEE 2019**

A. 2 kV/m

B. 0.7 kV/m

C. 1 kV/m

D. 1.4 kV/m

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