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JEE MAIN ELECTROMAGNETIC WAVES — PROPERTIES OF EM WAVES (SPEED, TRANSVERSE NATURE, ENERGY, MOMENTUM, INTENSITY) — PYQS

Max. Marks: 80 **Questions:** 20

Section A (MCQ) — 17 questions

Q.1 A point light source emits E.M. waves in free space. A detector, placed at a distance of L m, measures the intensity as I_0. The detector is now shifted to another location on the same spherical surface ensuring the angle between original location and new location as 45°. The measured intensity at new location will be _____.

[JEE Main 2026 (Online) 6th April Morning Shift]

(1) $\frac{I_0}{4}$ (2) I_0 (3) $\frac{I_0}{\sqrt{2}}$ (4) $\frac{I_0}{2}$

Scan or tap for the full solution

Q.2 For an electromagnetic wave propagating through vacuum, $\vec{k}$, $\vec{E}$ and ω represent propagation vector, electric field and angular frequency, respectively. The magnetic field associated with this wave is represented by :

[JEE Main 2026 (Online) 6th April Evening Shift]

(1) $\frac{\vec{E}\times\vec{k}}{\omega}$ (2) $\frac{\vec{k}\times\vec{E}}{\omega}$

(3) $\omega(\vec{E}\times\vec{k})$ (4) $\omega(\vec{k}\times\vec{E})$

Scan or tap for the full solution

Q.3 Given below are two statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A): The electromagnetic wave exerts pressure on the surface on which they are allowed to fall.

Reason (R): There is no mass associated with the electromagnetic waves.

In the light of the above statements, choose the correct answer from the options given below :

[JEE Main 2026 (Online) 5th April Evening Shift]

(1) Both (A) and (R) are true and (R) is the correct explanation of (A)

(2) Both (A) and (R) are true but (R) is not the correct explanation of (A)

(3) (A) is true but (R) is false

(4) (A) is false but (R) is true

Scan or tap for the full solution

Q.4 A magnetic field vector in an electromagnetic wave is represented by $\vec{B}=B_0\sin\left(2\pi\nu t-\frac{2\pi x}{\lambda}\right)\hat{j}$. Its associated electric field vector is _____.

[JEE Main 2026 (Online) 4th April Evening Shift]

(1) $\vec{E}=-\nu\lambda B_0\sin\left(2\pi\nu t-\frac{2\pi x}{\lambda}\right)\hat{k}$

(2) $\vec{E}=-\nu\lambda B_0\sin\left(2\pi\nu t-\frac{2\pi x}{\lambda}\right)\hat{i}$

(3) $\vec{E}=\nu\lambda B_0\sin\left(2\pi\nu t-\frac{2\pi x}{\lambda}\right)\hat{k}$

(4) $\vec{E}=\nu\lambda B_0\sin\left(2\pi\nu t-\frac{2\pi x}{\lambda}\right)\hat{i}$

Scan or tap for the full solution

Q.5 An electromagnetic wave travelling in **x-direction** is described by field equation $E_y=300\sin\omega\left(t-\frac{x}{c}\right)$. If the electron is restricted to move in **y-direction** only with speed of 1.5×10^6 m/s then ratio of maximum electric and magnetic forces acting on the electron is _____.

[JEE Main 2026 (Online) 2nd April Morning Shift]

(1) 200 (2) 150 (3) 400 (4) 300

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Q.6 An electromagnetic wave travels in free space along the x-direction. At a particular point in space and time, $\vec{B}=2\times10^{-7}\hat{j}$ T is associated with this wave. The value of corresponding electric field $\vec{E}$ at this point is _____ V/m.

[JEE Main 2026 (Online) 2nd April Evening Shift]

(1) $60\hat{k}$ (2) $-60\hat{k}$ (3) $30\hat{k}$ (4) $-600\hat{k}$

Scan or tap for the full solution

Q.7 The electric field of an electromagnetic wave travelling through a medium is given by $\vec{E}(x, t) = 25\sin(2.0 \times 10^{15}t - 10^{7}x)\hat{n}$ then the refractive index of the medium is ____.
(All given measurements are in SI units)

[JEE Main 2026 (Online) 28th January Morning Shift]

(1) 2 (2) 1.2 (3) 1.5 (4) 1.7

Scan or tap for the full solution

Q.8 A plane electromagnetic wave is moving in free space with velocity $c = 3 \times 10^8$ m/s and its electric field is given as $\vec{E} = 54\sin(kz - \omega t)\hat{j}$ V/m, where $\hat{j}$ is the unit vector along y-axis. The magnetic field vector $\vec{B}$ of the wave is :

[JEE Main 2026 (Online) 28th January Evening Shift]

(1) $-1.8 \times 10^{-7}\sin(kz - \omega t)\hat{i}$ T

(2) $+1.8 \times 10^{-7}\sin(kz - \omega t)\hat{i}$ T

(3) $1.4 \times 10^{-7}\sin(kz - \omega t)\hat{k}$ T

(4) $1.4 \times 10^{-7}\sin(kz - \omega t)\hat{i}$ T

Scan or tap for the full solution

Q.9 A point source is kept at the center of a spherically enclosed detector. If the volume of the detector is increased by 8 times, the intensity will

[JEE Main 2026 (Online) 24th January Evening Shift]

(1) increase by 64 times (2) decrease by 4 times

(3) decrease by 8 times (4) increase by 8 times

Scan or tap for the full solution

Q.10 The ratio of speeds of electromagnetic waves in vacuum and a medium, having dielectric constant k = 3 and permeability of $\mu = 2\mu_0$, is (μ_0 = permeability of vacuum)

[JEE Main 2026 (Online) 23rd January Evening Shift]

(1) 6:1 (2) 3:2 (3) $\sqrt{6}:1$ (4) 36:1

Scan or tap for the full solution

Q.11 A laser beam has intensity of 4.0×10^{14} W/m^2. The amplitude of magnetic field associated with beam is _____ T.
(Take $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/Nm^2 and $c = 3 \times 10^8$ m/s)

[JEE Main 2026 (Online) 22nd January Evening Shift]

(1) 1.83 (2) 2.0 (3) 5.5 (4) 18.3

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Q.12 The electric field in a plane electromagnetic wave is given by :
$E_y = 69\sin[0.6 \times 10^3 x - 1.8 \times 10^{11}t]$ V/m.
The expression for magnetic field associated with this electromagnetic wave is _____ T.

[JEE Main 2026 (Online) 21st January Morning Shift]

(1) $B_z = 2.3 \times 10^{-7}\sin[0.6 \times 10^3 x - 1.8 \times 10^{11}t]$

(2) $B_z = 2.3 \times 10^{-7}\sin[0.6 \times 10^3 x + 1.8 \times 10^{11}t]$

(3) $B_y = 2.3 \times 10^{-7}\sin[0.6 \times 10^3 x - 1.8 \times 10^{11}t]$

(4) $B_y = 69\sin[0.6 \times 10^3 x + 1.8 \times 10^{11}t]$

Scan or tap for the full solution

Q.13 The unit of $\sqrt{\frac{2I}{\varepsilon_0 c}}$ is :
(I = intensity of an electromagnetic wave, c = speed of light) [JEE Main 2025 (Online) 7th April Evening Shift]

(1) Vm (2) NC^{-1} (3) NC (4) Nm

Scan or tap for the full solution

Q.14 The radiation pressure exerted by a 450 W light source on a perfectly reflecting surface placed 2 m away from it, is

[JEE Main 2025 (Online) 3rd April Morning Shift]

(1) 3×10^{-8} Pascals (2) 0

(3) 1.5×10^{-8} Pascals (4) 6×10^{-8} Pascals

Scan or tap for the full solution

Q.15 Given below are two statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.
Assertion (A): Electromagnetic waves carry energy but not momentum.
Reason (R): Mass of a photon is zero.

In the light of the above statements, choose the most appropriate answer from the options given below :

[JEE Main 2025 (Online) 29th January Morning Shift]

(1) Both (A) and (R) are true and (R) is the correct explanation of (A)

(2) Both (A) and (R) are true but (R) is not the correct explanation of (A)

(3) (A) is false but (R) is true

(4) (A) is true but (R) is false

Scan or tap for the full solution

Q.16 Due to presence of an em-wave whose electric component is given by $E = 100\sin(\omega t - kx)\ NC^{-1}$ a cylinder of length 200 cm holds certain amount of em-energy inside it. If another cylinder of same length but half diameter than previous one holds same amount of em-energy, the magnitude of the electric field of the corresponding em-wave should be modified as

[JEE Main 2025 (Online) 28th January Morning Shift]

(1) $50\sin(\omega t - kx)\ NC^{-1}$

(2) $400\sin(\omega t - kx)\ NC^{-1}$

(3) $200\sin(\omega t - kx)\ NC^{-1}$

(4) $25\sin(\omega t - kx)\ NC^{-1}$

Scan or tap for the full solution

Q.17 The magnetic field of an E.M. wave is given by $\vec{B} = \left(\frac{\sqrt{3}}{2}\hat{i} + \frac{1}{2}\hat{j}\right)30\sin\left[\omega\left(t - \frac{z}{c}\right)\right]$ (S.I. Units).

The corresponding electric field in S.I. units is:

[JEE Main 2025 (Online) 28th January Evening Shift]

(1) $\vec{E} = \left(\frac{1}{2}\hat{i} + \frac{\sqrt{3}}{2}\hat{j}\right)30c\sin\left[\omega\left(t + \frac{z}{c}\right)\right]$

(2) $\vec{E} = \left(\frac{1}{2}\hat{i} - \frac{\sqrt{3}}{2}\hat{j}\right)30c\sin\left[\omega\left(t - \frac{z}{c}\right)\right]$

(3) $\vec{E} = \left(\frac{\sqrt{3}}{2}\hat{i} - \frac{1}{2}\hat{j}\right)30c\sin\left[\omega\left(t + \frac{z}{c}\right)\right]$

(4) $\vec{E} = \left(\frac{3}{4}\hat{i} + \frac{1}{4}\hat{j}\right)30c\cos\left[\omega\left(t - \frac{z}{c}\right)\right]$

Scan or tap for the full solution

Section B (Numerical) — 3 questions

Q.18 The equation of the electric field of an electromagnetic wave propagating through free space is given by :

$E = \sqrt{377}\sin(6.27 \times 10^3 t - 2.09 \times 10^{-5} x)$ N/C

The average intensity of the electromagnetic wave is $\left(\frac{1}{\alpha}\right)$ W/m^2. The value of α is _____.

$\left(\text{Take } \sqrt{\frac{\mu_0}{\varepsilon_0}} = 377 \text{ in SI units}\right)$

[JEE Main 2026 (Online) 23rd January Morning Shift]

Scan or tap for the full solution

Q.19 The electric field of a plane electromagnetic wave, travelling in an unknown nonmagnetic medium is given by,

$E_y = 20\sin(3 \times 10^6 x - 4.5 \times 10^{14} t)$ V/m

(where x, t and other values have S.I. units). The dielectric constant of the medium is _____

(speed of light in free space is 3×10^8 m/s)

[JEE Main 2026 (Online) 22nd January Morning Shift]

Scan or tap for the full solution

Q.20 If an optical medium possesses a relative permeability of $\frac{10}{\pi}$ and relative permittivity of $\frac{1}{0.0885}$, then the velocity of light is greater in vacuum than that in this medium by _____ times.

($\mu_0 = 4\pi \times 10^{-7}$ H/m, $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m, $c = 3 \times 10^8$ m/s)

[JEE Main 2025 (Online) 4th April Evening Shift]

Scan or tap for the full solution

ANSWER KEY

Section A (MCQ) — 17 questions

Ques.	1	2	3	4	5	6	7	8	9	10	11
Ans.	**2**	**2**	**2**	**1**	**1**	**2**	**3**	**1**	**2**	**3**	**1**
Ques.	12	13	14	15	16	17					
Ans.	**1**	**2**	**4**	**3**	**3**	**2**					

Section B (Numerical) — 3 questions

Ques.	18	19	20								
Ans.	**2**	**4**	**6**								