Exercise - I (Conceptual Questions) Build Up Your Understanding

1. If $\vec{E}$ and $\vec{B}$ are the electric and magnetic field vectors of electromagnetic waves then the direction of propagation of electromagnetic wave is along the direction of –
(1) $\vec{E}$ (2) $\vec{B}$
(3) $\vec{E} \times \vec{B}$ (4) none of these
PEW001

2. The electromagnetic waves do not transport -
(1) energy (2) charge
(3) momentum (4) information
PEW002

3. The wave function (in S.I. units) for an electromagnetic wave is given as –
$\psi(x,t)=10^3 \sin\pi(3\times10^6 x-9\times10^{14}t)$
The speed of the wave is –
(1) 9×10^{14} m/s (2) 3×10^8 m/s
(3) 3×10^6 m/s (4) 3×10^7 m/s
PEW003

4. In the above problem, wavelength of the wave is –
(1) 666 nm (2) 666 Å
(3) 666 μm (4) 6.66 nm
PEW004

5. In an electromagnetic wave the average energy density is associated with –
(1) electric field only
(2) magnetic field only
(3) equally with electric and magnetic fields
(4) average energy density is zero
PEW005

6. In an electromagnetic wave the energy density associated with magnetic field will be
(1) $\frac{1}{2}LI^2$ (2) $\frac{B^2}{2\mu_0}$
(3) $\frac{1}{2}\mu_0 B^2$ (4) $\frac{1}{2}\frac{\mu_0}{B^2}$
PEW006

7. In the above problem, the energy density associated with the electric field will be –
(1) $\frac{1}{2}CV^2$ (2) $\frac{1}{2}\frac{q^2}{C}$
(3) $\frac{1}{2}\frac{\varepsilon^2}{E}$ (4) $\frac{1}{2}\varepsilon_0 E^2$
PEW007

8. If there were no atmosphere, the average temperature on earth surface would be –
(1) lower (2) higher
(3) same (4) 0° C
PEW008

9. In which part of earth's atmosphere is the ozone layer present?
(1) troposphere (2) stratosphere
(3) ionosphere (4) mesosphere
PEW009

10. The ozone layer is earth's atmosphere is crucial for human survival because it –
(1) contains ions
(2) reflects radio signals
(3) reflects ultraviolet rays
(4) reflects infrared rays
PEW010

11. The frequency from 3×10^9 Hz to 3×10^{10} Hz is –
(1) high frequency band
(2) super high frequency band
(3) ultra high frequency band
(4) very high frequency band
PEW011

12. The frequency from 3MHz to 30 MHz is known as –
(1) audio band
(2) medium frequency band
(3) very high frequency band
(4) high frequency band
PEW012

13. The AM range of radiowaves have frequency –
(1) less than 30 MHz
(2) more than 30 MHz
(3) less than 20000Hz
(4) more than 20000Hz
PEW013

14. Select wrong statement from the following for EMW-
(1) are transverse
(2) travel with same speed in all medium
(3) travel with the speed of light
(4) are produced by accelerating charge
PEW014

15. The waves related to tele-communication are -
(1) infrared (2) visible light
(3) microwaves (4) ultraviolet rays
PEW015

16. The nature of electromagnetic wave is –
(1) longitudinal
(2) longitudinal stationary
(3) transverse
(4) transverse stationary
PEW016

17. Greenhouse effect keeps the earth surface –
(1) cold at night (2) dusty and cold
(3) warm at night (4) moist
PEW017

18. The speed of electromagnetic radiation in vacuum is :-
(1) $\mu_0\varepsilon_0$ (2) $\sqrt{\mu_0\varepsilon_0}$
(3) $\frac{1}{\mu_0\varepsilon_0}$ (4) $\frac{1}{\sqrt{\mu_0\varepsilon_0}}$
PEW018

19. What is the cause of greenhouse effect?
(1) Infrared rays (2) Ultraviolet rays
(3) X-rays (4) Radio waves
PEW019

20. The conduction current is the same as displacement current when source is :-
(1) ac only (2) dc only
(3) both ac and dc (4) neither dc nor ac
PEW020

EXERCISE-I (Conceptual Questions) ANSWER KEY

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	3	2	2	1	3	2	4	1	2	3	2	4	1	2	3
Question	16	17	18	19	20										
Answer	3	3	4	1	3										

Exercise - II (Previous Year Questions) AIPMT/NEET

Re-AIPMT 2015

1. The energy of the em waves is of the order of 15 keV. To which part of the spectrum does it belong?

(1) γ-rays (2) X-rays

(3) Infra-red rays (4) Ultraviolet rays

PEW028

AIPMT 2015

2. A radiation of energy 'E' falls normally on a perfectly reflecting surface. The momentum transferred to the surface is

(c = Speed of light) :-

(1) $\frac{2E}{c}$ (2) $\frac{2E}{c^2}$ (3) $\frac{E}{c^2}$ (4) $\frac{E}{c}$

PEW029

NEET-I 2016

3. Out of the following options which one can be used to produce a propagating electromagnetic wave?

(1) A charge moving at constant velocity

(2) A stationary charge

(3) A chargeless particle

(4) An accelerating charge

PEW030

4. A 100 Ω resistance and a capacitor of 100 Ω reactance are connected in series across a 220 V source. When the capacitor is 50% charged, the peak value of the displacement current is :-

(1) 4.4 A (2) $11\sqrt{2}$ A

(3) 2.2 A (4) 11 A

PEW031

NEET (UG) 2017

5. In an electromagnetic wave in free space the root mean square value of the electric field is E_{rms} = 6V/m. The peak value of the magnetic field is :-

(1) 2.83×10^{-8} T (2) 0.70×10^{-8} T

(3) 4.23×10^{-8} T (4) 1.41×10^{-8} T

PEW032

NEET (UG) 2018

6. An em wave is propagating in a medium with a velocity $\vec{V} = V\hat{i}$. The instantaneous oscillating electric field of this em wave is along +y axis. Then the direction of oscillating magnetic field of the em wave will be along :-

(1) –z direction (2) +z direction

(3) –y direction (4) –x direction

PEW033

NEET (UG) 2019 (Odisha)

7. For a transparent medium relative permeability and permittivity, μ_r and $\in_r$ are 1.0 and 1.44 respectively. The velocity of light in this medium would be,

(1) 2.5×10^8 m/s (2) 3×10^8 m/s

(3) 2.08×10^8 m/s (4) 4.32×10^8 m/s

PEW034

NEET (UG) 2020

8. Light with an average flux of 20 W/cm² falls on a non-reflecting surface at normal incidence having surface area 20 cm². The energy received by the surface during time span of 1 minute is :

(1) 48×10^3 J (2) 10×10^3 J

(3) 12×10^3 J (4) 24×10^3 J

PEW035

9. The ratio of contributions made by the electric field and magnetic field components to the intensity of an electromagnetic wave is :

(c = speed of electromagnetic waves)

(1) $1 : c^2$ (2) $c : 1$

(3) 1 : 1 (4) 1 : c

PEW036

NEET (UG) 2020 (COVID-19)

10. The E.M. wave with shortest wavelength among the following is

(1) Ultraviolet rays (2) X-rays

(3) Gamma-rays (4) Microwaves

PEW037

11. The magnetic field in a plane electromagnetic wave is given by :

$B_y = 2 \times 10^{-7} \sin(\pi \times 10^3 x + 3\pi \times 10^{11} t)T$

Calculate the wavelength.

(1) $\pi \times 10^3$ m (2) 2×10^{-3} m

(3) 2×10^3 m (4) $\pi \times 10^{-3}$ m

PEW038

NEET (UG) 2021

12. A capacitor of capacitance 'C', is connected across an ac source of voltage V, given by $V = V_0 \sin \omega t$. The displacement current between the plates of the capacitor, would then be given by :

(1) $I_d = V_0 \omega C \cos \omega t$ (2) $I_d = \frac{V_0}{\omega C} \cos \omega t$

(3) $I_d = \frac{V_0}{\omega C} \sin \omega t$ (4) $I_d = V_0 \omega C \sin \omega t$

PEW039

13. For a plane electromagnetic wave propagating in x-direction, which one of the following combinations gives the correct possible directions for electric field (E) and magnetic field (B) respectively?

(1) $\hat{j}+\hat{k}, \hat{j}+\hat{k}$ (2) $-\hat{j}+\hat{k}, -\hat{j}-\hat{k}$

(3) $\hat{j}+\hat{k}, -\hat{j}-\hat{k}$ (4) $-\hat{j}+\hat{k}, -\hat{j}+\hat{k}$

PEW040

NEET (UG) 2022

14. When light propagates through a material medium of relative permittivity ε_r and relative permeability μ_r, the velocity of light, v is given by : (c = velocity of light in vacuum)

(1) $v = \sqrt{\frac{\mu_r}{\varepsilon_r}}$ (2) $v = \sqrt{\frac{\varepsilon_r}{\mu_r}}$

(3) $v = \frac{c}{\sqrt{\varepsilon_r \mu_r}}$ (4) $v = c$

PEW041

15. Match List - I with List -II

List -I (Electromagnetic waves)		List-II (Wavelength)	
(a)	AM radio waves	(i)	10^{-10} m
(b)	Microwaves	(ii)	10^2 m
(c)	Infrared radiations	(iii)	10^{-2} m
(d)	X-rays	(iv)	10^{-4} m

Choose the correct answer from the options given below :

(1) (a) - (iii), (b) - (ii), (c) - (i), (d) - (iv)

(2) (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)

(3) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

(4) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

PEW042

RE-NEET (UG) 2022

16. The magnetic field of a plane electromagnetic wave is given by

$\vec{B} = 3\times10^{-8} \cos(1.6\times10^3 x + 48\times10^{10} t)\hat{j}$, then the associated electric field will be :

(1) $3\times10^{-8} \cos(1.6\times10^3 x + 48\times10^{10} t)\hat{i}\, V/m$

(2) $3\times10^{-8} \sin(1.6\times10^3 x + 48\times10^{10} t)\hat{i}\, V/m$

(3) $9\sin(1.6\times10^3 x - 48\times10^{10} t)\hat{k}\, V/m$

(4) $9\cos(1.6\times10^3 x + 48\times10^{10} t)\hat{k}\, V/m$

PEW043

17. The ratio of the magnitude of the magnetic field and electric field intensity of a plane electromagnetic wave in free space of permeability μ_0 and permittivity ε_0 is

(c - velocity of light in free space)

(1) c (2) $\frac{1}{c}$

(3) $\frac{c}{\sqrt{\mu_0 \varepsilon_0}}$ (4) $\frac{\sqrt{\mu_0 \varepsilon_0}}{c}$

PEW044

NEET (UG) 2023

18. In a plane electromagnetic wave travelling in free space, the electric field component oscillates sinusoidally at a frequency of 2.0×10^{10} Hz and amplitude 48 Vm^{-1}. Then the amplitude of oscillating magnetic field is : (Speed of light in free space = 3×10^8 m s^{-1})

(1) 1.6×10^{-8} T (2) 1.6×10^{-7} T

(3) 1.6×10^{-6} T (4) 1.6×10^{-9} T

PEW049

RE-NEET (UG) 2023

19. $\in_0$ and μ_0 are the electric permittivity and magnetic permeability of free space respectively. If the corresponding quantities of a medium are $2\in_0$ and $1.5\mu_0$ respectively, the refractive index of the medium will nearly be :

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

PEW050

20. To produce an instantaneous displacement current of 2 mA in the space between the parallel plates of a capacitor of capacitance 4 μF, the rate of change of applied variable potential difference $\left(\frac{dV}{dt}\right)$ must be :

(1) 800 V/s (2) 500 V/s
(3) 200 V/s (4) 400 V/s

PEW051

NEET (UG) 2024

21. A parallel plate capacitor is charged by connecting it to a battery through a resistor. If I is the current in the circuit, then in the gap between the plates :

(1) there is no current.
(2) displacement current of magnitude equal to I flows in the same direction as I.
(3) displacement current of magnitude equal to I flows in a direction opposite to that of I.
(4) displacement current of magnitude greater than I flows but can be in any direction.

PEW052

22. The property which is not of an electromagnetic wave travelling in free space is that :

(1) they are transverse in nature.
(2) the energy density in electric field is equal to energy density in magnetic field.
(3) they travel with a speed equal to $\frac{1}{\sqrt{\mu_0 \in_0}}$
(4) they originate from charges moving with uniform speed.

PEW053

RE-NEET (UG) 2024

23. The electromagnetic radiation which has the smallest wavelength are :

(1) X-rays
(2) Gamma rays
(3) Ultraviolet rays
(4) Microwaves

PEW054

24. If the ratio of relative permeability and relative permittivity of a uniform medium is 1 : 4. The ratio of the magnitudes of electric field intensity (E) to the magnetic field intensity (H) of an EM wave propagating in that medium is

$\left(\text{Given that } \sqrt{\frac{\mu_0}{\varepsilon_0}} = 120\pi\right)$:

(1) $30\pi : 1$ (2) $1 : 120\pi$
(3) $60\pi : 1$ (4) $120\pi : 1$

PEW055

EXERCISE-II (Previous Year Questions) ANSWER KEY

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	2	1	4	3	1	2	1	4	3	3	2	1	2	3	3
Question	16	17	18	19	20	21	22	23	24						
Answer	4	2	2	2	2	2	4	2	3						

Exercise – III (Analytical Questions) Master Your Understanding

1. For EM waves

(a) γ rays have higher penetrating power than x rays

(b) x rays have higher penetrating power than γ rays

(c) Infrared has higher wavelength than x-rays

(d) Range of visible light is 4000 Å to 7000 Å

then correct options are

(1) a, b and d (2) a, c and d

(3) a and c (4) a, b and d

PEW045

2. Electric field associated with EM wave in free space is given by $\vec{E}=30\sin\left(6\times10^8 t+kz\right)\hat{i}$ then match the following columns.

	Column-I		Column-II
(a)	Direction of propagation of EM wave	(p)	–y axis
(b)	Wave length of EM wave	(q)	2 m^{-1}
(c)	Direction of magnetic field of EM wave	(r)	3.14 m
(d)	Propagation constant 'k' of EM wave	(s)	'–z' axis

(1) a-p, b-r, c-s, d-r (2) a-s, b-r, c-p, d-q

(3) a-p, b-q, c-s, d-s (4) a-s, b-r, c-p, d-p

PEW046

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

Assertion (A) : MRI is less harmful medical diagnosis technique than CT-scan

Reason (R) : X-rays are used in CT-scan, while MRI uses radio waves.

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

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

(2) Both **(A)** and **(R)** are true and **(R)** is NOT the correct explanation of **(A)**.

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

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

PEW047

4. **Match the column I with column II -**

	Column-I (Law)		Column-II (Mathematical formula)
(A)	Faraday law	(P)	$\oint\vec{E}.d\vec{A}=\frac{q}{\epsilon_0}$
(B)	Ampere Maxwell law	(Q)	$\oint\vec{B}.d\vec{A}=0$
(C)	Gauss law for magnetism	(R)	$\oint\vec{E}.d\vec{\ell}=-\frac{d\phi_B}{dt}$
(D)	Gauss law for electrostatics	(S)	$\oint\vec{B}.d\vec{\ell}=\mu_0 i+\epsilon_0\mu_0\frac{d\phi_E}{dt}$

Options :-

(1) A → R, B → Q, C → S, D → P

(2) A → P, B → Q, C → S, D → R

(3) A → P, B → S, C → Q, D → R

(4) A → R, B → S, C → Q, D → P

PEW048

EXERCISE-III (Analytical Questions) ANSWER KEY

Question	1	2	3	4
Answer	2	2	1	4