Mastering Physics With Physics Guruji

DPP - Daily Practice Problems

Chapter-wise Sheets

Date : | Start Time : | End Time :

PHYSICS

CP22

SYLLABUS : Electromagnetic Waves

Max. Marks : 120 **Marking Scheme :** (+4) for correct & (–1) for incorrect answer **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 30 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. An electromagnetic wave in vacuum has the electric and magnetic field $\vec{E}$ and $\vec{B}$, which are always perpendicular to each other. The direction of polarization is given by $\vec{X}$ and that of wave propagation by $\vec{k}$. Then

(a) $\vec{X} \| \vec{B}$ and $\vec{k} \| \vec{B} \times \vec{E}$ (b) $\vec{X} \| \vec{E}$ and $\vec{k} \| \vec{E} \times \vec{B}$

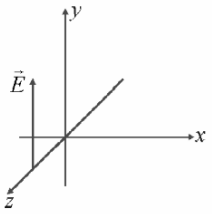
(c) $\vec{X} \| \vec{B}$ and $\vec{k} \| \vec{E} \times \vec{B}$ (d) $\vec{X} \| \vec{E}$ and $\vec{k} \| \vec{B} \times \vec{E}$

2. If E and B represent elctric and magnetic field vectors of the electromagnetic wave, the direction of propagation of electromagnetic wave is along

(a) $\vec{E}$ (b) $\vec{B}$

(c) $\vec{B} \times \vec{E}$ (d) $\vec{E} \times \vec{B}$

3. The figure here gives the electric field of an electromagnetic wave at a certain point and a certain instant. The wave is transporting energy in the negative z-direction. The direction of the magnetic field of the wave at that point and instant is



(a) + ve x-direction (b) –ve x-direction

(c) +ve z-direction (d) –ve y-direction

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ

Space for Rough Work

4. A plane electromagnetic wave is incident on a material surface. If the wave delivers momentum p and energy E, then

(a) $p = 0, E = 0$ (b) $p \neq 0, E \neq 0$

(c) $p \neq 0, E = 0$ (d) $p = 0, E \neq 0$

5. Intensity of electromagnetic wave will be

(a) $I = c\mu_0 B_0^2 / 2$ (b) $I = c\varepsilon_0 B_0^2 / 2$

(c) $I = B_0^2 / c\mu_0$ (d) $I = E_0^2 / 2c\varepsilon_0$

6. The electric field of an electromagnetic wave travelling through vaccum is given by the equation $E = E_0 \sin(kx - \omega t)$. The quantity that is independent of wavelength is

(a) $k\omega$ (b) $\frac{k}{\omega}$ (c) $k^2\omega$ (d) ω

7. When an electromagnetic waves enter the ionised layer of ionosphere, the motion of electron cloud produces a space current and the electric field has its own capacitative displacement current, then

(a) the space current is in phase of displacement current

(b) the space current lags behind the displacement current by a phase 180°.

(c) the space current lags behind the displacement current by a phase 90°.

(d) the space current leads the displacement current by a phase 90°.

8. 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) 4.58×10^{-6} J/m^3 (b) 6.37×10^{-9} J/m^3

(c) 81.35×10^{-12} J/m^3 (d) 3.3×10^{-3} J/m^3

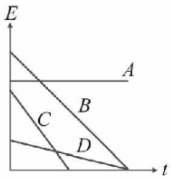
9. The figure shows graphs of the electric field magnitude E versus time t for four uniform electric fields, all contained within identical circular regions. Which of them is according to the magnitudes of the magnetic field?

(a) A

(b) B

(c) C

(d) D



10. The electric field part of an electromagnetic wave in a medium is represented by $E_x = 0$;

$$E_y = 2.5\frac{N}{C}\cos\left[\left(2\pi\times10^6\ \frac{rad}{m}\right)t - \left(\pi\times10^{-2}\ \frac{rad}{s}\right)x\right];$$

$E_z = 0$. The wave is :

(a) moving along x direction with frequency 10^6 Hz and wave length 100 m.

(b) moving along x direction with frequency 10^6 Hz and wave length 200 m.

(c) moving along – x direction with frequency 10^6 Hz and wave length 200 m.

(d) moving along y direction with frequency $2\pi \times 10^6$ Hz and wave length 200 m.

11. A lamp emits monochromatic green light uniformly in all directions. The lamp is 3% efficient in converting electrical power to electromagnetic waves and consumes 100 W of power. The amplitude of the electric field associated with the electromagnetic radiation at a distance of 5 m from the lamp will be nearly:

(a) 1.34 V/m (b) 2.68 V/m (c) 4.02 V/m (d) 5.36 V/m

12. During the propagation of electromagnetic waves in a medium:

(a) Electric energy density is double of the magnetic energy density.

(b) Electric energy density is half of the magnetic energy density.

(c) Electric energy density is equal to the magnetic energy density.

(d) Both electric and magnetic energy densities are zero.

RESPONSE GRID					
4. ⓐⓑⓒⓓ	**5.** ⓐⓑⓒⓓ	**6.** ⓐⓑⓒⓓ	**7.** ⓐⓑⓒⓓ	**8.** ⓐⓑⓒⓓ
9. ⓐⓑⓒⓓ	**10.** ⓐⓑⓒⓓ	**11.** ⓐⓑⓒⓓ	**12.** ⓐⓑⓒⓓ	

Space for Rough Work

13. A plane electromagnetic wave travels in free space along x-axis. At a particular point in space, the electric field along y-axis is 9.3 V m^{-1}. The magnetic induction (B) along z-axis is

(a) 3.1×10^{-8} T (b) 3×10^{-5} T

(c) 3×10^{-6} T (d) 9.3×10^{-6} T

14. The speed of electromagnetic wave in vacuum depends upon the source of radiation. It

(a) increases as we move from γ-rays to radio waves

(b) decreases as we move from γ-rays to radio waves

(c) is same for all of them

(d) None of these

15. The energy of electromagnetic wave in vacuum is given by the relation

(a) $\frac{E^2}{2\varepsilon_0}+\frac{B^2}{2\mu_0}$ (b) $\frac{1}{2}\varepsilon_0 E^2+\frac{1}{2}\mu_0 B^2$

(c) $\frac{E^2+B^2}{c}$ (d) $\frac{1}{2}\varepsilon_0 E^2+\frac{B^2}{2\mu_0}$

16. If microwaves, X rays, infrared, gamma rays, ultra-violet, radio waves and visible parts of the electromagnetic spectrum are denoted by M, X, I, G, U, R and V then which of the following is the arrangement in ascending order of wavelength ?

(a) R, M, I, V, U, X and G (b) M, R, V, X, U, G and I

(c) G, X, U, V, I, M and R (d) I, M, R, U, V, X and G

17. The ratio of amplitude of magnetic field to the amplitude of electric field for an electromagnetic wave propagating in vacuum is equal to :

(a) the speed of light in vacuum

(b) reciprocal of speed of light in vacuum

(c) the ratio of magnetic permeability to the electric susceptibility of vacuum

(d) unity

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

(a) A charge moving at constant velocity

(b) A stationary charge

(c) A chargeless particle

(d) An accelerating charge

19. The pressure exerted by an electromagnetic wave of intensity I (watts/m^2) on a nonreflecting surface is [c is the velocity of light]

(a) Ic (b) Ic^2 (c) I/c (d) I/c^2

20. Which of the following electromagnetic waves has minimum frequency ?

(a) Microwaves (b) Audible waves

(c) Ultrasonic wave (d) Radiowaves

21. In an electromagnetic wave

(a) power is transmitted along the magnetic field

(b) power is transmitted along the electric field

(c) power is equally transferred along the electric and magnetic fields

(d) power is transmitted in a direction perpendicular to both the fields

22. A point source of electromagnetic radiation has an average power output of 1500 W. The maximum value of electric field at a distance of 3m from this sources in Vm^{-1} is

(a) 500 (b) 100 (c) $\frac{500}{3}$ (d) $\frac{250}{3}$

23. All components of the electromagnetic spectrum in vacuum have the same

(a) energy (b) velocity

(c) wavelength (d) frequency

RESPONSE GRID					
	13. (a)(b)(c)(d)	**14.** (a)(b)(c)(d)	**15.** (a)(b)(c)(d)	**16.** (a)(b)(c)(d)	**17.** (a)(b)(c)(d)
	18. (a)(b)(c)(d)	**19.** (a)(b)(c)(d)	**20.** (a)(b)(c)(d)	**21.** (a)(b)(c)(d)	**22.** (a)(b)(c)(d)
	23. (a)(b)(c)(d)				

Space for Rough Work

24. Which of the following statement is false for the properties of electromagnetic waves?

(a) Both electric and magnetic field vectors attain the maxima and minima at the same place and same time.

(b) The energy in electromagnetic wave is divided equally between electric and magnetic vectors

(c) Both electric and magnetic field vectors are parallel to each other and perpendicular to the direction of propagation of wave

(d) These waves do not require any material medium for propagation.

25. A radiation of energy 'E' falls normally on a perfectly reflecting surface. The momentum transferred to the surface is (C = Velocity of light)

(a) $\frac{2E}{C}$ (b) $\frac{2E}{C^2}$ (c) $\frac{E}{C^2}$ (d) $\frac{E}{C}$

26. If v_s, v_x and v_m are the speed of soft gamma rays, X-rays and microwaves respectively in vacuum, then

(a) $v_s > v_x > v_m$ (b) $v_s < v_x < v_m$

(c) $v_s > v_x < v_m$ (d) $v_s = v_x = v_m$

27. An electromagnetic wave going through vacuum is described by $E = E_0\sin(kx - \omega t)$; $B = B_0 \sin(kx - \omega t)$. Which of the following equations is true

(a) $E_0k = B_0\omega$ (b) $E_0\omega = B_0k$

(c) $E_0B_0 = \omega k$ (d) None of these

28. If c is the speed of electromagnetic waves in vacuum, its speed in a medium of dielectric constant K and relative permeability μ_r is

(a) $v = \frac{1}{\sqrt{\mu_r K}}$ (b) $v = c\sqrt{\mu_r K}$

(c) $v = \frac{c}{\sqrt{\mu_r K}}$ (d) $v = \frac{K}{\sqrt{\mu_r C}}$

29. A plane electromagnetic wave in a non-magnetic dielectric medium is given by $\vec{E} = \vec{E}_0(4\times10^{-7}x - 50t)$ with distance being in meter and time in seconds. The dielectric constant of the medium is :

(a) 2.4 (b) 5.8 (c) 8.2 (d) 4.8

30. Frequency of a wave is 6×10^{15} Hz. The wave is

(a) radiowave (b) microwave

(c) x-ray (d) None of these

RESPONSE GRID					
	24. ⓐⓑⓒⓓ	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ	28. ⓐⓑⓒⓓ
	29. ⓐⓑⓒⓓ	30. ⓐⓑⓒⓓ			

DAILY PRACTICE PROBLEM DPP CHAPTERWISE CP22 - PHYSICS			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	45	Qualifying Score	60
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work