NEET ANSWER KEY & SOLUTIONS

SUBJECT :- PHYSICS

CLASS :- 12th **PAPER CODE :- CWT-7**

CHAPTER :- ELECTRO MAGNETIC WAVES

ANSWER KEY

1.	(D)	**2.**	(B)	**3.**	(A)	**4.**	(B)	**5.**	(C)	**6.**	(A)	**7.**	(A)
8.	(B)	**9.**	(C)	**10.**	(A)	**11.**	(D)	**12.**	(C)	**13.**	(B)	**14.**	(A)
15.	(A)	**16.**	(D)	**17.**	(A)	**18.**	(B)	**19.**	(B)	**20.**	(C)	**21.**	(A)
22.	(B)	**23.**	(A)	**24.**	(C)	**25.**	(C)	**26.**	(A)	**27.**	(C)	**28.**	(C)
29.	(D)	**30.**	(D)	**31.**	(B)	**32.**	(B)	**33.**	(A)	**34.**	(D)	**35.**	(B)
36.	(C)	**37.**	(A)	**38.**	(C)	**39.**	(B)	**40.**	(A)	**41.**	(C)	**42.**	(D)
43.	(C)	**44.**	(C)	**45.**	(A)	**46.**	(B)	**47.**	(C)	**48.**	(C)	**49.**	(D)
50.	(B)												

SOLUTIONS

SECTION-A

1. (D)

Sol. $\mu_0 = 4\pi \times 10^{-7}, \varepsilon_0 = 8.85 \times 10^{-12} \frac{N\text{-}m^2}{C^2}$

so $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} = 3 \times 10^8 \frac{meter}{sec}$.

2. (B)

Sol. Infrared causes heating effect.

3. (A)

Sol. $\lambda_{\gamma-rays} < \lambda_{x-rays} < \lambda_{\alpha-rays} < \lambda_{\beta-rays}$.

4. (B)

Sol. Ozone layer absorbs most of the *UV* rays emitted by sun.

5. (C)

Sol. EM waves travels with perpendicular to *E* and *B*. Which are also perpendicular to each other $\vec{v} = \vec{E} \times \vec{B}$

6. (A)

Sol. In vacuum velocity of all EM waves are same but their wavelengths are different.

7. (A)

Sol. $\lambda = \frac{c}{\nu} = \frac{3 \times 10^8}{8.2 \times 10^6} = 36.5\ m$

8. (B)

Sol. $c = \frac{E}{B} \Rightarrow B = \frac{E}{c} = \frac{18}{3 \times 10^8} = 6 \times 10^{-8} T$.

9. (C)

Sol. According to the Maxwell's EM theory, the EM waves propagation contains electric and magnetic field vibration in mutually perpendicular direction. Thus the changing of electric field give rise to magnetic field.

10. (A)

Sol. Here $E_0 = 100\ V/m,\ B_0 = 0.265\ A/m.$

$\therefore$ Maximum rate of energy flow *S* = $E_0 \times B_0$

= $100 \times .265 = 26.5 \frac{W}{m^2}$

11. (D)

12. (C)

Sol. $\vec{E}$ and $\vec{B}$ are mutually perpendicular to each other and are in phase i.e. they become zero and minimum at the same place and at the same time.

13. (B)

Sol. Molecular spectra due to vibrational motion lie in the microwave region of EM-spectrum. Due to Kirchhoff's law in spectroscopy the same will be absorbed.

14. (A)

Sol. E_x and B_y would generate a plane EM wave travelling in *z*-direction. $\vec{E}$, $\vec{B}$ and $\vec{k}$ form a right handed system $\vec{k}$ is along z-axis. As $\hat{i} \times \hat{j} = \hat{k}$

$\Rightarrow E_x \hat{i} \times B_y \hat{j} = C\hat{k}$ *i.e. E* is along *x*-axis and *B* is along *y-axis.*

15. (A)

Sol. $v_{\gamma-rays} > v_{UV\text{-rays}} > v_{\text{Blue light}} > v_{\text{Infraredrays}}$

16. (D)

Sol. Ground wave and sky wave both are amplitude modulated wave and the amplitude modulated signal is transmitted by a transmitting antenna and received by the receiving antenna at a distance place.

17. (A)

18. (B)

Sol. EM waves transport energy, momentum and information but not charge. EM waves are uncharged

19. (B)

Sol. EM waves carry momentum and hence can exert pressure on surfaces. They also transfer energy to the surface so $p \neq 0$ and $E \neq 0$.

20. (C)

Sol. The angular wave number $k = \frac{2\pi}{\lambda}$; where λ is the wave length. The angular frequency is $w = 2\pi\nu$.

The ratio $\frac{k}{\omega} = \frac{2\pi/\lambda}{2\pi\nu} = \frac{1}{\nu\pi} = \frac{1}{c}$ = constant

21. (A)

Sol. $\frac{E_0}{B_0} = C$. also $k = \frac{2\pi}{\lambda}$ and $\omega = 2\pi\nu$

These relation gives $E_0 K = B_0 \omega$

22. (B)

Sol. $\nu = \frac{1}{2\pi\sqrt{LC}}$ and $\lambda = \frac{C}{\nu}$

23. (A)

Sol. $I = \frac{1}{2}\varepsilon_0 C E_0^2$

$\Rightarrow E_0 = \sqrt{\frac{2I}{\varepsilon_0 C}} = \sqrt{\frac{2 \times 5 \times 10^{-16}}{8.85}} = 0.61 \times 10^{-6}\ \frac{V}{m}$

Also $E_0 = \frac{V_0}{d}$

$\Rightarrow V_0 = E_0 d = 0.61 \times 10^{-6} \times 2 = 1.23\,\mu V$

24. (C)

25. (C)

Sol. Population covered = $2\pi hR$ × Population density

= 2π × 100 × 6.4 × 10^6 × $\frac{1000}{(10^3)^2}$ = 4 × 10^6

26. (A)

27. (C)

28. (C)

Sol. Refractive index $= \sqrt{\frac{\mu\varepsilon}{\mu_0\varepsilon_0}}$

Here μ is not specified so we can consider $\mu = \mu_0$

then refractive index $= \sqrt{\frac{\varepsilon}{\varepsilon_0}} = 2$

$\therefore$ Speed and wavelength of wave becomes half and frequency remain unchanged.

29. (D)

30. (D)

31. (B)

32. (B)

33. (A)

Sol. Intensity or power per unit area of the radiations $P = f\nu$

$\Rightarrow f = \frac{P}{\nu} = \frac{0.5}{3 \times 10^8} = 0.166 \times 10^{-8}\ N/m^2$

34. (D)

Sol. $\nu = \frac{c}{\sqrt{\mu_r \varepsilon_r}} = \frac{3 \times 10^8}{\sqrt{1.3 \times 2.14}} = 1.8 \times 10^8\ m/sec$

35. (B)

Sol. $I' = I e^{-\mu x}$ $\Rightarrow$ $x = \frac{1}{\mu}\log_e \frac{I}{I'}$ (where I = original intensity, I' = changed intensity)

$36 = \frac{1}{\mu}\log_e \frac{I}{I/8} = \frac{3}{\mu}\log_e 2$ ....(i)

$x = \frac{1}{\mu}\log_e \frac{I}{I/2} = \frac{1}{\mu}\log_e 2$ .....(ii)

From equation (i) and (ii), $x = 12\ mm$.

SECTION-B

36. (C)

Sol. $\lambda_m > \lambda_v > \lambda_x$

37. (A)

Sol. If maximum electron density of the ionosphere is N_{max} per m^3 then the critical frequency f_c is given by $f_c = 9(N_{max})^{1/2}$.

$\Rightarrow 1 \times 10^6 = 9(N)^{1/2}$ $\Rightarrow N = 1.2 \times 10^{12}\ m^{-3}$

38. (C)

39. (B)

40. (A)

41. (C)

42. (D)

Sol. Direction of wave propagation is given by $\vec{E} \times \vec{B}$.

43. (C)

Sol. Speed of light of vacuum $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ and in another medium $v = \frac{1}{\sqrt{\mu \varepsilon}}$

$$\therefore \frac{c}{v} = \sqrt{\frac{\mu\varepsilon}{\mu_0\varepsilon_0}} = \sqrt{\mu_r K} \Rightarrow v = \frac{c}{\sqrt{\mu_r K}}$$

44. (C)

Sol. EM wave is in direction

Electric field is in direction

$\vec{E} \times \vec{B} \rightarrow$ direction of propagation of EM wave

45. (A)

Sol. Magnetic field vectors associated with this electromagnetic wave are given by

$\vec{B}_1 = \frac{E_0}{c}\hat{k}$ cos (kx – ωt) & $\vec{B}_2 = \frac{E_0}{c}\hat{i}$ cos (ky – ωt)

$\vec{F} = q\vec{E} + q(\vec{V} \times \vec{B})$

$= q(\vec{E}_1 + \vec{E}_2) + q(\vec{V} \times (\vec{B}_1 + \vec{B}_2))$

by putting the value of $\vec{E}_1$, $\vec{E}_2$,

The net Lorentz force on the charged particle is

$\vec{F}$ =qE_0[0.8cos (kx–ωt) $\hat{i}$ +cos(kx–ωt) $\hat{j}$ +0.2cos(ky–ωt) $\hat{k}$]

at t = 0 and at x = y = 0

$\vec{F} = qE_0[0.8\hat{i} + \hat{j} + 0.2\hat{k}]$

46. (B)

Sol. $\frac{E}{B} = c$

E = B × c

= 15 N/c

47. (C)

Sol. Force due to electric field is in direction – $\frac{(\hat{i}+\hat{j})}{\sqrt{2}}$

because at t = 0, E = $-\frac{(\hat{i}+\hat{j})}{\sqrt{2}} E_0$

Force due to magnetic field is in direction $q(\vec{v} \times \vec{B})$ and $\vec{v} \parallel \hat{k}$

∴ it is parallel to $\vec{E}$

∴ net force is antiparallel to $\frac{(\hat{i}+\hat{j})}{\sqrt{2}}$.

48. (C)

Sol. In air $\frac{E_0}{B_0} = C$

In the medium of refractive index = n

$\frac{E}{B} = \frac{C}{n}$

It is possible if

E = $\frac{E_0}{\sqrt{n}}$ and $B = B_0\sqrt{n}$

$\therefore \frac{B_0}{B} = \frac{1}{\sqrt{n}}, \frac{E_0}{E} = \sqrt{n}$

49. (D)

Sol. Option 4 Is Correct

50. (B)

Sol. $E_0 = \sqrt{2}\, E_{rms} = \sqrt{2} \times 6$ V/m

$B_0 = \frac{E_0}{C} = \frac{\sqrt{2}\times 6}{3\times 10^2}$ T = $\sqrt{2} \times 10^{-8}$ T

= 2×1.414 × 10^{-8} T

= 2.828× 10^{-8} T