	INDIAN SCHOOL AL WADI AL KABIR	
Class: XIIA/B/C/D	Department: SCIENCE 2025 – 26 SUBJECT: PHYSICS	Date: 07-11-2025
Worksheet No: 8	CHAPTER: 8 ELECTROMAGNETIC WAVES	Note: A4 FILE FORMAT

NAME OF THE STUDENT:	CLASS & SEC:	ROLL NO.

Multiple choice questions;(choose the correct option)

1. which of the following rays coming from the Sun plays an important role in maintaining the Earth's warmth.
(A) infrared rays (B) gamma rays (C) UV- rays (D) visible light rays *CBSE 2025*

2. Which of the following electromagnetic waves has photons of largest momentum?
(A) X rays (B) AM radio waves (C) microwaves (D) TV waves *CBSE 2025*

3. The dimensions of $(\mu\varepsilon)^{-1}$, where ε is permittivity and μ is permeability of a medium, are:
(A) $[M^0L^1T^{-1}]$ (B) $[M^0L^2T^{-2}]$ (C) $[M^1L^2T^{-2}]$ (D) $[M^1L^{-1}T^1]$ *CBSE 2025*

4. A beam of light of urban 720 nm in air enters water (refractive index = 4/3). Its wavelength in water will be;
(A) 540 nm (B) 480 nm (C) 420 nm (D) 720 nm *CBSE 2025*

5. In the four regions, I, II, III and IV, the electric fields are described as: *CBSE 2024*
Region I: $E_x = E_0 \sin (kz - \omega t)$
Region II: $E_x = E_0$
Region III: $E_x = E_0 \sin kz$
Region IV: $E_x = E_0 \cos kz$
The displacement current will exist in the region:
(A) I (B) IV (C) II (D) III

6. Electromagnetic waves with wavelength 10 nm are called: *CBSE 2024*
(A) Infrared waves (B) Ultraviolet rays (C) Gamma rays (D) X-rays

7. Which one of the following has the highest frequency? *CBSE 2024*
(A) Infrared rays (B) Gamma rays (C) Radio waves (D) Microwaves

8. The phase difference between electric field E and magnetic field B in an electromagnetic wave propagating along Z axis is – *CBSE 2024*
(A) 0 (B) π (C) $\frac{\pi}{2}$ (D) $\frac{\pi}{4}$

9. The electromagnetic waves used to purify water are *CBSE 2024*
(A) Infrared rays (B) Ultraviolet rays (C) X-rays (D) Gamma rays

10. In the process of charging of a capacitor, the current produced between the plates of the capacitor is: (where symbols have their usual meanings) *CBSE 2023*
(A) $\mu_0 \frac{d\phi_E}{dt}$ (B) $\frac{1}{\mu_0} \frac{d\phi_E}{dt}$ (C) $\varepsilon_0 \frac{d\phi_E}{dt}$ (D) $\frac{1}{\varepsilon_0} \frac{d\phi_E}{dt}$

11. $\vec{E}$ and $\vec{B}$ represent the electric field and magnetic field of an electromagnetic wave respectively, the direction of propagation of wave is along. *CBSE 2023*
(A) $\vec{B}$ (B) $\vec{E}$ (C) $\vec{E} \times \vec{B}$ (D) $\vec{B} \times \vec{E}$

12. A beam of light travels from air into a medium. Its speed and wavelength in the medium are 1.5 x 10^8 m/s and 230 nm respectively. The wavelength of light in air will be *CBSE 2023*
(A) 230 nm (B) 345 nm (C) 460 nm (D) 690 nm

13. The electromagnetic radiations used to kill germs in water purifiers are called: *CBSE 2023*
(a) Infrared waves (b) X-rays (c) Gamma rays (d) Ultraviolet rays

14. The electromagnetic waves used in radar systems are: *CBSE 2023*
(a) Infrared waves (b) Ultraviolet rays (c) Microwaves (d) X-rays

15. Which one of the following electromagnetic radiation has the least wavelength? *CBSE 2023*
(A) Gamma rays (B) Microwaves (C) Visible light (D) X-rays.

Assertion and Reason type questions;

***Directions:** Choose any one of the following four responses.*
(a) Both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) Both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) Assertion is correct, Reason is incorrect
(d) Both Assertion and Reason are correct.

16. Assertion (A): Electromagnetic waves can travel through a vacuum.
Reason (R): Electromagnetic waves do not require a medium for propagation.

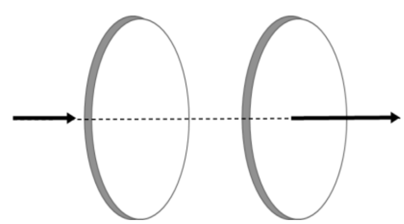
17. Assertion (A): The speed of electromagnetic waves in a vacuum is constant for all frequencies.
Reason (R): The speed of electromagnetic waves depends only on the medium in which they propagate.

18. Assertion (A): Microwaves are used in radar systems for detection of objects.
Reason (R): Microwaves have high penetrating power and can travel long distances.

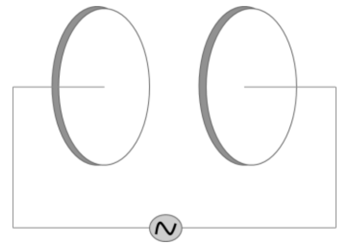
19. Assertion (A): Infrared radiation is used for remote control devices.
Reason (R): Infrared radiation is invisible to the human eye but can be detected by snakes.

Descriptive questions (2/3 marks)

20. Figure shows a capacitor made of two circular plates each of radius 12 cm, and separated by 5.0 cm. The capacitor is being charged by an external source. The charging current is constant and equal to 0.15A. (a) Calculate the capacitance and the rate of change of potential difference between the plates. (b) Obtain the displacement current across the plates. (c) Is Kirchhoff's first rule (junction rule) valid at each plate of the capacitor? Explain.



21. A parallel plate capacitor made of circular plates each of radius R = 6.0 cm has a capacitance C = 100 pF. The capacitor is connected to a 230 V ac supply with a (angular) frequency of 300 rad s^{-1}. (a) What is the rms value of the conduction current? (b) Is the conduction current equal to the displacement current? (c) Determine the amplitude of B at a point 3.0 cm from the axis between the plates.



22. What physical quantity is the same for X-rays of wavelength 10^{-10} m, red light of wavelength 6800 Å and radio waves of wavelength 500m?

23. A plane electromagnetic wave travels in vacuum along z-direction. What can you say about the directions of its electric and magnetic field vectors? If the frequency of the wave is 30 MHz, what is its wavelength?

24. A radio can tune in to any station in the 7.5 MHz to 12 MHz band. What is the corresponding wavelength band?

25. A charged particle oscillates about its mean equilibrium position with a frequency of 10^9 Hz. What is the frequency of the electromagnetic waves produced by the oscillator?

26. The amplitude of the magnetic field part of a harmonic electromagnetic wave in vacuum is B_0 = 510 nT. What is the amplitude of the electric field part of the wave?

27. Suppose that the electric field amplitude of an electromagnetic wave is E_0 = 120 N/C and that its frequency is ν = 50.0 MHz. (a) Determine, B_0, ω, k, and λ.
(b) Find expressions for E and B.

28. The terminology of different parts of the electromagnetic spectrum is given in the text. Use the formula $E = h\nu$ (for energy of a quantum of radiation: photon) and obtain the photon energy in units of eV for different parts of the electromagnetic spectrum. In what way are the different scales of photon energies that you obtain related to the sources of electromagnetic radiation?

29. In a plane electromagnetic wave, the electric field oscillates sinusoidally at a frequency of 2.0×10^{10} Hz and amplitude 48 V m^{-1}.
(a) What is the wavelength of the wave?
(b) What is the amplitude of the oscillating magnetic field?
(c) Show that the average energy density of the E field equals the average energy density of the B field. [$c = 3 \times 10^8$ m s^{-1}]

30. Consider an induced magnetic field due to changing electric field and an induced electric field due to changing magnetic field. Which one is more easily observed? Justify your answer.

Answers:

ANS; 1. A, 2. A, 3. B, 4. A, 5. A, 6. B 7. B 8. C 9. B 10. C 11. C 12. C 13. D 14. C 15. A.
16. A
17. C
18. A
19. B
20. *Given, r = 12 cm = 0.12 m, d = 5 cm = 0.05 m, I = 0.15 A.*

$$(a)\ C = \frac{\epsilon_0 A}{d} = \frac{\epsilon_0 \pi r^2}{d} = \frac{8.85 \times 10^{-12} \times 3.14 \times (0.12)^2}{0.05} = 8.0032 \times 10^{-12}\ F = 8\ pF.$$

As, q = cv, differentiating both sides, $\frac{dq}{dt} = C\frac{dV}{dt}$,

$$\frac{dV}{dt} = \frac{1}{C}\frac{dq}{dt} = \frac{I}{C} = \frac{0.15}{8 \times 10^{-12}} = 0.01875 \times 10^{12}\ V/s = 1.87 \times 10^{10}\ V/s$$

(b) $I_c = I_d = 0.15\ A$

(c) yes; (displacement current is equal to conduction current)

21. *Given; r = 6cm = 0.06 m, C = 100pF, V = 230 volt, ω = 300 rad s^{-1}*

$$(a)\ I_{rms} = \frac{V_{rms}}{X_c} \quad \text{and } X_c = \frac{1}{\omega C}$$

$$I_{rms} = \frac{V_{rms}}{\frac{1}{\omega C}} = \omega C \times V_{rms} = 300 \times 100 \times 10^{-12} \times 230 = 6.9 \times 10^{-6} = 6.9\ \mu A.$$

(b) yes.

$$(c)\ \text{As, } B = \frac{\mu_\circ}{2\pi}\frac{r}{R^2}i_d \quad \text{or } B_o = \frac{\mu_0}{2\pi}\frac{r}{R^2}i_o \quad \text{or } B_o = \frac{\mu_0}{2\pi}\frac{r}{R^2}i_{rms}\sqrt{2}$$

$$B_o = 2 \times 10^{-7}\frac{3 \times 10^{-2}}{(6 \times 10^{-2})^2}\, 6.9 \times 10^{-6}\sqrt{2} = \frac{6.9}{6} \times 1.414 \times 10^{-11}\ T = 1.63 \times 10^{-11}\ T.$$

22. *Speed of light.*

23. *Electric field; x- axis and magnetic field; y-axis.*

$$\lambda = \frac{C}{v} = \frac{3 \times 10^8}{30 \times 10^6} = 10\ m$$

24. $\lambda_1 = \frac{C}{\upsilon_1} = \frac{3 \times 10^8}{7.5 \times 10^6} = 40$ m $\qquad \lambda_2 = \frac{C}{\upsilon_2} = \frac{3 \times 10^8}{12 \times 10^6} = 25$ m

40 m to 25 m.

25. *Frequency of an em-wave is the same as that of a charged particle oscillating about its mean position,* $\upsilon = 10^9$ *Hz.*

26. *As,* $C = \frac{E_o}{B_o} \Longrightarrow E_o = C B_o = 3 \times 10^8 \times 510 \times 10^{-9} = 153$ N/C

27. *(a)* $C = \frac{E_o}{B_o} \Longrightarrow B_o = \frac{E_o}{C} = \frac{120}{3 \times 10^8} = 40 \times 10^{-8} T = 400 \times 10^{-9} T = 400 nT.$

$$\lambda = \frac{C}{\upsilon} = \frac{3 \times 10^8}{50 \times 10^6} = 6\ m$$

$$K = \frac{2\pi}{\lambda} = \frac{2 \times 3.14}{6} = \frac{6.28}{6} = 1.05\ rad/m$$

$$\omega = 2\pi\nu = 2 \times 3.14 \times 50 \times 10^6 = 3.14 \times 10^8\ rad/s$$

(b) $\mathbf{E = E_0 \sin (kx - \omega t)} = 120 \sin (1.05x\ 3.14 \times 10^8\ t)$ N/C

$\mathbf{B = B_0 \sin (kx - \omega t)} = 400 \times 10^{-9} \sin (1.05x\ 3.14 \times 10^8\ t)$ T

28. $E = h\nu = h\frac{C}{\lambda}, (\lambda = 1m) = \frac{6.626 \times 10^{-34} \times 3 \times 10^8}{\lambda=1m} J = \frac{6.626 \times 10^{-34} \times 3 \times 10^8}{1.6 \times 10^{-19}} eV = 1.24 \times 10^6 eV = 1.24$ MeV

Photon energy for other wavelengths in the figure for electromagnetic spectrum can be obtained by multiplying approximate powers of ten.

29. Given, $\nu = 2.0 \times 10^{10}$ Hz, $E_o = 48$ V/m

(a) $\lambda = \frac{C}{\upsilon} = \frac{3 \times 10^8}{2 \times 10^{10}} = 1.5$ cm

(b) $C = \frac{E_o}{B_o} \Longrightarrow B_o = \frac{E_o}{C} = \frac{48}{3 \times 10^8} = 16 \times 10^{-8} T = 160 \times 10^{-9} T = 160\ nT$

(c) Electric energy density, $u_E = \frac{1}{2} \epsilon_\circ E^2$

magnetic energy density $u_B = \frac{1}{2} \frac{B^2}{\mu_\circ} s$

$$As,\ u_B = \frac{1}{2} \frac{B^2}{\mu_\circ} = \frac{1}{2\mu_\circ} \frac{E^2}{c^2} = \frac{1}{2\mu_\circ} \frac{E^2}{\frac{1}{\mu_\circ \epsilon_\circ}} = \frac{\mu_\circ \epsilon_\circ}{2\mu_\circ} E^2 = \frac{1}{2} \epsilon_\circ E^2 = u_E$$

$$[c = \frac{E_o}{B_o} \text{ and } c = \frac{1}{\sqrt{\mu_\circ \epsilon_\circ}},\ c^2 = \frac{1}{\mu_\circ \epsilon_\circ}]$$

30. Induced electric fields from changing magnetic flux are more readily observed because

they are more directly related to practical applications (faradays law of EMI). whereas induced magnetic fields from changing electric fields are often less noticeable and require specific conditions to be observed (Maxwell's equations, specifically the displacement current concept).

Prepared by: *Mr Randhir Kumar Gupta*	*Checked by:* *HOD Science*

.