

CLASS 12

PHYSICS

EXTRA QUESTIONS

Class 12 Physics Chapter 8 Electromagnetic Waves – Extra Questions with Answers

From displacement current to the electromagnetic spectrum, Class 12 Physics Chapter 8 explains how a changing electric field generates electromagnetic waves -- these questions revisit the key ideas and formulas.

Contents

Very Short Answer Questions (1 mark)

Short Answer Questions (2–3 marks)

Higher-Order Thinking / Application Questions

Class 12 Physics Chapter 8 – Solutions and Notes

From displacement current to the electromagnetic spectrum, Class 12 Physics Chapter 8 explains how a changing electric field generates electromagnetic waves — these questions revisit the key ideas and formulas.

Very Short Answer Questions (1 mark)

Q1. What is the phase relationship between the oscillating electric and magnetic fields in an electromagnetic wave?

Ans: They oscillate **in phase** — both reach their maximum and minimum values, and pass through zero, at the same instant.

Q2. Which field, E or B, is mainly responsible for the physiological, chemical, and photographic effects of an electromagnetic wave?

Ans: The **electric field (E)**, since it produces a much larger force on charged particles (electrons in atoms/molecules) than the magnetic field does.

Q3. What is the SI unit of displacement current?

Ans: The **ampere (A)** — the same unit as ordinary conduction current, since displacement current is defined so as to have the dimensions of current.

Q4. What fraction of the total average energy of an electromagnetic wave is carried by its electric field?

Ans: **Half** — since the average energy density of the E field equals that of the B field ($u_E = u_B$), each contributes exactly half of the wave's total average energy density.

Q5. Arrange gamma rays, ultraviolet rays, and microwaves in order of increasing wavelength.

Ans: **Gamma rays < ultraviolet rays < microwaves** (gamma rays have the shortest wavelength in the electromagnetic spectrum, microwaves comparatively the longest of these three).

Short Answer Questions (2–3 marks)

Q6. A parallel plate capacitor with circular plates of radius 5cm is being charged such that the displacement current between the plates is 2A. Find the rate of change of the electric field between the plates.

Ans: $I_d = \epsilon_0 A (dE/dt) \Rightarrow dE/dt = I_d / (\epsilon_0 A)$, where $A = \pi r^2 = \pi \times (0.05)^2 \approx 0.00785 \text{ m}^2$.
 $dE/dt = 2 / (8.854 \times 10^{-12} \times 0.00785) \approx \mathbf{2.88 \times 10^{13} \text{ V/(m}\cdot\text{s)}}$.

Q7. State the relation between the electric field amplitude E_0 and magnetic field amplitude B_0 of an electromagnetic wave travelling in vacuum, and briefly explain why this ratio must equal the speed of light.

Ans: $E_0 = cB_0$, i.e. $E_0/B_0 = c$. This follows directly from Maxwell's equations applied to a plane electromagnetic wave in vacuum: solving the coupled wave equations for E and B shows the wave travels at speed $c = 1/\sqrt{(\mu_0 \epsilon_0)}$, and consistency between the two coupled equations (Faraday's law and the Ampere–Maxwell law) forces the amplitude ratio E_0/B_0 to equal exactly this same speed, c.

Q8. Why can electromagnetic waves travel through vacuum, whereas mechanical waves (like sound) cannot?

Ans: A mechanical wave is a disturbance that propagates through the physical displacement of a material medium's particles — with no particles (vacuum), there is nothing to displace, so it cannot travel. An electromagnetic wave, by contrast, is a self-sustaining oscillation of the electric and magnetic fields themselves: a changing E field generates a B field (Ampere–Maxwell law), and that changing B field in turn

generates an E field (Faraday's law), each regenerating the other as the wave moves forward — no material medium is needed at all, only the fields.

Higher-Order Thinking / Application Questions

Q9. A microwave oven operates at a frequency of 2450MHz. Find the wavelength of the microwaves it produces and the energy of a single microwave photon in eV.

Ans: $\lambda = c/f = (3 \times 10^8)/(2450 \times 10^6) \approx 0.122\text{m}$ (**12.2cm**). Photon energy $E = hf$, using $h = 4.14 \times 10^{-15} \text{eV}\cdot\text{s}$: $E = 4.14 \times 10^{-15} \times 2450 \times 10^6 \approx 1.01 \times 10^{-5} \text{eV}$ — an extremely small energy per photon (which is why a microwave photon cannot ionize atoms or break chemical bonds; the oven instead works by a huge number of these low-energy photons causing water molecules to rotate and heat up via friction).

Q10. Maxwell predicted the existence of electromagnetic waves purely from theory, years before Hertz produced and detected them experimentally. Explain, in terms of what Maxwell actually added to the existing laws of electricity and magnetism, how this prediction arose — and why its later experimental confirmation was historically significant.

Ans: Before Maxwell, Ampere's law related magnetic fields only to conduction currents, and (unlike Faraday's law, where a changing B field produces an E field) there was no known way for a changing electric field to produce a magnetic field. Maxwell noticed this asymmetry was also mathematically inconsistent with charge conservation in situations like a charging capacitor, and fixed it by adding the displacement current term, $\epsilon_0(d\Phi_E/dt)$, to Ampere's law. With this addition, his complete set of four equations became symmetric between E and B, and solving them for empty space (no charges or currents) gave a valid, self-consistent wave solution — oscillating E and B fields regenerating each other and travelling at a speed that, remarkably, worked out to be exactly the already-measured speed of light. This led Maxwell to conclude that light itself is an electromagnetic wave, and predicted that other electromagnetic waves (invisible to the eye) should also exist. Hertz's 1887 experiments, which generated and detected exactly such waves in the laboratory using oscillating electrical circuits, confirmed this prediction directly — a landmark moment because it showed that a purely mathematical/theoretical modification to existing laws, made to fix an internal inconsistency, could correctly predict an entirely new, previously unobserved physical phenomenon.

Class 12 Physics Chapter 8 – Solutions and Notes

For complete step-by-step answers and a quick summary, check the [Class 12 Physics Chapter 8 Solutions](#) and [Class 12 Physics Chapter 8 Revision Notes](#).

See also: [Chapter 1](#) | [Chapter 2](#) | [Chapter 3](#) | [Chapter 4](#) | [Chapter 5](#) | [Chapter 6](#) | [Chapter 7](#) | [Chapter 8](#)

Practice more: [Chapter 1](#) | [Chapter 2](#) | [Chapter 3](#) | [Chapter 4](#) | [Chapter 5](#) | [Chapter 6](#) | [Chapter 7](#) | [Chapter 8](#)

Quick revision: [Chapter 1](#) | [Chapter 2](#) | [Chapter 3](#) | [Chapter 4](#) | [Chapter 5](#) | [Chapter 6](#) | [Chapter 7](#)

Recommended: Buy the Printed NCERT Class 12 Physics Book

Contains Amazon affiliate links.

If you'd like a printed copy alongside the PDF, here's a verified option:

NCERT Physics Textbook Part 1 for Class 12 (2025-26 Edition)

4.4 out of 5 stars (159 ratings) · Rs. 155

Buy on Amazon →

Price and availability may change on Amazon. As an Amazon Associate, ncertbooks.org earns from qualifying purchases.

© NCERTBooks.org — your one-stop source for Class 1 to 12 NCERT Books, Solutions, Extra Questions, Revision Notes, Formulas Handbooks and more. Visit ncertbooks.org for the latest chapters as they are published.